REQUEST FOR QUALIFICATION (RFQ)
CUM
REQUEST FOR PROPOSAL (RFP)

(Ref No. AITL/SBIA/2017-18/01)

APPOINTMENT OF MASTER SYSTEM INTEGRATOR (MSI)

FOR

SUPPLY, IMPLEMENTATAION, INTEGRATION, OPERATIONS AND MAINTENANCE OF SMART CITY ICT COMPONENTS AT

SHENDRA AREA OF AURIC

Volume III – Terms of Reference

April, 2017

Aurangabad Industrial Township Limited (AITL)

Udyog Sarathi, MIDC Office, Marol Industrial Area
Andheri (East), Mumbai, Maharashtra, India - 400093

Aurangabad Industrial Township Limited

International Competitive Bidding (ICB)

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Abbreviations

Terms	Definition
AAA	Authentication, Authorization, and Accounting
AAC	Advance Application Controller
AASHTO	American Association of State Highway and Transportation Officials
ACC	AURIC Control Centre
ACD	Automatic Call Distribution
ADF	Automatic Document Feeder
ADS	Active Directory Services
AEE	AURIC e-Governance and ERP systems
AGC	Automatic Gain Control
AGP	Advanced Graphics Processor
AHU	Air Handling Units
AITL	Aurangabad Industrial Township Limited
AMC	Annual Maintenance Contract
AMD	Advanced Micro Devices
AMI	Advanced Meter Infrastructure
AMR	Automatic Meter Reading
ANI	Automatic Number Identification
ANSI	American National Standards Institute
API	Application Program Interface
ARP	Address Resolution Protocol
ARV	After Repaired Value
ASC	Auto Signal Compensation
ASCII	American Standard Code for Information Interchange
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
ATCC	Automatic Traffic Counting & Classification System
ATP	Acceptance Test Procedures
AURIC	Aurangabad Industrial City
AVC	Advance Video Coding
AVL	Automatic Vehicle Locater
AWG	American Wire Gauge
BHC	Benzene Hydro Chloride
BHIM	Bharat Interface for Money
BIS	Bureau of Indian Standards
BMP	Bitmap
BMS	Building Management System

Terms	Definition
BOOTP	Bootstrap Protocol
BOQ	Bill of Quantities
BPEL	Business Process Execution Language
BPL	Below Poverty Line
BPM	Business Process Management
BSI	British Standards Institution
BSSID	Basic Service Set Identifier
BTU	British Thermal Unit
CAD	Computer Aided Dispatch
CAT	Category
CATV	Cable TV
CBR	Constant Bit-Rate
CCD	Charge Coupled Device
CCITT	Consultative Committee on International Telephone & Telegraph
CCTV	Closed Circuit Television
CDMA	Code Division Multiple Access
CDRW	Compact Disc Re-Writable
CFC	Citizen Facilitation Centre
CIF	Common Intermediate Format
CIP	Construction in Progress
CLI	Caller Line Identification
CLIR	Connected Line Identification Restriction
CMDB	Configuration Management Database
CMOS	Complementary Metal-Oxide Semiconductor
CNIP	Calling Number Identification Presentation
CNIR	Calling Number Identification Restriction
COLP	Connected Line Identification Presentation
COTS	Commercially Available-Off-The-Shelf
CPU	Central Processing Unit
CRCA	Cold Rolled Close Annealed
CRM	Customer Relationship Management
CSA	Canadian Standards Association
CST	Central Sales Tax
CSV	Comma Separated Values
CTI	Computer Telephony Integration
DBMS	Data Base Management System
DCMS	Display Content Management System
DDC	Direct Digital Control

Terms	Definition
DDS	Digital Display Screen
DEO	Data Entry Operator
DFC	Dedicated Freight Corridor
DFDL	Data Format Description Language
DHCP	Dynamic Host Configuration Protocol
DIMM	Dual In-Line Memory Module
DIY	Do It Yourself
DLP	Defect Liability Period
DLPTM	Digital Light Processing
DMIC	Delhi Mumbai Industrial Corridor
DMICDC	Delhi Mumbai Industrial Corridor Development Corporation
DMS	Document Management System
DNIS	Dialled Number Identification Service
DNS	Domain Name Service
DOB	Date of Birth
DOD	Depth of Discharge
DOS	Days of Services
DOT	Department of Telecom
DRP	Disaster Recovery Plan
DVD	Digital Video Disc
DVI	Digital Visual Interface
DWG	AutoCAD drawings
EAI	Enterprise Application Integration
ECB	Emergency Call Box
ECBC	Energy Conservation Building Code
ECC	Error Connecting Code
ECM	Enterprise Content Management
ECMA	European Computer Manufacturers Association
EEPROM	Electrically Erasable Programmable Read Only Memory
EIA	Electronic Industries Alliance
EIRP	Effective Isotropic Radiated Power
EMAIL	Electronic Mail
EMD	Earnest Money Deposit
EMS	Enterprise Management System
EPABX	Electronic Private Automatic Branch Exchange
EPC	Evolved Packet Core
EPROM	Erasable Programmable Read Only Memory
ERP	Enterprise Resource Planning

Terms	Definition
ESB	Enterprise Service Bus
ESD	Electrostatic Discharge
ESQL	Extended Structured Query Language
ETS	Educational Testing And Assessment
ETSI	European Telecommunications Standards Institute
FAQ	Frequently Asked Questions
FAT	Factory Acceptance Tests
FCC	File Client Cache
FCR	Field Call Report
FCU	Fan Coil Unit
FDMS	Fibre Distribution and Management System
FHSS	Frequency Hopping Spread Spectrum
FIFO	First In, First Out
FOB	Freight on Board
FOSC	Fibre-Optic Splice Closures
FPS	Frames Per Second
FSB	Front Side Bus
FSK	Frequency Shift Keying
FTP	File Transfer Protocol
FTTX	Fibre-to-the-X
GAAP	Generally Accepted Accounting Principles
GCP	Garbage Collection Point
GDP	Gross Domestic Product
GFSK	Gaussian Frequency Shift Keying
GIF	Graphics Interchange Format
GIS	Geographic Information System
GPI	General Purpose Interface
GPR	Ground Probing RADAR
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communications
GST	Goods and Services Tax
GUI	Graphical user interface
GVW	Gross Vehicle Weight
HDCP	High-bandwidth Digital Content Protection
HDD	Horizontal Directional Drilling
HDMI	High-Definition Multimedia Interface
HDPE	High-Density Polyethylene

Terms	Definition
HDTV	High Definition Television
HHC	Hand Held Computers
HHD	Hybrid Hard Drive
HMI	Human Machine Interface
HRM	Human Resource Management
HRMS	Human Resource Management System
HSD	High Speed Diesel
HTML	Hypertext Markup Language
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol Secure
HUDCO	Housing and Urban Development Corporation Limited
HVAC	Heating, Ventilation, and Air Conditioning
IAT	Installation Acceptance Tests
ICB	International Competitive Bidding
ICEA	Insulated Cable Engineers Association
ICMP	Internet Control Message Protocol
ICT	Information & Communications Technology
IDS	Intrusion Detection System
IEC	International Electro-technical Commission
IECQ	International Electro-technical Commission Quality Assessment System for Electronic Components
IEE	Institute of Electrical Engineers
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IET	Institution of Engineering and Technology
IGMP	The Internet Group Management Protocol
IIFCL	Infrastructure Finance Company Limited
IKE	Indian Institutes of Technology
IMAP	Internet Message Access Protocol
INR	Indian Rupees
IOS	Integrated Operating System
IPFIX	Internet Protocol Flow Information Export
IPS	Intrusion Prevention System
IRE	Institute of Radio Engineers
IRIG	Inter-Range Instrumentation Group
ISA	Industry Standard Architecture
ISDN	Integrated Services Digital Network
ISI	Indian Standards Institute

Terms	Definition
ISM	Industrial, Scientific, Medical
ISO	International Organization for Standardization
ISP	Internet Service Provider
ITIL	Information Technology Infrastructure Library
ITS	Intelligent Transportation System
ITU	International Telecommunication Union
IVRS	Interactive Voice Response System
JBIC	Japan Bank for International Cooperation
JMS	Java Message Service
JPEG	Joint Photographic Experts Group
JSON	JavaScript Object Notation
JSR	Java Specification Request
KPI	Key Performance Indicator
KVA	Kilo Volt Ampere
KVM	keyboard, Video and Mouse
LAN	Local Area Network
LCD	Liquid Crystal Display
LCV	Light Commercial Vehicle
LDAP	Lightweight Directory Access Protocol
LDPE	Low Density Poly Ethylene
LED	Light Emitting Diode
LIC	Life Insurance Corporation
LIFO	Last In, First Out
LLDP	Link Layer Discovery Protocol
LMS	Land Management System
LNA	Low Noise Amplifier
LPM	Litre Per Minute
LTE	Long Term Evolution
LULC	Land Use Land Cover
MAC	Media Access Control
MAF	Manufacturers Authorization Form
MAV	Multi Axle Vehicle
MBA	Master of Business Administration
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MDF	Medium-Density Fibreboard
MED	Media Endpoint Discovery
MGE	Modular GIS Environment

Terms	Definition
MHZ	Megahertz
MIB	Management Information Bases
MIDC	Maharashtra Industrial Development Corporation
MIL STD 810F	United States Military Standard 810F
MIME	Multipurpose Internet Mail Extensions
MIMO	Multiple Input, Multiple Output
MIS	Management Information System
MJPEG	Motion Joint Photographic Experts Group
MNRE	Ministry of New and Renewable Energy
MOV	Metallic Oxide Varistor
MPEG	Moving Picture Experts Group
MPLS	Multiprotocol Label Switching
MQTT	Message Queue Telemetry Transport
MRI	Meter Reading Instruments
MRP	Material Requirements Planning
MSI	Master System Integrator
MST	Multiple Spanning Tree
MTBF	Mean Time Between Failure
MTR	Main Telecom Room
MTTR	Mean Time to Repair
NABL	National Accreditation Board for Testing and Calibration Laboratories
NBC	National Building Code
NEFT	National Electronics Funds Transfer System
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Prevention Association
NIC	Network Interface Card
NIST	National Institute of Standards and Technology
NMS	Network Management System
NOC	Network Operation Centre
NPL	National Physics Laboratory
NSC	National Safety Council
NTC	Negative Temperature Coefficient
NTP	Network Time Protocol
NTS	Network Time Server
NVR	Network Video Recorder
OBU	On-Board Unit
OCEF	Optical Cable Entrance Facility
ODBC	Open Database Connectivity

Terms	Definition
OEM	Original Equipment Manufacturer
OFC	Optical Fibre Cable
OGC	Open Geospatial Consortium
ONVIF	Open Network Video Interface Forum
OPEX	Operating Expenses
OPS	Open Pluggable Specification
OSD	On Screen Display
OTDR	Optical Time Domain Reflectometer
OTP	One Time Password
OWS	Operator Workstation
PAS	Publicly Available Specification
PAT	Prototype Approval Tests
PBAX	Private Automatic Branch Exchange
PCB	Printed Circuit Board
PCC	Power Control Centre
PCI	Peripheral Component Interconnect
PCM	Pulse-Code Modulation
PDF	Portable Document Format
PDIF	Sony/Philips Digital Interconnect Format
PEAP	Protected Extensible Authentication Protocol
PGT	Post Graduate Training
PHP	Personal Home Page
PID	Proportional plus Integral plus Derivative
PIN	Personal Identification Number
PIO	Public Information Officer
PIT	Pre-Installation Testing
PKI	Public Key Infrastructure
PLB	Permanently Lubricated
PLC	Programmable Logic Controller
PMD	Polarization Mode Dispersion
PMO	Project Management Office
PNG	Portable Network Graphics
POE	Power over Ethernet
POP	Point of Presence/ Proof of Performance
POT	Portable Operator Terminals
PPB	Parts per Billion
PPM	Parts per Million
PPP	Public Private Partnership

Terms	Definition
PRA	Probabilistic Risk Assessment
PRI	Primary Rate Interface
PRP	Parallel Redundancy Protocol
PSD	Photoshop Image
PSP	Public/Semi Public
PSTN	Public Switch Telephone Network
PTC	Positive Temperature Coefficient
PTZ	Pan-Tilt-Zoom
QCIF	Quarter Common Intermediate Format
QSIG	Q Signalling
RADIUS	Remote Authentication Dial-In User Service
RAID	Redundant Array of Independent Disks
RAM	Random Access Memory
RCA	Root Cause Analysis
RCC	Reinforced Cement Concrete
RDBMS	Relational Database Management System
REST	Representational State Transfer
RFC	Request for Comments
RFID	Radio Frequency Identification
RFP	Request for Proposal
RFQ	Request for Quotation
RGB	Red Blue Green
RMON	Remote Monitoring
ROM	Read Only Memory
RPO	Recovery Point Objective
RRE	Remote Reader Electronics
RSA	Rivest, Shamir, and Adelman
RSTP	Rapid Spanning Tree Protocol
RTC	Real Time Clock
RTF	Rich Text Format
RTGS	Real Time Gross Settlement
RTI	Right to Information
RTO	Regional Transport Office
RTP	Real-time Transport Protocol
RTSP	Rapid Spanning Tree Protocol
RTU	Remote Terminal Unit
RTV	Real Time Video
SAIL	Steel Authority of India Limited

Terms	Definition
SAS	Statistical Analysis System
SAT	System Acceptance Test
SATA	Serial Advanced Technology Attachment
SBIA	Shendra Bidkin Industrial Area
SCADA	Supervisory Control and Data Acquisition
SCP	Security Certified Program
SCSI	Small Computer System Interface
SDCU	Standalone Digital Control Units
SDHC	Secure Digital High Capacity
SDK	Software Development Kit
SDLC	Software Development Life Cycle
SDRAM	Synchronous Dynamic Random Access Memory
SEO	Search Engine Optimization
SFP	Small Form-factor Pluggable
SFTP	Secure File Transfer Protocol
SIEM	Security Information and Event Management
SIF	Source Input Format
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SIT	System Integration Testing
SLA	Service Level Agreement
SMPS	Switched-Mode Power Supply
SMS	Short Message Service
SMT	Surface Mount Technology
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SOA	Service-Oriented Architecture
SOAP	Simple Object Access Protocol
SOP	Standard Operating Procedure
SOW	Statement of Work
SPA	Special Planning Authority
SPM	Suspended Particulate Matter
SPV	Special Purpose Vehicle
SQL	Software Queueing Language
SRS	Software Requirement Specifications
SSD	Solid-State Drive
SSH	Secure Shell
SSID	Service Set Identifier

Terms	Definition
SSL	Secure Sockets Layer
SSO	Single Sign-On
SVC	Scalable Video Coding
SVGA	Super Video Graphics Array
SWB	Static Weigh Bridge
SWG	Standard Wire Gauge
SWIFT	Society for Worldwide Interbank Financial Telecommunication
SWM	Solid Waste Management
TACACS	Terminal Access Controller Access Control System
TAT	Turn Around Time
TCP	Transmission Control Protocol
TDM	Time Division Multiplexing
TDS	Tax Deducted at Source
TEC	Telecommunication Engineering Centre
TFA	Treated Fresh Air
TFT	Thin-Film Transistor
TGT	Trained Graduate Teacher
THD	Total Harmonic Distortion
TIA	Telecommunications Industry Association
TIF	Tagged Image Format
TIFF	Tagged Image File Format
TLS	Transport Layer Security
TOD	Time of Day
TRAI	Telecom Regulatory Authority of India
TRD	Test Results Documentation
TSN	Time Since New
TSO	Time Since Overhaul
TSP	Telecom Service Provider
UAT	User Acceptance Test
UBS	Urban Bus Specification
UDP	User Datagram Protocol
UFD	User Fare Display
UGR	Underground Reservoirs
UHF	Ultra-High Frequency
ULC	Underwriters Laboratories of Canada
UPC	Ultra-Physical Contact
UPS	Uninterruptible Power Supply
URL	Uniform Resource Locator

Terms	Definition
USB	Universal Serial Bus
USSD	Unstructured Supplementary Service Data
UTC	Universal Time Coordinated
UTP	Unshielded Twisted Pair
VAC	Volt AC
VAT	Value Added Tax
VBR	Variable Bit-Rate
VCR	Video Cassette Recorder
VDC	Volt DC
VDM	Video Display Module
VDW	Voice Directed Warehousing
VFD	Variable Frequency Drive
VGA	Video Graphics Array
VLAN	Virtual Local Area Network
VMS	Video Management System
VOC	Volatile Organic Compounds
VOIP	Voice Over Internet Protocol
VPN	Virtual Private Network
WAN	Wide Area Network
WBS	Wide Dynamic Range
WEEE	The Waste Electrical and Electronic Equipment (Directive)
WIP	Work in Progress
WIPS	Wireless Intrusion Prevention System
WLAN	Wireless Local Area Network
WSDL	Web Service Definition Language
WSRP	Web Services for Remote Portals
XAUTH	Extended Authentication
XLPE	Cross Linked Polyethylene insulation
XML	Extensible Markup Language
XMPP	Extensible Messaging and Presence Protocol

1 Introduction

1.1 Overview

Government of India (GoI) has envisaged the development of Delhi Mumbai Industrial Corridor (DMIC) along the alignment of proposed multi-modal high axle load Dedicated Freight Corridor (DFC) between Delhi and Mumbai. The corridor covers approximately 1483 km and passes through six (6) states. To tap the development potential of the proposed freight corridor, a band spanning 150 km on both sides of the freight corridor has been identified as the 'Influence Region' and is proposed to be developed as DMIC. The multi-billion dollar DMIC is one of the largest infrastructure and economic development programs in India's history.

The Delhi Mumbai Industrial Development Corporation (DMICDC) acts as an intermediary for the purposes of development and establishment of infrastructure projects and facilities in India. It is responsible for developing and disseminating appropriate financial instruments, negotiating loans and advances of all nature, and formulating schemes for mobilization of resources and extension of credit for infrastructure. DMICDC undertakes project development services for investment regions/industrial areas/economic regions/industrial nodes and townships for various central agencies and state governments. The shareholders of DMICDC include different agencies: Government of India represented through Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce and Industry, Japan Bank for International Cooperation (JBIC), Housing and Urban Development Corporation Limited (HUDCO), India Infrastructure Finance Company Limited (IIFCL) and Life Insurance Corporation of India (LIC).

GoI's national Programme "Make-In-India" has the mandate to promote the manufacturing sector in a comprehensive manner. The programme aims to facilitate investment, foster innovation, enhance skill development, protect intellectual property, and build best-in-class manufacturing infrastructure in India. Overall, the contribution of manufacturing sector to the GDP of India is still lower as compared to that of other fast developing economies of countries like Thailand, China, Indonesia and Malaysia. Through this "Make-In-India" Programme, GoI aims to enhance the contribution of manufacturing sector to the country's GDP and aims to surpass the contribution realized in other developing economics. DMICDC with the development of DMIC project plays a key role in realizing this GoI's vision of Make-In-India.

As part of one of the project initiatives undertaken by DMICDC, Shendra-Bidkin Industrial area is being implemented in the state of Maharashtra as a greenfield industrial smart city. Shendra-Bidkin Industrial area, known as Aurangabad Industrial City (AURIC) is being jointly developed between DMICDC and Maharashtra Industrial Development Corporation (MIDC) under the SPV of Aurangabad Industrial Township Limited (AITL).

MIDC is the industrial development arm of the Government of Maharashtra responsible for creating state-of-the-art infrastructure for industrial development in each district of the state and assisting entrepreneurs in setting up industrial units. Within a span of five (5) decades of its inception, MIDC has become the premier industrial infrastructure development agency in India, a powerful engine of progress with a trailblazing record and above all the pride of Maharashtra.

AITL has 51% stake of MIDC and 49% stake of DMIC Trust. AITL will also have the status of a Special Planning Authority (SPA) and will be responsible for development, management and operations of AURIC.

1.2 Project Background

AURIC is strategically located near Aurangabad in Maharashtra. Besides an existing rail and highway network that connects the new city with major cities in India, AURIC is approximately 10 minutes away from Aurangabad International Airport and approximately 30 minutes away from downtown Aurangabad. The Jawaharlal Nehru Port Trust's proposed dry port and container terminal at Jalna is also approximately 40 minutes away. AURIC is planned as an extension of the existing MIDC's Shendra Industrial Park to the town of Bidkin located near Aurangabad.

Aurangabad has significant potential for growth in various manufacturing sectors. The Aurangabad District is already an established location for automobile and automobile-related manufacturing. Aurangabad will be the showcase for Maharashtra's strengths in manufacturing and technology — automobiles, textiles, apparel, consumer durables, and green industry. AURIC will be the next sought after trade city, venue for manufacturing-related research and design, and high-tech hub centrally located within the state. The strategic location of the AURIC places it at the convergence of Maharashtra's production, manufacturing, and tourism (historic sites). The industrial area also has the potential to become a niche for meetings, incentives, conventions, and exhibitions.

Development of AURIC has been divided into two (2) phases – Phase 1 is AURIC-Shendra and Phase 2 is AURIC-Bidkin. AURIC-Shendra spreads across an area of approximately 8.45 sq.km while AURIC-Bidkin is spread across approximately 32.03 sq.km. Currently, Phase 1 (i.e. Shendra) is under implementation. With the overall vision of developing AURIC as a smart greenfield industrial city, AITL also has a focus on mixed-use development that includes residential, commercial, public-amenities along with social infrastructure beyond the industrial land use. The overall vision of the project includes implementation of state-of-the-art infrastructure that will be highly reliable, available and integrated over technology. AURIC aims to drive the expansion of Aurangabad as a major industrial hub with an aim to attract and retain a highly skilled workforce and generate over 150,000 jobs as direct employment along with housing over 300,000 people including the industrial workforce and their families. Specifically, AURIC-Shendra area is expected to have a population of approximately 60,000 people over the next 10-15 years with approximately 1000 plots.

The paradigm shift towards modern cities includes a strong need to have integrated and connected infrastructure with a focus on citizen-centric services. The overall vision of AURIC includes positioning of Information & Communications Technology (ICT) as the key enabler to integrate various functions of the city development and operations, provide advanced and affordable services to the citizens along with efficient governance and management of the city operations. ICT will enable creation of a sustainable eco-system of the government, industries/businesses, social infrastructure with an overall citizen-centric development. It will enable AITL to be an efficient and tech-savvy organization that will truly leverage ICT for its operations and decision making. ICT will cultivate the development of a digital and connected city which ultimately helps in promoting and sustaining economic growth and development. An illustration of the systems that are envisaged as part of the project is presented in Exhibit 1 below:

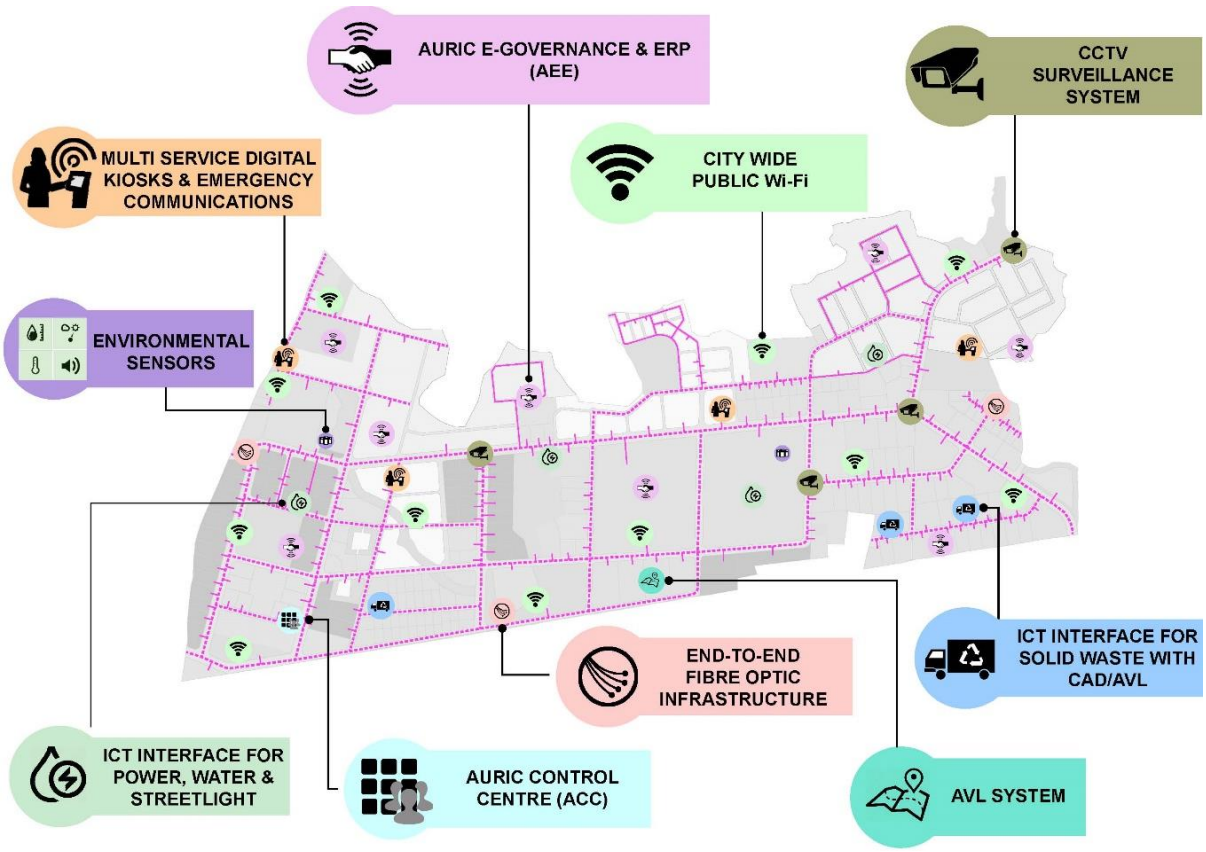


Exhibit 1: Smart City ICT Components

This RFQ cum RFP (Bidding Documents) is for the appointment of a Master System Integrator (MSI) that shall be responsible for supply, implementation, integration, operations and maintenance of smart city ICT components for Shendra area of AURIC (Project). The MSI shall be responsible for complete turnkey of the system including the design, supply, installation, testing, integration, commissioning, operation and maintenance of the components that are being provided as part of this Project.

The Client has appointed an ICT Consultant for the Shendra area of AURIC who will be the representative for AITL on this Project. In addition, the Client also has an overall Program Manager for the development of AURIC. EPC Contractors have been appointed for the civil trunk infrastructure, utilities work and the implementation of the Project.

Exhibit 2 below shows the location map of Shendra and Bidkin areas of AURIC. Exhibit 3 and Exhibit 4 shows the projected population and employment for Shendra-Bidkin Industrial Areas respectively.

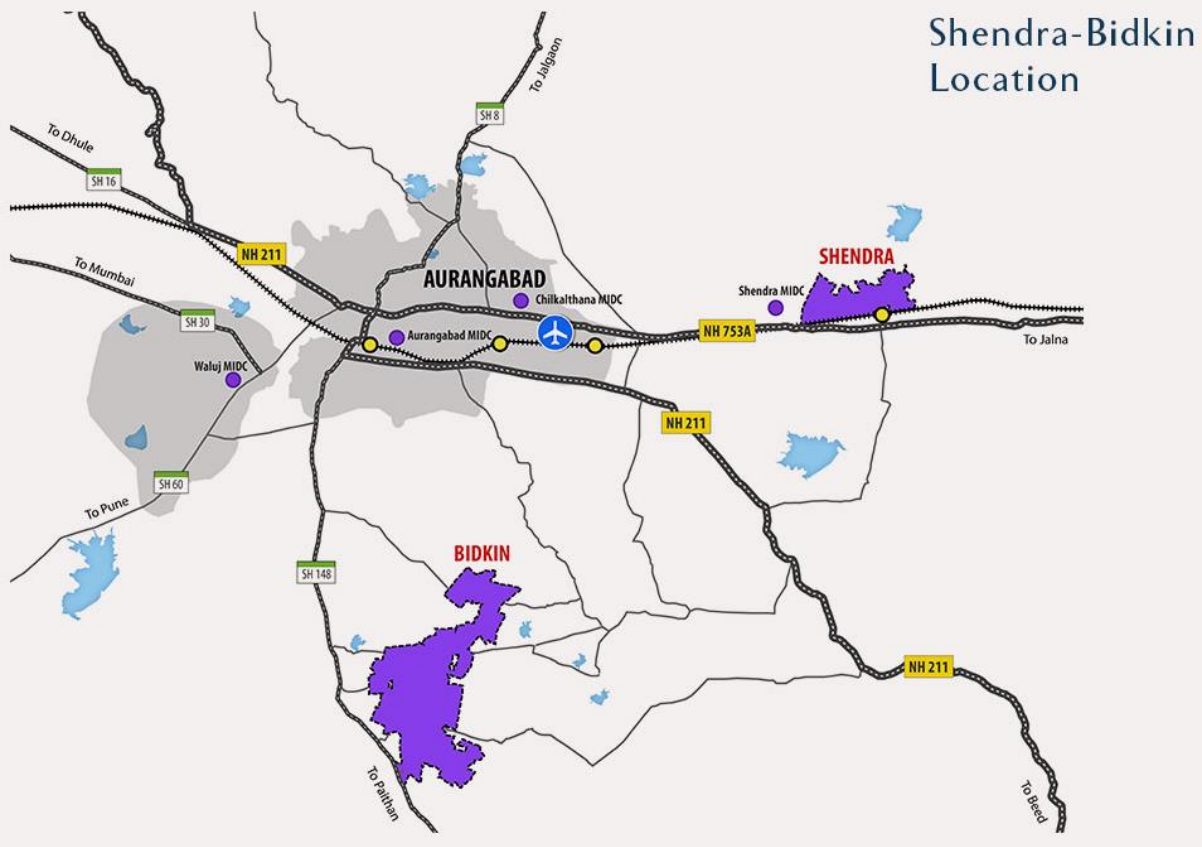


Exhibit 2: Shendra-Bidkin

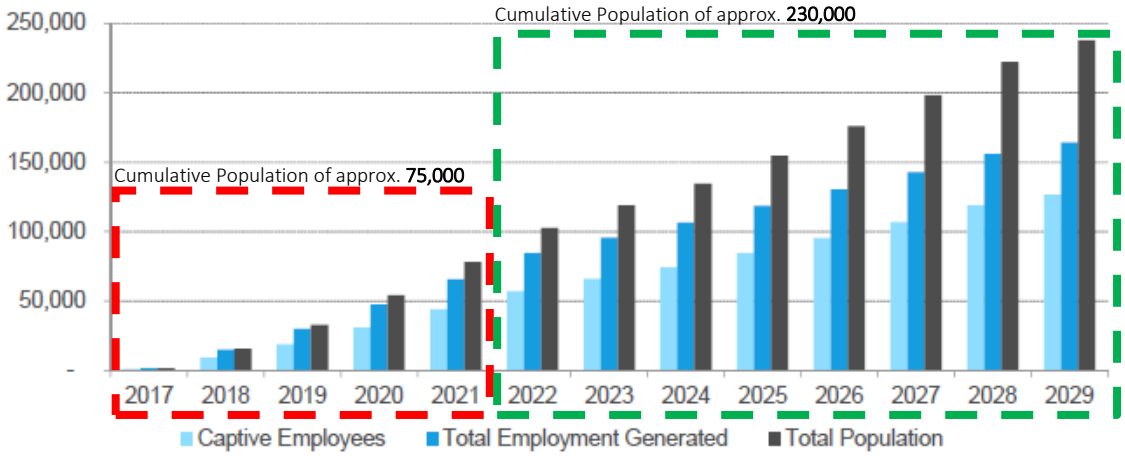


Exhibit 3: SBIA-Population Projection

Source: Techno-Economic Validation for Shendra-Bidkin Mega Industrial Park

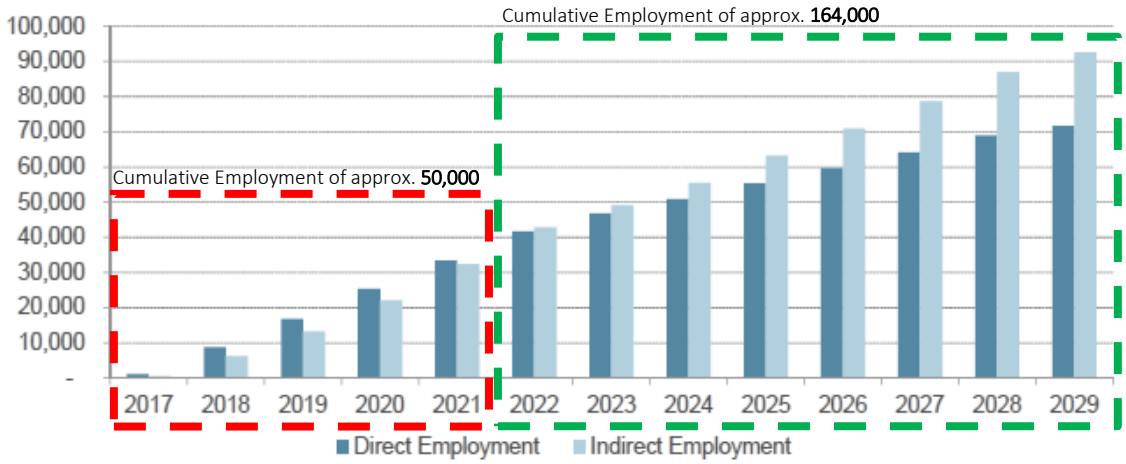


Exhibit 4: SBIA-Employment Projection

Source: Techno-Economic Validation for Shendra-Bidkin Mega Industrial Park

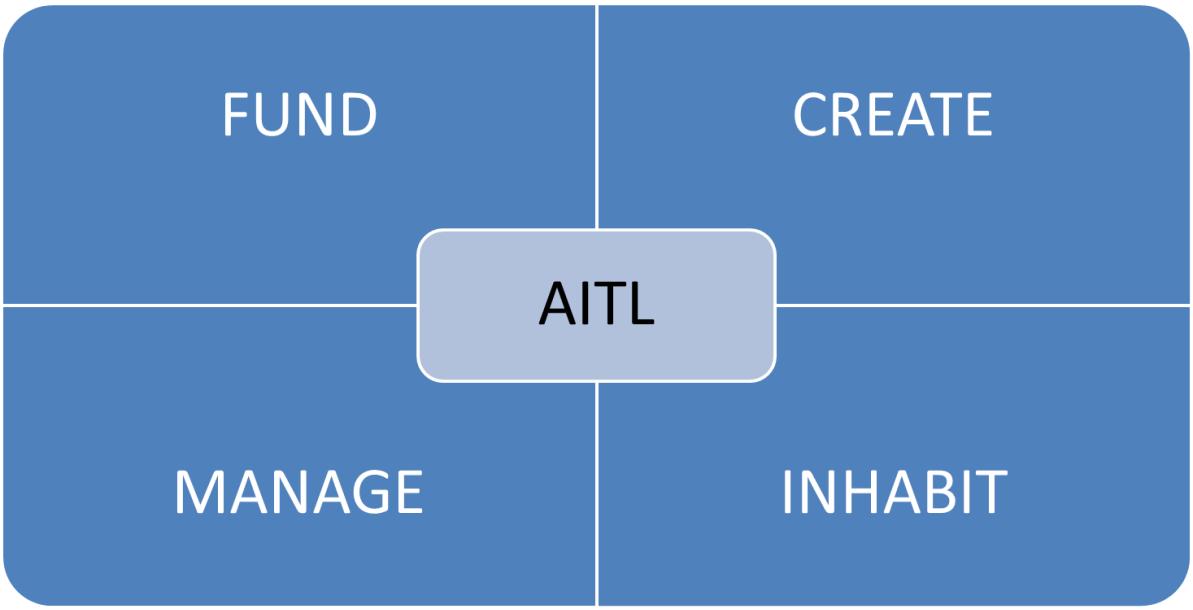
2 Project Overview and Components

AITL intends to implement a greenfield industrial smart city called AURIC. As one of the key initiatives for realizing this vision, AITL plans to implement a state-of-the-art ICT infrastructure along with various components for Shendra area of AURIC as part of this Project. At the centre of the Project is the AURIC Control Centre (ACC) which will be the nerve centre for the city. This ACC will be common for both Shendra and Bidkin areas of AURIC. All applications and sensors installed as part of AURIC will be integrated at the ACC and will be monitored/controlled from this common location. The ACC will interface with all end-devices and applications including at field level and at the user level. It will be the location from where the city will be operated and managed in terms of the infrastructure, critical systems and operations. All components that will be integrated at the ACC will communicate to the ACC using either wired or wireless communications. The wired communications i.e. for the field devices and sensors will be over a purposeful-built fibre optic based infrastructure which will be deployed throughout the Project area. The fibre optic infrastructure will be used to meet both AITL needs and non-AITL needs i.e. tenants of AITL. It is desired that with this Project, an overall Fibre-to-the-X (FTTX) architecture is implemented for all field device connectivity and for connectivity to every plot. The wireless communications on the other hand will include purposeful built wireless network such as M2M communications for some field applications like utilities or will be realized using the city Wi-Fi network. The city Wi-Fi network will be deployed throughout the public areas of Shendra and will be used to enable broadband to be accessible, affordable and available for the citizens. For applications such as e-governance, the citizen will use either the city Wi-Fi service or AITL's multi-services digital kiosks, or may use the respective connectivity from the respective Internet service provider. Multiple e-governance services are being planned as part of AURIC and AITL aims to provide 100% of citizen services online. The backend of the e-governance system and the backbone for AITL operations will be an Enterprise Resource Planning (ERP) system that will be primarily used by AITL for operating and managing the city. It is envisaged that the ERP system will be the one common system used by AITL for all activities required as part of the operations and management of AURIC.

A smart city also includes the concept of safe city. AITL also plans to implement proactive CCTV surveillance system that will be used to monitor the city and its assets. In addition, automatic traffic counters and classifiers will be implemented at all entry and exit points of Shendra to monitor traffic flows and other parameters. Environmental sensors will also be implemented at strategic locations for monitoring various parameters such as pollutant levels which will enable AITL to continuously track the environmental impact of the city. An integrated vehicle tracking system for city vehicles will be implemented for automatically tracking locations of all city vehicle assets at the command and control centre. Specifically for solid waste management, in addition to tracking, it is also desired to automatically dispatch the waste collection vehicles based on various parameters and inputs including bin level sensors.

AITL as an organization is expected to be lean. In addition, there may be outsourced services being managed by a City Manager who may operate some of the functions on behalf of AITL.

Being a greenfield site, AITL will need to go through the business cycle of Funding, Creating, Inhabiting and Managing the city as depicted in the below diagram. Note that part of this cycle is already underway and the details are only provided to help in providing background understanding of the Project.



Fund: The initial priority is funding the city infrastructure from various internal and external sources based on investment plans, which in turn are based on various projects and their funding needs. FUND function will also need facility to manage various sources of funds and their utilization on various projects. The internal sources of funds will be mainly from allocation of land. However internal sources of funds will become active only after land allocation starts. In addition, there could be various projects that could be taken in Public-Private-Partnership (PPP) mode. These projects will be jointly funded and as such will need to be monitored from that aspect. A time scale plan of investment and sources of funds will need to be created to manage the funds and their utilization. The key functions of funding the city are:

- Budget and Grant Management;
- Allocation of Land and Revenue Management;
- Public Private Partnership Management;
- Investment Planning.

Create: Once the city is funded, various planned projects need to be executed. This function is broadly termed as "Creating" the city. The manner in which the creation of city is conceptualized and executed will determine the pace of progress in attracting industrialists/entrepreneurs to invest in the city. The projects need to be executed in a manner that AURIC is created as a world class industrial city meeting the broad objectives of AITL.

Main use of funds in creating the city will be in land development, infrastructure creation like network, water, electricity facilities, and other city infrastructure, civic facilities like parks, clubs, social infrastructure, street lights etc. The city needs to be created in a manner that industrialist and citizens alike choose it over other investment and residential options. The key elements of creating the city are:

- Build Infrastructure for city development:
  - Telecom and other ICT infrastructure;
  - Power;
  - Water;
  - Water Treatment;
  - Waste Management;

  - Land Allocation and Road infrastructure;
  - Progress tracking for all the above projects.
- Land allocation for Commercial, Education, Residential establishment;
- Create Social Infrastructure like Parks, Clubs, Healthcare, Education, Library etc.

The key business objective for AITL in this phase are:

- Manage the grants and funds allocated by the stakeholders;
- Control the budgets and monitor the projects for building the trunk infrastructure;
- Generate funds by attracting private partners and businesses to invest in land and facilities.

Inhabit: Once basic infrastructure is in place and plans are afoot to create the city, efforts need to be started for attracting and retaining industrialists and citizens to the city. Facilitation centre needs to be created to answer queries of prospects. In parallel, tie up with various private and government agencies are required to be done to cover all the functions required to run the city. All civic amenities need to be in place and in working condition. A showcase to the current state and progress chart is required to be made available to all prospects. AITL is also vested with municipal powers and availability of municipal functions will be key in attracting citizens. Various functions in making the city inhabitable are:

- Attract and retain entrepreneurs;
- Provide unique ID to entrepreneurs and citizens;
- Facilitate Citizens and Residents;
- Provision of digital locker for citizens and entrepreneurs to store their documents;
- Enable Commercial/ Social/ Health facilities;
- Provision of services like Fire, Police, Traffic;
- Operate city and its Infrastructure;
- Provide Civic amenities and utilities;
- Provide Municipal Functions under purview of AITL.

Manage: Even before first citizens and industrialists inhabit the city, robust practices of managing the city needs to be provisioned. Inhabitants, citizens and industrialists alike will be able to request for any service through multiple channels like kiosks at suitable places, telephone, walk in to customer centre, mails or through interactive mobile application. The centralized city command and control centre will have the tracking feature to know issues proactively in any segment of city infrastructure. City Manager will have service level agreements to ensure level of service to be provided to inhabitants. Once city is operational, there will be provision required to carry out minor works encompassing electrical, telecom, water, waste water, roads, parks, streetlights, social infrastructure of the city. Solid waste collection will be automated with the use of RFID enabled bins. SCADA based systems and alarms will be used to proactively monitor water and electricity distribution network among other utilities. Citizen engaging services will be channelized through the use of city Wi-Fi infrastructure. Various functions under managing the city are as under:

- Monitor key performance indicators;
- Operate and Manage Infrastructure Services through City Manager;
- Command and Contact Centre Driven services delivery mechanism;

- Self-service Kiosks for enhanced user experience;
- Service Level Management;
- Escalation Management with vendors;
- Minor works Management;
- Revenue and Expense Management;
- Billing for services such as water, power and telecom as applicable.

Key Stakeholders in the System

The key stakeholders that shall be the direct/indirect users of the system are:

- AITL employees;
- Citizens residing in the city as well as workers;
- Any outsourced employees, managing the various city functions as applicable;
- Third Party Vendors;
- Other Government Departments/Organizations;
- Industrialists and citizens both existing and prospective.

A summary of the Project components that shall be implemented by the MSI as part of this Project are presented below:

Component	Project Requirement
Fibre Optic Infrastructure	End-to-end fibre optic infrastructure (passive and active) to meet all the current and future needs of the Project with an overall architecture of Fibre-to-the-X (FTTX) for a connected city using various Points-of-Presence (PoP) facilities.
City-Wide Wi-Fi	City-Wide Wi-Fi to make broadband services more accessible, affordable and available for citizens and workforce across Shendra.
AURIC e-Governance and ERP (AEE)	AEE will comprise of implementation of various citizen engaging e-governance initiatives with a target of 100% of AITL's services being available online. AEE also includes a robust state-of-the-art ERP system for planning and managing AITL's city operations more efficiently. The ERP system shall enable AITL to have efficient business processes that can be managed in an integrated manner.
CCTV Surveillance System including Automatic Traffic Counter and Classifier (ATCC)	CCTV surveillance system for proactive monitoring of strategic areas and infrastructure across. Automatic Traffic Counters and Classifiers (ATCC) for monitoring flow and type of traffic at all entry/exit points of Shendra.
Multi-Services Digital Kiosks and Emergency Communications	Integrated and interactive multi-services digital kiosks for citizen services and emergency communications with Wi-Fi and CCTV across various public areas.
ICT interface for Smart Solid Waste Management with CAD/AVL	ICT interface infrastructure required for integrating solid waste bins, collection trucks and operations along with dispatch for solid waste collection.

Component	Project Requirement
Environmental Sensors	Implementation of environmental sensors at strategic locations in Shendra for monitoring of various parameters such as temperature, humidity, wind speed, rainfall and pollutants.
Automatic Vehicle Location (AVL) System	Real-time tracking and monitoring of key AITL/non-AITL vehicles including police, fire, solid waste trucks, ambulance and water tankers.
Other In-Facility Systems	This includes Building Management System and Access Control System. Building management system for monitoring, control and automation of critical infrastructure at ACC and Point-of-Presence (POP) Rooms. Access control system for controlled access with integrated biometric functionality for both ACC and POP rooms.
Solar Panel with Batteries	Solar panel with integrated battery at poles where ICT infrastructure will be mounted.
IT Infrastructure	This includes implementation of complete IT Infrastructure to be provided as part of this Project such as Operator Workstations, Communication Cabinets with Racks, Servers, UPS, Data Security Solutions and Databases.
AURIC Control Centre (ACC)	AURIC Control Centre (ACC) which will be the 'nerve-centre' of AURIC for real-time monitoring and control of the connected infrastructure and city services.

Overall, the expectation from this Project is that:

- The solution architecture should be open, interoperable and scalable;
- Adherence to the model framework of cyber security requirements set for Smart City (K-15016/61/2016-SC-1, Government of India, and Ministry of Urban Development);
- All the components of the Technical Architecture should:
  - at least comply with the published eGovernance standards, frameworks, policies and guidelines available on http://egovstandards.gov.in (updated from time-to-time); and
  - In reference to the leading industry standards and as per indicative standards mentioned at Appendix B.
- The overall architecture shall support:
  - Expandability: Open ended; allows upgrading to take advantage of continued evolution in transportation information and control systems;
  - Interoperability: Machine independent; allows the largest-possible markets for deployment;
  - Compatibility: Non-interference; various devices within the same system must be able to operate without interfering with the operation of other devices;
  - Interchangeability: Vendor independent; devices from different vendors that perform the same functions may be interchanged;
  - Open: Non-proprietary; promotes rapid development of new technologies and acceptance by consumers;

  - Scalable: Flexible; standards recognize local conditions with a wide range of ICT devices and communication channel capabilities. Legacy systems are accommodated to the extent possible;
  - State-of-the-art: Use of the best available standards to avoid locking in obsolescent technologies.
- Minimize the infrastructure such as poles, by co-locating various equipment (CCTV, Wi-fi, Sensors, switches etc.) on streetlight poles.

Along with the implementation of the above mentioned components by the MSI, the MSI shall also be responsible for end-to-end coordination and integration with the following components (provided by Others). This has been further expanded in the detailed scope of work section of this RFQ cum RFP.

Component	Project requirement
Triple Play Voice, Video and Data Services	AITL plans to lease out dedicated backbone and distribution fibre optic infrastructure to the Telecom Service Providers (TSPs) as part of this Project. This fibre optic infrastructure will be implemented by the MSI and will be used by the TSPs. AITL will essentially provide 'dark fibre' to the TSPs and will provide TSPs dedicated space for co-locating their respective equipment at POP rooms. MSI shall coordinate with various TSPs to incorporate their requirements in terms of dark fibre infrastructure.
Passive Infrastructure for Cellular Services	A tower company will be appointed by AITL for the installation, operations and maintenance of passive infrastructure for cellular services including cell phone towers and integrated smart poles. AITL will also provide dedicated space to the tower company for installation of towers and co-location of equipment (provided by cellular service providers). The MSI shall coordinate with the tower company and incorporate their requirements in terms of passive infrastructure.
ICT interface with Power, Water and Street Lighting Infrastructure for Internet of Things (IoT)	At present, EPC Contractor is implementing the civil and utilities trunk infrastructure. The water, power and street lighting infrastructure being provided by the EPC Contractor will be SCADA based and will be integrated at the ACC for the purposes of monitoring and control of critical parameters. The integration of these SCADA enabled utilities at the ACC and complete coordination with the EPC Contractor shall be the responsibility of this MSI.
Hosting Services	AITL will appoint a cloud service provider for meeting the hosting needs of the Project. Part of the Project IT infrastructure in the form of servers will be used via Infrastructure-as-a-Services (IaaS) provided by the cloud service provider. This will be used by the MSI for hosting services and infrastructure as detailed in this RFQ cum RFP.
Civil Trench for Fibre Optic Infrastructure	EPC Contractor shall be providing the civil trench for the fibre optic infrastructure at majority of the places for backbone and distribution network. Details of this trench have been provided as part of this RFQ cum RFP. The MSI shall use this civil trench for the fibre optic infrastructure and coordinate with the EPC Contractor as needed.
AURIC Hall for ACC	AURIC Hall EPC Contractor shall be responsible for the design-build of the AURIC Hall building. This is the location where the ACC will be implemented. The MSI shall coordinate with the AURIC Hall Building Contractor for the implementation of the ACC at the AURIC Hall.

Component	Project requirement
Solid Waste Management Operations Agency	AITL will appoint a dedicated agency for solid waste collection and operations. MSI shall coordinate with the solid waste management agency for the ICT infrastructure and components being provided as part of this Project.
e-Land Management System	AITL is currently implementing an e-Land Management System (e-LMS) which is being used for land allotment and management. The MSI shall be responsible for complete integration with this e-Land Management System.

2.1 Project Phasing

The Project and its components will be implemented in a phased manner which will broadly be in-line with both the Client requirements and the availability of on-site civil infrastructure. Note that since the EPC Contractor is responsible for the civil and utilities trunk infrastructure and the AURIC Hall Building Contractor is responsible for the AURIC Hall construction, the overall implementation of the Project is dependent on both these contractors which has been captured in the proposed phasing. If the respective on-site civil infrastructure is ready before time, the MSI's Project plan shall be flexible to accommodate the implementation of these modules before time. Some Project components may be implemented in parallel under different phases. The order of implementation may be subject to revisions based on Project priorities and discussions with the Client.

Note that the phasing list is not all inclusive and the Bidder shall refer to other sections of the RFQ cum RFP and the Bill of Quantities (BoQ) for exact quantities and requirements of these components. The percentage mentioned against an individual Project component is the percentage of total quantity of the respective component being implemented.

Phase (completion)	Project Components

Phase 1
(October 2017)
	• Modules of AEE:
	  ➢ Website + Citizen portal + City app;
	  ➢ Grievance Redressal;
	  ➢ Finance & Accounts;
	  ➢ Misc. billing including maintenance charges for plots;
	  ➢ Purchasing;
	  ➢ Contracts;
	  ➢ Utility Billing;
	  ➢ Automated Building Plan Approval System.
	• 100% completion of Environmental Sensors;
	• Integration with GIS, Cloud and e-LMS.

Phase 2a
(December 2017)
	• Modules of AEE:
	  ➢ Record management;
	  ➢ e-procurement (including e-bidding of plots);
	  ➢ Asset management and maintenance;
	  ➢ Inventory management;
	  ➢ Projects and works management;
	  ➢ Citizen card;
	  ➢ Digital locker with document management system;
	  ➢ HR & payroll.
	• Citizen Facilitation Centre (CFC);
	• 30% completion of City Wi-Fi and Fibre Optic Infrastructure;
	• Two (2) POP facilities;
	• 30% completion of Multi-Services Digital Kiosk and CCTV;
	• Integration with two (2) cellular towers, cloud, e-LMS and GIS;

Phase (completion)	Project Components
Phase 2b (March 2018)	• One (1) POP facility; • 50% completion of City Wi-Fi and Fibre Optic Infrastructure; • 50% completion of Multi-Services Digital Kiosk and CCTV; • AVL system (all vehicles); • Legal (land related), birth & death, trade licensing, RTI & any other module of AEE; • KPIs & Dashboards; • Integration with two (2) cellular towers, cloud, e-LMS and GIS.
Phase 3a (August 2018)	• One (1) POP facility; • 75% completion of City Wi-Fi and Fibre Optic Infrastructure; • 75% completion of Multi-Services Digital Kiosk and CCTV; • 100% completion of Auric Control Centre- ACC; • 100% completion of Integration with utilities; • 100% completion of ICT interface for solid waste; • Integration with one (1) cellular, cloud, e-LMS and GIS.
Phase 3b (January 2019)	• 100% completion of Fibre optic infrastructure and City Wi-Fi; • 100% completion of Multi-Services Digital Kiosk and CCTV; • 100% completion of GIS platform including Web-GIS.

The subsequent sections present the overview, business, functional and technical requirements of the components and broad scope of services to be undertaken by the MSI as part of this Project.

The Client intends to implement ICT infrastructure and components designed to meet the requirements as specified in this RFQ cum RFP document. The Bidder shall completely understand the requirements of the Client and implement the solutions which includes all the required hardware and software. Since this is a turnkey contract, any specific hardware or software not included in the RFQ cum RFP but required to meet the Bidder's proposed solution and the requirements of the Project shall be included as part of the Bidder's scope of work.

2.2 Business, Functional and Technical Requirements

2.2.1 Fibre Optic Infrastructure

Overview

An underlying enabler of a smart city is a highly reliable and available fibre optic infrastructure. AURIC-Shendra will be the first city of its kind that will have an end-to-end fibre optic infrastructure with an overall FTT-X architecture for all its services. This infrastructure will be used for both AITL and non-AITL services including AITL tenants. It is expected that overall, fibre optic infrastructure will be used for connectivity to all 'things' being implemented as part of Shendra city and will be the underlying enabler for connectivity.

The end-to-end fibre optic infrastructure shall be provided as per the following:

- A total of five (5) POP facilities shall be provided for co-location of equipment and fibre optic termination for both AITL and non-AITL needs;
- Among these five (5) POP facilities plus AURIC Hall, a dedicated fibre optic infrastructure shall be provided in a partial-mesh architecture. This fibre optic infrastructure shall be dedicated for backbone communications of the Project;
- From each of these POP facilities, there will be a dedicated fibre optic infrastructure required for distribution communications of the Project. This distribution communications will be used to provide connectivity to AITL field devices and for connectivity to plots. This shall be provided in a dual ring configuration;
- The last layer for communications will be the access layer i.e. connectivity to every plot and field device that will be provided from the distribution network. This is further divided into two (2) scenarios:
  - For AITL plots – access communications includes connectivity from the distribution communications trench until the Main Telecom Room (MTR) of the building. This includes fibre optic civil infrastructure and network cabling;
  - For non-AITL plots – access communications also includes connectivity from the distribution communications trench until the MTR of the building. However, in this case, the MSI will only provide fibre optic civil infrastructure (ducts) from the nearest manhole just until outside the property line of the respective plot;
  - For field device – access communications to all AITL field devices.

The AITL network is envisaged to have the following key attributes:

- Reliability, Availability and Resiliency: AITL network shall have a high degree of reliability, availability and resiliency, even in the event of failed links, equipment failure, and overloaded conditions with a self-healing architecture. In addition, the failure of a single link or piece of equipment should not impact the overall network performance;
- Scalability: The network shall be scalable that can grow to include new user groups and can support new applications without impacting the level of service delivered to existing users;
- Manageability and Sustainability: Once designed and developed, the AITL available network staff must be able to manage and support the network. In order that it functions effectively and efficiently;
- Affordable and accessible: The services utilizing the AITL network (TSP) will be affordable and within reach of the target consumers;

- Publically Available: AITL network shall be publically available to encourage Digital India and Internet penetration;
- Generate Revenue: AITL network shall be able to generate revenue for AITL so that it is sustainable and profitable.

Architecture

Backbone Architecture

The backbone will be designed between Primary POP and all the four (4) secondary POPs. Auric Hall, the location of the ACC will form an additional node on this backbone network, and will also be connected using the backbone network.

Exhibit 4 below shows the proposed backbone network connectivity between each Point of Presence along with connectivity for AURIC Hall. The backbone architecture for Shendra is being proposed as partial mesh where all of the data that is transmitted between the POPs will take the shortest path (or least costly path) between POPs with high reliability, resilience and survivability. In the case of a failure or break in one of the links, the data takes an alternative path to the destination. Each POP shall be connected to at least two (2) additional POPs for high availability, reliability and survivability of the overall backbone network.

The overall backbone network connectivity will be such that each link shall be able to meet its individual zone requirement plus account for redundant network switching capacity required in case of any link failure along with provision for future growth in terms of bandwidth requirements of the network. It is expected that the backbone network is continuous i.e. there is no field splicing of the backbone network and all terminations of the backbone network happens only at the POP facilities and AURIC Hall.

Exhibit 5 below presents the preliminary architecture for the backbone communications.

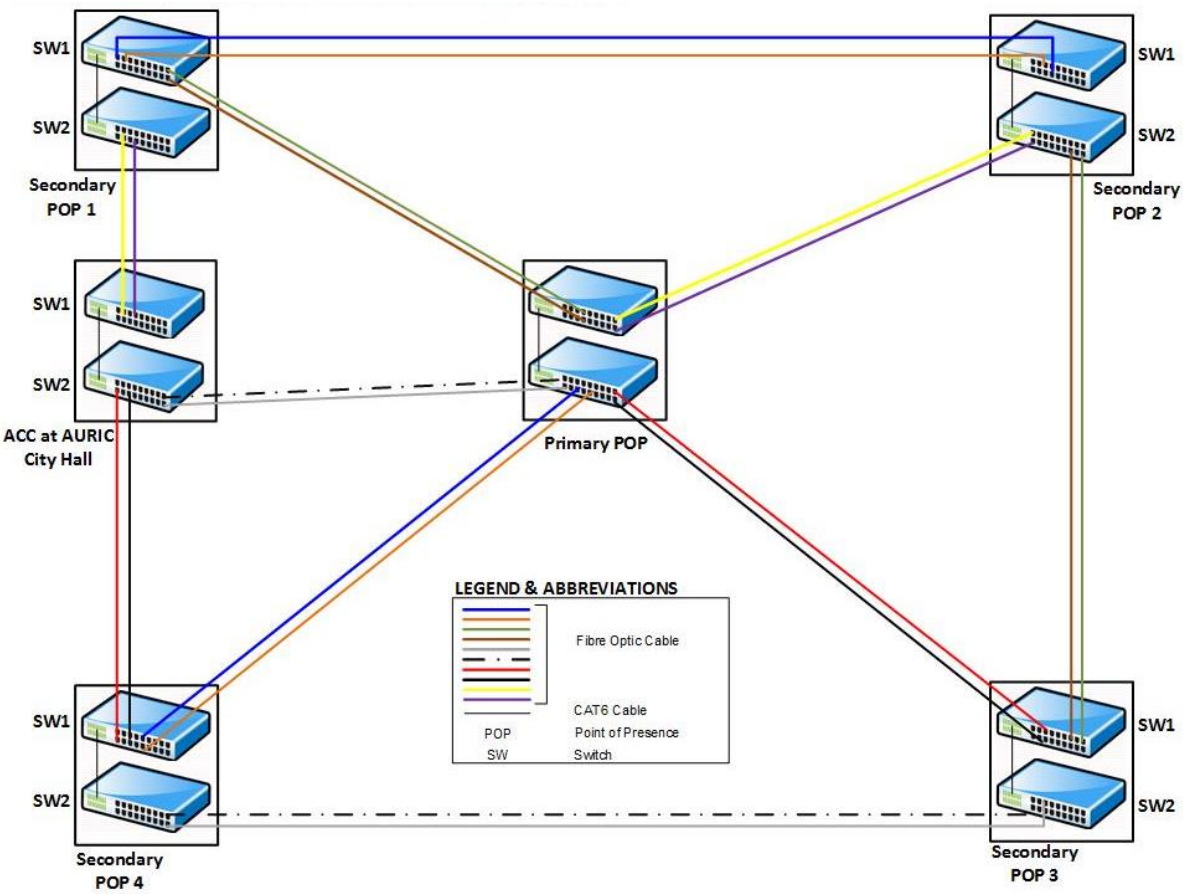


Exhibit 5: Preliminary Architecture for Backbone Communications

Distribution Architecture

The distribution architecture will be Layer 2 based is designed for a ring configuration for the fibre optic network. This ring will be created using both redundant POPs and geographically redundant paths wherever available. The distribution fibre will be used to connect a particular 'zone' from a respective POP. This zone will include distribution connectivity to both plots and end-devices.

Access Distribution for City-wide AITL Services

Using the distribution network, the access network will provide end-to-end connectivity to the field devices and plots. The access network will be divided into the following parts:

- For AITL field devices;
- For AITL plots;
- For non-AITL plots.

Active Electronics for Fibre Optic Network

It is expected that all network switches at access level (field) shall be Layer 2 based and shall be industrial grade, suited to perform as per on-site conditions.

All network switches at distribution level (POP) shall also be Layer 2 based but may not be industrial grade. Further, all network switches for backbone (POP) shall be Layer 3 based.

Point of Presence

Point-of-Presence (POP) rooms are where all telecom services (AITL and non-AITL) will originate/terminate. This space will be shared between AITL services and tenants including telecom service providers and cellular among others. There is one (1) primary POP and four (4) secondary POPs proposed at geographically distributed locations across Shendra. The POPs shall have dedicated space for each of the tenant and AITL services. They will also have the main cellular towers co-located in the same plot location with dedicated space for cellular services.

The POPs are sized as approximately 1,800 sq.ft. building size as shown in the illustrative sketch below in Appendix A. Note that it is expected that the POP will not just cater to Shendra's needs today but also future growth in terms of space requirements and support tenant co-locations. Based on the building size of 1,800 sq.ft. and tower, a setback in compliance with the development guidelines will be required for sizing the entire plot area.

BR - 1 Business Requirements

BR 1.1	End-to-end city wide fibre connectivity is required as a part of the Project to support the Smart City functions and enhance the quality of services for the citizens.
BR 1.2	AITL shall own all end-to end fibre infrastructure including trench, cable tray, duct, fibre, splices, and other accessories and will become a dark fibre provider for all AITL right of way.
BR 1.3	The fibre optic infrastructure shall be utilized by AITL as well as other city agencies (upon approval of AITL) as a common ICT infrastructure.
BR 1.4	Overall network shall be divided into three (3) parts: backbone, distribution and access networks. AITL to provide end-to-end backbone and distribution networks for all purposes along with access network for field devices. For access networks to plot, depending on the plot type, it will be a combination of AITL and respective plot developer that will provide this network.
BR 1.5	There will be five (5) Point of Presence (POP) rooms plus AURIC hall that will be the co-location and aggregation facilities for an integrated high-speed network backbone. The POP rooms will be the co-location spaces for both AITL network and non-AITL network (leased to various tenants). Each of these POPs and the AURIC Hall shall be connected over a dedicated high speed backbone network that will support a carrier grade, IP/MPLS based partial mesh architecture. Each of the POPs will provide dedicated connectivity using the distribution layer and serve a particular 'zone'. A 'zone' has a group of devices and plots that will ultimately be connected using the distribution and access network. Connecting the distribution layer, there will be the access layer i.e. the access network that will provide connectivity to the respective end-devices and plots. Each zone for a particular POP shall be approximately 2 sq.km.
BR 1.6	AITL shall provide Point of Presence (POP) rooms to the TSPs and other tenants and lease out space to them.
BR 1.7	For the TSPs, cellular and other tenants, only the 'bare-shell' infrastructure with partitioned space within the POP shall be provided as a part of this Project. The tenants shall be responsible for using this 'bare-shell' infrastructure space and provide all their required actives inside their dedicated space.

BR 1.8	The overall network architecture shall support a combination of partial mesh for the backbone communications and ring for distribution network. Maximum number of rings per pair of fibre shall be five (5). All rings shall be dual home based architecture.
BR 1.9	AITL network shall be reliable, interoperable, open standards based, available and resilient. It shall be scalable, manageable, supporting segregation of traffic and sustainable. It shall also generate revenue for AITL.
BR 1.10	All backbone networking shall be IP/MPLS based.
BR 1.11	All backbone electronics shall be sized with sufficient capacity to support the redundancy and future traffic growth in order to complete traffic rerouting on the backbone in event of a fibre or switch failure without impacting overall network performance.
BR 1.12	For distribution architecture, all AITL plots will have redundant entry and exit fibre paths for connectivity until the plot levels with redundant FOSCs and single switch at the telecom room of the building.
BR 1.13	For distribution architecture, all non-AITL plots will have single entry and exit fibre path for connectivity until the plot level with single FOSC outside the plot.
BR 1.14	As Shendra is being developed as one of the first greenfield industrial smart cities, high priority is placed on the city's ICT infrastructure to be a key enabler in providing modern triple play services to the citizens. As part of the ICT infrastructure, AITL will provide the entire passive infrastructure i.e. dark fibre infrastructure for TSPs and other tenants for both backbone and distribution network.
BR 1.15	All splicing for distribution network of TSPs and other tenants shall be the responsibility of the respective TSPs and tenants under the supervision of AITL.
BR 1.16	AITL will register with DoT as Infrastructure Provider 1 (IP1) with help of consultant and MSI.

FR - 1 Functional Requirements

Fibre Optic Civil Infrastructure – Trench/Duct/Manhole/Handhole	
FR 1.1	The backbone and distribution trench for 60m, 45m, 30m Right-of-Way (RoW) – In this case, there shall be a concrete encased trench that will be provided by the EPC Contractor along the road. The concrete encased trench shall be provided with a tray based system and shall have dedicated tray for fibre optic infrastructure for the duct installations.
FR 1.2	The backbone and distribution trench for less than 30m RoW – In this case, open trench shall be provided by the MSI on one side of the road that shall be used for installation of the fibre optic infrastructure. EPC Contractor will provide hume pipes for crossing to connect the other side of the roads which will be used by the MSI for installing the fibre optic infrastructure.
FR 1.3	The access trench shall be provided by MSI for every plot and connectivity to every field device.
FR 1.4	Manholes and handholes shall be placed at strategic locations for the fibre optic infrastructure throughout the AITL RoW. These manholes and handholes shall be provided by the EPC Contractor. However, the handholes and manholes required inside the AITL plots shall be provided by the MSI. These manholes shall be used for placing the fibre optic splice enclosure (FOSC).
FR 1.5	The handholes inside the plots shall be sized per minimum 0.5m x 0.5m x 0.5m (l x w x d) inside clear space.
FR 1.6	The fibre optic cable shall be installed inside dedicated Permanently Lubricated (PLB) High Density Polyethylene (HDPE) smooth wall configuration ducts inside the trench. These HDPE ducts shall be sized to provide sufficient future growth capacity for Shendra.
FR 1.7	HDPE duct shall be laid throughout Shendra using both the concrete encased trench and open trench.
FR 1.8	The HDPE duct shall be suitable for underground fibre optic cable installation by blowing as well as conventional pulling.
FR 1.9	The HDPE duct shall be suitable for laying in RCC trench, trenches by directly burying, laying through hume pipe and laying through trenchless digging i.e. Horizontal Directional Drilling (HDD).
FR 1.10	There are three (3) types of ducts for fibre optic laying to fulfill the end-to-end connectivity of the ICT infrastructure: • 3 times 4x40mm (OD) HDPE ducts, each set of 4-40mm installed inside its dedicated HDPE outersleeve (of required diameter) for backbone and distribution infrastructure. • 7x20mm (OD) HDPE ducts with one HDPE outersleeve (of required diameter) for connectivity to every plot; and • 1x20mm (OD) HDPE duct to connect every field device location.
FR 1.11	The colour allocation for the backbone/distribution ducts are: • All outersleeves – orange • 4x40mm aqua colour ducts inside one outersleeve

	• 1x40mm orange, 1x40mm blue, 1x40mm slate and 1x40mm green inside one outersleeve • 1x40mm aqua, 1x40mm blue, 1x40mm slate and 1x40mm green inside one outersleeve.
FR 1.12	The colour allocation for the 7x20mm ducts is: 1x20mm orange, 1x20mm blue, 1x20mm aqua, 1x20mm slate, 1x20mm green, 1x20mm brown, and 2x20mm orange inside one (1) orange outersleeve.
FR 1.13	All HDPE ducts shall be colour coded as per EIA/TIA 598 standard.
FR 1.14	For access infrastructure to plots, there shall be two (2) scenarios: • For AITL plots, there are approximately 23 plots that will be under AITL inside which there will be dedicated connectivity required between the manhole and respective plot's Main Telecom Room (MTR). This connectivity will be provided using the 7x20mm HDPE duct configuration which will be installed its dedicated outersleeve. • For non-AITL plots, the 7x20mm HDPE duct configuration inside the dedicated outersleeve will be provided until just outside the plot property line.
FR 1.15	For field device connectivity, each device shall have dedicated 1x20mm HDPE duct for access network.
FR 1.16	The duct shall be supplied with tracer wire and shall have in-built rodent protection chemical at outer sheath of every duct.
Optical Fibre Cable	
FR 1.17	The AITL fibre optic network shall have an overall Fibre-to-the-X (FTTX) architecture.
FR 1.18	End-to-end fibre optic infrastructure shall include only single mode Optical Fibre Cable (OFC), loose tube, armoured cable configuration rated for outdoor installations.
FR 1.19	All fibre optic cable shall be ordered in standard tube and colour configuration based on EIA/TIA 598.
FR 1.20	Each of the POP rooms and AURIC Hall shall be connected over a dedicated 24 count fibre optic cable. This cable shall only be used for backbone communications and will not be field spliced. It will only be terminated at the POP and AURIC Hall and will have redundant entry and exit paths to all POPs and AURIC Hall for inside plot. This 24 count fibre optic cable shall be provided in two (2) separate tubes i.e. 12 count per tube.
FR 1.21	For distribution to plots, a dedicated 96 count fibre optic cable will be provided end-to-end in the respective zone. Similarly, for connectivity to AITL field devices, a dedicated 96 count fibre optic cable will be provided end-to-end in the respective zone. For AITL field equipment, it is expected that a lot of the field devices will be co-located i.e. leverage the same field infrastructure for mounting and use the same network switch. It is expected that the field devices like Wi-Fi and CCTV will share the same streetlight poles and will be connected over a ring architecture. All 96 count distribution fibre shall be ordered with fibre in eight (8) tubes with 12 count per tube.
FR 1.22	For the TSPs and other tenants, a dedicated 96 count fibre optic cable shall be provided for each tenant. This will be provided with fibre in eight (8) tubes i.e. 12 count per tube.

FR 1.23	For AITL plots, access network shall have two (2) separate 12 count fibre optic cables from the manhole to the respective MTR. This will be ordered with 4 count per tube configuration. For non-AITL plots, access network of fibre cable including FOSC and cable shall be provided either by the Telecom Service Providers or the Plot Holder between MTR of the plot and the AITL manhole. For AITL device connectivity, access network shall be provided via dedicated six (6) count fibre optic cable per network switch.
UTP Copper Cable and Accessories	
FR 1.24	Outdoor-rated Unshielded Twisted Pair (UTP) Communications Category (CAT) 6 Cable with armouring to provide Ethernet connectivity between network switches and end devices such as CCTV, Wi-Fi, etc. located within 90 m from the switch location.
FR 1.25	The UTP cable shall be outdoor-rated UTP CAT 6 cable and shall have a guaranteed transmission performance up to 250 MHz.
FR 1.26	Wherever installed, the UTP cables shall be supplied with either in-built surge suppressor or shall have additional surge suppressors as specified.
FR 1.27	Each conductor of the UTP cable shall be insulated with a coloured high density polyethylene jacket with varying twisted length to minimize crosstalk.
FR 1.28	Additional accessories to include CAT 6 Patch Cords required for data communications connections, CAT6 Patch Panels for cable termination and Surge Suppressors for protection from voltage spikes as per the design requirements.
FR 1.29	The UTP patch panels shall be sized to support the design requirements as per the RFQ cum RFP. At least 50% of the capacity of the patch panel ports shall be left as spare.
FR 1.30	The surge arrestor shall be such that they do not interfere with normal communications.
FR 1.31	The termination shall protect the cable terminations from water and mechanical damage and shall be resistant to salt corrosion.
FR 1.32	Any provided patch panel or wall plate shall provide mechanical support for all connections enclosed and shall maintain insulation between them.
FR 1.33	All cable entries shall be provided with appropriate cable pathway.
Fibre Optic Accessories	
FR 1.34	**Optical Connectors:** Optical connectors shall be used to terminate optical fibre for their interconnection and distribution.
FR 1.35	**Fibre Patch cords:** Fibre Patch cords shall be used to connect Fibre Termination Panel to the network switch.
Fibre Distribution Management System (FDMS)/Optical Cable Entrance Facility (OCEF) and Fibre Termination Panels:	
FR 1.36	OCEF/FDMS shall be installed at the ACC and at POPs and shall be used to manage all fibre entry/exit inside all POPs and ACC.

FR 1.37	The OCEF/FDMS shall be equipped with splice trays to accommodate the requirement of this Project.
FR 1.38	The OCEF/FDMS shall have built in slots to secure fibre and management clips to hold spools of slack fibre.
FR 1.39	The OCEF/FDMS shall have identification labels inside the door.
Fibre Optic Patch Panel:	
FR 1.40	Fibre Optic Patch Panels shall be installed at termination location at POP, ACC, AITL plots and at every field switch location installed on the pole or cabinet.
FR 1.41	The Patch panels shall be capable of supporting SC type ports for backbone and distribution and ST/LC type ports for access.
FR 1.42	The Patch panels shall have the capacity for terminating the number of fibre as required per the requirements of the Project plus additional 20% spare for future.
Intelligent Patching System:	
FR 1.43	At POP rooms and ACC, intelligent patch panels shall be installed for AITL infrastructure.
FR 1.44	The Intelligent patching system shall comprise of intelligent patch panel, modules, and associated software to be provided at the POPs and ACC locations to manage network planning, implementation and operational activities like moves, adds and changes.
FR 1.45	System Hardware shall be capable of seamlessly feeding information directly into the software platform.
FR 1.46	The software platform shall provide fully accurate and comprehensive documentation of all network infrastructure components as well as advanced detection and alert capabilities to allow full control over the environment.
Communications Cabinets with Racks	
FR 1.47	Please refer to the Communication Cabinets with Racks specifications mentioned under IT Infrastructure specification Section 2.2.11.2.
Fibre Asset Management	
FR 1.48	With implementation of a fibre optic network, there is a requirement to create a fibre asset management system for management of the infrastructure.
FR 1.49	The fibre asset management system shall be a purposeful-built tool that will allow mapping of all fibre counts in terms of count colour, number and allocation (entity or device) among other variables.
FR 1.50	Fibre asset management system shall be configurable and easy to operate and update. It is expected that post any implementation of the fibre optic infrastructure, this asset management system shall be updated on an on-going basis.
Active Electronics (Switches, Media Converters, Wireless Gateways)	
FR 1.51	Industrial grade, POE/POE+ enabled, Layer-2 Ethernet switches shall be installed at the field for connectivity to field devices.
FR 1.52	Layer-2, non-industrial grade Ethernet switches shall be installed per POP for distribution to field devices and plots.

FR 1.53	Layer 3 based Ethernet Switch/Router at all the Point of Presence (POP) locations including AURIC Hall for communication between the POPs and AURIC Hall to support a partial mesh architecture.
FR 1.54	Core router for connectivity to the outside world i.e. for worldwide web services and for connectivity to the cloud service provider.
FR 1.55	Layer 2 switches at the field shall have 1 Gbps backhaul fibre support.
FR 1.56	Each of the Layer 2 switches at the POP shall support at least 1 Gbps per port (fibre) for distribution with backhaul uplink of 10 Gbps copper/SFP+ while the Layer 3 switches/routers at the POP and ACC shall have 10Gbps support per port. Any attenuators required as part of the overall solution shall be provided by the MSI. Note that all fibre optic SFPs shall be ordered to support minimum 10 km distance for distribution and combination of 10km and minimum 25 km for backbone depending on the distance requirements. This shall be validated by the MSI during the design stage.
FR 1.57	The overall architecture of the system is such that there will be a partial mesh between all POPs including ACC i.e. for Layer 3 switches/router and a ring configuration between all Layer 2 switches at the POP.
FR 1.58	The switches from any one vendor shall be interoperable with other brands.
FR 1.59	Communications Media Converter to be installed, if required, on a per device basis where the distance between the IP enabled device and the respective switch is greater than 90m.
FR 1.60	The Communications Media Converter shall enable fibre to copper and copper to fibre media conversion for IP enabled devices. MSI may also use an Ethernet extender as an alternative to the Media converter based on prior permission from AITL.
FR 1.61	Wireless M2M Gateways to enable Internet of Things (IoT) shall be installed at cellular towers and/or streetlight poles.
FR 1.62	These gateways can support the data aggregation of the Smart Bins and for water and power meters (future).
FR 1.63	The gateways shall be capable of supporting continuous communications among all devices.
FR 1.64	All the active devices shall enable security features in the network switches to disallow any unauthorized access to the port / network.
Network Management System (NMS)	
FR 1.65	The NMS shall facilitate the retrieval, storage, analysis and display of status information from all network devices attached to the system that are SNMP and/or ICMP capable, and shall facilitate remote configuration of these devices.
FR 1.66	The NMS shall provide the ability to view the network and its associated IP SNMP/ICMP enabled devices including switches and other IP devices connected over the network. It shall support a minimum of 5000 end points.
FR 1.67	The NMS should include all hardware and software required to configure, control and monitor the network connected SNMP/ICMP based devices.

Point of Presence (POP)	
FR 1.68	POP facilities are co-location spaces for both AITL and non-AITL infrastructure.
FR 1.69	Each POP shall typically serve approximately 2 sq.km area.
FR 1.70	All POPs shall be telecommunications grade facilities built for 24x7x365 operations. They should support a raised cable tray based design.
FR 1.71	Primary POP will serve as a primary hosting space for AITL for the support of all AITL applications that require local servers and data storage (example CCTV) along with networking equipment and fibre terminations. It will also serve as the termination point for distribution fibre networks as well as nodes on the core backbone communications ring that supports intra-POP communication. In addition, it will also be the telecom and cellular service providers' point of entrance to Shendra and will house the respective service providers' equipment.
FR 1.72	Secondary POPs will serve as the termination point for distribution fibre networks as well as nodes on the core backbone communications ring that supports intra-POP communication. In addition, it will also serve as the telecom and cellular service providers' plus other tenant co-location facility and may also serve as their entry point to Shendra.
FR 1.73	Each POP building shall have separate partitioned rooms for minimum 7 tenants including AITL.
FR 1.74	Separate access for AITL, TSP's and other tenants shall be required in the building. Bare shell infrastructure with partitioned space will be provided to all tenants within the POPs.
FR 1.75	Each POP area shall have Security surveillance using fixed CCTV that record entry and exit to prevent unauthorized entry as well as access control functionality along with electronic door locks. For CCTV Specifications, Please refer to the Fixed CCTV specifications mentioned under City Surveillance System Section 2.2.4. For Access Control Specifications, Please refer to the Access Control System specifications mentioned under Other In-Facility Systems Section 2.2.9.2.
Enterprise Management System (EMS)	
FR 1.76	The EMS shall be able to support the proposed hardware and software components (IT and Non-IT) deployed over the tenure of the Contract. The EMS shall be capable of providing early warning signals to the Helpdesk Agents on the performance issues, and future infrastructure capacity augmentation. The EMS shall also support single pane / dashboard with visibility across multiple areas of applications for monitoring.
FR 1.77	EMS shall provide at a minimum the following functions: • Configuration Management • Fault Management • Incident, Problem and Change Management • Asset Management • Remote Control • SLA Management & Monitoring • Performance Management • Monitoring Backup and Management • Event Management

	• Server, Storage and other Infrastructure Management • Monitor network components of the LAN & WAN • Network Link Monitoring • Helpdesk Monitoring, Management and Reporting • Traffic Analysis.
Help Desk	
FR 1.78	The help desk shall be a web enabled management system with SMS and email based alert system for the Helpdesk Call management and SLA reporting.
FR 1.79	Help desk facility shall be provided through Toll-free lines, landlines, helpdesk tool, E-mail, direct walk-in etc.
FR 1.80	The Help desk shall log user calls related to system and assign an incident/ call ID number. Severity shall be assigned to each call as per the SLAs.
FR 1.81	Help desk shall track each incident / call to resolution. Escalate the calls, to the appropriate levels, if necessary as per the escalation matrix agreed upon with Authority/authorized entity.
FR 1.82	Help desk shall analyze the incident / call statistics and provide monthly reports.
Rodent Repellent System	
FR 1.83	The entry of rodents and other unwanted pests shall be controlled using non-chemical, non-toxic devices. Ultrasonic pest repellents shall be provided in the false flooring and ceiling to repel the pests without killing them. However, the MSI shall conduct periodic pest control using chemical spray once in a quarter as a contingency measure to effectively fight pests.

TR - 1 Technical Requirements

HDPE Duct	
TR 1.1	At a minimum the HDPE duct shall meet or exceed the applicable industry standards as listed below: • Indian standards including IS:4984- specifications for HDPE duct • ISO standards (ISO 9001, ISO 14000) • ASTM standards • TEC specifications • Other standards as detailed in this specification.
TR 1.2	The HDPE ducts shall be installed end-to-end across Shendra. They will be used for backbone, distribution and access communications.
TR 1.3	The HDPE ducts shall be ordered in different configurations and colours as detailed in the functional requirements. These colours shall be maintained throughout the useful life of the duct.
TR 1.4	The 40mm (OD) with 3.5mm wall thickness and 20mm (OD) with 2.0mm wall thickness coilable HDPE ducts shall be of smooth configuration and shall be suitable for outdoor underground installations.

TR 1.5	All HDPE ducts shall be continuous. Where the duct reel ends, the HDPE ducts shall be joined using approved industry standard couplers or inside manholes/handholes. Where couplers are used, they shall be single piece HDPE coupler which shall be used to provide water proof and air proof secure fit in accordance with the manufacturer's recommended procedure for joining ducts.
TR 1.6	The duct sweeps shall not exceed 180 degrees for the sum total of duct sweeps for a section of duct between duct termination points (i.e. manholes and handholes).
TR 1.7	**Sheathing Raw Material:** • Shall be per IS 2530 • The Melt Flow Index shall be as per IS 33 • The outer sheath thickness shall be in the range 1.2 mm +/- 0.2 mm.
TR 1.8	The duct shall be free from visual defects like blisters, shrink holes, flaking, scratches groove lines & roughness.
TR 1.9	The duct's outer sheathing shall have in-built rodent protection for every duct.
TR 1.10	Minimum Bending Diameter shall be at least 15 times of outer diameter (OD) of the duct or as per standard manufacturer recommendations.
TR 1.11	Bending Performance: There shall be no damage when mounted on a mandrel of duct diameter for 30 minutes.
TR 1.12	In the HDPE Duct, the coextruded inner layer of solid permanent lubricant shall be integral part with HDPE and white in colour, clearly visible in cross section of duct. The inner lubricant material shall be of friction reducing, polymeric material. The lubricant materials shall have no toxic or dermatic hazards for safe handling.
TR 1.13	The coil shall be at least 300 meters in length.
TR 1.14	The pre-installed PP rope/Fishline shall be ordered along with the PLB duct. In this case PP rope/Fish line is safely tied to the end caps at either ends with hooks to facilitate pulling of the OFC cables at a later stage. The rope shall be polypropylene, and shall meet IS: 5175 standard. It shall have 1.5m of line coiled in the bottom of handholes and manholes at the end of each duct run.
TR 1.15	The duct shall be supplied with atleast 0.6mm diameter in-built copper tracer wire. The tracer wire shall be 12 gauge, copper 600V insulated blue wire in all empty conduits. The tracer wire shall interconnect in the manholes and handholes. Tracer wire terminals shall have a tag to identify it as AITL fibre. This tracer wire shall be provided for all sections where there is open trenching.
TR 1.16	The HDPE ducts shall be supplied in reels or coils after sealing both ends by end caps. The following markings shall be provided on each packing: • Code of product • Name of Manufacturer • Date of manufacturing • Length of PLB HDPE duct • Dimension of Outer diameter and Inner diameter • Client's name.
TR 1.17	All the duct shall be clearly marked at intervals of 1 meters with the following data which is not less than 5 mm high. The details of marking on duct shall be approved by AITL before commencement of manufacturing: • AITL with logo

	• Manufacture's name or trade mark • Year and month of manufacturing • Type of PLB HDPE duct and size • Running length marking.
Laying of PLB HDPE Duct in Open Trench	
TR 1.18	HDPE ducts shall be laid in open trench for less than 30m RoW or for access to plots/devices.
TR 1.19	The duct trench shall be dug as per route plan (indicating the various dimensions and other details of the trench) approved by the AITL for each type of soil type.
TR 1.20	Due care and precaution during excavation shall be taken to avoid possible damage of any other underground plans/facilities in the proposed underground PLB HDPE Duct route and shall indemnify AITL for all damages and shall be solely responsible for all the damages and losses.
TR 1.21	The minimum depth at which the duct shall be laid will be in compliance with DOT norms and telecom best practices.
TR 1.22	No blasting is permitted near permanent work or dwellings. Blasting shall be so made that pits are as close to the designed dimensions as practicable.
TR 1.23	The width of trench at the top and bottom shall be adequate for proper installation of PLB HDPE ducts with required quantities.
TR 1.24	The trench depth shall be measured from the bottom of the trench. Trench shall be located at the lowest point of lower area, if possible.
TR 1.25	In case of uneven ground, the MSI ensure that the bottom of the trench is not uneven, the MSI shall maintain minimum depth of the trench as per specifications and may be required to increase the depth at some locations and provide a suitable gradient in the trench.
TR 1.26	The backfilling and compacting of trench in layers of 200 mm, restoration of road, nalla, pavements etc. after the completion of laying work.
TR 1.27	Provided that the PLB HDPE ducts has been properly laid and jointed in the trench, and the back filling operation shall follow as closely as practicable.
TR 1.28	The back filling operation shall be performed in such a manner as to provide firm support under and above the PLB HDPE duct and to avoid bend or deformation of the PLB HDPE duct, when the PLB HDPE duct gets loaded with the back filled earth.
TR 1.29	Where in any location the back filling is unevenly centred over the trench due to carelessness or any other cause, it shall be redressed at the MSI's expenses.
TR 1.30	No debris shall be allowed in backfill at any time.
TR 1.31	At locations where the backfill material contains hard rocks, rock fragments and other hard materials which may cause damage to the pipe and where rock has been excavated from the trench and it is intended to refill the trench, the trench shall be initially filled. De-rocked loose earth above the top of the duct shall be screened through a suitable mesh if so required and backfilling only thereafter be completed and finished with excavated material.
Laying of PLB HDPE Duct in RCC Trench	
TR 1.32	RCC Trench shall be provided by the EPC Contractor. MSI shall lay the HDPE duct for fibre inside this RCC Trench end-to-end.

TR 1.33	The HDPE duct inside RCC Trench shall be laid using a tray based system supported by brackets. This shall be applicable for all RoW excluding less than 30m.
Other Installation Requirements	
TR 1.34	During transportation and storing at the site duct, it is necessary to seal the ends of the duct with proper End caps against water penetration or other impurities.
TR 1.35	When installing duct in an open trench from a drum, it should be uncoiled from the bottom and not from the top of the drum.
TR 1.36	The fill ratio of the duct shall be in compliance with the National Electric Code (NEC) standard NFPA 70, ANSI/TIA 568 and ANSI/TIA 569.
TR 1.37	When placing multiple ducts in a single trench simultaneously, it is important not to cross or twist the ducts inside the trench, when installing large quantities of ducts it is possible to stack them one on top of the other in addition to side by side.
TR 1.38	Positioning of the ducts must be designed in the planning stage to ensure clarity between ducts placement.
TR 1.39	When placement of the duct is completed and connections of the duct ends are deferred to a later stage, it is advised to overlap duct ends by one meter from each side.
TR 1.40	Both ends of the duct must be properly sealed with end plug to prevent water, dust or any other foreign particle from entering into the duct.
TR 1.41	Pump out water, if any, from the trench before placement of duct.
TR 1.42	Whenever tree roots are found in the trench make sure to lay the ducts under the tree roots and not the above.
TR 1.43	Place the duct along the trench as straight as possible.
TR 1.44	Tightly close the ends of the ducts with self-tightening End Plug so that no dirt, dust or moisture into the duct.
TR 1.45	No spacer will be used however the duct should be tied together with cable tie at an interval of 2 meter positively so as to keep them together.
TR 1.46	**Installation of Plastic Couplers:** • Cut the duct at the same place where they overlap. Cutting should be done in such a way that the duct end matches with each other perfectly because it is very important for the coupling joints to be airtight. • Proper pipe shears or cutters must be used for smooth cutting. Do not use a hacksaw to cut the duct. • Deburr both the inside and the outside edges of the duct with a deburring tool • Apply a small amount of proper lubricant (liquid detergent) for better installation of plastic couplers. • Tighten the plastic coupler with C-Spanner.
TR 1.47	**End Plug:** • Close the ends of duct with end plugs so that moisture, dirt and dust do not enter inside the duct. • It seals the duct ends completely and prevents air, moisture from entering the duct, ever when it is laid underground.

	• Further interior surface of empty ducts also remains clean even after several years. • Inspect the Neoprene Rubber for various defects such as pin holes, cuts, etc. In case of any such defect, replace the rubber gasket with a new one.
TR 1.48	**Warning Tape:** • This warning tape shall be provided above the telecom duct throughout the route (for open trench only) at a depth of 50% of total trench depth. • Warning tape should be made of HDPE or LDPE (Low Density Poly Ethylene) and other inert material and shall be either bright yellow or orange in colour. • The thickness of tape shall be 1 mm and minimum width 150 mm with life of 25 years. • Neither the colour of tape nor the marking printed inscribed on it shall change or fade away throughout the life time of tape. • The tape should contain a printed message in English "WARNING AITL OFC".
TR 1.49	**Duct Route Indicators:** • Prefabricated or Precast RCC duct route Indicators are needed to be placed on the Duct Route for open trench. • The route indicator shall be made of RCC material. It shall have embedded on both sides "AITL OFC". • The route indicator shall be provided based on standard DOT practices. • Route indicators shall be fixed at every 50 meter interval in city area and at both ends of the road crossing for open trench only.
Testing: Following testing specific to HDPE duct shall be met. For other testing requirements, refer to the testing section.	
TR 1.50	**Factory Testing Requirements:** • Factory acceptance tests shall be conducted on randomly selected final assemblies of all equipment to be supplied. Visual inspection shall be carried out on 100% basis for all the equipment/items offered. Factory acceptance testing shall be carried out on PLB HDPE and accessories. • From each batch PLB-HDPE duct presented by the MSI for Factory acceptance testing, the AITL shall select random sample (s). • The following tests shall be carried out during Factory Acceptance Testing (FAT): ➢ Visual Inspection ➢ Dimension Check ➢ Hydraulic Characteristics ➢ Reversion Test ➢ Tensile Strength and Elongation Test ➢ Environmental Stress Crack Test ➢ Impact Strength Test ➢ Crush Resistance ➢ Mandrel Test ➢ Ovality Test

	➢ Coil Set Test ➢ Internal Co-efficient of Friction ➢ Ash content ➢ Colour fading ➢ Optical Fibre Cable Blowing Test ➢ Air Pressure test on plastic coupler ➢ Ageing test on accessories • Dimensional test shall be carried out on 10% sample of the respective lot. • In case any of the selected samples fail, the failed sampled is rejected and additional 20% samples shall be selected randomly and tested. In case any sample from the additional 20% also fails the entire batch may be rejected.
TR 1.51	**Duct Integrity Test Procedure:** After laying the Duct network, HDPE ducts shall be tested for proper laying, crush, deformity and pressure testing. The MSI shall have to remove the obstruction/deformity of any kind before handing over of the Duct network to client.
Following tests are to be carried out on the laid HDPE duct:	
TR 1.52	**Duct Cleaning (Sponge Test):** • Compressed air should be blown through the duct in order to remove any dirt and water that has accumulated inside the duct with the help of suitable capacity Air Compressor. • A short blast of air about 2-3 bar shall be blown through the duct for about 2 minutes. • Sponge will be blown through the duct to thoroughly clean the duct from inside.
TR 1.53	**Crush and Deformity Test:** • This test is to be done to check the integrity of the duct. • During installation, while backfilling process there is a possibility of flattening, twisting or kinking of the duct. • This is also possible if the duct has not been uncoiled properly and is laid improperly. • Place the wooden shuttle in the duct. Note: Shuttle should be 80% of inner diameter of the duct and 150 mm in length. • Connect the Compressor pipe fitting to the duct. • Place the flexible wire grip to the downstream end of the duct. • Connect the air hose supply to the compressor and the equipment. • Open the discharge valve of the compressor and blow the shuttle through the duct. Note: The shuttle will pass through at a very high speed and must be trapped in flexible wire grip to avoid accident and injury.
TR 1.54	• Mandrel/Shuttle Test – A mandrel/shuttle of at least 90% of the inside diameter size shall be passed through the duct to test the clear pathway of the duct.
TR 1.55	**Pressure Testing:** • This test is carried out to detect leakage in duct, if any. Seal one end of the duct with End Coupler and then through End Coupler with valve, feed the

	compressed air into the duct. • Raise the pressure upto 5 Bar and then observe. After observing for 30 minutes, pressure drop of upto a max. 0.5 Bar is permissible.
TR 1.56	The detection device for detecting the presence of the buried HDPE Duct with co-extruded copper wire/tracer wire, shall have following features: • One set of Transmitter and Receiver along with suitable batteries in a portable box. • Capability to detect HDPE duct with co-extruded copper/tracer wire wire up to a depth of 3 meters. • Capability to emit peak audible signal when the HDPE duct with co-extruded copper wire/tracer wire is exactly below the receiver. • Capability to distinguish presence of passive metallic objects as well as current carrying metallic conductors other than the duct itself. • Capability to indicate the depth of the duct at which it has been buried. • Capability to change the frequency of detection current to avoid possibility of mixing up with detection of another HDPE Duct with co-extruded copper wire/tracer wire in the vicinity, if any. • It should have a backlit LCD display for visibility in low light conditions. • It should have rugged one piece case design and sealed keypad for withstanding tough weather conditions and for superior moisture resistance.
TR 1.57	**Impact Strength on individual duct:** • There shall be no crack/split when 9.1kg load (Tup B) dropped from 1.5 meters. Height after conditioning at 0ºC for one Hour. • Environmental Stress Crack resistance characteristics for duct: ➢ No cracking when tested with 10% LGEPAL solution, CO 0630 Solution at 50^0C for 96 Hours. ➢ The Tensile strength of yield shall be atleast 20N/ mm^2 as per ASTM F 2160, and ASTM D 638 Type IV. ➢ Hydraulic Characteristics - No Swelling leakage or bursting observed after 48 hours at an induced stress of 3.8 Mpa @ 80^0C as per IS 4984. ➢ Elongation at Break for both 40 mm and 20 mm duct shall be atleast 500% as per ASTM F 2160, and ASTM D 638 Type IV standard.
HDPE Handhole	
TR 1.58	The product shall meet or exceed the following American Society for Testing and Materials (ASTM) Standards: • ASTM C 857-95: Standard Practice for Minimum. Structural Design Loading for Underground Precast. Concrete Utility Structures; • ASTM C 109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars; • ASTM C 580: Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concrete; • ASTM C 496: Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens;

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ASTM C 543: Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered Nickel-Chromium-Molybdenum;
ASTM C 1028: Standard Test Method for Determining the Static Coefficient of Friction;
ASTM C 570: Standard Specification for Oil- and Resin-Base Caulking Compound.

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<tr><td>TR 1.59</td><td>Handholes shall be made of medium duty HDPE with Polymer Concrete Lid.</td></tr>
<tr><td>TR 1.60</td><td>Boxes, rings and lids should sustain a minimum vertical test load of 33,500 lb (AASHTO HS 20 loading) as a stand-alone unit, over a 10-inch x 20-inch square steel plate centred on the cover and body in accordance with ASTM C 857-95 design load A-16.</td></tr>
<tr><td>TR 1.61</td><td>The boxes, rings and lids shall meet the physical and chemical requirements listed in Table.
<table>
<tr><th colspan="3">Physical and Chemical Properties of Handhole components</th></tr>
<tr><th>Property</th><th>ASTM</th><th>Test Value</th></tr>
<tr><td>Compressive Strength</td><td>C 109</td><td>11,000 psi</td></tr>
<tr><td>Flexural Strength</td><td>C 580</td><td>1,800 psi</td></tr>
<tr><td>Tensile Strength</td><td>C 496</td><td>1,700 psi</td></tr>
<tr><td>Effects of Acids</td><td>D 543</td><td>Very Resistant</td></tr>
<tr><td>Effects of Alkalis</td><td>D 543</td><td>Very Resistant</td></tr>
</table>
</td></tr>
<tr><td>TR 1.62</td><td>Holes for keeping service loops of duct shall be of suitable height and direction as per the Project requirements.</td></tr>
<tr><td>TR 1.63</td><td>Furnish lids that have a non-skid surface for pedestrian traffic with a minimum coefficient of friction of 0.50 in accordance with ASTM C 1028 without the use of coatings.</td></tr>
<tr><td>TR 1.64</td><td>All lids shall be manufactured with the markings “AITL” in the logo area of the lid, in 25 mm recessed letters.</td></tr>
<tr><td>TR 1.65</td><td>Lid access points shall have recessed reinforced steel pull slots to allow for the removal of the cover with a hook or lever. Replace the lid if damage occurs to the pulling point.</td></tr>
<tr><td>TR 1.66</td><td>Bolts used on handholes and lids shall be stainless steel, recessed hex head bolts with washer.</td></tr>
<tr><td>TR 1.67</td><td>The top of handhole shall be flushed with the ground level.</td></tr>
<tr><td>TR 1.68</td><td>All PLB HDPE duct entries, cable entries and holes shall be properly sealed.</td></tr>
<tr><td>TR 1.69</td><td>Seal duct ends inside all handholes with at least 50mm thick duct caulking after fibre is installed. Seal vacant duct with a manufacturer end plug and attach detectable pull tape.</td></tr>
<tr><td>TR 1.70</td><td>Handholes shall have capabilities to absorb water as per ASTM 570 standards. They shall be provided with sump holes or open bottom for water drainage.</td></tr>
<tr><td>TR 1.71</td><td>The handholes shall be installed with a minimum of 101mm layer of small rock in the bottom to prevent mud and wildlife (rodents) from intruding the handholes. The gravel shall help facilitate drainage.</td></tr>
</table>

TR 1.72	No handholes shall be installed under direct traffic load and shall be only suitable for installation at boulevards or areas where there is pedestrian movement.
TR 1.73	The HDPE manholes shall have following markings provided on each unit: • Code of product • Name of Manufacturer • Date of manufacturing • Named as 'AITL OFC HANDHOLE'
Optical Fibre Cable	
The Single mode optical fibre shall meet or exceed the following industry standards:	
TR 1.74	ITU-T G.652- Characteristics of a single-mode optical fibre and cable.
TR 1.75	ANSI/ICEA S-87-640-1999 - Standard for Optical Fibre Outside Plant.
TR 1.76	Telcordia GR-20: Generic Requirements for Optical Fibre and Optical Fibre Cable.
TR 1.77	All applicable TIA/EIA standards for single mode fibre cable and those listed in these technical requirements.
TR 1.78	The fibre optic cable shall be single mode, loose tube armoured cable which shall be ordered in different fibre count and tube configuration as detailed in the functional requirements.
TR 1.79	The single mode optical fibre shall enable dual operating wavelengths at 1310nm and 1550nm nominal. The optical fibre shall be non-dispersion shifted.
TR 1.80	Single mode fibre shall have attenuation not greater than 0.36 dB/km at 1310 nm and 0.25 dB/km at 1550 nm.
TR 1.81	The single mode optical cable shall have the cladding diameter = 125.0µm ±1.0 and Mode Field diameter = 9.2µm ± 0.4.
TR 1.82	The single mode optical cable shall have polarization mode dispersion (PMD) coefficient ≤ 0.2 at 1310nm.
TR 1.83	Fibre attenuation measurements shall be made in the factory in accordance with EIA-455-78A for single-mode fibre. The spectral width of the source used to measure attenuation shall be less than 10 nm.
TR 1.84	When Optical Time Domain Reflectometer (OTDR) is used, measurements shall be made from both directions and the results shall be averaged.
TR 1.85	The attenuation of the single mode fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.1 dB at 1310 nm or 1550nm wavelength. Fibre shall have no voids, air bubbles, or streaks in them. Factory splicing is not permitted. Attenuation Uniformity shall be measured in accordance with EIA-455-59.
TR 1.86	The Chromatic Dispersion of single mode fibre shall be measured in accordance with EIA-455-175 or EIA-455-168.
TR 1.87	The cut-off wavelength of cabled fibre shall be less than 1260 nm. The wavelength shall be measured according to EIA-455-170.
TR 1.88	The single mode fibre optic cable shall be armoured cable that shall be suitable for outdoor installations, with protection against rodents.

TR 1.89	The minimum bending radius of the fibre optic cable shall be at least 15 times the diameter of the cable or better during operation, and shall be at least 10 times the diameter of the cable or better during installation.
TR 1.90	Fibre optic cable shall be able to withstand a pulling tension of at least 2700N without any resulting damage.
TR 1.91	The optical fibre coating and/or buffer shall consist of materials that are environmentally stable in order to reduce long term effects of stress corrosion caused by moisture absorption. The coating shall be suitable for removal by industry standard mechanical stripping methods. No chemicals shall be required to strip the coating and/or buffer material.
TR 1.92	Colour coding of individual tubes and fibre shall be in accordance with EIA-598. The fibre colour coding shall be visible throughout the life of the cable. Colour concentrates or inks used to colour the optical fibre shall be heat stable and shall not be capable of permeating through the protective fibre coating causing transmission degradation of the optical fibre.
TR 1.93	All cable shall be supplied on wooden reels, with both ends of the cable accessible for testing. Each reel shall be clearly labelled with the cable code, length, and date of manufacture. All reels shall be protected with solid (2x4) wooden lagging, intended for export shipment.
TR 1.94	Material used in optical fibre cables must not support galvanic action. The core cladding shall be all glass that is predominately silica (SiO_2). Phosphorus, if used as a dopant in the optical fibre, shall be limited to a minimum to reduce the potential effects on fibre attenuation due to hydroxyl ions.
TR 1.95	All fibre optic cables shall be spliced inside dedicated manholes as per the Project requirements. It is the scope of the MSI to provide any additional protection required to the fibre optic cable inside manhole as needed to meet the Project requirements.
TR 1.96	Cable Code and Length Marking shall comply with Telcordia GR-20 standards. This shall include sequentially numbered length markings in meters imprinted on the jacket, and this length marking shall not be reset to zero along the cable length.
TR 1.97	In addition to length markings, each length of the cable must be permanently marked to include the following: • Manufacturer cable and ID code • Year of manufacturer (cable) • Customer Name “AITL” • Number of fibre • SM (single mode)
TR 1.98	The entire fibre length shall be capable of withstanding a potential tensile stress of not less than 100 kpsi (0.7 Gpa).
TR 1.99	Dry water-blocking materials shall be applied over the cable core to prevent the ingress of water, and movement along the cable sheath.
TR 1.100	Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed. The buffer tubes shall be enclosed in a cable sheath as specified in this section.
TR 1.101	The cabled optical fibre shall maintain mechanical and optical integrity through an operational temperature range of 0°C to +70°C.

TR 1.102	The change in attenuation for single-mode fibre shall not be greater than 0.05 dB/km at 1310 nm and 1550 nm at the operational temperatures limits.
TR 1.103	Temperature cycling measurements shall be made in accordance with EIA-455-3A as per below: • Storage Temperature: 0°C to 60°C • Installation Temperature: 0°C to 55°C • Operating Temperature: 0°C to 70°C
TR 1.104	The cable shall maintain its mechanical and optical performance for an in-service period exceeding 25 years. The MSI shall provide documentation proof to validate this.
TR 1.105	Lightning withstand current shall comply with Telcordia GR-20 standards.
TR 1.106	A sheath slitting cord is required for each sheath.
Installation Requirements:	
TR 1.107	The cable shall support a vertical rise up to 10 m without intermediate cable support.
TR 1.108	The outer jacket of the cable shall be fungus inert and shall be suitable for long term exposure to sunlight and weather.
TR 1.109	Each cable shall be reeled in such a way that both ends of the cable are readily accessible for testing, without any need for unreeling. The inner end of the cable shall be properly secured to prevent whipping when the end of the reel is reached. A minimum of 3 m of the inner end of the cable shall be accessible for optical testing. The inner end must be securely fastened or protected against shipping or installation damage.
TR 1.110	A 20m slack per cable in every manhole and 15m slack per cable inside every handhole shall be placed along the fibre optic cable route as per AITL requirement.
TR 1.111	Each length of cable shall be wound on a separate cable reel.
TR 1.112	Suitable mechanical pulling aids shall be deployed to ensure that the maximum pulling tension is not exceeded at any time during the installation.
TR 1.113	Tags shall be installed at all cable end points (manholes, handholes, etc.).
TR 1.114	The cable shall be neatly dressed, labelled and organized.
Testing: Following testing specific to fibre optic cable shall be met.	
TR 1.115	**Factory Testing Requirements:** • Prior to shipment, Factory-controlled tests shall be performed to verify compliance of the above stated specifications. • Each cable reel shall be shipped with test results indicating the length of the cable reel and the attenuation at 1310 nm and 1550 nm for each fibre, as applicable. A copy of these test results shall also be provided to AITL or their designate. • Any test that reveals the materials or equipment does not meet the stated specifications shall constitute failure. • Visual inspection shall be carried out on 100% basis for all the equipment/items offered. • Dimensional test shall be carried out on 10% sample of the respective lot.

	• In case any of the selected samples fail, the failed sampled is rejected and additional 20% samples shall be selected randomly and tested. In case any sample from the additional 20% also fails the entire batch may be rejected.
TR 1.116	**Pre-Installation Testing Requirements:** • Once delivered to the MSI, the MSI shall, prior to installation, conduct a reel test. • Inspecting for any physical damage of the reel or cable. • Measure using an OTDR, the attenuation at 1310nm and 1550nm for one fibre from each buffer tube from both ends of the cable.
TR 1.117	**Post-Installation Testing Requirements:** • Inspecting for any physical damage of the exposed portions of cable. • Measure using an OTDR, the attenuation at 1310 nm and 1550 nm for every fibre from each buffer tube from both ends of the cable. This includes all connectorized and unconnectorized links with intermediate cable butt splices as applicable. • Inspecting for proper slack loops inside manholes.
TR 1.118	**Mechanical Testing Requirements:** The cable shall meet the following test requirements without physical damage to the cable and/or cable components and without degradation of optical transmission.
TR 1.119	**Crush And Impact Test (Outdoor Cable):** A crush and impact test shall be carried out on a sample of cable approximately 10 m in length according to the method stated in EIA-455-41, and EIA-455-25A /IEC 794. Optical loss measurements are to be made at the 1550 nm nominal wavelength. A permanent or temporary increase in the attenuation loss value greater than 1.0 dB/test-fibre-km shall constitute failure.
TR 1.120	**Twist And Flexibility Test:** A twist and flexibility test shall be carried out on a sample of cable approximately 5 m in length according to the methods stated in EIA-455-85/IEC 794, and EIA-455-104. Optical loss measurements are to be made at the 1550 nm nominal wavelength. A permanent or temporary increase in the attenuation loss value greater than 1.0 dB/test fibre-km shall constitute failure.
TR 1.121	**Water Ingress Test:** A water ingress test shall be carried out on a sample of cable according to the requirements of EIA-455-82A/IEC 794. No water shall leak through the open end of the 1.0m test sample.
TR 1.122	**Certificates And Proof Of Factory Testing:** The bandwidth and attenuation of every fibre in each cable shall be tested in the factory. Single mode measurements shall be taken at 1310 nm and 1550 nm. These factory test results shall be provided with the cable. One copy shall be attached to the cable reel, inside the lagging, prior to shipment, and one copy shall be sent to AITL's Project management office.
UTP Copper Armoured Cable and Accessories	
TR 1.123	The cable shall comprise of four (4) uniformly twisted insulated conductor pairs. Each pair shall have different colour insulation for identification and the two cores of any

	one pair shall also have different coloured insulation for the identification of a specific core.
TR 1.124	A non-hygroscopic dielectric tape shall be wrapped around the insulated pairs.
TR 1.125	The laid up core shall be wrapped with aluminum tape and bonded with an overlap to provide 100% shielding.
TR 1.126	A tight fitting black polyethylene jacket shall be extruded over the shield.
TR 1.127	Conductors shall be twisted to form pairs with an average mutual capacitance of less than 56 nF/km with a far end crosstalk loss of 69 dB/km or better.
TR 1.128	The cable shall have a water repellent filled core and shall have a sunlight and weather resistant jacket of polyethylene (e.g. XLPE).
TR 1.129	Each conductor in the cable shall consist of #23 AWG (0.57 mm), stranded high conductivity copper with a D.C. loop resistance of less than 94 ohms/ loop km and a nominal propagation velocity of 69%.
TR 1.130	The cable shall have a guaranteed transmission performance upto 250 MHz.
TR 1.131	The cable shall have characteristic impedance of 100 ± 15 (Ohms).
TR 1.132	Materials used in the cable shall not support galvanic action.
Copper Patch Cords	
TR 1.133	Patch cords fabricated from UTP cable shall be of suitable length to connect field devices with the switch/ FTP. Patch cords shall be sized to minimize excess cable interconnecting equipment, with cables routed and dressed to maintain a neat appearance.
TR 1.134	Patch cords shall be terminated with 8-pin 8-conductor “RJ-45” style connectors.
TR 1.135	Pre-fabricated patch cords shall be supplied in individual packages.
TR 1.136	All cabling and connectors shall be in accordance with ANSI/TIA/EIA-568-B.
Copper Patch Panel	
TR 1.137	The copper communication cable shall be terminated at the associated patch panel or field device.
TR 1.138	The patch panels shall be sized to support the design requirements.
TR 1.139	The standard termination is to be according to ANSI/TIA/EIA-568A.
TR 1.140	The termination shall protect the cable terminations from water and mechanical damage and shall be resistant to salt corrosion.
TR 1.141	All material of the termination and associated mounting accessories shall be non-reactive and the complete assembly shall not support galvanic cell action.
TR 1.142	All cable entries shall be provided with appropriate cable pathway.
TR 1.143	Any provided patch panel or wall plate shall provide mechanical support for all connections enclosed and shall maintain insulation between them.
TR 1.144	Connectors shall be sealed water resistant, and shall accommodate the #23 AWG gauge solid conductors. Insulation displacement terminal lugs are permitted.
Surge Suppressor	

TR 1.145	Wherever installed, the UTP cables shall be supplied with either in-built surge arrestor or shall have additional surge suppressors.
TR 1.146	Wherever required, Surge suppressors shall be provided and mounted on the active pairs. Two levels of protection shall be provided: • The first protection level shall be a three electrode gas tube discharge protector module. This is only required for cables that leave the cabinet location. • The second level of protection shall be a back-to-back Zener diode arrangement and Metallic Oxide Varistor (MOV). The protection shall be compatible with the first level of protection.
TR 1.147	The surge suppressors shall be such that they do not interfere with normal communications.
Fibre Optic Splice Closure (FOSC)	
TR 1.148	Be capable of accepting minimum six (6) cables in a butt splice configuration. Any additional cables shall be supported using standard accessories provided by the manufacturer.
TR 1.149	Fibre Optic Splice Closures shall be IP 68 rating.
TR 1.150	Be re-enterable without the use of additional parts or special materials.
TR 1.151	Not require special tools to enter or assemble.
TR 1.152	Be constructed of non-corrosive materials.
TR 1.153	Have a life expectancy of at least 25 years.
TR 1.154	Be capable of storing up to 3.0m lengths of expressed buffer tubes.
TR 1.155	Accommodate splice organizers which accept heat-shrink fusion protectors or splice protection packs.
TR 1.156	Have provisions for storing Fibre splices and un-spliced Fibre/buffer tubes.
TR 1.157	Be non-filled (no encapsulating material) to prevent water intrusion.
TR 1.158	Meet all performance standards over the operating temperature range of 0°C to +60°C.
TR 1.159	Be capable of preventing a 3.0m water head from intruding into the splice compartment for a period of 7 days, and a 2.0m water head for an indefinite period of time.
Optical Connectors	
TR 1.160	The optical connectors shall comply with Telcordia GR-326-CORE, NWT, American Society for Testing and Materials (ASTM), Telecommunications Industry Association (TIA), as well as Underwriters Laboratories for flammability tests.
TR 1.161	Optical connectors shall conform to the following standards at a minimum: • Small form factor SC and ST/LC • UPC type • Push-on/pull-off interconnection, dry contact, physical contact • Suitable for single-mode installations • Simple polishing tools for infield installation

	• Available in duplex styles • Connector strain relief limits cable bending radius • Adapters available to mate with other connectors • Insertion Loss < 0.2 dB • Return Loss > -55dB • Repeatability <= 0.1 dB • Thermal Shock <= 0.1 dB • Temperature Cycling <= 0.1 dB 0°C to +60°C (40 Cycles) • Humidity Cycling <= 0.1 dB +60°C (10-95 percent)
Fibre Patch Cords	
TR 1.162	Patch cord material shall conform to the following standards at a minimum: • House a single fibre in a 900 micron tight buffer tube. • House the tight buffer in a flame retardant jacket with space between the jacket and tight buffer filled with Kevlar strength components. • Be available in duplex configurations. • Both mating faces of each connector shall be cleaned using fibre optic cleaning solvent cleaning wipe or patch prior to mating the connector surfaces.
Fibre Distribution and Management System (FDMS)/Optical Cable Entrance Facility (OCEF)	
TR 1.163	The system shall be modular and shall provide compact fibre patching/ splicing system.
TR 1.164	The system shall be fully equipped with necessary accessories such Fan-outs, Fibre Arrangement System, SC and ST/LC connectorised patchcords, 0-dB adapters etc.
TR 1.165	The system shall be able to accommodate all types of optical fibre cable structures.
TR 1.166	The system must guarantee trouble-free extension with no downtime maintenance.
TR 1.167	The system shall have a patch distribution frame with a capacity to meet the Project requirements.
TR 1.168	Each splice tray shall accommodate minimum 24 fibres.
TR 1.169	The system shall have metal housing with movable drawer and integrated fibre management.
TR 1.170	The system shall have a front door with latch for patch cord protection and management.
TR 1.171	The system shall have dedicated cable management and routing to limits bend radius. The cable management could be horizontal or vertical as deemed fit for best performance and shall comply with Industry Standards.
TR 1.172	The system shall have Slack storage in sliding tray to manage and protect excess optical fibre length.
TR 1.173	The system shall be supplied with adjustable mounting bracket available for 19" rack mounting.
TR 1.174	The device shall support operating temperature range of 10°C to +40°C.

Fibre Optic Patch Panels	
TR 1.175	The Patch panels shall adhere to Telecordia GR-449 Core or equivalent specifications.
TR 1.176	The Patch panels shall be capable of supporting SC type ports for backbone cabling and ST/LC for distribution and access cabling.
TR 1.177	The Patch panels shall include the mounting hardware for EIA/TIA standard racks as per rack requirements.
TR 1.178	The Patch panels shall provide a minimum of four cable entry points.
TR 1.179	The Patch panels shall support rings to maintain minimum fibre bending radius, and to prevent accidental physical damage.
TR 1.180	The Patch panels shall provide physical protection for the individual fibres.
TR 1.181	The Patch panels shall provide terminating facilities for fibre optic connectors, including the through adapter.
TR 1.182	The Patch panels shall provide a lockable compartment in which fusion splice trays are housed which is separate from the fibre patching area.
TR 1.183	The Patch panels shall provide bulkhead mounting hardware for a variety of connectors but shall be equipped with SC and ST/LC connectors unless otherwise noted.
Intelligent Fibre Optic Patching System	
TR 1.184	The system hardware shall accommodate intelligent modules that utilize minimal additional rack space for scalability and growth of network management in a low risk and cost-effective manner.
TR 1.185	The modular patch panel shall offer the choice of an installation that is fully intelligent or “intelligent ready” for future upgrades.
TR 1.186	The front of the panel shall include LEDs located above each port that indicate the connectivity status, as well as multi-functional push buttons for guiding technicians through moves, adds, and changes (MACs).
TR 1.187	The system shall have an interface unit at the centre of the panel to add further built-in functionality such as patch cord tracing and maintenance operations, without the need for additional control equipment.
TR 1.188	The panel shall offer a method for labelling in compliance with TIA/EIA 606-A labelling standards.
TR 1.189	System Hardware shall be capable of seamlessly feeding information directly into the software platform.
TR 1.190	The software platform shall provide fully accurate and comprehensive documentation of all network infrastructure components as well as advanced detection and alert capabilities to allow full control over the environment.
TR 1.191	The software platform shall have the capability of real time viewing of Communication Racks for remote site management from the ACC or any other connected location.
TR 1.192	The software platform shall provision to provide real time information of devices movement from one location to other.

TR 1.193	The software shall automatically provide complete linkage information (from switch port up to the end device) in graphical format, providing full end-to end visibility and automatic updates of new locations when moves occur.
TR 1.194	The software shall identify between unauthorized and authorized changes on the network connectivity and send alerts accordingly.
TR 1.195	The software shall provide complete Fault Summary with customizable log files to generate reports for various requirements.
TR 1.196	In case any changes are made to the network (patching) during a planned (power) down time, the software shall register and report the changes if any during the power down time, once the system is up again, without any human intervention.
TR 1.197	The software shall be capable of integrating the solution with any 3rd party software or in.
TR 1.198	The software shall be provide with an unlimited user licenses to enable use by multiple users.
Communications Cabinets with Racks	
TR 1.199	Please refer to the Communication Cabinets with Racks specifications mentioned under IT Infrastructure specification Section 2.2.11.2.
Active Electronics	
Ethernet Switch – Layer 2	
The Layer 2 Ethernet switch includes two types of switches –Type I-Industrial grade switch at field and Type II - Non-industrial grade switch at POP facility.	
Type I - Industrial Grade Field Switch	
TR 1.200	The Industrial Grade Switch installed at the field shall have at least three (3) 1000BaseTX ports and three (3) 10/100BaseTX ports with two (2) Gigabit Ethernet SFP (1000BaseFX) ports for backhaul (uplink) connectivity. The PoE/PoE+ feature may also be provided via industrial grade PoE/PoE+ injectors for these switches.
TR 1.201	The copper ports shall support PoE / PoE+.
TR 1.202	The industrial grade switches shall support a MAC table size of upto 8000 addresses.
TR 1.203	The industrial grade switches shall at a minimum carry IP30 rating.
TR 1.204	The industrial grade switches shall support – • IEEE 802.3, 802.3ad, 802.3u, 802.3ab, 802.3z, 802.3x protocols. • IEEE 802.1D for STP, 802.1w for Rapid STP, 802.1s for Multiple Spanning Tree Protocols. • IEEE 802.1q for VLAN tagging, 802.1p for CoS, 802.1X for Authentication and 802.3ad for port trunk LACP. • Broadcast storm protection, port lock/port security, RADIUS, TACAS+, SSL/SSH security.
TR 1.205	The industrial grade switches shall support – • IPv4/v6, SNMP v1/v2/v3, LLDP, Server/Client, DHCP, TFTP, Telnet, IGMP v1/v2.

TR 1.206	All switches installed on-field shall be capable of working in the harsh environmental conditions with immunity to EMI and heavy electrical surges. They shall support: • EN-60950-1 or Equivalent; • EN 55022/24 or CISPR 22; • FCC Part 15 Class A • IEC 60068-2-27 and 2-32 or Equivalent; • IEC 60068-2-6 or Equivalent. All standards to be latest as per Manufacturer's certifications.
TR 1.207	The switches shall be powered by 12/24/48VDC input as per the design requirements with dual redundant inputs and integrated power supply. The terminal blocks for the power supply options shall support reliable, maintenance-free connections. Any power conversions required shall be in the scope of the MSI.
TR 1.208	The industrial grade switches shall support operating temperature range of 0°C to +65°C (without any fans) with ambient relative humidity of 5-95%, non-condensing.
Type II - Non-Industrial Grade Switch	
TR 1.209	These switches shall have at least twenty-four (24) 1000Base-X ports for connectivity to the field devices with at least two (2) 10G Ethernet SFP (10GBase-T/SFP+) ports for inter-switch uplink connectivity.
TR 1.210	The switches shall support a switching capacity of at least 88 Gbps.
TR 1.211	All switches shall support a MAC table size of at least 16,000 addresses.
TR 1.212	The switches shall be powered by 220-240VAC, 50Hz input as per the design requirements with dual redundant hot swappable power supply (in-built) and redundant variable speed fans. Any power supply required for conversion shall be in the scope of the MSI.
TR 1.213	The switches installed inside POP buildings shall support an operating temperature range of 10°C to +40°C with ambient relative humidity of 10-85%, non-condensing.
General Requirements	
TR 1.214	All Layer 2 Ethernet switches (for Type II only) shall be managed switches and shall comply with the following as a minimum: • IEEE: ➢ 802.3u (fast Ethernet, 100Mbps) ➢ 802.3z (1000BaseFX) ➢ 802.3ab (1000BaseTX) ➢ 802.3x (Full Duplex with flow control) ➢ 802.3ad LACP ➢ IEEE 802.1D MAC Bridges ➢ IEEE 802.1p Priority ➢ 802.1q (VLAN) ➢ IEEE 802.1AB Link Layer Discovery Protocol (LLDP) ➢ 802.1s (multiple spanning tree protocol) ➢ 802.1w (rapid spanning tree protocol) ➢ 802.3ad (port trunking)

	• Safety:
	  ➢ UL CSA 60950 or equivalent
	  ➢ CAN/CSA-C22.2 No 60950 or equivalent
	  ➢ EN 60950 or equivalent
	• Electromagnetic emissions:
	  ➢ FCC Part 15 Class A
	• IGMP v1/v2
	• TACACS+ and Radius
	• SNMPv1/v2c/v3

TR 1.215	All Layer 2 switches at a minimum shall support the following: • IPv4/IPv6 • CoS • IP Multicast • Security • Storm Control • Spanning Tree Route Guard • Secure Sockets Layer (SSL)/SSH • Network Management • Non-Blocking Type • Support Auto-Sensing • Support Auto-Negotiation
TR 1.216	The fibre optic ports shall support the required distance i.e. between field switch and POP rooms.
TR 1.217	All switches shall support standard 19” rack mount.
TR 1.218	All switches shall have the function to enable/disable ports for limiting unauthorized access to the network.
TR 1.219	All switches shall support Network Time Protocol (NTP) for time synchronization.
TR 1.220	All switches shall support multilevel user passwords for prevention against unauthorized configuration.
TR 1.221	All switches shall support SSH/SSL based security and MAC based port security.
TR 1.222	All switches shall support RADIUS authentication service.
TR 1.223	The device shall have LED indicators for Power, LAN, Signal, RS-232, and Ethernet Link & Activity.
TR 1.224	All switches shall have a Mean Time Between Failure (MTBF) of at least 250,000 hours.
Ethernet Switch & Router – Layer 3	
The Layer 3 Ethernet switch/router includes three types –Type I-Backbone Ethernet switch/router, Type II – Core router, and Type III – Server/workstation connectivity Ethernet Switch.	
Type I - Backbone Ethernet Switch/Router	
TR 1.225	The Layer 3 based backbone Ethernet switch/router shall be installed for backbone connectivity between POP to POP and between AURIC Hall.

TR 1.226	The Layer 3 based backbone Ethernet switch/router shall have minimum 8 SFP+ ports with 10 Gb/s connectivity including Copper/ /Fibre ports (for backhaul between POPs and AURIC Hall) as per the design requirements and scalable to additional 4 SFP+ 10 Gb/s ports. These ports shall support hot swap modules to support upgrade of ports in the future. It is expected that at least 2 ports per switch shall support Copper port/Fibre Ports configuration for inter-switch connectivity. Any attenuators required for inter-switch connectivity shall be provided by MSI.
TR 1.227	The backbone switch/router shall have a minimum switching capacity of 160 Gbps, non-blocking.
TR 1.228	The backbone switch/router shall support IP/MPLS connectivity and shall be carrier grade.
Type II – Core Router	
TR 1.229	The core router shall be installed at the POP/ACC for connectivity to outside world.
TR 1.230	The core router shall have a minimum throughput of 80 Gbps per slot.
TR 1.231	The core router shall have multiple = 10 Gigabit Ethernet Small Form-Factor Plus Pluggable (SFP+) ports with following interfaces: 10 Gigabit Ethernet, 1 Gigabit Ethernet.
Type III – Server/Workstation Connectivity Ethernet Switch – Minimum 48 Ports	
TR 1.232	The Layer 3 based Ethernet switch shall be installed for connectivity to servers and workstations at AURIC Hall and POP.
TR 1.233	The Layer 3 based Ethernet switch shall have a minimum of 48 ports Ethernet interface with a combination of 1/10 Gig SFP+ ports.
Common Requirements – Switch/Router	

TR 1.234	All Layer 3 switches/routers shall comply with
	• IEEE:
	  ➢ 802.3u (fast Ethernet, 100Mbps)
	  ➢ 802.3z (Gigabit Ethernet)
	  ➢ 802.3ae (10 Gigabit Ethernet)
	  ➢ 802.3x (Full Duplex with flow control)
	  ➢ 802.1q (VLAN)
	  ➢ 802.3p (CoS)
	  ➢ 802.1d (spanning tree protocol), 802.1w (rapid spanning tree protocol) and 802.1s (multiple spanning tree protocol)
	  ➢ 802.3ad (link aggregation control protocol)
	  ➢ 802.3 (Management)
	• IPv4/v6IGMP v1/v2/v3;
	• VRF;
	• Routing Information Protocol v2 (RIPv2), Open Shortest Path First Version 2 (OSPFv2), Border Gateway Protocol (BGP), and Intermediate System-to-System (IS-IS)
	• OSPFv3 and BGPv3;
	• Policy based routing;
	• Multicast;

	• ACL;
	• VRF;
	• Per port QoS configuration;
	• Safety:
	  ➢ EN/IEC/UL CSA 60950-1
	• Electromagnetic emissions:
	  ➢ FCC Part 15 Class A

TR 1.235	All layer 3 switches/routers shall support IP/MPLS based networking.
TR 1.236	All switches/routers shall support standard 19" rack mount or DIN rail mounting options.
TR 1.237	All interfaces shall be modular.
TR 1.238	The switches/routers shall support at least one (1) dual personality port (RJ-45 or USB micro-B) serial console port.
TR 1.239	The switches/routers shall be supported with LED indicators for easy troubleshooting.
TR 1.240	The switches/routers shall support operating temperature range of 10°C to +40°C with ambient relative humidity of 10-85% non-condensing.
TR 1.241	The backbone switches/routers shall be powered by 220-240VAC, 50Hz input as per the design requirements with hot swappable dual redundant power supply (in-built) and redundant variable speed fans.
TR 1.242	All switches/routers shall have a Mean Time Between Failure (MTBF) of at least 170,000 hours.
General Requirements – Core Router	
TR 1.243	The core router shall be chassis based with modular architecture for scalability with Redundant - Route Processor, Power supply, Switching fabric; and shall deliver multiple IP services over a flexible combination of interfaces.
TR 1.244	Shall support Network Interface module.
TR 1.245	The core router shall have a total switching capacity of at least 400 Gbps, non - blocking.
TR 1.246	The core router shall be support standard TIA/EIA 19" rack mounting.
TR 1.247	The core router shall be configurable up to 50K MAC addresses.
TR 1.248	The core router shall support 4000 multicast routes.
TR 1.249	The core router shall support both IPv4 and IPv6 policy based routing.
TR 1.250	The core router's management functionality shall be greater than SNMP v2.
TR 1.251	The core router shall have event and system history logging capabilities. The Router shall generate system alarms on events and capable of log analysis.
TR 1.252	The core router at a minimum shall support the following protocols: • IPv4/IPv6 • QoS/CoS • IP multicast • General:

	➢ IEEE 802.1D MAC Bridges ➢ IEEE 802.1p Priority ➢ IEEE 802.1Q VLANs ➢ IEEE 802.1s Multiple Spanning Trees ➢ IEEE 802.1w Rapid Reconfiguration of Spanning Tree • Security: ➢ RFC 1492 TACACS+ ➢ RFC 2138 RADIUS Authentication ➢ RFC 2866 RADIUS Accounting ➢ Secure Sockets Layer (SSL)/ SSH • Network Management: ➢ IEEE 802.1AB Link Layer Discovery Protocol (LLDP) • RFC 3031 MPLS (Multi-Protocol Label Switching) • RFC 1098 A Simple Network Management Protocol (SNMP) • RFC 2819 Four groups of RMON: 1 (statistics), 2 (history), 3 (alarm) and 9 (events) • ANSI/TIA-1057 LLDP Media Endpoint Discovery (LLDP-MED) • SNMPv1/v2c/v3
TR 1.253	The core router shall be powered by 220-240VAC/50Hz input as per the design requirements. Any power converters required shall be under the scope of the MSI.
TR 1.254	The core router shall support N+1 hot swappable redundant power supply module with redundant fan modules.
TR 1.255	The core router shall comply with the following standards: • FCC 47 CFR Part 15 Class A; • VCCI Class A; • AS/NSZ Class A; • ICES-003 Class A; • EN55022/CISPR 22 Information Technology Equipment; • Emissions: EN55024/CISPR 24 Information Technology Equipment; • Immunity: EN300 386 Telecommunications Network Equipment; • EMC: EN50082-1/EN61000-6-1 Generic Immunity Standard; • Safety: UL60950-1; CSA C22.2 No. 60950; EN 60950-1; IEC 60950-1; • AS/NZS 60950.1
Media Converter	
TR 1.256	Communications Media Converter, if required shall be installed, on a per device basis where the distance between the IP enabled device and the respective switch is greater than 90m.

TR 1.257	The device shall comply with: • IEEE 802.3- Standard defining the physical layer and data link layer media access control of wired Ethernet; • CSA/UL 60950; and • EN 50121-4.
TR 1.258	The device shall enable fibre to copper and copper to fibre conversion for devices where the distance between the IP enabled ITS device and the switch is greater than 90m.
TR 1.259	The device shall have transmit and receive data LED indicators for quick and easy troubleshooting.
TR 1.260	The device shall support full duplex and half duplex operation (configurable).
TR 1.261	The device shall have link pass through support.
TR 1.262	The device shall have an integrated high-reliability power supply.
TR 1.263	The operating temperature, power input voltage, surge, ESD and vibration should comply with applicable sections of EN 50155.
TR 1.264	The device shall enable fibre to copper and copper to fibre conversion for devices where the distance between the IP enabled IP enabled device and the switch is greater than 90m.
TR 1.265	The device shall be powered by 220-240VAC/50Hz or 24VDC input as per the design requirements.
TR 1.266	The device shall be protected against overload current and reversed polarity.
TR 1.267	The device shall support LC/ST connectors for single-mode fibre optic connection.
TR 1.268	The device shall communicate over 10/100/1000BaseTX copper signal port over Ethernet.
TR 1.269	The interfaces shall be modular.
TR 1.270	The device shall be supported with LED indicators for easy troubleshooting.
TR 1.271	The device shall support operating temperature range of 0°C to +60°C with relative humidity of 5-95% non-condensing.
TR 1.272	The device shall be compliant with necessary cUL, UL, RoHS, CRoHS & WEEE regulations.
TR 1.273	The device shall at a minimum carry IP30 rating for use in harsh environmental conditions.
TR 1.274	The device shall have a Mean Time Between Failure (MTBF) of at least 350,000 hours.
Wireless Gateway	
TR 1.275	Gateways shall be able to operate on the RF network to support IoT.
TR 1.276	Gateways shall support operations in ISM 865-867 MHz band and shall also support operations in cellular bands.
TR 1.277	Gateway shall be rugged & shall be able to work in open environment conditions.
TR 1.278	Gateway shall be IP 67 rated.

TR 1.279	Gateways shall have internal antenna or shall support required connector for any external antenna (IP67).
TR 1.280	Gateways shall support minimum 128-bit AES encryption.
TR 1.281	It shall have the minimum storage of 2GB SD Card which shall be further expandable.
TR 1.282	The device shall be powered by 220-240VAC/50Hz or 12/24/48VDC input as per the design requirements.
TR 1.283	RF output power shall not exceed 20 dBm (or as per the DOT standard requirements for license free band operations for low power devices) and shall be programmable.
TR 1.284	The device shall communicate over Ethernet and have in-built RJ45 connectors.
TR 1.285	The device shall support operating temperature range of 0°C to +60°C with ambient relative humidity of 10-95% non-condensing.
TR 1.286	Mean time between failures (MTBF) of gateway shall be 1,00,000 hours.
Network Management System (NMS)	
TR 1.287	The NMS shall have an integrated user-friendly application.
TR 1.288	The NMS shall include all required licenses and shall be scalable for management of service provider configurations.
TR 1.289	The NMS shall provide real-time monitoring of the entire network infrastructure and shall allow users to easily navigate with graphical interface and easy to use network management tools.
TR 1.290	The NMS shall provide at a minimum, event alert via the existing Microsoft Exchange Server email or pop-up alarm or export to CSV.
TR 1.291	The NMS shall automatically generate reports on a daily, weekly and monthly basis in formats including graphs, bar charts, distribution and summary. The system shall be capable of printing out reports and also exporting the reports to other systems or web servers.
TR 1.292	The NMS shall display a simple map of the whole network as a tree and shall have the option of direct selection of objects. The system shall provide a navigation tree to display the current alarm status of each subnet. All the system shall support PAN/ ZOOM feature and shall have all the devices visible in one window along with the provision for these two features.
TR 1.293	The NMS shall provide polling agents to upload status, changes or alerts of the local devices attached with the Ethernet enabling devices.
TR 1.294	The NMS shall provide real time Management Information Bases (MIBs) displays and shall provide the MIB variable data in tabular or graphical format. The MIB displays shall provide various expressions like utilization, percentage errors and volume.
TR 1.295	The NMS shall provide features for security and accountability and shall generate a log file for any user access to configuration or platform changes.
TR 1.296	The NMS shall be capable of managing any SNMP/ICMP device from any vendor.
TR 1.297	The NMS shall support SNMPV1, SNMPV2C and SNMPV3 and shall automatically discover and poll SNMP and ICMP devices.
TR 1.298	SNMP traps for all IP enabled devices shall be provided by the respective product manufacturers.

TR 1.299	The NMS shall allow notifications to be automatically sent to phones, offsite workstations, etc. for efficient response.
TR 1.300	The NMS shall monitor as a minimum the base station units and the subscriber station units along with other IP enabled equipment that is being provided as part of this Project.
TR 1.301	The NMS shall allow for providing different levels of security access i.e. viewing, logging and managing.
TR 1.302	The NMS shall allow for display different colours for the links including red, green, orange, yellow to show the status of the links and the connected devices.
TR 1.303	The operation of the NMS shall be tested while the backbone network is under 30% network utilization.
TR 1.304	The NMS shall have secure wired and wireless guest access that provision controlled wireless access to tenants, while keeping the network secure.
TR 1.305	The NMS shall have role-based access control provides flexibility to segment the wireless network into one or more virtual domains controlled by a single management platform.
TR 1.306	The NMS must provide an interface for IT helpdesk personnel to create guest credentials.
TR 1.307	The NMS shall be supplied with a server with Windows or Linux based OS (latest) or later and a workstation. • For NMS Server Specifications, Please refer to the Server specifications mentioned under IT Infrastructure specification Section 2.2.11.3. • For NMS Workstation Specifications, Please refer to the Workstation specifications mentioned under IT Infrastructure specification 2.2.11.1.
Point of Presence (POP)	
TR 1.308	POP design shall at a minimum meet the following reference standards: • NBC (National Building Code), 2005 • DoT guidelines for arrangement & installation of telecommunication equipment inside & outside building. • TEC norms for basic infrastructure of internal & external communication network.
TR 1.309	**General:** • The POPs shall include both primary and secondary POP facilities. These facilities shall act as co-location spaces for both AITL and non-AITL (tenants) needs. • The Primary POP will also act in a Secondary POP capacity as a termination point for distribution fibre that connects to the plots located within its immediate vicinity. • All TSPs including cellular service providers along with other tenants shall terminate their equipment inside the POPs. It is expected that at one of the POPs, the TSPs will terminate their fibre from outside Shendra. • All AITL owned fibre optic infrastructure shall originate and terminate at the POPs with dual entry-exit redundant paths.

	• The POPs shall have sufficient space for UPS for AITL infrastructure. The TSPs shall be given only bare shell space with partition i.e. dedicated space. The TSPs shall be responsible for any additional active infrastructure required inside their respective space. • Each room shall have provision of underfloor raceway/ trench for access of communication/ emergency electrical supply (UPS supply) as per the standard practice of arrangement for equipment racks. • Each room shall have provision of electrical and In-Out cable access of outdoor unit for air conditioning of required capacity with 100% redundancy as per TEC norms. • All POP rooms shall have an industry standard rodent repellent system.
TR 1.310	**Building Construction:** • Air filtration efficiency in accordance with ASHRAE 52.1 telecom industry standards. • HVAC shall be designed in such a way that the operating temperature is maintained at average 23 degrees C with spot minimum of 18 degrees C and spot maximum of 26 degrees C. Humidity shall be in the range of 40-60% RH. This shall be applicable for the AITL area only and include full redundancy. • All POPs shall include industry standard fire detection systems. In addition, the AITL room at each POP i.e. approximately 100 sq.ft shall also include gas suppression systems. • All cabling and pathways within the POPs shall be fire stopped only. • Average lux level across all spaces (internal) in POP rooms shall be 300. Only LED lights shall be used to meet the lighting requirements of the POP facility.
TR 1.311	**Electrical:** • POP rooms shall have redundant electrical feeds for power. This shall be coordinated with the EPC Contractor. In-coming power shall be tapped by the MSI from the nearest tapping point. Associated electrical panel at the POP shall also be provided by the MSI. • Each suite/tenant shall have separated metered power, supplied from the main electrical panel located in the AITL suite (tenant to provide their own meter), while for AITL, MSI shall provide this meter. • All electrical wiring, switch, sockets, etc. used for internal/ external building electrification shall be certified by Indian standards under grade-A and fulfill the requirement of ECBC guidelines. • Separate wiring shall be laid for UPS supply and wiring shall be interface at distribution board/ Panel board with main supply. • In case of Raceway, separate raceway shall be provide for electrical cable/wiring. • Air conditioning points rating shall be confirmed as per the required capacity of room.
TR 1.312	**Communication:** • MSI shall provide the access of OFC and RF cables for cellular tower to each TSP room and other tenant rooms as per the design requirements.

	• MSI shall provide the dedicated raceway/ trench inside the building for entire communication network. • All raceway/ trench shall be properly sealed to protect water, dust etc. from outside and have suitable opening wherever required to operation & maintenance. • Trench/ raceway layout plan shall be furnished by MSI and submit to AITL for their review & approval. • MSI shall follow the recommendation of AITL and local telecom authority to freeze the location & height of communication points.
Enterprise Management System (EMS)	
Availability - Monitoring, Management and Reporting	
TR 1.313	The proposed system shall support multiple types of discovery like IP range discovery – including built-in support for IPv6, Seed router based discovery and discovery whenever new devices are added with capability to exclude specific devices.
TR 1.314	The proposed system shall support exclusion of specific IP addresses or IP address ranges.
TR 1.315	The discovery shall be able to identify and model of the ICT asset.
TR 1.316	The proposed system shall provide a detailed asset report, organized by proper naming of all devices, listing all ports for all devices. The proposed system shall provide sufficient reports that identify unused ports in the managed network infrastructure that can be reclaimed and reallocated. The proposed system shall also intelligently determine which ports are operationally dormant.
TR 1.317	The proposed system shall determine device availability and shall exclude outages from the availability calculation with an option to indicate the reason.
TR 1.318	The proposed system shall provide out of the box root cause analysis.
Service Level - Monitoring, Management and Reporting	
TR 1.319	The proposed service management system shall provide a detailed service dashboard view indicating the health of each of the component and services provisioned as well as the SLAs.
TR 1.320	The system shall provide an outage summary that gives a high level health indication for each service as well as the details and root cause of any outage.
TR 1.321	The system shall be capable of managing IT and Non-IT resources in terms of the business services they support, specify and monitor service obligations, and associate users/Departments/ Organizations with the services they rely on and related Service/Operational Level Agreements. Presently, services shall include E-mail, Internet Access, Intranet and other services hosted.
TR 1.322	The Service Level Agreements definition facility shall support defining a set of one or more service that specify the Service obligations stipulated in an SLA contract for a particular time period (weekly, monthly, quarterly, etc.).
TR 1.323	SLA violation alarms shall be generated to notify whenever an agreement is violated or is in danger of being violated. These alarms shall be automatically shared with the authorized people.
TR 1.324	The system shall provide the capability to designate planned maintenance periods for services and take into consideration maintenance periods defined at the IT

	resources level. In addition the capability to exempt any service outage from impacting an SLA shall be available.
TR 1.325	The reports supported shall include one that monitors service availability (including Mean Time to Repair (MTTR), Mean Time between Failure (MTBF), and Maximum Outage Time thresholds) and the other that monitors service transaction response time.
TR 1.326	The system shall provide a historical reporting facility that shall allow for the generation of on-demand and scheduled reports of Service related metrics with capabilities for customization of the report presentation.
Application Performance - Monitoring, Management and Reporting	
TR 1.327	The proposed solution shall proactively monitor all user transactions for any web-application hosted; detect failed transactions; gather evidence necessary for triage and diagnosis of problems that affect user experiences and prevent completion of critical business processes.
TR 1.328	The proposed solution shall determine if the cause of performance issues is inside the application, in connected back-end systems or at the network layer.
TR 1.329	The proposed solution shall correlate performance data from HTTP Servers (external requests) with internal application performance data.
TR 1.330	The proposed solution shall see response times based on different call parameters. For example the proposed solution shall be able to provide CPU utilization metrics.
TR 1.331	The proposed solution shall allow data to be seen only by those with a need to know and limit access by user roles.
TR 1.332	The proposed solution shall measure the end users' experiences based on transactions.
TR 1.333	The proposed solution shall give visibility into user experience without the need to install operators on user desktops.
TR 1.334	The solution shall be deployable as an appliance-based system acting as a active/passive listener on the network thus inducing zero overhead on the network and application layer.
TR 1.335	The proposed solution shall be able to provide the ability to detect and alert which exact end users experience HTTP error codes such as 404 errors or errors coming from the web application.
TR 1.336	The proposed system shall be able to detect user impacting defects and anomalies and reports them in real-time for Slow Response Time, Fast Response time, Low Throughput, Partial Response, Missing component within transaction.
TR 1.337	The proposed system shall be able to instantly identify whether performance problems like slow response times are within or outside the Data centre without having to rely on network monitoring tools.
TR 1.338	The proposed system shall be able to provide trend analysis reports and compare the user experience over time by identifying transactions whose performance or count has deteriorated over time.
Systems and Database Performance - Monitoring, Management and Reporting	
TR 1.339	The proposed system shall addresses management challenges by providing centralized management across physical and virtual systems.

TR 1.340	The proposed system shall be able to monitor various operating system parameters such as processors, memory, files, processes, file systems, etc. where applicable, using operators on the servers to be monitored.
TR 1.341	It shall be possible to configure the operating system monitoring operators to monitor based on user-defined thresholds for warning/critical states and escalate events to event console of enterprise management system.
TR 1.342	It shall also be able to monitor various operating system parameters depending on the operating system being monitored yet offer a similar interface for viewing the operators and setting thresholds.
TR 1.343	The proposed solution shall support monitoring Processors, File Systems, Log Files, System Processes, and Memory etc.
TR 1.344	The proposed tool shall provide Process and NT Service Monitoring wherein if critical application processes or services fail, administrators are immediately alerted and processes and services are automatically re-started.
TR 1.345	The proposed tool shall be able to provide Log File Monitoring which enables administrator to watch system logs and text log files by specifying messages to watch for. When matching messages gets logged, the proposed tool shall notify administrators and enable to take action like sending an email.
TR 1.346	The proposed database performance management system shall integrate network, server & database performance management systems and provide the unified view of the performance state in a single console.
TR 1.347	It shall be able to automate monitoring, data collection and analysis of performance from single point.
TR 1.348	It shall also provide the ability to set thresholds and send notifications when an event occurs, enabling Database Administrators (DBAs) to quickly trace and resolve performance-related bottlenecks.
TR 1.349	Role based Access — Enables role-based management by defining access privileges according to the role of the user.
TR 1.350	The proposed Virtual Performance Management system shall integrate latest virtualization technologies.
Helpdesk - Monitoring, Management and Reporting	
TR 1.351	The proposed helpdesk system shall provide flexibility of logging, viewing, updating and closing incident manually via web interface.
TR 1.352	The proposed helpdesk system shall support ITIL processes like request management, problem management, configuration management and change order management with out-of-the-box templates for various ITIL service support processes.
TR 1.353	Each incident shall be able to associate multiple activity logs entries via manual update or automatic update from other enterprise management tools.
TR 1.354	The proposed helpdesk system shall be able to provide flexibility of incident assignment based on the workload, category, location etc.
TR 1.355	Each escalation policy shall allow easy definition on multiple escalation levels and notification to different personnel via window GUI/console with no or minimum programming.

TR 1.356	The proposed helpdesk system shall provide grouping access on different security knowledge articles for different group of users.
TR 1.357	The proposed helpdesk system shall have an updateable knowledge base for tech al analysis and further help end-users to search solutions for previously solved issues.
TR 1.358	The proposed helpdesk system shall support tracking of SLA (Service Level Agreements) for call requests within the help desk through service types.
TR 1.359	The proposed helpdesk system shall be capable of assigning call requests to tech al staff manually as well as automatically based on predefined rules, and shall support notification and escalation over email, web etc.
TR 1.360	The proposed helpdesk system shall integrate tightly with the knowledge tools and CMDB and shall be accessible from the same login window.
TR 1.361	It shall support remote management for end-user & allow analysts to do the desktop sharing for any system located anywhere, just connected to internet.
TR 1.362	Remote desktop sharing in the system shall be operator less & all activity shall be automatically logged into the service desk ticket.
TR 1.363	It shall allow IT team to create solution & make them available on the end – user login window for the most common requests.
Traffic Analysis through EMS	
TR 1.364	The traffic analysis system shall be from same OEM providing Network Fault & Performance Management System.
TR 1.365	The tool shall support Flow monitoring and traffic analysis for NetFlow, J-Flow, sFlow, Netstream, IPFIX technologies.
TR 1.366	The solution shall provide a central web based integration point across any of the flow protocols and shall be able to report from a single console across at least 20,000 interfaces.
TR 1.367	The solution shall be of passive type and should not cause any performance overheads.
Incident Management and Root Cause Analysis Reporting	
TR 1.368	An information security incident is an event (or chain of events) that compromises the confidentiality, integrity or availability of information. All information security incidents that affect the information or systems of the enterprise (including malicious attacks, abuse / misuse of systems by staff, loss of power / communications services and errors by users or computer staff) shall be dealt with in accordance with a documented information security incident management policy.
TR 1.369	Incidents shall be categorized and prioritized. While prioritizing incidents the impact and urgency of the incident shall be taken into consideration.
TR 1.370	It shall be ensured that the incident database is integrated with Known Error Database (KeDB), Configuration Management Database (CMDB). These details shall be accessible to relevant personnel as and when needed.
TR 1.371	Testing shall be performed to ensure that recovery action is complete and that the service has been fully restored.
TR 1.372	When the incident has been resolved, it shall be ensured that the service desk records of the resolution steps are updated, and confirm that the action taken has been agreed to by the end user. Also, unresolved incidents (known errors and

	workarounds) shall be recorded and reported to provide information for effective problem management.
TR 1.373	Information security incidents and weaknesses associated with information systems shall be communicated in a manner allowing timely corrective action to be taken.
TR 1.374	Controls related to incident management need to be implemented and each implemented control shall have a documentary evidence to substantiate and demonstrate effective implementation.
Change and Configuration Management	
TR 1.375	Change management provides information on changes, and enables better control of changes to reduce errors and disruption in services.
TR 1.376	All changes shall be initiated using change management process; and a Request For Change (RFC) shall be created. All requests for change shall be evaluated to determine the impact on business processes and IT services, and to assess whether change shall adversely affect the operational environment and introduce unacceptable risk.
TR 1.377	All changes are logged, prioritized, categorized, assessed, authorized, planned and scheduled to track and report all changes.
TR 1.378	Ensure review of changes for effectiveness and take actions agreed with interested parties. Requests for change shall be analyzed at planned intervals to detect trends. The results and conclusions drawn from the analysis shall be recorded and reviewed to identify opportunities for improvement.
TR 1.379	Controls related to change management need to be implemented and each implemented control shall have a documentary evidence to substantiate and demonstrate effective implementation.
TR 1.380	The roles and responsibilities of the management shall include review and approval of the implementation of change management policies, processes and procedures.
TR 1.381	A configuration management database shall be established which stores unique information about each type Configuration Item CI or group of CI.
TR 1.382	The Configuration Management Database (CMDB) shall be managed such that it ensures its reliability and accuracy including control of update access.
TR 1.383	The degree of control shall maintain the integrity of services and service components taking into consideration the service requirements and the risks associated with the CI.
TR 1.384	Corrective actions shall be taken for any deficiencies identified in the audit and shall be reported to the management and process owners.
TR 1.385	Information from the CMDB shall be provided to the change management process and the changes to the CI shall be traceable and auditable.
TR 1.386	A configuration baseline of the attached CI shall be taken before deployment of a release into the live environment. It shall be stored in the safe environment with appropriate access control.
TR 1.387	Master copies of CI shall be recorded in the CMDB and shall be stored in secure physical or electronic libraries which shall be referenced in the configuration records. This shall be applicable to documentations, license information, software and hardware configuration images.

2.2.2 City-Wide Wi-Fi

Overview

City-Wide Wi-Fi is one of the key service offerings by AITL to its citizens; an initiative aimed to enable mobile broadband to be affordable, accessible and available for citizens. The Wi-Fi infrastructure includes a combination of Wi-Fi Access Points (APs), mounting infrastructure, and associated active and passive infrastructure including fibre/copper based network.

Since Shendra will be a greenfield smart city which will have a considerable number of workforce and population, there is a requirement to provide city Wi-Fi services across all public spaces and other strategic locations for enabling the mobile broadband to be affordable, accessible and available for its citizens. Through this approach, AITL will be able to offer Wi-Fi as a service to its citizens across Shendra.

In addition to citizen benefits, the presence of a city Wi-Fi network creates many benefits for the AITL workforce. AITL employees will also utilize the benefits of mobile connectivity for m-governance applications throughout the City, allowing efficient access to mobile applications that support their individual work processes, from building inspections to solid waste removal, and municipal services. Any municipal function that requires employees to be mobile will benefit from the Wi-Fi connectivity. Financially, this will reduce the costs for cellular data (3G/ LTE) that AITL will be paying as almost all mobile data will flow across the city Wi-Fi network. Moreover, Wi-Fi will be used for offering e-governance services for the citizens.

For the implementation of a city Wi-Fi network, the following are the two (2) types of infrastructure being proposed for Wi-Fi Access Points:

- Outdoor Rated Access Point (AP) co-located on Street Light Poles: This setup will be used across all public right-of-way areas;
- Integrated with Multi-Services Digital Kiosk: Wi-Fi access points will be integrated at the Multi-Services Digital Kiosk that will be installed at the strategic locations within the plots such as AURIC Hall, parks, etc.

Architecture

The approach for Wi-Fi is that AITL will invest in building the Wi-Fi infrastructure including access points and associated hardware and software, and will provide fibre to each of the access points for backhaul purposes. However, the MSI will have a neutral operator responsible for operating the Wi-Fi network and will also be responsible for providing the raw bandwidth for the Wi-Fi network. This neutral operator will act as an operator of operators i.e. tenant based model who in-turn will offer Wi-Fi services from various telecom service providers. The MSI can offer additional value-add services such as music, videos, games etc over this Wi-Fi LAN network and can also use this network for 3G/4G offloading.

The Wi-Fi APs and Multi-Services Digital Kiosk will be connected using dedicated fibre optic infrastructure. Each of the Wi-Fi APs will have dedicated fibre counts that will connect back to the POP. For redundancy, the AP shall use wireless frequency for creating a mesh to ensure continuous communications in case of a fibre link not being available.

Wi-Fi network shall also include a Wi-Fi management software and application with a secure login procedure. The city Wi-Fi network shall also support mobility i.e. people driving or walking within Shendra will be able to access the Wi-Fi network on the move for within the coverage area as per the project requirements.

The overall concept of operations for city Wi-Fi is such that AITL will provide Wi-Fi as a service to its citizens. It will allow citizens to use Wi-Fi for various e-governance applications, use Wi-

Fi with a one-time login, coupon based login or premium plan. The summary of the overall concept of operations in terms of different services being offered via the city Wi-Fi network are:

- One-time login – each session will last for 30 minutes or 100MB (whichever happens first) post which the user will have to go through the login process again;
- AURIC city services i.e. e-governance and m-governance – all e-governance and m-governance services to be offered to citizens and AITL employees using the Wi-Fi LAN at no cost to the citizens for any amount of time;
- Plans – various coupons will be available for using the city Wi-Fi services. These coupons will be made available at strategic locations across Shendra including Multi-Services Digital Kiosk. Further, they can also be available via sms service. In addition, there will be premium plans available to the citizens for:
  - Purchasing a premium plan session at one time that lasts more than 30 minutes or 100 MB and/or at a faster speed;
  - Extended dwelling plan – It is expected that the Wi-Fi operator is neutral and allows multiple Internet Service Providers (ISPs) to offer their services using this Wi-Fi network. As part of the Project, it is expected that there will be some ISPs who also offer wired broadband services in Shendra. Therefore, there will be an option for the user to extend the wired broadband service plan at the dwelling to city Wi-Fi service by paying a premium over the base plan that is being used by the user.

The overall indicative process flow for the city Wi-Fi network has been presented as part of the Exhibit 6 below.

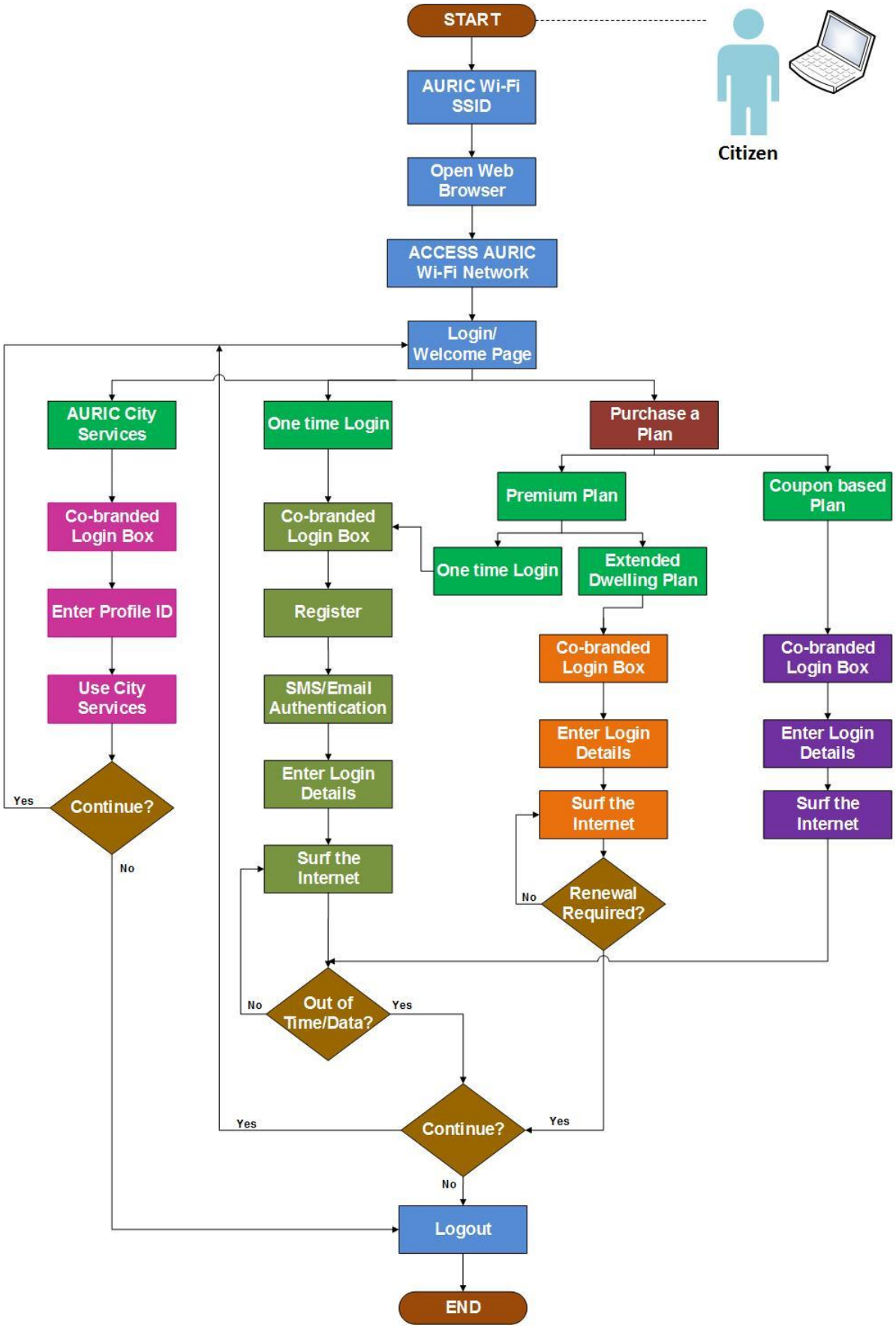


Exhibit 6: Process Flow for the City Wi-Fi Network

BR - 2 Business Requirements

BR 2.1	City-Wide Wi-Fi shall be one of the key service offerings by AITL to its citizens.
BR 2.2	City-wide Wi-Fi is an initiative aimed to enable the mobile broadband to be affordable, accessible and available for the citizens.
BR 2.3	City-wide Wi-Fi shall be used for offering e-Governance services for the citizens and m-governance services to AITL workforce. For municipal functions and e-Governance services, the Wi-Fi services shall be free of charge.
BR 2.4	Wi-Fi shall be provided at no cost to the user for 30 minutes or 100 MB (whichever happens earlier) at 4 Mbps download per user per session. Post this, the MSI may create custom plans for the user based on consultations with the Client.
BR 2.5	Wi-Fi services shall be provided using a neutral operator i.e. an operator who supports multiple ISPs (tenant based model) to offer their services through the AITL infrastructure. Further, 3G/4G offload can also be supported using city Wi-Fi network.
BR 2.6	Beyond the free Wi-Fi services for citizens, the MSI may monetize the Wi-Fi services without impacting the overall user experience and in consultation with the Client. The MSI will retain all monetization derived from the city Wi-Fi services.
BR 2.7	Wi-Fi services shall support the extended dwelling plan option i.e. extend a user's personal broadband connection across Shendra.
BR 2.8	MSI at his own cost may offer Wi-Fi as a service to any plot holder within the plot or building after getting consensus with the Client.
BR 2.9	Wi-Fi services shall be offered in compliance with the regulations and policies from both TRAI and DOT.
BR 2.10	Wi-Fi Operator shall be a Licensed ISP in India who shall be able to meet all requirements for operations of network as per RFQ cum RFP. MSI shall be responsible for ensuring all compliance with DOT/TRAI norms at any given point in time during operations of Wi-Fi without any liability to the Client.
BR 2.11	Wi-Fi network shall be integrated with payment gateway (provided by AITL) and coupon based system for payments by the users for browsing.
BR 2.12	MSI to assume contention ratio of 200:1 for the Wi-Fi services.

FR - 2 Functional Requirements

General	
FR 2.1	City wide Wi-Fi Network shall comprise of the following components: • Access Points (Aps) including the mounting infrastructure • Wireless Controllers • Wi-Fi Management System • Associated active and passive infrastructure
FR 2.2	City-wide Wi-Fi shall have a secure, seamless and redundant network. It shall support industry standard based two (2) step authentication procedure.

FR 2.3	City-wide Wi-Fi services shall be provided across all public spaces and other strategic locations in consultations with the Client.
FR 2.4	The target bandwidth proposed per end-user is 4 Mbps throughout the City on a per session basis for the 30 minutes or 100 MB per session that will be given to the user at no cost.
FR 2.5	The system shall be designed for scalability and allow future expansions in terms of subsequent project phases, increased user density and geographical coverage.
FR 2.6	The Wi-Fi transition from one access point to another shall be seamless. Users must be able to use same login details even if they move from one Wi-Fi zone to another.
FR 2.7	All AITL promotions can use the Wi-Fi network without any cost.
FR 2.8	Advertising streams shall be planned and implemented carefully. Because of the advertising, there shall not be a scenario where the citizen is unable to login to the network for a long time and gets annoyed.
FR 2.9	It is expected that the time taken by the user to login and use the Internet from the time he sees the initial page shall be less than 3 minutes.
Access Point	
FR 2.10	For the implementation of a city Wi-Fi network, the following are the two (2) types of infrastructure being proposed for Wi-Fi Access Points: • Outdoor Rated Access Point (AP) co-located on Street Light Poles: This setup shall be used across all public right-of-way areas. • Integrated with Multi-Services Digital Kiosk: Wi-Fi access points shall be integrated at the Multi-Services Digital Kiosks installed at the strategic locations within the plots such as AURIC Hall, parks, etc.
FR 2.11	The access points shall be capable of managing and configuring remotely through a wireless controller.
FR 2.12	Wi-Fi access point shall support dual frequencies (in compliance with DoT and TRAI regulations) including both 2.4 GHz and 5 GHz spectrum. It shall support wireless mesh configuration for redundancy of the network in case of a fibre link being unavailable.
FR 2.13	Access points shall support 802.11ac wave II multi-user MIMO.
FR 2.14	Access points shall have an integrated in-built or external antenna (IP67).
FR 2.15	User can create a profile which will be authenticated using his mobile number (SMS) and email. Further, user can also login using his city application i.e. smart card based session.
FR 2.16	Access Point and Multi-Services Digital Kiosks shall be connected using dedicated fibre optic infrastructure for backhaul to Point of Presence (POP).
FR 2.17	The Wi-Fi access point shall be controller based that can be managed by using Wi-Fi controller at ACC or POP.
FR 2.18	The Wi-Fi access point shall be configurable using a Wireless Management system. The software shall include profile configuration, built-in diagnostic, alignment tools, network mapping, network monitoring and maintenance and highly developed security features.

Wi-Fi Controller	
FR 2.19	Wi-Fi network shall include Wi-Fi controller to monitor, manage, and control access points from the ACC.
FR 2.20	The controller shall ensure seamless roaming within AURIC.
FR 2.21	The controllers should communicate back and forth with the centralized security system and network management system in real time.
FR 2.22	The controller shall have inbuilt wireless intrusion protection capabilities.
Wi-Fi Management System	
FR 2.23	The City-wide Wi-Fi shall also include a Wi-Fi management software and application with a secure login procedure.
FR 2.24	Wi-Fi management system shall be a centralized system to monitor, analyze, and configure wireless network in automatic fashion. It shall be an authentication and management system for the city Wi-Fi network and shall be installed at the ACC or POP.
FR 2.25	The system shall be capable of providing Access Point groups with the highest quality network resource allocation by analyzing the past 24 hours of RF network statisoptimizing the network for the next day.
FR 2.26	GUI: The system shall have a configurable graphical user interface (GUI) to provide user friendly experience for policy management, and day to day administration functions.
FR 2.27	Database: The system shall have a centralized database and subscriber management system.
FR 2.28	The Wi-Fi network shall support multiple BSSIDs as needed to support the overall concept of operations including support for multiple operators.
FR 2.29	Fully redundant Authentication, Authorization, and Accounting (AAA) services with OTP/password shall be provided to support city wide services.
FR 2.30	The Wi-Fi network shall include a billing software that shall automatically generate the revenue from all the services being offered using this network. This billing software will have transparent interface with AITL's systems.
User Login Authentication and Plans	
FR 2.31	Beyond the 30 minutes or 100 MB limit, the user shall have to go through the process of logging in again. At this stage, the MSI may offer custom plans to the users.
FR 2.32	Industry standard two (2) step authentication shall be required for all sessions.
FR 2.33	iOS and Android applications to be given for seamless connectivity to network-Autodetect/Autologin.
FR 2.34	The user shall have the option of either logging in by viewing advertising or can obtain a coupon for the session for a nominal cost.
FR 2.35	Premium plans shall be offered to the users on daily, weekly or monthly subscriptions basis. Also, there shall be plans for the residential or industrial users who can pay a small premium to use their dwelling Wi-Fi service across the city.
FR 2.36	Users shall have an option to enable/ disable connection to city Wi-Fi.

FR 2.37	Users shall also get prompts and alerts for excess data usage.
FR 2.38	Multiple payment gateway integration required allowing the users to make the payments using online/ offline mode, including prepaid mobile balance & e-wallet applications and coupon based.
FR 2.39	AITL shall be able to generate MIS report to view overall usage, collections and other usage statistics over a defined time period.
Encryption and Security	
FR 2.40	The Wi-Fi network shall have built-in encryption mechanism to encrypt all communications and data transfer over the Wi-Fi for all the users of Wi-Fi.
FR 2.41	Wi-Fi network shall not connect to rogue networks. It shall be segmented for public and utility networks by using VPNs or separate networks in the wired core so that any traffic from the Internet users is not routed into any other sensor network and vice-versa.
FR 2.42	Wi-Fi network shall support Protected Extensible Authentication Protocol (PEAP) protocol.
FR 2.43	Wi-Fi network shall have a wireless network content filtering tool for filtering of malicious content on the internet such as pornography sites, rogue sites, torrents etc.
FR 2.44	The Wi-Fi Network shall support industry standard two step authentication for secure login procedure.
FR 2.45	The Wi-Fi Network shall allow users to roam securely from one access point to another, within or across subnets, without any perceptible delay security during re-association.
FR 2.46	The Wi-Fi Network shall support BSSID based IEEE 802.1x authentication and accounting.
FR 2.47	The Wi-Fi network shall support MAC based authentication to provide simple authentication based on users MAC address.

TR - 2 Technical Requirements

General	
TR 2.1	The Wi-Fi access points shall be co-located on Street Light Poles and mounted on the Multi-Services Digital Kiosks.
TR 2.2	The Wi-Fi central hardware and software shall be installed at the POP or ACC.

TR 2.3	• Organization IEEE:
	  ➢ IEEE 802.11a/b/g/n/ac
	• Organization European Standard (EN):
	  ➢ EN50121-1 EMC
	• Organization Underwriters Laboratory and IEC:
	
	• Department of Telecommunications guidelines
	• Telecom Regulatory Authority of India guidelines

Access Point	
TR 2.4	The Wi-Fi access point shall be Outdoor rated, dual radio, 802.11ac Wave II, 5-GHz and 2.4-GHz. It shall support operations in 802.11a/b/g/n/ac.
TR 2.5	The Wi-Fi access point shall be supplied with omni-directional antennas as needed to meet the design requirements of the Project. It shall support multiple unique antenna patterns. The antennas shall have antenna gain required to support the coverage requirements of the Project.
TR 2.6	The Wi-Fi access point shall have a built-in spectrum analyser capable of part-time or dedicated spectrum analysis to identify sources of RF interference either built-in or as part of the overall solution.
TR 2.7	The Wi-Fi access point shall be controller based that can be managed by using Wi-Fi controller at ACC.
TR 2.8	The Wi-Fi access point shall be configurable using a Wireless Management system. The software shall include profile configuration, built-in diagnostic, alignment tools, network mapping, network monitoring and maintenance and highly developed security features.
TR 2.9	The Wi-Fi access point shall provide the fastest and highest throughput with lowest latency even in the most challenging RF environment.
TR 2.10	The Wi-Fi access point shall support dual frequency as authorized by DoT.
TR 2.11	The total transmitted power (EIRP) of the Wi-Fi access points shall be in compliance with the regulations of the Department of Telecom (DoT), India.
TR 2.12	The Wi-Fi access point shall have multiple SSIDs with QoS and security policies.
TR 2.13	The Wi-Fi access point shall allow setting up of configurable speeds per user and configurable number of users. It shall support upto 200 concurrent users at any time.
TR 2.14	The Wi-Fi access point shall support reliable multicast video to maintain video quality.
TR 2.15	The Wi-Fi access point shall also support additional features for AITL staff members as needed using a separate secure SSID. Each AP shall support at least 16 different BSSIDs.
TR 2.16	The Wi-Fi access point shall support 20 MHz, 40 MHz, and 80 MHz channelization.
TR 2.17	The Wi-Fi access point shall be IEEE 802.3af/at Power over Ethernet (POE)/POE+ compliant.
TR 2.18	The Wi-Fi access point shall support: • Minimum One PoE+ autosensing port 10/100/1000BASE-T Ethernet network interface (RJ-45). • Power over Ethernet or Power over Ethernet+.
TR 2.19	The Wi-Fi access point shall have LED based visual indicator for: • Power/System status • Link status
TR 2.20	The Wi-Fi access point shall be capable of working at a temperature range of 0˚C to 60˚C and at a humidity of 5% to 95%, non-condensing.
TR 2.21	The Wi-Fi access point shall be IP67 compliant and NEMA 4X rated.
TR 2.22	The Wi-Fi access point must support IPV4 and IPV6.

TR 2.23	The Wi-Fi access point shall support telnet and/or SSH login/ console for troubleshooting.
TR 2.24	The Wi-Fi access point shall be reliable ensuring fast, dependable bandwidth and industry standard encryption for security.
TR 2.25	The Wi-Fi access point shall independently be configurable to handle security, mesh, WIPS (either in-built or part of overall solution), RF Management, QoS, roaming, local forwarding without the need for a controller so as to increase performance of the WLAN network.
TR 2.26	The Wi-Fi access point shall be supplied with OEM mounting kit and shall support pole mounting option.
Wi-Fi Controller	
TR 2.27	The controller shall support 802.11a/b/g/n/ac.
TR 2.28	Each controller shall support 500 access point nodes at a minimum and shall be scalable as and when required upto 2000 access point per controller.
TR 2.29	The Controller shall support redundancy feature i.e. Active: Active and Active: Standby features. Same licence shall be shared by the controllers.
TR 2.30	The controller shall support centralized or distributed traffic forwarding architecture.
TR 2.31	The controller shall ensure a high throughput even in the most challenging RF environment.
TR 2.32	The controller shall be highly available with minimum downtime.
TR 2.33	The controller shall ensure seamless roaming.
TR 2.34	The controllers shall communicate back and forth with the Network Management System (NMS) in real time.
TR 2.35	The controller shall have inbuilt wireless intrusion protection capabilities.
TR 2.36	The controller shall have ability to map SSID to VLAN and it shall ensure VLAN reliability by proactively determining and adjusting to changing RF conditions.
TR 2.37	The controller shall support automatic radio channel adjustment for intelligent channel switching and real-time interference detection.
TR 2.38	The controller shall support user load balancing to balance the number of users across multiple APs to optimize AP and user throughput.
TR 2.39	The controller shall be capable of managing authentication, encryption, VPN connections, IPv4 and IPv6 Layer 3 servicess.
TR 2.40	The controller shall have redundant power supplies to maintain uninterrupted network operations.
TR 2.41	The controller shall meet the following power specifications: • AC input voltage: 100 VAC to 240 VAC • AC input frequency: 50-60 Hz
TR 2.42	The controller shall support two (2) dual-media ports: 2 x 10 Gigabit Ethernet interface or more.
TR 2.43	The controller shall meet the following environmental specifications: • Operating temperature range: 10°C to 40°C • Operating humidity of 10% to 80% non-condensing

TR 2.44	The Wi-Fi controller shall be reliable ensuring fast, dependable bandwidth and industry standard encryption for security.
TR 2.45	The controller shall be rack mountable.
Wi-Fi Management System	
TR 2.46	Wi-Fi management system shall be a centralized system to monitor, analyze, and configure wireless network in automatic fashion. It shall be an authentication and management system for the city Wi-Fi network and shall be installed at the ACC. It shall support plug-and-play environment with zero configuration.
TR 2.47	GUI: The system shall have a configurable graphical user interface (GUI) to provide user friendly experience for policy management, and day to day administration functions.
TR 2.48	Database: The system shall have a centralized database and subscriber management system.
TR 2.49	The system shall be capable of providing Access Point groups with the highest quality network resource allocation by analyzing the past 24 hours of RF network statistics, and proactively optimizing the network for the next day.
TR 2.50	It shall be integrated with tool for monitoring and managing radio frequency (RF) dynamics within the wireless network, to include the following functions and benefits: • Accurate location information for all wireless users and devices • Up-to-date heat maps and channel maps for RF diagnostics • Visual display of errors and alerts
TR 2.51	The system shall be capable of restricting bandwidth to a user/users as per the policies.
TR 2.52	The system shall be both IPv4 and IPv6 compliant.
TR 2.53	The system shall be capable of logging and creating real time reports for users per access point and controller the bandwidth usage.
TR 2.54	The system shall be capable of displaying a list of managed devices and access points associated to the Wi-Fi controller.
TR 2.55	Subscriber services: The system shall provide the users with a self-service portal to enable the new users to register, subscribe, seek information on tariff and billing, update user profile, and make payment through the portal.
Server	
TR 2.56	The system shall support a centralized servers for user authentication, authorization and accounting.
TR 2.57	The server shall have an integrated embedded management solution to monitor the server for ongoing management, service alerting, reporting and remote management.
TR 2.58	Please refer to the Server Specification as mentioned under IT infrastructure Section 2.2.11.3.

2.2.3 AURIC e-Governance and ERP (AEE)

Overview

As part of the AURIC e-Governance and ERP (AEE) systems, multiple applications will be provided for both citizen facing and AITL specific requirements. The e-governance system broadly includes citizen facing applications that will become the point of interface for the citizens with AITL. The applications will be made available over different mediums including citizen application, portal and website. Further, the ERP system will effectively be the backbone for AITL that will enable efficient and integrated operations and maintenance of the city. The ERP system will be closely integrated with the e-governance system and will become the main system used by AITL for city governance and operations.

ERP system shall be required to be implemented to automate the internal business functions at AITL. The ultimate goal of AEE is to create one holistic system which allows AITL to be lean and efficient in their business processes and functions and provide 100% online services to the citizens. Since AITL is a greenfield industrial smart city, most of the key functionalities available in standard software shall be configured meeting the business requirements in key functions of AITL. Besides the standard state-of-the-art ERP system, functionalities like Document Management System, Portal for customer communication (Service requests/ Complaints), Bespoke solutions for E- Government functions as listed in this document, web enablement of GIS foundation layer, and SOA based integration framework for integrating various application systems etc. are required to be developed/customized.

Main system components for AEE:

- AITL Corporate Website – there is an existing website www.auric.city which will be revamped as part of this Project;
- Customer Facing Systems: Multi-Channel Communication Centre for citizens, Portal, E-governance functions, M-Governance Functions, Social Governance, Web based GIS layer, Digital Locker, citizen smart card, Kiosk and Mobile Applications, Management Information System along with KPI and Dashboards;
- Back office Systems i.e. ERP: Comprising of Finance and Accounts, Purchasing, budgeting, contract management system, Asset Management, Electricity and water connection, Billing, Maintenance, Projects, Stores, HR and Payroll;
- Framework for integrating various applications;
- Foundation Layer: A SOA based integration solution, document management system, will be an integral part of the overall solution.

The vision of AITL is to use IT towards establishment of people centred, responsive, well governed functions and to provide a single, easy, secure, and reliable means of access to municipal information and services to the citizens of this area. A Citizen Facilitation centre, multi-services digital kiosk, mobile application and website backed with an integrated portal is the front end of these applications.

At the core of the stakeholders service experience will be AITL portal which will be a gateway to various stakeholders including citizens. The Portal will have an intuitive user interface for rendering various services and providing role based access to various systems in use at AITL. Through the Portal, any user can seek service, status check on service request, lodge an incident/complaint, get information, and provide suggestions. It is envisaged that the citizen shall interact with AITL via the portal which shall direct the query / grievance to the relevant department using work flows.

The Face to face contact point for the citizens will be a Citizen Facilitation Centre (CFC). The Citizen Facilitation centre would be manned by trained employees of AITL. These employees

shall assist the citizens with information, application or complaints. The employees shall also take care of e-mail, postal service letters and phone calls. The employees shall log into the portal and conduct the business required for the citizen. The CFC may be used to verify and upload documents to the digital locker.

Benefits to the Citizen

- The citizen benefits because there is transparency, efficiency and integrity in his dealings with AITL, furthermore, there is ease in information access;
- Convergence of services and delivery mechanism and extending outreach;
- The service delivery is faster to the citizens;
- Online visibility on water and electricity consumption with a one day time lag;
- Payment of Land related maintenance charges, Water bills, Power bills is online;
- Reducing the cost of citizen like travel cost, wages cost etc;
- Reducing the time in availing the services like travelling, waiting time;
- Online status of application Redressing citizen Grievance within a stipulated time frame;
- Access to all Citizen and Business related services at AURIC;
- Access to information easily with service delivery counters within reach;
- High Level of Convenience;
- Facility of payment at convenient points and extended hours;
- Negligible Queuing;
- Minimizing the number of customer visits.

BR - 3 Business Requirements

BR 3.1	AITL shall have a state of the art ERP system which shall automate and digitise various AITL functions and business processes.
BR 3.2	AITL shall have a comprehensive suite of e-Governance applications which shall provide convenient, anytime, anywhere citizen and employee services with an aim of 100% online and paperless delivery of services.
BR 3.3	AEE shall provide a holistic and integrated solution to meet the needs of both AITL and citizens.
BR 3.4	AEE shall enhance transparency, accessibility and efficiency of AITL functions in an integrated manner.
BR 3.5	AEE shall provide significant improvement in Government to Customer (G2C), Government to Employee (G2E), Government to Business (G2B) & Government-to-Government (G2G) interfaces and services.
BR 3.6	AEE shall streamline, standardize electronic information gathering and access.
BR 3.7	AEE shall facilitate information reuse, across and within various departments of AITL.
BR 3.8	AEE shall reduce system maintenance and training requirements by adopting standard systems and processes for AITL.

BR 3.9	AEE shall provide electronic delivery of services to meet citizen expectations and requirements. Intent is to create efficiencies in the internal working of AITL and provide user friendly interfaces, so that the citizens shall have a trouble free user experience.
BR 3.10	AEE shall support e-commerce initiatives (e.g., online filing, payments etc.).
BR 3.11	ERP and e-Governance system shall have continued compliance with Government frameworks including NeGP and Government of Maharashtra e-Governance policy, legal regulations and standards.
BR 3.12	e-Governance solution shall at least comply with the published e-Governance standards, frameworks, policies and guidelines available on http://egovstandards.gov.in (updated from time-to-time).
BR 3.13	AEE solution shall be modular and customizable to meet the requirements of the Project.
BR 3.14	Since the AEE solution will be common for both Shendra and Bidkin, it shall be scalable to accommodate future growth and support hardware and software additions and upgrades.
BR 3.15	AEE solution shall have the capability for printing of all bills generated by any AEE module.
BR 3.16	AEE shall include citizen smart card which will become a unique id. This smart card will be integrated with all data including data from land management system, ERP system, e-governance system, and shall also support integration with social infrastructure like healthcare and education. The vision is to have a soft smart card which does not require any upgrade to the soft code of the unique id for every update.
BR 3.17	AEE shall support integration with Aadhar card as well as digital and electronic signature for applicable services.
BR 3.18	Some of the functionality defined in the AEE and Smart City Platform may overlap. It is the MSI's responsibility to optimize the functionality as part of his overall solution for the Project.

2.2.3.1 E-Governance

AITL recognizes the importance of Information Technology (IT) to enhance the efficiency and effectiveness of service delivery to citizens and stakeholders. Due to this, AITL has set up a vision to develop a fully digital organization by comprehensive deployment of IT across its departments of conduct business. As part of the vision, it has been envisaged to implement electronic delivery of AITL services to citizens for greater efficiency, transparency and accountability. Intent is to allow citizens and stakeholders to access and use AITL services online in order to provide ease of use and promote paperless and digital platforms. Following modules shall be implemented as part of envisaged e-Governance solution of the AEE:

- **Corporate Website:** to provide useful information to citizen and stakeholders.
- **AITL Portal and Mobile Applications:** It shall provide a gateway to all stakeholder experience including citizens.
- **Citizen Facilitation Centre (CFC):** It shall provide in person contact point for all citizens.
- **Birth and Death Certificate Module**: It shall provide the capability for online registration of birth and death certificates.

- **Trade Licenses:** It shall be an online module for periodic review and approval of licenses.
- **Right to Information (RTI):** It shall provide information to accept applications, register requests, disposal to relevant department, track status, maintain an appeal register and status of appeals.
- **Legal – Related to Land only:** It shall assist the legal cell of AITL to monitor and analyze all land related cases and expenditures.
- **Citizen Grievance Redressal:** It shall be an online module for citizens through AITL portal and mobile application to register and track all public grievances associated with AITL functions.
- **GIS Platform with Web GIS:** It shall consist of implementation of GIS Map of Shendra which shall be a common platform across all AITL solutions. It shall also include web enabled version of the GIS map shall be implemented for citizens and AITL employees.
- **Management Information System (KPI Dashboard):** Performance management framework shall be implemented to demonstrate 'Open Data' initiatives.
- **Digital Locker:** It shall be an online file storage facility for citizens and businesses.
- **Smart Card System:** it shall be used by citizens, workers and businesses as a digital identity.
- **Automated Building Plan Approval System:** Online solution to AITL for building layout plans scrutiny.

All the above mentioned modules shall be closely integrated with the back-end ERP system to perform as one cohesive and holistic system which shall play a vital role in electronic and automated service delivery to citizens.

Considerable encouragement shall be provided to citizens and businesses to adopt digital and online services.

Corporate Website

The AITL corporate website is the face of AITL and shall present AURIC to various stakeholders. It will be accessed by citizens, investors and corporates alike and shall provide factual and attractive information to investors. The corporate web site should clearly communicate a sense of 'identity' at first glance.

AITL's website should serve as a cutting-edge communication tool that clearly conveys its mission, vision, offerings and purpose. The site shall help prospects and citizens to better understand and engage with the AITL's mission. The website shall be a useful tool for the target audience, while being visually appealing, user-friendly, and state-of-the-art. It must allow easy navigation. The site must have an attractive mix of text, images, audio and video. The website should:

- Increase traffic and visitor engagement through architecture, design, and other features such as social media integration;
- Help visitors easily understand the AITL's mission and obtain information about AURIC's offerings;
- Deliver content concisely and clearly. This content includes dynamic information.

The Corporate web site should have links to log-in for visitors, residents and employees. This log in shall redirect the user to the portal with rights to view or transact as per user status.

The home page shall be clean and visually compelling that quickly conveys to the visitor, the AITL's mission and what the AITL does. This shall include dynamic 'Call-Outs' which highlight what's new on the website as well as information sliders.

FR - 3 Functional Requirements

AITL Corporate Website	
FR 3.1	**Home Page:** A clean, visually compelling home page that quickly conveys to the visitor, the AITL's mission and what AITL does. It will include (but not limited to) the following information either directly or linked through other pages: • About AURIC • Message from the MD • Investment opportunities • Link to the AITL portal • Tenders • Key statistics • City Information • History of Aurangabad • Tourist Locations • City Map • GIS map • Links to Facebook, twitter etc. with integration of social governance. • Photo Gallery • Online Services listing (e-governance services) • FAQs • Feedback • Contact Us • Log in • Search • News & Updates • Job postings & opportunities • Land Management System
FR 3.2	**Corporate Branding:** Clearly communicates a sense of 'identity' at first glance.
FR 3.3	**Visual appeal:** The site must have an attractive mix of text, images, audio and video.
FR 3.4	**Fast Loading Pages:** Optimization of web pages for a faster browsing experience with compatibility with key industry browsers and platforms.
FR 3.5	**Responsive Design:** The site must be mobile-optimized through responsive design methods. Therefore, it should detect that a mobile device is being used and present the user with the mobile version first. The user should be able to switch to the desktop version and adjust resolution and format accordingly.

FR 3.6	**Simple and clear navigation:** The site should be easy to navigate. Information should be grouped and presented in a logical manner and require no more than three levels of "drill down" for the user to find the desired information thus creating a clean, clear, easy and satisfying user experience. This should include drop down menus, so that the visitor can easily find what they are looking for with a few clicks of the mouse.
FR 3.7	**Search Tools:** Provide search capabilities using key words or phrasing that will provide access to content from throughout the site. Additionally, make it possible to download historical and recent data whereby the user can define his/her preference. Select a platform that allows users to search content of the website easily and quickly without the need for extremely high speed devices (desktop, laptop and mobile) and high speed internet access.
FR 3.8	**Links:** Links should be placed within the website to allow individuals to contact institutions affiliated with the AITL and access to the portal as well the respective Ministries *(can be called Useful Links)*.
FR 3.9	**Easy access to Key performance indicators:** Seamless integration with AITL's dashboard data to provide continuously updated graphs and charts. This will be decided with AITL input & consent.
FR 3.10	**News/Update feed:** Constant and dynamic update feed on site home page. Displays announcements and notifications for new content additions on front page of site.
FR 3.11	**Calendar and bookings:** A dynamic calendar that displays events as well as filters for searching/sorting events and booking any available venues/functions.
FR 3.12	**Contact Form:** Provides a web-based contact form with anti-spam controls.
FR 3.13	**Automated e-mails**: automatically send follow-up emails to our stakeholders (subscribers) if they visited a specific web page, or completed some specific task (e.g. survey) on the website.
FR 3.14	**Social Media Engagement Tools:** New tools to improve interaction with social media.
FR 3.15	**Blog:** The site should have a Blog section to facilitate discussions on various topics.
FR 3.16	**Career:** The site should have a career section which should accept online job application that would be fed directly into the HRM system (ERP).
FR 3.17	**Language Options:** The website ought to be easily translated into other languages i.e. Hindi and Marathi even if documents remain in English.
FR 3.18	**AITL Website app:** The site should allow for the download of an AITL website app. The app should be compatible with Android and iPhones.
FR 3.19	**Search Engine Optimization (SEO):** Website availability using common search engines to ensure it is optimized using SEO.
FR 3.20	**Compatibility:** Site must be compatible with common operating platforms including Google Chrome, Microsoft® Internet Explorer 8.0 or higher, Microsoft Edge, Mozilla Firefox, and Safari 5.0 or higher.
FR 3.21	**Mobile Access:** Site must be "responsively designed" to accommodate mobile users. This also includes accommodations for slower, cellular internet connections. This includes compatibility with iOS, Android and other industry standard platforms.
FR 3.22	**Settings**: Website must not require plug-ins as a default.

FR 3.23	**Performance:** Site must be able to handle multimedia (video) with high performance.
FR 3.24	**HTML Compliance:** Full compliance with HTML 5.0 or higher.
FR 3.25	**Parallel sites**: After 'Go Live' there should be two (2) sites running parallel, one for testing purposes and the other for production. All maintenance should be carried out in the test environment and be approved before migrating to the live environment.
FR 3.26	**Easy Maintenance:** Site should be easy to maintain, site should not require significant investment of time to keep site up and working with quick and easy fixes site should be easy to update with new content.
FR 3.27	**Security:** Site shall be secure against hacking and other vulnerable activities.
Design and Construction	
FR 3.28	Work closely with the AITL at each stage of the design to identify user needs and corresponding user interface requirements, workflows, and functionalities.
FR 3.29	Ensure integration of all elements including content, information format, compatibility with software platforms used by AITL and standards for content management.
FR 3.30	Select a platform that allows easy integration of multimedia products and user-friendly administrator interface.
FR 3.31	Create wireframes, storyboards and prototypes to propose options for implementation. Provide three (3) template designs for review to select a concept. Concepts should reflect the AITL's corporate identity, nature and purpose.
FR 3.32	Develop corresponding user interface components (web templates, style sheets, scripts, images, dashboards, social media interfaces) as needed.
FR 3.33	Use simple, cost-effective techniques to test designs with representatives of target audience prior to launch of site.
FR 3.34	Submit the final concept to AITL for review prior to 'going live'.
FR 3.35	Secure the existing website prior to transitioning to the new platform.
FR 3.36	Keep a full backup of the website through the duration of the Project.
FR 3.37	Manage all upgrades and updates on the website including content update in an efficient and integrated manner.
FR 3.38	Website design shall support easy upgrades and updates on content without the need to redo the base design.

Customer Facing Systems: Portal, Kiosks and Mobile Application

AITL is developing AURIC as a mixed use industrial area and will have municipal powers and functions in this area. The municipal functions envisaged are:

- Local level governance;
- Primary Collection of Solid Waste;
- Maintenance of Storm Water Drains;
- Maintenance of Municipal Roads;
- Maintenance of parks, gardens and play grounds;
- Primary education and medical needs (outsourced to private agency);

- Governance of markets, cremation grounds and slaughterhouses as applicable;
- Regulating advertisements;
- Allotment of Trade Licenses directly or indirectly;
- O&M of internal sewers and community toilets as applicable;
- Street lighting;
- Operation and Maintenance of Heritage points in the city;
- Assessment Land maintenance charges;
- Utility Payment: Payments relating to electricity and water bills;
- Interaction with:
  - Fire service;
  - Police.

In line with the National e-Governance Plan (NeGP), the aim of AITL is to "Make all citizen services accessible to the common man in AURIC, through common service delivery outlets, and ensure efficiency, transparency, and reliability of such services at affordable costs to realise the basic needs of the resident or common man".

AURIC, being a smart city, is expected to have a high internet penetration with city Wi-Fi and fibre backbone. In addition, mobiles would also enable anytime, anywhere access to and delivery of services which would be ideal for delivery Govt. services, financial inclusion, micro credit, location (GPS) based services, etc. AITL, is fully geared up to exploit the huge potential for empowerment through mobile governance.

At the core of the stakeholders' service experience will be AITL portal which will be a gateway to various stakeholders including citizens. The Portal will have an intuitive user interface for rendering various services and providing role based access to various systems in use at AITL. Through the Portal, any user can seek service, status check on service request, lodge an incident/complaint, get information, and provide suggestions. It is envisaged that the citizen shall interact with AITL via the portal which shall direct the query / grievance to the relevant department using industry standard work flows. Similarly, for AITL, the portal shall act as a gateway for single sign on services to check all sorts of services and requests related to m-governance.

The in-person contact point for the citizens will be a Citizen Facilitation Centre (CFC). The Citizen Facilitation centre would be manned by trained employees of AITL. These employees shall assist the citizens with information, application or complaints. The employees shall also take care of e-mail, postal service letters and phone calls. The employees shall log into the portal and conduct the business required for the citizens. The CFC may be used to verify and upload documents to the digital locker.

The citizen can also access services at multi-services digital kiosks that will be set up in AURIC at strategic locations. Kiosks will be put up at suitable location across the city thereby giving city stakeholders a free access to various services at convenient locations.

The heart of a smart city is a mobile application i.e. the citizen app which will be used by citizens for accessing all city services. Another version of the app will be for m-governance which will be used by AITL for their day-to-day operations and functions.

The citizen may log in by their smart card at either the facilitation centre or a kiosk or from their personal devices integrated with website, portal and city app.

The key objective of the Portal, Facilitation centre, Mobile App and the kiosk will be to:

- Provide Single Window services to citizens on anytime, anywhere basis;
- Provide a single and integrated view of AITL information system;
- Provide a single application form for all services as required.

AITL Portal	
FR 3.39	It shall be a State of the art portal based on industry standard best practices.
FR 3.40	Citizen Portal and Mobile App shall be in Hindi, English and Marathi and shall be user friendly.
FR 3.41	AITL Portal and Mobile Application shall be single window service to stakeholders with a single and integrated view of AITL information system.
FR 3.42	Users may access the portal directly or via the web site to avail of services.
FR 3.43	Broadly, Portal is required to provide the following features: • Role based access to core systems like ERP, Land Management system, GIS system and any other system. • Link to E Government Services – Birth and Death certificate, Grievance; redressal, Trade licenses, RTI, Legal case management, etc. • Link to web based GIS system. • Link to E-Auction system for land. • Digital lockers and Digital ID. The Digital ID shall take the form of smart card. • Management Reports and KPI Dashboard. • Provision to request any service.
FR 3.44	Multi-user system with multi-level security system shall be included.
FR 3.45	The portal will be accessed by: • Public & corporates • Citizen – residents • Industrial units • Commercial establishments • Education establishment • Health establishment • AITL employees • Any outsourced employees • Government bodies • Third party vendors
FR 3.46	Each type of stakeholder shall have different needs and authorisations and the portal must facilitate all requirements.
FR 3.47	The portal also needs to have mobile mirroring with Android & iOS (and other industry standard OS) compatibility.
FR 3.48	The various users shall be authenticated from the common LDAP server for which the roles will get assigned from the server. Depending on their roles and responsibilities, the respective users shall be taken to their respective home page.

	The layer shall visually integrate the applications in place with single-sign-on implemented. LDAP roaming profile shall ensure seamless mobility of the user.
FR 3.49	**Public and corporates:** shall access the portal for information on AURIC and hence the portal must be comprehensive enough to provide detailed and attractive information. They shall have access to the web GIS view of AURIC, showing occupied and vacant land parcels among other parameters. They shall also have access to information on industries, residential properties, education & health facilities, setting up a business and links to the land management system. In addition, KPIs, as decided by AITL, shall also be visible to them.
FR 3.50	**Citizens who are residents:** will have access to all the above and more. The citizen is expected to have a unique id i.e. smart card, authenticated by a smart card and a PIN or an id and password. This shall give him access to his ledgers, digital locker and registering complaints. It shall also facilitate payment of utility bills. The resident can swipe the smart card at either a kiosk or the citizen facilitation centre. Alternately they can log in using a property id. In any of the 3 cases, the basic data (including pending payments or dues) shall be populated for their viewing. The citizen can apply for certificates by clicking on the 'apply for certificates' link. This shall take the user to the e-Gov section for certificates. Similarly, the user may click on the RTI, Grievances or pay utility bills link by clicking 'apply for services'. It is expected that through one login one id, multiple departments can use common authenticated documents of a citizen from the respective citizen digital locker to provide services without the need of the citizen to provide same document to multiple departments within AITL. The citizen will need to interact with AITL for any of the following reasons (but not limited to): • Information • Consolidated application for utilities • Grievance / Complaints regarding municipal services • Primary education and medical needs (planned and maybe outsourced) • Allotment of Trade Licenses (direct or indirect) • Assessment & payment of taxes: Land related maintenance charges, and other government taxes as applicable • Utility Payment: Payments relating to electricity, water bills • Application & issue of Certificates • RTI • Scan the portal for sections on real estate availability for purchase or rental (integrated with Land Management System) • Job opportunities All the above should be tiles on the landing page.
FR 3.51	**Industrial units** shall use all the above. In addition, they will also have a section with a pre-decided format wherein they must upload key performance data every month or on a defined frequency. This will pertain to production, employment, tax paid, etc.
FR 3.52	**Commercial establishments** will have access to the data as citizens; with additions of links to the trade licenses of the e-Gov modules. They shall also have an MIS format to upload data for monthly MIS requirements.

FR 3.53	**Education institutions** will have access to data as above and in the future, will have a link from the portal for the citizen. They shall also upload MIS data such as (but not limited to): • Building self or rented and how much is area • Whether it has playground, lab facility, and library • Mid-day meals • Classrooms with infrastructure • Electricity • Water supply • Toilet availability • Gender wise students in each class • Teachers in the school with details (TGT PGT etc. and), Educational qualification, permanent or contractual, number of years of experience • School dropout rates • Passing students percentage It is required to create log-in category for educational institutions and formats for periodic upload of this data and flag delays in upload of the same. Further, there may be a need to integrate advanced technology such as virtual classroom with the e-governance services of AITL. The technology infrastructure required at the school level for the remote classroom shall be provided by the respective education institute but the necessary integration with e-governance shall be a part of the Project. In addition, the education institute will also integrate with the citizen smart card and periodically update information on citizens attending the school by sharing this information in a prescribed format to AITL. It is required that this periodic information is updated in the citizen smart card automatically once it comes to AITL.
FR 3.54	**Health centres** will have access to data as above and in the future, will have a link from the portal for the citizen. They shall also upload MIS data such as: • Patient Analysis • Utilization Reports for Nurses / Doctors • Occupancy reports • Patient Feedback Analysis • Generation of Daily/Monthly/Quarterly reports • Generation of reports required for Governmental bodies • Special Disease report • Birth & death intimation It is required to create log-in category for health centres and formats for periodic upload of this data and flag delays in upload of the same. Further, there may be a need to integrate advanced technology such as remote doctor, telepresence, appointment booking, availability of doctor, disease related information, etc with the e-governance services of AITL. The technology infrastructure required at the health centre shall be provided by the respective institute but the necessary integration with e-governance shall be a part of the Project. In addition, the health centre shall also integrate with the citizen smart card and periodically update any information for the citizen by sharing this information in a prescribed format with

	AITL. It is required that this periodic information is updated in the citizen smart card automatically once it comes to AITL.
FR 3.55	**AITL employees** shall have access to the portal with respect to their work requirement. It is envisaged that AITL employees shall also be issued a smart card which shall work as an access card. They shall access internal ERP and e-Gov systems for all approval and reporting purposes based on the clearances inherent in the role and hierarchy. The portal may be accessed for registering a complaint, issuing a certificate, verifying status of projects, updating GIS databases and other work flow requirements.
FR 3.56	**Any Outsourced employees:** They shall have access to operation and maintenance functions as required. Events shall be triggered on application for utilities, initiation of projects or receipt of complaints and passed on to the concerned employees.
FR 3.57	**AITL and Outsourced employees** shall have access to ERP & e-Gov modules. They shall also have access to the detailed desktop and web version of the GIS map to be able to respond to the event and update the database.
FR 3.58	Through service Portal, any user can seek service, status check on service request, lodging incident/complaint, getting information, providing suggestions.
FR 3.59	The user shall contact AITL by following means: • In person through Citizen Facilitation Centre • Mobile Application • E-mail • Web Portal • Surface mail • Digital service kiosks In any of the above cases, the citizen query / data must interact with the ERP / e-Gov / LMS / Other system to be processed. It is expected that in any situation the query shall be directed to the portal and the data input by the citizen or the operator at the facilitation centre.
FR 3.60	Login options of different user groups shall be provided. The mobile version shall mirror the portal and be adapted for optimum viewing on multiple operating systems and device sizes.
FR 3.61	The Portal platform shall support deployment on all three platforms - Linux, UNIX and Windows.
FR 3.62	The Portal platform shall provide support for portal standards such as JSR 168, WSRP 2.0 and JSR-170.
FR 3.63	Support for Web-based administration that can monitor data and events, monitor portal components such as HTTP server, Portal Cache, Portal Repository etc. and maintain portal configuration files.
FR 3.64	Support for centralized, web based user provisioning ensuring single definition of users, roles, groups and access rights.
FR 3.65	System shall have search capabilities that support powerful and comprehensive full-text searching, metadata searching or people search.
FR 3.66	It shall support multiple databases like Oracle, SQL Server, DB2, Informix etc. without requirement of any additional software.

FR 3.67	Shall manage portal content using web content management from common content management repository through out-of-the-box integration.
FR 3.68	The portal solution shall allow the users themselves to personalize their user interface.
FR 3.69	The portal solution shall provide several layers of caching infrastructure to provide content to users. Access to content shall be cached to reduce the load and increase performance.
FR 3.70	Portal shall support a stand-alone, service-oriented architecture.
FR 3.71	Support for out of the box integration with content management system for web content management and publishing on the portal.
FR 3.72	The administration tools shall provide granular control and delegation of administration tasks for custom role-based management.
FR 3.73	Portal shall deliver content based on user attributes or preferences.
FR 3.74	Support for unified Single Sign On for internal integrated applications.
FR 3.75	Support for personalization of home page using drag & drop functionality.
FR 3.76	Support for display of the user's work list information.
FR 3.77	Support for personalized notifications and alerts.
FR 3.78	The portal solution shall provide analytics console for accessing portal metrics. The analytics console shall be available as an integrated application so that the product is easy to learn and easy to deploy.
FR 3.79	The portal solution shall provide secure and controlled access to the analytics console. Only portal administrators shall be able to access the console without exposing data that might be sensitive or private.
FR 3.80	Portal shall provide comprehensive tracking and graphical display of portal/community traffic, searched keywords, quick system response time, document downloads, user turnover, visit duration, etc.
FR 3.81	Portal shall provide support for discussion forums.
FR 3.82	Leverages a common management console to manage all distinct applications/modules and monitor performance.
FR 3.83	Provides ability to perform Advanced Search based on multiple metadata.
FR 3.84	Ability to display search keywords in bold within title and excerpt of search result page.
FR 3.85	Ability to perform search across web content, files on a file server, databases, IMAP email, document repositories and applications.
FR 3.86	Search results are based on user's security role and display what the user is authorized to access.
FR 3.87	Ability to integrate with LDAP based security.
FR 3.88	Support for analytics on Search performed such as reports on most popular searches, documents not found etc. Based on this, administrator can boost document relevancy and customize search results.

FR 3.89	Support for embedding 'Search as a Service' so that searches can be invoked via Service API. Search facility shall provide suggest facility.
FR 3.90	Enterprise wide Portal shall enable content publishing within portal framework.
FR 3.91	Portal shall provide Template driven portal development to simplify portal creation process.
FR 3.92	The portal shall implement security features, such as password complexity, automatic blocking (temporary/permanent) of user logins after given number of unsuccessful login attempts (should be parameterized), controlled access to content stored on the portal and logging of security incidents using Identity management solution.
FR 3.93	Reporting and Monitoring shall be inbuilt and provided as part of Portal inherent capability.
FR 3.94	Inherent Portal analytics shall be able to capture page traffic, portlet traffic, content usage, services and response times.
FR 3.95	Analytics console with inbuilt UI framework for Analytics reports, graphs and charts.
FR 3.96	Shall support a single content management repository for both structured and unstructured content.
Key Information	
FR 3.97	Home Page: • Message from MD • Vision, Mission, Objectives • Link to various sub-sections: ➢ About AITL ➢ City Information ➢ GIS Maps ➢ Current events ➢ News on AURIC / land / Job postings ➢ Projects ➢ Information dissemination ➢ News ➢ Statistics ➢ Starting a business ➢ Online Services ➢ Apply for land ➢ Apply for utilities ➢ Citizen Grievances ➢ RTI ➢ Apply for certificates / birth / death ➢ Pay utility bills / tax ➢ Job openings / requirements ➢ Land availability / requirements ➢ Links to external sites: Income tax, Pollution board, Facebook, twitter etc.

	• All the above should be tiles on the landing page. This will lead the user to detailed sections on each of the above. One example of RTI is given below. ➢ RTI: o Names of PIO o Departments/Wards: Introduction, Objectives, responsibilities, powers & duties of officers, activities, time limit. o Telephone Directory o Committee: Members, purpose, type, frequency of meeting, documents available for public. o Projects/ Activities: Budget head, work activities, allocated amount, current statistics. o Details of concessions, subsidies given, computerization done in various depts. o Integration required for updation of data for RTI with projects, accounts, HRMS, Fleet, material, asset. o Application form o Apply for information o Application status o Further details are in the section on RTI ➢ Opinion Poll ➢ Photo Gallery ➢ Tenders ➢ FAQs ➢ Emergency Information ➢ Employee/ Citizen Login using LDAP ➢ Payment Gateway ➢ Feedback ➢ Contact Us
FR 3.98	• All forms and downloads as per Maharashtra government and MIDC/AITL requirements. • All e-gov applications currently covered in these bodies. Refer to their web sites. • Other e-gov applications as understood under the e-municipality project may need to be developed / integrated • Shall support integration with Aadhar and other government initiatives
City Information	
FR 3.99	Online Services (Partial List): • Birth / Death Certificates • Duplicate Bills • No Dues Certificates • Work Orders • Downloading of Forms • Sale of Tender Forms

	• Status on Applications / Complaints • Payment Details, Bill Details • Self-Assessment of Charges and Taxes as applicable • Apply for land (integration with LMS) • Citizen Grievances • Apply for utilities and payment of bills
Mobile Governance	
FR 3.100	In line with the NeGP objectives, following services through mobile governance are required to be delivered: • e-municipality Services including submission of forms and payments. • Acknowledgements and status updates related to delivery of public services. • Grievance registration and tracking. • Alerts related to emergencies, Government notifications and campaigns, weather information (for fishermen and farmers), tax reminders, pensions. • Alerts to nearest hospitals and police stations during accidents/ disasters. • Reporting suspicious activity to Law Enforcement agencies. • Maps and location-based services. • Employment opportunities (job ads, availability of jobs). • Mobile-based application filing, such as RTI filing, applying for government services, license renewals, etc. • Citizen engagement: opinion polls and feedback gathering, stakeholder consultation. • Mobile-based polls. • Mobile work flow alerts to outsourced and AITL employees. • Mobile audit for AITL employees. • Ability to book key facilities at AURIC. • Integration with weather, environmental and other sensors being provided as part of AITL for enabling open data initiatives.
FR 3.101	The mobile version should mirror the portal and be adapted for optimum viewing on multiple operating systems and device sizes. However the actual application layout design for both mobile and web is the responsibility of the MSI.
FR 3.102	Mobile mirroring is for web site, portal, e-gov & modules of ERP. It is also assumed that MSI would attempt to include as many services over mobile devices as possible, beyond the ones explicitly mentioned in this document.
FR 3.103	All the important features and functionalities envisaged in the present RFQ cum RFP should be made available through the mobile application. • The bidder should design the architecture and should be responsible for its robustness, reliability and scalability. The architecture as envisaged by AITL is that the Portal provides the multi-channel communication interface which drives the mobile apps. • The Portal in turn integrates the ERP, E-GOV and other applications which are expected to provide out of the box proven and robust functionality which is running at multiple customer sites

	• It is expected that the Bidder would study the detailed requirements related to ERP, E-Gov and other applications as specified in the RFP and detail out the functionality/business processes which would be provided on the Portal. • A subset of the Portal Functionality (which may be all functionality depending on the business process design suggested by the bidder) would be mobile enabled such as but not limited to the following: ➢ AITL perspective : approval of leave applications, purchase requisitions, payment release etc, initiate a requisition, work order confirmation etc ➢ Citizen perspective: apply for birth certificate, register a birth/death, lodge a complaint, pay property tax and other bills etc ➢ Industry Perspective : apply for water connection or electricity connection, apply for trade etc • The bidder should not assume that the above mentioned examples is a complete list. It is repeated that the solution architects preparing the bid, must have an end to end business process perspective which cuts across business applications which also demonstrates the quality of resources deployed for preparing the solution design which should be included in the proposal. • Role based authorisation design should cover end to end business processes as well as the unit application component level • The final list of business processes to be mobile enabled would be finalised during the project in a phase or sprint as planned by the bidder.
FR 3.104	All the facilities for a citizen can be accessed through an intuitively designed mobile application.
FR 3.105	AITL Portal shall be made mobile-compliant through the following: • Open standards shall be adopted for mobile applications for ensuring the interoperability of applications across various operating systems and devices. • Uniform/ single pre-designated numbers (long and short codes) shall be used for mobile-based services to ensure convenience: e.g. 51969 and 166 procured by DeitY for M-Gov Services. • Exploit the exploit the mobile services delivery gateway, which would be a central hub for all mobile transactions for device and technology agnostic solutions. • Provide mobile-based services through all delivery channels including SMS, Voice/ IVR, Unstructured Supplementary Service Data (USSD), GPRS/3G, SIM ToolKit, and mobile application store (m-Appstore).
Citizen Facilitation Centre (CFC)	
FR 3.106	The Citizen Facilitation Centre would be manned by trained employees of AITL.
FR 3.107	These employees shall assist the citizens with information, application or complaints.
FR 3.108	The employees shall also take care of e-mail, postal service letters and phone calls.
FR 3.109	The employees shall log into the portal and conduct the business required for the citizen.
FR 3.110	The citizen may also log in by scanning their smart card at either the facilitation centre or a multi-services digital kiosk.
FR 3.111	The CFC may be used to verify and upload documents to the digital locker.

Citizen Help Desk	
FR 3.112	Facility to lodge New Complaints, Check Status.
FR 3.113	Facility to check citizen data: • Birth/Death registrations • Bill Dues • Application Status • Payment Status • Renewal Status: ➢ Integration Required with all modules
FR 3.114	Facility for Citizen Charter: • Integration Required with Grievance Redressal Module.
FR 3.115	Application Acceptance & Delivery of Outputs: • Department-wise categorization • Allow system to accept service specific inputs • Capture of Mobile No. & E-Mail of Applicant • Re-submission of rejected application after compliance • Check-list for documents to be submitted along-with Application • Define citizen charter (list of the officers & duration for service delivery)
FR 3.116	Fees to be accepted: • Integration Required with Accounts
FR 3.117	Generate Token of Application acceptance.
FR 3.118	Rejection Note in case of inadequate application.
FR 3.119	Marking the application to Corresponding department/Ward /Officer: • Integration Required with Workflow Module
FR 3.120	Delivery of the output through CFC or Internet: • Integration Required with Departmental Modules
FR 3.121	Payment Acceptance: • Integration Required with Accounts and Departmental Modules • Land related charges and taxes as applicable • Water Bills and Power Bills • Licenses as applicable • All Departmental Services • Tender Document Fees • Any other AITL function
FR 3.122	Citizen Services (General): • Integration Required with Accounts and Departmental Modules • Nursing Home Registration (as applicable) • Registration of Hospitals (as applicable) • NOCs for other government Departments • Tree Cutting / Trimming Service

	• Road / Water / Drainage / Electrical • Any other Service under AITL's functions
FR 3.123	SMS alert to applicant upon decision and progress
FR 3.124	Services Statistics: CFC-wise / Kiosk-wise and Department-wise
FR 3.125	Officer-wise list of services pending beyond the stipulated time: • Integration Required with HR module

Birth and Death Certificate Module

The registration of births and deaths is one of the functions of a Municipality. Registrar of the Municipality is the authorized person for issue of birth and death certificates. Hospitals are responsible for the registration of births & deaths within the municipality. The births and deaths, which take place in the hospital are recorded and reported to the municipalities. For non-hospital events, the concerned parties can make necessary applications to the Municipalities.

The Birth and death module primarily deals with recording of birth and death details taking place within AURIC. The process includes recording/registration of the primary data in relation to birth/death, information on the fee collected including the penalties and issue of the certificates.

The main activities of birth and death process are:

- Birth & death registration;
- Validation of data;
- Application Registration;
- Issue of birth and death certificates;
- Corrections in the registration details;
- Updation of registration details (Inclusion of child's name).

Birth and Death Certificate	
FR 3.126	Services: • Birth Certificate Application Request • Birth Certificate Application Status • Birth Certificate Printing • Birth Certificate Search • Birth Statistics • Death Certificate Application Request • Death Certificate Application Status • Death Certificate Printing • Death Certificate Search • Death Statistics • Birth Certificate Modification Request

FR 3.127	It shall be a Web based Scalable solution.
FR 3.128	It must have Secured authentication and authorization mechanism to enable internet access.
FR 3.129	This module may be accessed via the portal or the mobile application. It must have an interface with authorised hospitals for birth and death information.
FR 3.130	It shall have Scalable architecture framework for tech enabling plug and play solutions.
FR 3.131	The system must follow due diligence to authenticate the identity of the applicant and the authority to apply and receive the certificate.
General Registration Requirement	
FR 3.132	Portal shall have information about the Birth / Death processes & documents required for the convenience of the citizen.
FR 3.133	System shall have facility to avail the service online & through CFC.
FR 3.134	System shall capture all the details and documents required for application.
FR 3.135	System shall have facility to download required forms. System shall have provision for e-forms.
FR 3.136	System shall have facility for online payment and through CFC.
FR 3.137	System shall have facility to send the alerts through SMS and email.
FR 3.138	System shall have facility to accept the request for certificate to be sent through courier/mail. For this system, shall capture the address at which the certificate needs to be delivered and charges should be calculated accordingly.
FR 3.139	System shall have the facility to deliver the issued certificate via mail by official to the applicant.
FR 3.140	System shall have the provision to maintain Birth Register as defined in the process.
FR 3.141	The system must be able to accept requests and payments and print receipts and acknowledgements which will be emailed or printed and delivered. The intimation of certificate readiness and delivery shall also be linked using citizen id and email.
FR 3.142	System shall have the provision to maintain Death Register as defined in the process.
Registration of Birth/Death	
FR 3.143	System shall provide an interface to hospitals/ individual for online registration of birth/death. Alternatively, same may be done by CFC official using the similar interface once the information is received by the CFC official. The system must follow due diligence to authenticate the identity of the applicant and the authority to apply and receive the certificate.
Data to be captured	
FR 3.144	• Registration of Birth (Hospital / Home / Jail / etc.): ➢ Normal & Delayed Registration ➢ Child Details – Gender, DOB, Time, Weight, Name, Birth Place, Birth Mark etc. ➢ Parent Details – Name, Address, Qualification, Occupation

	➢ Delivery Method, Informant Details, Attachments in case of delayed registrations ➢ Registration of Still Birth – Foetal Death Cause along with other birth registration details ➢ GIS (for marking the hospital + parents address) • Registration of Death: ➢ Name and address ➢ Normal & Delayed Registration ➢ General Details – Gender, DOD, Time, Name, Attention type, Pregnancy related Death ➢ General Details – Death place type, death place, Cemetery type, Informants Details ➢ Medical Certificate Details - Death Cause, Death Manner. • Defining charges for Birth and Death Services: ➢ Delay Charges based on no. of days of delay ➢ Birth Certificate charges ➢ Death Certificate charges ➢ Child Name Insertion charges ➢ Duplicate certificate charges • Integration with Web to validate the Birth / Death Certificate • Integration with SMS / Payment gateway / Finance module • Integration to citizen and KPI database for updation and reflection in statistics • Integration with Document/workflow management system • Integration with mailing and messaging system
Name Corrections in Birth/Death Certificates	
FR 3.145	Government official shall be able to add/modify/delete the Birth and Death details based on the approval/right as per process.
FR 3.146	System shall have the facility to upload additional documents required.
Late Registration of Birth/Death	
FR 3.147	System shall have the facility to allow the late registration of birth/death as per the rules.
FR 3.148	Application shall automatically be routed to the concerned Government Officials as per the duration gap of the registration as per the Birth/Death registration rule.
MIS	
FR 3.149	Variety of Reports to be sent to AITL/State / Central government authority.
FR 3.150	Monthly Summary Report of Birth.
FR 3.151	Monthly Summary Report of Still Birth.
FR 3.152	Monthly Summary Report of Death.
FR 3.153	Birth / Death reports for various Health Schemes.
FR 3.154	Reports to Health Department with respect to Death Causes in a period.
FR 3.155	Reports to analyse services delivered through various delivery channels.

Integration Requirement	
FR 3.156	Document/workflow Management System.
FR 3.157	Mailing and Messaging System.
FR 3.158	SMS Gateway.
FR 3.159	Accounting System.
FR 3.160	Finance System.
FR 3.161	Payment Gateway.

Trade Licenses

AITL has provisioned for commercial establishments in AURIC area. These establishments must be issued trade licenses and governed. The licenses shall be periodically reviewed, renewed or rejected. The envisaged system shall have the provision of:

- Online application of licenses (includes portal, mobile & facilitation centre);
- Evaluation of applications through document management system;
- Online approvals.

Licensing Department issues licenses to the shops, trader and market within the jurisdiction of AITL. AITL may give these licenses directly or in coordination with other authorized municipality (if applicable).

Note: The licensee will be required to submit periodic (to be decided by AITL) data on turnover, tax paid, number of employees, and other KPIs which will be updated on the AITL dashboard.

Trade Licenses	
FR 3.162	**Service Objective:** Permitting business units to trade.
FR 3.163	**Stakeholders**: Citizen, Data Entry Operator, Marketing Inspector, Office Secretary, Dealing Assistant, Tax Collector, MD.
FR 3.164	**Process Input:** Declaration Form.
FR 3.165	**Process Output:** Trade License.
FR 3.166	**Integration Requirements:** SMS Gateway, Payment Gateway, GIS, ERP, Land maintenance charges, Utilities.
FR 3.167	**Services:** License application, License Online Receipt Print, License Online Receipt Search, License Renewal.
Process	
FR 3.168	Application for licenses with all documents attached will be submitted online via the portal or in person at the facilitation centre. The license application shall be evaluated, using checklist and rules as per Maharashtra Government and will be shortlisted and issued licenses.
FR 3.169	Citizens may also apply online by paying through payment gateway with the required fee; and the required documents (Scanned Copies). Acknowledgement number with tentative date of delivery is generated for Citizen & application gets forwarded to authorized AITL staff.

FR 3.170	If applied through Citizen Facilitation Centre - Data Entry Operator (DEO) fills up the Online Application Form on the portal and Scans and Uploads the requisite documents, Acknowledgement number with tentative date of delivery is generated for Citizen & application gets forwarded to authorized AITL staff.
FR 3.171	AITL conducts site verification and using the GIS application verifies the spatial data. Once the license is issued, the data will also have to be updated in the GIS database.
FR 3.172	The application is to be classified under a suitable category and comments updated on the system - regarding approval/rejection; the report gets forwarded through the system to the next authority who verifies and approves/rejects. If it is approved an alert is generated and SMS/e-mail sent to the applicant to deposit the required license fee against the application, and the notification is updated so that the fee may be appropriately adjusted. Payment of license fee {based on type of firm and category of the same (A, B or C)} + Sanitation tax to be done online or through any CFC.
FR 3.173	If rejected, an email/SMS notification will be sent explaining the reason for rejection. The status is updated against the application. An acknowledgement receipt is generated against the remitted fee and updated against the application. Alert may be sent to the next authority for approval.
FR 3.174	The Issuing authority logs in and approves/rejects. If approved- Trade license issued with sanitation tax paid status, which is updated in system and issued with digital signature and mailed (email/postal) to applicant and notification of issuance of license sent on SMS/email.
FR 3.175	If rejected- notification sent via SMS/email. And license fee either remitted back to originating account/credit card in case of online transaction/ paid in cash through CFC upon providing the valid acknowledgement receipt issued at the time of remitting fee by citizen.
FR 3.176	**Configuration:** • Business types – This includes the configuration of different business licenses. • Business Categories – This includes the configuration of business categories like Whole seller, retailer, manufacturer etc.
FR 3.177	**Master Data:** • Business owner types • Holidays • Products • License Types • License Groups • Licenses • Required Licenses • Business Rules • Product Usages • Product Permissions • License Reports • Signing Authority

Information in the Master	
FR 3.178	Sanitary zone/division information in the Sanitary Zones/wards/Division Master.
FR 3.179	In the Revenue Master: • Revenue wards information under sanitary zones/wards/divisions • Revenue blocks under revenue wards information • Election Wards Information • Locality categories • Sanitary zones/ward/division allocation to Sanitary Inspectors • Trade categories • Sub-trade categories
FR 3.180	Allow the configuration of: • Late fee details for the corresponding time periods in the penalty fee master • Trade rates • Revenue Block Categorizations
FR 3.181	Preparation of report of field inspection of the applicant's premises (with comments of the SI/HO).
FR 3.182	Recording the NOC/Installation Permission Details.
FR 3.183	Allow the highest rank officer to view the recommendations of the SI/HO on a new license application.
FR 3.184	Facilitate the highest rank offier to enter his remarks in the above case.
FR 3.185	Capturing of the license fee/late fee details (Cheque/DD details, etc.).
FR 3.186	Generation of a new license after the information on the necessary approvals are recorded in the system.
FR 3.187	Allow printing of the license document from the system.
FR 3.188	Recording the application details from the application form submitted by the applicant.
FR 3.189	Data from the application collected for License renewal.
FR 3.190	Recording of the trade License renewal details.
FR 3.191	Recording of the Panchanama details collected from the reports.
FR 3.192	Generation of the list of defaulters of renewal fees.
FR 3.193	Generation of the list of license holders who wish to close their trades on their own.
FR 3.194	Update the status of a trade license as 'active' or 'closed', and the reasons for closure are entered.
FR 3.195	Recording of the details from the application submitted by the applicant for change of Title.
FR 3.196	Generation of license with changed title, after necessary steps completed.
FR 3.197	Allow printing of the above license.
FR 3.198	Details of the un-assessed trades-individuals performing trade without a proper trade license.

FR 3.199	Track the renewal notices sent to the license holders to renew their License.
FR 3.200	Track response dates, late fee applicability, etc. for the above.
FR 3.201	Capture of grievances against a license, or in general.
FR 3.202	Generation of demand collection and balances revenue ward-wise for AURIC.
FR 3.203	**Processes:** • Issue of new license • Duplicate License • Registration of Application • Verification of Application • License issue or rejection of the application • Renewal/Closure of license • Change in Name of Business • Change in Business • Transfer of License • Issuing the demand notice to the license holder for renewal of his trade license. Depending upon the timeliness of the payment of the license renewal fee, the license is either renewed or a closure notice is issued to the licensee. • Cancellation of License
FR 3.204	**License Holder's Details:** • One or multiple owners • Capture of Mobile No. / E-Mail ID • License holder's photograph(s) • Link to Property Number • License Details – Temporary/ Permanent License, Name of Business, Business Address • Trade/ Business Details – License Type, Subtype - multiple levels to define types and sub types. • License type, sub-type, unit of measure wise license amount.
FR 3.205	**Issuance of License:** • License Application • Calculation of License Fee • License Online Receipt Print • License Online Receipt Search • Letter of Intent • License Certificate • License Renewal
FR 3.206	**License Sanction Process:** • Applicant Entry • Business Information Feeding and application number allocation • Authenticate the application before registering it • Receipt for issuing license • Authenticate the application by the authority

	• Sanction/Renewal of license • Rejection of license • Cancellation of application • Log Management of the issuing/renewal of licenses • Automatic/Manual Surcharge Calculation • Automatic Renewal of licenses on receipt but should be authorized by the authority
FR 3.207	**Other Departmental Process:** • Scrutiny of Applications • Inspection Entry • Generation of Show Cause Notice Hearing • Reminder Notice for Renewal • Cancellation of License by Force
FR 3.208	**Search Facility:** • For the issued licenses • Renewal of licenses • Pending Applications
FR 3.209	**Reports:** • Different types of licenses • Pending Application Report • Expiry License Reports • Renewal License Reports • Notices for the renewal of licenses • Applicant List • Issued Card List • License Income Report • License status/log report
Integration with other Modules	
FR 3.210	Finance module: Automatic posting of the receipt amount to the cash ledger and license ledger. Automatic renewal of the license on receipt.
FR 3.211	SMS / email integration (SMS gateway provided by AITL).
FR 3.212	GIS.
FR 3.213	Payment Gateway (Payment gateway provided by AITL).
MIS	
FR 3.214	License Register.
FR 3.215	List of Defaulters.
FR 3.216	Reminder Notice for Renewal.
FR 3.217	Demand / Collection Register.
FR 3.218	Reports showing Changes in License Types, Business Partners, Cancellation Licenses, etc.

FR 3.219	Facility to forecast the impact of reduction / deduction of License Fee.
FR 3.220	The licensee will be required to submit periodic (to be decided by AITL) data on turnover, tax paid, number of employees, and other KPIs which will be updated on the AITL dashboard.

Right to Information (RTI)

The module for RTI should have the ability to accept applications, register requests, disposal to relevant department, track status, maintain an appeal register and status of appeals.

Right to Information (RTI)	
Content	
FR 3.221	**RTI circulars:** • Names of Public Information Officer (PIO). • Details of Departments: Introduction, Objectives, responsibilities, powers & duties of officers, employees with gross salary, activities, time limit, directory with telephone numbers. • Committee: Members, purpose, type, freq. of meeting, docs available for public. • Projects/ Activities: Budget head, work activities, allocated amount, current statistics. • Details of concessions, subsidies given, computerization done in various depts. • Integration required for updation of data for RTI with projects, accounts, HRMS, Fleet, material, asset. • Scope as per RTI.
General	
FR 3.222	Provide all services under RTI under a single category.
FR 3.223	Be able to retrieve service request form.
FR 3.224	Request can be received on the portal, the mobile application or at the citizen facilitation centre. The request has to be forwarded appropriately and track kept of the information supplied and time lines. The request can also be forwarded from the state government or information commission. In each case the information supplied has to follow the same path.
FR 3.225	Be able to route the service request to concerned officer (Public Information Officer - PIO).
FR 3.226	Have the functionality to accept service request even if the service request is not directed to particular section.
FR 3.227	Be able to route such application to MD's office for further re – routing.
FR 3.228	Allow MD to allocate service request to concerned PIO for service request under "other categories".
FR 3.229	Auto generate notification of pending service delivery request to concerned PIO on successful submission of service request.

FR 3.230	Be able to send SMS alert/Auto generated mails to the applicant and concerned authorities whenever required.
FR 3.231	Allow the concerned PIO to accept / reject the service request as per the guidelines of the RTI act.
FR 3.232	In case of rejection, the system shall allow the concerned PIO to state the reason of rejection.
FR 3.233	In case of acceptance, the system shall open a new page with all the accepted service request by the concerned PIO.
FR 3.234	Allow the PIO to send mail with a format of form B and Form C.
FR 3.235	Save the acceptance / rejection only on digital signature of the PIO.
FR 3.236	Auto generate notification to concerned officials about service request allocation.
MIS	
FR 3.237	Number of RTI filed.
FR 3.238	Pending RTI.
FR 3.239	Department / Employees involved.
FR 3.240	RTIs closed.

Legal – Related to Land Only

This module will assist the legal cell of AITL in monitoring and analyzing all their land related cases and expenditures.

Legal – Related to Land Only	
Masters	
FR 3.241	Advocates, Law firms & their fees.
FR 3.242	Court Master.
Case Management	
FR 3.243	Registration of new cases, allocate advocate, allocate AITL officer.
FR 3.244	Facility to attach various documents related to the case.
FR 3.245	Entry of Date of Hearing.
FR 3.246	Alerts to officers with respect to hearing date.
FR 3.247	Entry of hearing details.
FR 3.248	Capture of judgment.
FR 3.249	Details of payments to the advocates & law firms.
FR 3.250	Linkage to the departmental data.
FR 3.251	Linkage to GIS to capture location reference for cases.
FR 3.252	The system should be linked to the ERP for payment to law firms.
FR 3.253	It should also link to the customer master (using property id) for any transaction / interaction / case for updation of current situation.

FR 3.254	Legal Opinion on various departmental queries, agreement formats to be stored in Document Management.
MIS	
FR 3.255	Case Pendency reports (Department-wise / advocate or law firm wise / Officer-wise).
FR 3.256	AITL shall decide what information shall be posted on the dashboard.
FR 3.257	Reports with respect to Cases won / Lost / Appeals made.
FR 3.258	Payments to the Legal Advisor / Law firms.
FR 3.259	Repository for various act and provision with search option.
FR 3.260	Integration / Link to Maharashtra Government site for references.
FR 3.261	Repository of all the cases since 1950 by High court and Supreme Court with search feature.

Citizen Grievances Redressal

AITL will provide various public utility services due to which, it might receive few complaints/suggestions/feedback pertaining to its services. To address all these complaints, it is necessary to have an efficient and effective grievance redressal mechanism. The objective of public grievance monitoring system is to provide multiple channels of grievance recording, in order to make it more citizens friendly and to provide linkages to different sections for increased transparency, citizen participation and performance accountability.

The system should have the ability to maintain different types of grievances caused to the citizens, department or section that needs to address the grievance, number of days within which the grievance needs to be addressed and nature of grievance whether it is financial or non-financial.

The main activities as part of Public Grievance Monitoring Management process include:

- Registration of the complaint/suggestion;
- Issuance of acknowledgment;
- Trigger an event in the ERP system;
- Capturing of status of the complaint till it is resolved;
- Generation of necessary reports for proper monitoring.

Citizen Grievances Redressal	
FR 3.262	The purpose of this module will be to integrate inputs / complaints received on any of the systems and trigger events in the ERP system for the complaint to be resolved efficiently. The work flows outlined in this document aims at effective monitoring of service levels and reducing repeat complaints.
FR 3.263	Grievance Management system shall be a web based application where the citizen can send their concerned grievance & suggestion to the respective departments. The citizen may interact with AITL using the portal, the mobile app, the kiosk or approach the citizen facilitation centre. In all these cases the work flow shall proceed from the portal.
FR 3.264	Citizens can submit complaint/suggestion/application/grievances to AITL. Each complaint is recorded with a unique number which is given to the citizen. These

	complaints are then forwarded to different sections depending on the type and nature of the complaint. The concerned section staff attends the complaints within the given time period. The reply is sent back from the corresponding department/section to Grievance Handling section and status is updated for the user.
FR 3.265	Once the grievance is received, it shall have a work flow to trigger an event in the ERP system. The module shall have a comprehensive Service Delivery Framework which: • Is easily accessible • Responsive to citizen's needs • Enables quick decision capability • Connects all stakeholders with right kind of information in the quickest possible timeline • Allows all stakeholders clear visibility and communication
FR 3.266	The solution shall offer citizens ability of reaching out to AITL through variety of options to ensure broad based participatory framework of communication, thus enabling wider participation from citizens to improve service quality and civic livability quality. The proposed system shall offer multiple options by Citizen Facilitation Centre, online through web portal, SMS, phone calls & E-Mail, Web App, Mobile App, IVR, call back service, multi-services digital kiosks etc., to register a complaint. Further, a time bound call centre is also being proposed to support and manage in and out calls to and from Citizens. All complaints shall be allocated, routed and managed through an automated algorithm which is designed to identify actual resource within AITL to manage the complaint and thus removing human interface to work assignment. Further, concerned higher authorities within AITL are to be empowered with real-time mobile Apps and web Apps to monitor the complaint resolution process and capability to intervene if necessary, to help them in decision making process to take needful corrective actions. The system shall automate enforcement of SLA policies and streamline and automate every process from initial citizen request to resolution more efficiently and cost effectively.
FR 3.267	The system shall be capable of communicating with citizens and officers alike about the status and tracking of the complaints via SMS and email including unique tracking numbers.
FR 3.268	The complaint redressal system shall enable configuration of AITL's respective geographical and administrative jurisdictions including service delivery essential information. The highest office in government pertaining to AITL management should have access capability to aggregated data and analytics from all the wards within the system.
FR 3.269	The system shall have the ability to maintain different types of grievances caused to the citizens, department or section that needs to address the grievance, number of days within which the grievance needs to be addressed and nature of grievance whether it is financial or non-financial.
FR 3.270	It shall have the ability to maintain the statuses of the grievances registered in AURIC. Also, the ability to maintain the details of work/application that has not been addressed within the prescribed time, number of days of delay and compensation paid per day in case of delay in SLA of the grievances registered in AITL.
FR 3.271	The system must maintain the details of officers designated to redress grievances mapped to the department-section and the compensation details from the officer

	responsible and payment details to the citizens if the applications are not processed within the prescribed time. (Breach of SLA).
FR 3.272	On sending the grievance & suggestion the department officials are bound to respond to the grievance & suggestion as per the specified time frame. All grievances & suggestion would be allotted a unique number which would be the base for further correspondence. There would be automatic escalation plus provision for AITL staff to post confirmation of a 'before' and 'after' of the complaint. Following reports shall be generated by the applications: • All grievances registered during a given period • Pending grievance registered during a given period • Disposed grievance during a given period • Duration of grievances registered during the period • Repeated grievances registered during the period.
FR 3.273	All these reports can be generated departmental wise, grievance wise, department & grievance wise. On the basis of these reports analysis can be made and decisions shall be taken by government officials.
FR 3.274	AITL will provide various citizen and public services due to which, it might receive number of complaints/suggestions/feedback pertaining to its services. To address all these complaints, it is necessary to have an efficient and effective grievance redressal mechanism. It helps in making the administration more accountable, responsive and user friendly. The objective of public grievance monitoring system is to provide multiple channels of grievance recording, in order to make it more citizens friendly and to provide linkages to different sections for increased transparency, citizen participation and performance accountability.
Modes of complaint registration	
FR 3.275	• Through Citizen Facilitation Centre • Online through web portal • Through E-Mail • Through SMS • Mobile App • Through Calls • Multi-Service Digital Kiosks • Through IVR ➢ Based on Recorded details ➢ Call Back • Other existing complaint systems
FR 3.276	The system should be capable of converging information management and delivery system, which enables calls, collected through different communication channels to be converged on to the common distribution system and hence brings in commonality in allocation and response mechanism.
Complaint Registration	
FR 3.277	• Through Call Centre (Phone, e-Mail & SMS): ➢ A citizen calls designated telephone number.

	➢ Call centre operator registers the single or multiple complaints with required details. ➢ Complaints through e-Mail / SMS shall be received at call centre. ➢ Complainant shall be communicated the complaint tracking number(s) generated by the system and acknowledgement SMS send to the registered mobile number. • At Citizen Facilitation Centre: ➢ Citizen visits the CFC location in person to get his / her complaint registered. ➢ Complaint shall be registered in the system with all due details and a printed acknowledgement receipt shall be given to the citizen. • Through Website: ➢ Citizen shall be able to register his / her complaint on website and can print acknowledgement receipt. • Through Multi-Services Digital Kiosks: ➢ Citizen shall be able to register his / her complaints at multi-services digital kiosks which shall be located at all strategic locations around AURIC. Complainant shall be communicated complaint tracking number(s) generated by the system and acknowledgement SMS send to registered mobile number. • Through IVR: ➢ Citizen calls on the designated number. ➢ This feature shall be available when Call centre is not operational i.e. during non-working hours or when all lines at the call Centre are busy. ➢ In case all the activated extension numbers are engaged with other calls or operator not available to receive calls, the IVR system activates call waiting message for the caller with the option to either wait or option to dial 9 and give missed call for call back to caller or register call via voice recording. ➢ IVR system shall record the complaint details provided by the citizen during the call. ➢ Call centre operator registers the complaint based on the details provided in recording or calls back the citizen to register the complaint. ➢ Citizen is given a complaint registration number via SMS.
Complaint Allocation	
FR 3.278	Once a complaint is registered with the system, it automatically is assigned to a concerned area officer dealing with the problem based on the scientific algorithm engine built in to the system and allocation matrix defined. The system should automatically send an SMS and email to officer alerting him / her on the complaint. Application should offer following definable Allocation methods: • Workload based allocation • Round robin allocation based on SLA hours • Sequential allocation of complaint to each member of the team If the complaint is not resolved and closed within the specified period, the same should get escalated to higher authorities. The allocation and escalation process should be fully automated and not require any human intervention; however, system should provide a feature to switch to manual allocation, if needed.

Field Call Report in case of citizen area visit	
FR 3.279	The AITL officer updates the details of the work done along with the status of the complaint (Pending / closed) in the system against each complaint. The system shall maintain the history of the work done.
Complaint Closure	
FR 3.280	The officer needs to resolve a complaint within a specified SLA period. Once a complaint is resolved, the officer fills a field call report and submits to a superior, who in turn calls the complainant to seek his / her satisfaction on the measures undertaken to solve the problem. If the complaint is not redressed within a fixed number of hours, the system shoots off SMS and email to higher officials in hierarchy based on the escalation matrix defined.
Complaint Re-Open Process	
FR 3.281	The Citizen has option to re-open his / her complaint if not satisfied with the services rendered. The Citizen can request to re-open the complaint via Email or Phone or SMS. Any complaint can be re-opened only if it is within the SLA or re-open hours set for that complaint. All re-opened complaints shall be escalated to concerned senior officials.
Complaint Status	
FR 3.282	The Citizen should be able to know the status of his / her complaint online from website, application or through phone / SMS.
Citizen Feedback	
FR 3.283	Citizen should have an option on the website to voluntarily provide their feedback on the complaint redressal process and also to comment on the satisfaction/dissatisfaction received by them while using the system.
Problem Category, Problem Category, SLA	
FR 3.284	The various problems, for which the complaints are raised, could be part of a particular Department. These problems are categorized as Drainage Maintenance, Footpath, Roads etc could be part of Engineering department & Traffic signal/Central Verge plantation site, Tree cutting/trimming related problems could be part of Garden department. Application Administrator should be able to define standard SLA hours, problem category and problems. The application administrator shall be: • Able to add/edit/delete standard SLA • Able to add/edit/delete different type of problem category • Able to add/edit/delete problems under problem category • Able to attach standard SLA hours and department to each problem • Admin shall be able to change status of problem category in active/inactive state
Holiday, Department, Designation, Employee	
FR 3.285	The application administrator should be able to manage AITL's holiday calendar, department, designation and employee details in the system.

Allocation & Escalation Matrix	
FR 3.286	The application administrator should be able to maintain allocation matrix for the AITL's employees in resolving the various categories of problems for the area for which he / she is responsible to look at. This setup helps the Automatic Complaint allocation to the employees. Set the priority based on which the selected employee will receive the complaints for the selected department's problem category of his/her area. The application administrator should be able to set up the escalation matrix for each department at the various levels and to define what should be the mode of escalation communication for each of these levels and define their frequency. The system automatically escalates the complaints based on SLA, escalation matrix and the frequency defined.
Area Mapping, Area Transfer, Employee Transfer	
FR 3.287	Complaint allocation process should be tightly integrated with AITL's area, employees and complaints. Based on the problem location, the complaint should get allocated to the AITL official. Each area of a city is mapped with the AITL's operational area and each employee is mapped with location & department. The application administrator can transfer area from one operational area to another as well as an employee from one location to another. The transfer process shall be designed in such a way that all pending complaints shall be automatically be detached from the employee being transferred and the same shall be either automatically attached to the peer or higher official in hierarchy.
Complaint Transfer	
FR 3.288	AITL Official can transfer his / her pending complaints to another official from the same or different area / location.
Dashboard	
FR 3.289	Real-time processed information immensely aid senior officials in taking immediate corrective and preventive measures. Analytical reports help administration in identification of areas of concern and root-causes. The Grievances System shall provide a real-time dashboard.
Service Analytics Engine	
FR 3.290	The system should provide DIY (Do It Yourself) data analytics platform based on the philosophy of analytics for all. The platform should provide a simple query bar and users can input their analytics requirements using a DRAG and DROP functionality. This offers enormous ease and ability to any kind of user irrespective of IT knowledge to mine high level analytics reports from the service data. The system should consume structured, semi structured and un-structure data to offer capabilities like deep web analytics. The system should offer advanced abilities such as: 1. Prescriptive analytics 2. Predictive analytics 3. Diagnostic analytics

Mobile App for Citizen	
FR 3.291	Comprehensive Complaint Redressal System shall be one of the modules in AITL Portal and Mobile Application for easier registration of grievance. The grievance redressal module in AITL Portal and mobile application shall have: • Device Registration & profile creation • Complaint registration • Complaint Status • Upload geo location tagged pictures • Know your Location • Share App • Update Profile • Citizen Opinion
Mobile App for Complaint Closure	
FR 3.292	Grievance Redressal module in the AITL Portal and mobile app shall have a front-end Complaint Closure module for field. Below are the features of the Complaint Closure Module: • Easy-to-use authentication process via registered mobile number during initial application set up on the respective mobile devices. • Facility to view the list of complaints allocated to the respective field officer along with the easy access to detailed information on each registered complaint. • Visibility to problem location's image captured and submitted by the citizen, thereby facilitating field officer with ease of locating the problem area. • Real-time monitoring of problem based SLA compared to the defined SLA for each registered complaint allocated to the field officer, thereby allowing better complaint management. • The complaint is colour-coded based on their defined SLA status and problem category – Red for complaints that crossed SLA period for resolution and Green for those complaints that are within SLA. • Facility to change complaint status from 'Open' to 'On Hold' or 'WIP' or 'Close'.
Decision Support System through Mobile App	
FR 3.293	By virtue of their duty, officials in AITL are expected to move around. They demand a reliable and accurate system for taking necessary decisions in real-time mode. Through AITL portal and mobile app, senior officers shall have a capability which provides real-time dashboard of operational parameters and highlights areas of concern. It also provides contact book of entire team, that immensely help senior officer in reaching out to the right officer instantly for taking appropriate and timely decisions.
Online Services	
FR 3.294	Grievance Registration.
FR 3.295	Grievance Search.
FR 3.296	Grievance acknowledgement.
FR 3.297	Grievance resolution intimation.

Masters & Initial Setup	
FR 3.298	Complaint Type, Sub-types, Capture of Mobile No. of citizen.
FR 3.299	Mapping of Designation / Roles to Complaint Sub-type.
FR 3.300	Integration of Complaint Type / Sub-type with Departmental Modules.
FR 3.301	Citizen Charter for each Complaint Type (Define duration of complaint redressal & escalation path in case of no redressal).
Complaint Acceptance	
FR 3.302	Complaint Acceptance through Citizen Facilitation Centres / Internet / Kiosks.
FR 3.303	Facility to make Resident ID compulsory for certain complaints. Facility to check dues for allowing certain complaints.
FR 3.304	SMS alert to concerned employee.
FR 3.305	Facility to mention the action on complaint.
FR 3.306	Automatic escalation of Complaints (beyond stipulated time frame).
FR 3.307	SMS alert to citizen upon Action Taken Report.
FR 3.308	Facility to accept citizen feedback on the Administration Action.
FR 3.309	Facility to mark a complaint as fake / invalid (for not considering it in the normal reports or report for Project System).
MIS	
FR 3.310	Exhaustive reports shall be generated by the system for officers at various levels for effective decision making and period review of operations. Some of the MIS reports generated from the system will be as follows: • Department Wise AITL Location wise SLA Summary (Within SLA v/s Beyond SLA) • Registration Mode wise Complaint Summary • Department wise AURIC Location wise Average TAT Report • AURIC Location wise TAT • Detailed Complaint Report with FCR • Detailed Complaint Report without FCR • SLA Wise Ageing Details • Complaint Status Summary • Complaint Transfer Summary • Department wise weekly status report – Registered, Closed, Within SLA / Beyond SLA • Reopen Complaint as on Date with complaint status • Registered v/s Closed Complaints • Missed call Detail • AITL Employee Reporting Hierarchy • List of on hold complaints • Operator wise Login-Logout Report • List of mobile numbers from which complaints registered

	• List of complaints Transferred • AITL Standard SLA v/s Actual TAT report • Real-time statistical reports for AITL locations/departments is made available to senior officers on web based as well as on based mobile applications.
FR 3.311	Pendency reports (complaint-wise / Dept.-wise).
FR 3.312	Top Performers / Least Performers.
FR 3.313	Analysis of Grievances.

GIS Platform with Web GIS

GIS Map

GIS map of Shendra which shall be a common platform across all the solutions including City Wi-Fi Access Points, City Surveillance System, Environmental Sensors, ICT based Solid Waste Management, AVL, etc along with other GIS layers being provided by other contractors will be required as part of this Project. Note that the base map of Shendra in GIS that has land related properties which will be used to build the actual GIS map and platform will be provided to the successful MSI.

- GIS maps shall be comprehensive and detailed up to roads, houses and building level;
- GIS Map shall provide complete details of the city in various digital vector layers and allows for zoom in/out, searching, and retrieving information capabilities;
- GIS details procured shall include the following data with attributes:
  - Road Network:
    - City Arterial Roads;
    - Streets.
  - Administrative boundaries:
    - City Boundaries.
  - Building footprints and names;
  - Points of Interest data to include:
    - Health services (Hospitals, Blood Banks, and Diagnostics centre, Ambulance Services, Other Medical Services, etc.);
    - Community services (fire stations, police stations, banks, ATMs, post offices, educational facilities, AITL Buildings etc.);
    - Business Centres (Shopping malls, markets, commercial complexes etc.);
    - Residential areas (Apartments, housing societies etc.);
    - Transportation (bus stops/Terminus, parking areas, petrol bunks, railway stations, etc.);
    - Recreation facilities (Restaurants, theatres, auditoriums etc.);
    - Other utilities such as travel and tourism facilities, religious places, burial grounds, solid waste locations;
    - Local landmarks with locally called names.

- Land-Cover:
  - Green areas;
  - Open areas;
  - Water bodies.
- Address layers (Pin code, Locality, Sub-locality, House numbers/names);
- Geo referencing of all the assets pertaining to the aforementioned solutions as required;
- All data procured shall be imported into a central database;
- System Functionalities:
  - The system shall have capability to perform attribute or spatial queries on data from selected sources;
  - The system shall support Mobile platform, iOS, Android and Windows;
  - The system shall support clipping and/or downloading of raster and vector data by authorised users;
  - The system shall support server side Geo-processing;
  - The application shall have standard and modern map navigation tools of pan and zoom;
  - The application shall support client requests to print the spatial data;
  - The system shall be able to support industry-standard data types, industry-standard data formats, unlimited file size or database size, unlimited number of files or tables, and unlimited number of users;
  - The system shall support geocoding and reverse geocoding;
  - The system shall allow the users to perform advanced spatial analysis like geocoding, routing, buffering and attribute based analysis;
  - The application shall have standard and modern map navigation tools of pan and zoom;
  - The system shall have the facility wherein the user can opt to view in 2D or 3D environment;
  - The system shall be compatible with Google Maps, Bing™ Maps, Micro Station, AutoCAD, MGE, FRAMME, G/Technology, ODBC source;
  - The System shall support hierarchical legends, and watermarks;
  - The application shall allow users to views the data with different symbology styles like differentiating feature records based on attributes or types, dynamic label generation with conflict detection, and translucency of all raster data and area colour fill;
  - The system shall allow the user to find Address;
  - The system shall be able to consume real-time enterprise published spatial data. It shall be able to consume the third-party published OGC (Open Geo-Spatial) web-services.
- Application shall be OGC compliant for database and shall provision conversion to other database formats;

- GIS base maps shall be installed on work stations at AURIC Command and Control Centre (ACC). GIS maps and data replication shall happen from central system remotely.

Web GIS

AITL has already sanctioned survey and creation of the digitized map for Shendra area for land related properties. This map shall have plot boundaries and is being executed on the ArcGIS platform of Esri. The data shall be so available in a desktop version for editing.

Description provided for Web GIS is broad in scope. However, any work even if not specifically mentioned for Web GIS but reasonably implied for successful implementation and good performance of the system, are deemed to be included as part of the Project scope.

Web GIS	
FR 3.314	The proposed Geospatial layer for different municipal functions will be as follows: • Municipal Boundary • Plot details • Property data • Land use: Residential, mixed, commercial, group housing, industrial, institutional, recreation, green areas/parks • Roads • Street lights • Water Supply lines: Supply lines, overhead tanks, valves, boosters • Storm water drains: Drainage networks, inlets • Sewage Lines: Sewage network and main holes • Electricity lines: electricity poles, substations, High tension lines. • Monuments and Heritage sites • Solid waste disposal sites and location of dustbins • Education Institutes • Health centres • Advertisement hoardings • Markets • Police stations/ chowkis • Post offices • Banks • Fire stations
FR 3.315	**Objectives:** • Intent is to generate an intelligent application that can use spatial data for decision making under services like issuance of licenses, solid waste management, land maintenance charges, grievances & complaints, service requests, etc. • This shall enable creation of geo-database, which shall provide interfaces to the present and future business applications planned to be implemented by AITL. • GIS integration aims at editing and publishing all the assets under AITL for better information management, accurate estimation and tracking. These

	assets can be streets assets, building assets, public assets and other transport and utility network. • Different applications (pertaining to different services like issuance of construction permit, trade licenses, permits, municipal asset and solid waste management) shall be able to utilize the spatial database to process other relevant data in order to provide useful and scientifically and mathematically accurate information.
FR 3.316	All the GIS layers are already available with AITL (or will be provided as part of this Project) and it is expected to create a web service according requirements specified in the RFP and publish it, along with customization of the application to integrate with e-governance and ERP modules and query modules.
FR 3.317	Major views for publishing are as per below: • Public view: for common people who may view the vacant and occupied plots with all its attributes: dimensions, distance from roads and neighbouring plots, current land use and market value. • Second related view will be for Industrial or Citizen Residents. The query can be initiated using the resident smart card for access. In this view, ownership and tax details can be visible. • The detailed view will be for internal or outsourced employee users. Here depending on authorisation level, data may be displayed. The editing rights of spatial and non-spatial data are with the outsourced employees.
FR 3.318	Following assets and their attribute information shall be kept up-to-date (but not limited to): • Street Assets: Benches, street lights, traffic signals, signposts, garbage cans, fire hydrants, bus stops, bridges, overpasses and underpasses, tunnels, culverts, and guardrails. • Pipeline Network: Water supply system. • Drainage Network: Rivers. • Utility Network: Electricity, cable, telephone. • Transport Network: Roadways, Rivers. • Fleet Assets: Garbage trucks, ambulances, police vehicles, fire tenders, transport vehicles, construction equipment, and other vehicles. • Building Assets: Government offices, public buildings, educational buildings, public safety buildings, historic buildings, and sporting facilities. • Other Public Assets: Tourist facilities, religious facilities, monitoring stations, water and sewerage treatment plants, water wells, springs, reservoirs, dams, parks and playground equipment, trees, and car parks.
FR 3.319	AITL employees/outsourced employees shall require following integration with e-governance and ERP application: • Land maintenance related charges • Asset management- water, drain, sewage, electricity, fibre • Grievance redressal • Solid waste management • Utility payments • Land management system

FR 3.320	The integration has to be done on the concerned layer. Few integration points with e-governance module are mentioned below.
Land related charges	
FR 3.321	The attribute data with the property must store (but not limited to) data such as: • Property location geographic • Property location address • Status (vacant / sold) • Current use • Lease details • Charges details • Utility details
FR 3.322	The user shall: • Searching of Property Index Number • Land related charges link should be integrated and will have option to direct: ➢ Land related charges-> Search on online receipt ➢ Land related charges-> Search Ledger ➢ Land related charges-> Pay online • GIS Application to Land related charges Module • Property Lease Holder can be selected on the basis of: ➢ Administrative boundary ➢ Property Index Number ➢ Land related charges range selection ➢ Period Selection ➢ Who has paid, not paid. • On the basis of above search criteria, the selected Property data should be extracted: ➢ Details of Lease Holder like Name, Address, PIN ➢ Details of Arrears • There should be a link in land related charges module for GIS View to drive into GIS Application to View/Analyse the property geographical locational details i.e. address, Plot Area, constructed area, etc.
The Utility Asset Management Module	
FR 3.323	The GIS has to integrate with asset data of roads, water supply lines, sewage lines, storm water drains, electricity lines. The attribute shall include the following: • The location details • The geometry details • The engineering details • The attached property details
FR 3.324	The sub-modules should have the following functions: • GIS based Asset data visualization • GIS based asset maintenance management • GIS based asset construction management • GIS based web ticketing for complaint registration and solution

FR 3.325	The user should be able to denote the Place where the asset management activity is proposed by inserting a point/Line on the map and shall be created and saved in Project layer. A query can be generated on the project layer for Project Name, Functional Group, Budget, Project date and Project status. This may be accessed by other departments which will be affected by the project work.
GIS Application integration to Asset Management	
FR 3.326	• Searching of Zone/Ward/ GIS layers: • Built-up area for any property maintenance and Rent • Land use land cover (LULC) area for Vacant land • Transportation for any road maintenance • Sewage and Drainage for Maintenance • Public Lighting for maintenance • The Vacant Land will be linked with Asset Management-Asset Report-Asset Category-Market Value • This will be integrated with rent & maintenance • Query can be generated on project layer for Rent: Rent Type, Rental amount, Renewal date & Land: Market Value • The Building properties will be integrated with- Asset Management • Property Index Number • Fibre optic infrastructure and Wi-Fi network
Solid Waste Management Module	
FR 3.327	• Property Index Number Indexed with Garbage Collection Point(GCP) • Category of garbage collection points will be queried and viewed on Map based on PIN • Solid Waste Management-Reports-PIN, Category
Utility Payments	
FR 3.328	Utility payments link shall be available. it should integrate and be directed to the following module: • Water & electricity Charges-> Search Connection Page • Water & electricity Charges-> Search online receipts • Water & electricity Charges-> Search Ledger • Water & electricity Charges-> Pay online Page • To select the consumer on the basis of: ➢ Administrative boundary: o Zone o Word o Block/Locality ➢ Property Index Number ➢ Service No. ➢ Property Lease Holder ➢ House No.

FR 3.329	On the basis of above search criteria selected Property will integrate with utility payments Module (database) and highlight the search output (Spatial Highlights) in GIS application and dues report will be populated in a tabular Grid consisting of: • Details of Property Lease Holder like Name, Address, PIN • Details of Arrears
GIS integration with grievance management	
FR 3.330	The public grievance can be made addressed through e-governance (to the ERP) application as well as through GIS. In grievance, the citizens are expected to mention their complete address details or could use their QR code. And accordingly, the grievance registration will be highlighted on the map.
FR 3.331	• There shall be facility to mark the grievance to be addressed to which department. • The grievance type shall be mentioned from options available: regarding service, bill payment, delay, incident etc. • There will be grievance subtypes also.
FR 3.332	• The grievance status shall be searchable by department as well as public: ➢ By plot number ➢ By ticket number ➢ By grievance type ➢ By grievance subtype
FR 3.333	• There shall be facility available to view the status of grievance resolving: ➢ Solved ➢ Unsolved ➢ Under Process ➢ There shall be facility of escalation to higher level after a defined time period

Management Information System: KPI Dashboard

Performance management, monitoring and evaluation are critical elements utilized by the city to improve organisational and individual performance and to enhance service delivery. The establishment and development of the performance management framework ensures integration between strategic planning and performance management by linking the solutions/services to indicators and targets that can be used to measure performance.

The proposed performance management framework is developed based on global city performance framework like ISO: 37120 and others. Performance Management Framework shall demonstrate 'Open Data' initiatives.

Management Information System: KPI Dashboard	
FR 3.334	The dashboard shall be populated with data extracted from ERP and e-governance systems, smart city platform together with data supplied from inhabitants, health and educational institutions, Police and Fire services. Data from field sensors shall also be reflected. This shall be done to illustrate 'Open Data' and create awareness initiative.
FR 3.335	The exact parameters are to be finalized during implementation. However, a performance management dashboard must be provided and a facility to collect the information requirement for Dashboard must be provided through Portal solution. It may also require integration with various information providers. MSI will be responsible for complete solution design along with integration with information sources for respective indicators. Wherever information needs to be collected from stakeholders residing in the city or entrepreneurs or various facilities in the city, portal solution will need to be developed by MSI so as stakeholders can provide the information required and the same can be presented on KPIs and dashboard.
FR 3.336	The dashboard shall have a capability and format for key information input from providers such as health care and education and performance data such as production, employment, collections from industrial users.
Overview of the performance management framework elements	
FR 3.337	**Social Performance**: Performance management solution to monitor and track the performance of social services like health, education, safety, etc. This will help the municipals to assess whether the current state of these services is optimum and/or what are the improvement opportunities. Following are some of the illustrative performance indicators to measure social performance (but not limited): • Percentage of students completing primary education • Primary education student/teacher ratio • Number of higher education degrees per 100,000 population • Number of physicians per 100,000 population • Percentage of convictions and case closure for criminal cases • Citizen score for city governance • Citizen score for citizen services • Doctor patient ratio in city hospitals
FR 3.338	**Environmental Performance:** Measurement of environmental health of the city to assess how good or bad is the state of environment and the areas the city needs to focus on for improvements. Following are some of the illustrative performance indicators to measure environmental performance: • Particulate matter concentration

	• Greenhouse gas emissions measured in tones per capita • NO2 concentration • SO2 concentration • O3 concentration • Noise pollution • Green area (in hectares) per 100,000 population • Annual number of trees planted per 100,000 population
FR 3.339	**Economic Performance:** Measurement of the state of the city's financials to track and monitor aspects like city's revenue generation, budgets, expenditure, industrial expansion, businesses development, employment, poverty etc. with the aim of making a city self-sustaining and increasing its revenue generation. Following are some of the illustrative performance indicators to measure economic performance: • City's unemployment rate • Assess value of commercial and industrial properties as a percentage of total assessed values of all properties • Percentage of city population living in poverty • Percentage of people in full time employment • Youth unemployment rate • Number of businesses per 100,000 population • Capital spending as a percentage of total expenditures • Own-source revenue as a percentage of total revenues • Tax collected as a percentage of tax billed

Digital Locker

The digital locker facility is based on the concept of DigiLocker, a national Digital Locker System launched by the Govt. of India.

Digital Locker is an online storage facility provided by AITL to store important documents. Citizens can upload documents like Voter Id card, PAN card, BPL card, Driving license, education certificates etc. These documents will be linked to the property id number and can be treated as citizen documents. So, the citizen may not need to carry physical documents while applying for utilities or jobs or government certificates or educational institutions etc. It will address the challenges faced by citizens and government to submit and verify the authenticity of the documents multiple times.

The digital locker will enable anytime and anywhere access to the documents. Dedicated personal storage space will be allotted per allottee. The citizen can store authenticated and unauthenticated documents in the locker. The citizen can upload documents from the portal to the unauthenticated section. On producing originals at the citizen facilitation centre, and as per AITL work flow they can be verified and moved to the authenticated section.

Digital Locker	
FR 3.340	The storage space shall be linked to the document management system and shall have a clearly coded index for the type of documents to be stored.
FR 3.341	The citizen can store authenticated and unauthenticated documents in the locker.

FR 3.342	This will include and will not be limited to: • Lease agreement • PAN card • Aadhar card • Driving license • Passport copy (Pages specified)
FR 3.343	The citizen can submit these documents at the citizen facilitation centre or upload them directly to the Document Management System.
FR 3.344	Once these documents are received, AITL appropriate authority will have to authenticate the same before entering them in the locker.
FR 3.345	Self-certification shall be considered.
FR 3.346	Operation of the locker will be by either the citizen or AITL with addition security by way of an OTP to the residents registered mobile number or a PIN number.
FR 3.347	The citizen can use the digital locker to submit documents for any application with AITL.
FR 3.348	AITL will not be a certifying authority for the documents for any other organisation.
FR 3.349	The digital locker is only to reduce the requirement of the citizen having to submit documents with multiple applications.
FR 3.350	Additionally, the security of the locker may be increased by the use of digital signature.

Smart Card System

It is envisaged that the Industrial units and citizens shall have a smart card code as an identity. This shall be based on his credentials as supplied to the LMS or at the Citizen facilitation Centre or through mobile application/website/portal. The credentials shall be submitted once and validated and kept in a secure digital locker. The smart card shall be the front and access to this locker. This will be the citizen's or company's unique identity. The holder of the smart card can use it for accessing information on the portal, pay bills, use Wi-Fi services while in the city. The citizen may use also this id to submit any complaints / requests. This id must further be authenticated with a one-time password to the registered mobile number or a pin number for security purposes.

The citizen / company may use this id to apply for utilities, pay the bills and use other services on the portal. Guest users may also visit the portal and will have access to selective options.

Smart Card System	
FR 3.351	The applicant shall be issued a property id on successful allotment of an industrial plot, commercial or residential flat. The allotee shall have a digital locker and a smart card which will have to be linked / transposed to the digital locker.
FR 3.352	This smart card shall be his primary identity.
FR 3.353	This shall be based on his credentials as supplied to the LMS or at the Citizen facilitation Centre.
FR 3.354	The property id shall be allotted from the LMS system.

FR 3.355	Smart card shall also be given to citizens, both residents and workers as per the Project requirements.
FR 3.356	This smart card shall entitle him to storage space on AITL's server.
FR 3.357	The smart card shall only be updated at the backend at authorized AITL representative centres or via secure login of citizens using web portal services.
FR 3.358	The holder of the smart card can use it for accessing information on the portal, pay bills, use Wi-Fi services while in the city, and for other e-governance services.
FR 3.359	The citizen may use also this smart card to submit any complaints / requests.
FR 3.360	This smart card must further be authenticated with a one-time password to the registered mobile number or a pin number.
FR 3.361	The smart card shall not be a hard card but shall be a soft card like QR code which shall not necessarily require a hard print out and can be integrated with citizen mobile application and portal. The smart card shall be easy to upgrade with different information regarding an individual or a company and shall be used as the identity for all services and payments at AURIC.
FR 3.362	There shall be seamless updation of information at the backend of the smart card without any requirement of issuing new smart card.
FR 3.363	The smart card shall also integrate with the education and healthcare institute in a way that different information regarding citizen can be tracked by AITL through the smart card. As an example, a student studying in a school at AURIC can have information regarding his class for AITL using the smart card. The respective education and healthcare institutes will provide this information to AITL in a prescribed format which will then be integrated seamlessly using the smart card.
FR 3.364	The smart card system shall be secure and will require double authentication for displaying all information regarding a particular citizen or industry.
FR 3.365	The smart card system shall also include a reader which will be provided at AITL CFC and at multi-services digital kiosks among other areas (as finalized by the Client). Using the smart card reader, the information from the smart card can be visually seen on a screen and updated at the database for the respective citizen.
FR 3.366	Using the smart card, key performance indicators (socio-economic) shall be tracked and used by AITL for making decisions.

Automated Building Plan Approval System

Automated Building Plan Approval System should be able to provide online solution to AITL for building layout plans movement process monitoring for automatic development control regulations.

Automated Building Plan Approval System	
FR 3.367	The system shall be able to provide an online solution to AITL for automated building plan review, scrutiny and approval in compliance with the Development Control Regulations (DCR).
FR 3.368	The stakeholders of this system include – Applicant, Architect and AITL (Client).

FR 3.369	The system software shall be able to read the CAD drawings (supporting all versions of AutoCAD), which will be uploaded to the system.
FR 3.370	As part of the compliance check, the system shall produce a deviation report with comments and compliance based on the DCR provided by AITL.
FR 3.371	The system shall accept the files in the pre-defined format. System shall check the basic requirements i.e. land use, planning area, etc. as per the city norms. If the submitted plan is not permissible, then the system shall be able to generate automatic notifications along with the comments.
FR 3.372	• After pre-checking of the plans, the system shall be able to scrutinize in detail the building plans and generate the report accordingly with the comments.
FR 3.373	The system shall support following features: • Transparent citizen service delivery • Faster processing of file • Provide service to ensure efficiency and reliability • Email and Message service for notification and alerts
FR 3.374	The system shall be user friendly for both citizens and AITL staff.
FR 3.375	The system shall support minimum human intervention during the review and scrutiny process.
FR 3.376	The system shall integrate with the other modules such as LMS, ERP and other e-Governance applications over web-services.
FR 3.377	The system shall be independent of one particular machine and can be installed centrally with shared access for multiple users.
FR 3.378	The system shall be able to provide an online solution to AITL for automated building plan review, scrutiny and approval in compliance with the Development Control Regulations (DCR).

2.2.3.2 Enterprise Resource Planning (ERP) System

Overview

The ERP at AITL is envisaged to be the system of record, and a core component of a majority of the business processes. All the master data like Customers, Properties, Vendors, Equipment, Service Tax Rates, Electric and Water supply rates, Employees & Associates, Materials, Spares, G/L accounts, Banks, Cost Centres etc. would be maintained in this system.

ERP solution shall logically represent all assets as mentioned above to ensure that preventive, reactive and breakdown maintenance activities are efficiently processed.

Architecture

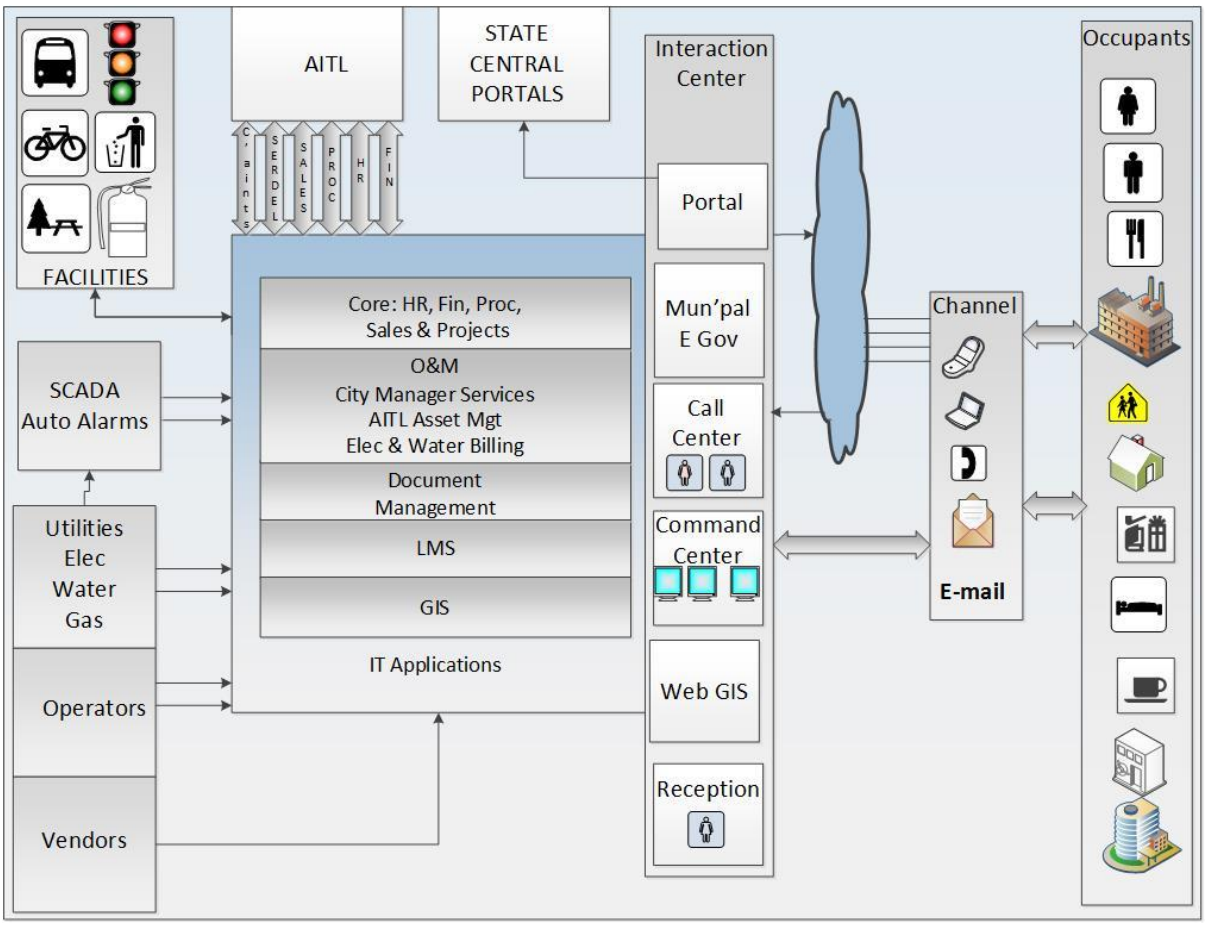


Exhibit 7: ERP Architecture

As shown in the schematic architecture of the AEE solution, ERP system shall be the backbone component of the envisaged solution. As a part of the backbone of the systems, it is planned to have an ERP system comprising of modules to address the following business functions:

- **Revenue Management:** E-Auction of plots, Land Sales (integration with Land Management System), Land related maintenance charges and other applicable taxes, Customer Chargeable Work, Rental for AITL facilities, etc.
- **Finance and Management Accounting:** General Ledger, Accounts Payable, Accounts Receivable, Asset Management, Depreciation Calculation, Over Head Costing, Work Order Costing, Investment Planning, Funds and Grants Management.

- **Purchasing and Inventory Management:** E-Procurement, Purchase Requisitions, Purchase Orders and Contracts, Receipt of Goods and Services, Invoice Receipt, Inventory and Spares Management, Vendor Master, Approval Hierarchies and MIS.
- **Contract Management:** Contract Lifecycle from Contract drafting, review from multiple perspective, and creating a final Contract document.
- **Operations, Maintenance & Asset Life Cycle Management:** Properties, Roads, Pipeline, Fibre Network Records, Asset/Equipment Master, Resource Master, Preventive, Predictive and Breakdown Maintenance, Notifications, Work Orders, Maintenance History Management and MIS.
- **Project and Works Management**: Capital Investment Planning, Managing Project Schedules and Costs, Project Execution, Project Accounting.
- **HR and Payroll:** HR Management, Payroll Management, Payroll Processing, Employee Self Service, Time and Attendance Management.
- **Water Utility Management and Billing:** Customer Service Management, New Connections, Temporary Water Connections, Automated Meter Reading, Service Management, Water Billing.
- **Electric Utility Management and Billing:** Customer Service Management, New Connections, Temporary Electricity Connections, Automated Meter Reading, Service Management, Electricity Billing.
- **Integration and Interfaces:** Creating Service Oriented Architecture (SOA) based enterprise framework to enable online integration for the various AEE
- **Access Channel:** Integrated Portal services to be accessed via several end user devices.
- **Enterprise Content Management System:** For storing, scanning, uploading, sharing of AITL documents.

The ERP modules would provide out of the box integration amongst themselves and further the ERP would be integrated with Document Management System, Land Management System (existing), Payment Systems, Banks (payment gateway), GIS, Portal, SCADA systems, Customer Facilitation Centre, Kiosks and E- Gov system.

The ERP system shall have the following requirements for the OEM and the solution:

- The multicurrency ERP package shall be based on globally used, proven, and fully integrated but modular commercially-off-the-shelf ERP product covering all the key modules required as per the RFQ cum RFP requirements. The ERP system shall be fully integrated across all modules including finance, vendor accounting, customer receivables accounting, management accounting, maintenance work orders, inventory, asset management, projects, investment management, utility billing. Master data like for Vendors, Properties, Customer, Materials, Assets should be stored only at one place (without duplication).
- The ERP software application should be readily deployable with or without configuration to suit the customer's specific process requirements and shall not involve developing the application and/or modules from scratch.
- ERP software shall be certified on various operating systems like Windows, Linux and Unix. Additionally, certified backend databases are Sybase ASE, DB2, MS SQL, ORACLE.
- The ERP software shall be implementable or deployable and maintainable by any other competent agency other than the manufacturer or agency which has developed the COTS software. The ERP software provider have a published method of appointment of implementation partners.

- The ERP Solution must have multiple implementation partners who have implement experience of implementing the proposed ERP solution.
- ERP supports localization features for India taxes and provides the legal changes for these taxes as a support package from time to time.
- ERP is completely scalable and supports large enterprise implementation. It shall be built for corporate operations.
- ERP shall support security features required for enterprise application.
- ERP OEM shall offer 24X7, SLA based support which is being separately signed with the customers/ implementation partners as part of licensing agreements.
- ERP OEM shall have a development center in India with more than 1000 Developers.
- Proposed COTS solution shall also be available with complete transparency including operation manuals, help documents and source code as a standard from the ERP OEM.
- The ERP Solution provider should have its own offices in India for service and support. Liaison offices, partner organization offices will not be treated as vendors own office.

The following tables list the detailed AITL functionality requirement:

Revenue Management	
FR 3.379	Land Leasing: Creation of a leasing order for land leases and subsequently raising an invoice to the customer, including collection of payment. System should allow payments via instalments. Integration is required with LMS.
FR 3.380	The system must track incoming payment for each instalment for Land/Plot allocation and maintain an auditable trace of such payments at the plot level. Additionally, the system provide functionality to follow up on pending payments by generating reports for AITL and send/generate reminder notices in the form of paper printouts and/or emails.
FR 3.381	Functionality for registering an occupier of a property as a customer directly in the ERP or through online integration with the LMS, with modify and inquire functionality. It should be possible for AITL users to segregate such customers based on customer type. This master record should be able to store all customer details as required by AITL with an auditable trace and time stamp. Further, at the master record level the system should allow assignment of authorizations to individuals for creation, modification and inquiry functionality.
FR 3.382	The system should allow for change or transfer of lease for any property or plot with a traceable record of the history of such occupiers.
FR 3.383	The system must generate a report on customers who have been allocated land with an option to report only on active customers.
FR 3.384	Land maintenance charges: Creation of a sales order for land maintenance charges for each leased plot as well as periodic billing with functionality for: • The user to modify the land maintenance charges with history being maintained of the old rates. • Land maintenance charges may vary from plot to plot and/ or customer to customer. • Billing frequency of Land maintenance charges may vary from plot to plot and/ or customer to customer. • System should allow payment of early payment discounts.

	• System should provide functionality for auto-generated reminder letter for unpaid land maintenance charges bills with automatic calculation and levy over interest and/or penalty. • Tracking of payments received against land maintenance charges bills. • Interfacing (real time) would be required with the LMS.
FR 3.385	Surcharges and Rebates on components of Land maintenance charges must be configurable. These could either be based on percentages or fixed amounts. In certain cases, rebates or subsidies are given to specific customers and the system must cater to this functionality requirement. The system must also allow revision upwards or downwards of surcharges and rebates with an old record history.
FR 3.386	Govt. Taxes and Levies: rates must be configurable and the system must automatically calculate the applicable amounts and apply them on the bills and if necessary show them as separate line items. The system must also allow revision upwards or downwards of such taxes and levies with an old record history.
FR 3.387	Submission of service tax in subsequent years with changes or without changes in property details like structure, usage etc.: • Capture details of multiple lease holders • Handle listing of multiple usage types within a property • Handing rebates, specific standardized rules, and considering various factors while calculating ARV of the property • Capturing floor wise details in case of buildings
FR 3.388	Functionality of Self-Assessment, subsequent assessments filed by the Citizen and making changes if any by AITL.
FR 3.389	Functionality for revising land maintenance charges about issuing a notice to the lease holder informing him/her about the revision of rates. In case of joint lease, functionality should provide for issuing notices to multiple parties. The address of these parties may not be the same as the property address and the system must be capable of storing these multiple address as per business requirement.
FR 3.390	Functionality for occupants/lease holders to file an objection against the revision notice.
FR 3.391	Fixing a Hearing in response to an objection by a citizen and issuing and intimation electronically and/or in letter format. The system should also provide the functionality to capture the proceedings of the Hearing and generating a final Hearing Order.
FR 3.392	Yearly land maintenance bill generation – handling arrears, penalty/interest, advance and self-assessment payments. There may be more than one component in the land maintenance bill like service tax or GST. The amounts against these components should be indicated clearly as separate line items.
FR 3.393	Collection of tax payments with automatic bifurcation in predefined proportion or as per priority defined with handling of rebates for early payments.
FR 3.394	Functionality for mutation (change in lease holder) of property through heredity or by sale of property.
FR 3.395	Functionality for occupants/lease holders to file an objection against the mutation.

FR 3.396	Fixing a Hearing in response to the mutation objection by a citizen and issuing and intimation electronically and/or in letter format. The system should also provide the functionality to capture the proceedings of the Hearing and generating a final Hearing Order.
FR 3.397	Revaluation of Property upon survey/ identification of change in property by AITL.
FR 3.398	Customer Facilitation Centre: • Issue of transfer certificate • Issue of land maintenance charges assessment certificate • Issue of property extract • Issue of duplicate bill
FR 3.399	Functionality to upload existing property records with outstanding as on cut-off date that is available in digital format. System must provide functionality for manual data entry through user friendly online screens of such data.
FR 3.400	Day to Day service tax related reports as per business requirement including interactive reports catering to what if scenarios.
FR 3.401	Integration of service tax billing and collection status with GIS for visual display.
FR 3.402	Advertisement Hoardings: Creation of a sales contract and subsequent billing from advertisement hoardings: • Registration of media agencies as customers • Functionality for booking an advertisement • Functionality for setting up new hoarding and display of advertisement • Functionality for renewal of advertisement contract
FR 3.403	AITL users must be able to carry out processes on the system like Contract Entry, Billing, Collection, Issue Renewal Notices, Contract Renewal, Suspension and Cancellation.
FR 3.404	Rechargeable Work: creation of a sales order and raising an invoice for work done which is chargeable to a customer. The system must allow functionality to set and revise the charge out rates, surcharges/rebates and Govt Taxes/Levies as per functionality provided for service taxes. These rates must automatically reflect in the sales orders and invoices referred above.
FR 3.405	• Usage of Telecom Fibre Network: creation of a sales order, raising an invoice record and follow-up payments for usage of fibre by telecom services providers: ➢ On fixed rental basis or ➢ Percentage of revenue basis • For the Option 2, integration would be required with the systems of the Telecom Service Provider (TSP) for capturing the revenue for the period. • Functionality should be available to AITL for raising invoices automatically.
FR 3.406	**Parking Lots**: Creation of a sales order and subsequent billing from parking lots.
FR 3.407	**Miscellaneous Revenues**: Functionality to account for miscellaneous revenues from digital services, or rental for usage of community halls etc.
FR 3.408	Reports as per business requirements of AITL relating to Revenue from Service Taxes, Land Sales, Telecom Fibre Usage etc.

FR 3.409	**The module for land maintenance charges shall include:** • Citizen Service: Self-Assessment of Property by Citizen. • Citizen Service: ➢ Submission of land maintenance charges in subsequent years with changes or without any changes in the property details like structure, usage etc. ➢ Capture details of multiple lease holders. ➢ Handle listing of multiple usage types within a property. ➢ Handing rebates, specific standardized rules, and considering various factors while calculating ARV of the property. ➢ Capturing floor wise details in case of buildings. • Authorization of Self-Assessment, subsequent assessments filed by the Citizen and making changes if any by AITL. • Informing Citizen about the changes done in form of a Notice. • Facilitating Citizen to file an objection against the Notice. • Hearing Letter informing date of hearing to the Citizen. • Capturing proceedings of hearing and generating final Hearing Order. • Yearly Bill generation – handling arrears, penalty/ interest, advance payments. • Collection – tax wise bifurcation in predefined proportion or as per priority defined, handling rebate on early payments. • Citizen Service: Mutation (change of lease holder) through heredity or by lease of property. • Tracking Objections and hearings against request for Mutation/ transfer. • Revaluation of Property upon survey/ identification of change in property by Municipality. • Citizen Service: Issue of Transfer Certificate. • Citizen Service: Land maintenance charges Assessment Certificate. • Citizen Service: Issue of Property Extract. • Citizen Service: Issue of Duplicate Bill. • Facility to upload existing property records and outstanding as on cut-off date that is available in digital format. • Data Entry of existing property records and outstanding as on cut-off date that is not available in digital format. • Day to day and MIS Reports.
FR 3.410	**Rent and Lease:** • Booking of Estate • Rent Payment schedule • Department process like Contract Entry, Billing, Collection, Renewal Notice, Contract Renewal • Reports
FR 3.411	System should provide functionality for visibility of actual revenues/payments at customer level by maintaining a customer account with a unique customer id.

	Functionality should be provided to the users for revenue planning at customer or product (or service level).
FR 3.412	System should provide functionality for revenue forecasting as well as revenue management at a level of detail as required by AITL. Additionally, roll up and drill down functionality for the revenue line items.
FR 3.413	As per AITL requirement, for all revenue line items by customer type, like rechargeable work, rent, lease, customer services and any other charges etc, the system should provide functionality to define and modify the applicable rates, surcharges/levies and applicable Govt taxes/levies. The system must provide functionality to maintain all business-related data in one master record, with a trace of the history records. Such data must automatically reflect in the sales orders and invoices as per the effective dates in the master record.
e-Auction for Land	
FR 3.414	**Public Notice** The system should allow AITL the issuance of a notice for a public offering on e-auction of Industrial/ Residential /Commercial /Institutional /Other plots of land on lease basis along with the associated terms and conditions.
FR 3.415	**Sale of Documents** The system should allow AITL to sell the documents related to e-auction on payment of the required non-refundable fee to prospective parties, on payment by credit cards/ net banking / RTGS/NEFT/SWIFT or any other means of payment as may be deemed appropriate by AITL. Further AITL users, should be allowed to set an appropriate fee via a user-friendly interface for the sale of these documents. The prospective parties are required complete the registration process as required by AITL. On completion of the user registration and successful payment of the required fee the prospective party should be able to download the required documents in PDF format. Complete integration is required with the back-end systems (like ERP, LMS, DMS etc) and AITL has the flexibility to record the revenues thus generated in an appropriate General Ledger/Sub Ledger account as per business requirement. An option must be provided to AITL for the bank charges, commissions or other intermediary payment charges to be paid either by the bidder or AITL.
FR 3.416	**User Registration** The prospective parties who are interested to acquire on lease the land plots through e-auction should get themselves registered with AITL for e-auctions before commencement of e-auctions. To register, the prospective party needs to fill an online form in the AITL website. After filling the online form an automated e-mail, shall be send to the e-mail provided by the prospective party requesting to submit certain documents like: • Individual: ➢ Aadhar Card or Any other proof of identity issued by the respective Government Authority ➢ PAN Card or equivalent ➢ Photocopy of the latest Income tax returns ➢ Cancelled cheque from their Bank account(s) to be submitted • Corporate:

	➢ PAN Card ➢ Photocopy of the latest Income tax returns ➢ VAT/ CST Registration Certificate ➢ Cancelled cheque from their Bank account(s) to be submitted ➢ Partnership Deed and Registration Certificate of the Partnership Firm ➢ Certificate of Registration or Certificate of Incorporation of the Company ➢ User Id and password is generated by the buyer himself during online registration
FR 3.417	**Communications and/or Amendments to E-Auction documents** The system must provide the functionality for AITL to issue on the website, as well as a direct communication by email to prospective parties, any modifications/ changes/ corrigendum etc to the Public Notice issued for the availability of plots of lands. These modifications may relate to: • Alterations of the Terms and conditions • Extensions of due date • Withdraw and cancel the bidding process • Notice for Pre-Bid Conference • Any other requirement communication The system must maintain traceability of such notifications vis a vis the original Public Notice, as well as maintain traceability of all e-mail clarifications received from the prospective parties and the responses issued by AITL for these clarifications.
FR 3.418	The system must provide an online dashboard for the prospective parties to place their bids
FR 3.419	**Contact Person** The system must provide functionality to specify the AITL contact person or representative for the e-auction. As per business requirement, the system must allow a change of the name of the contact person.
FR 3.420	**Earnest Money Deposit (EMD)** The system must provide the functionality forcing the prospective bidders to remit the EMD amount for each plot of land, the prospective party is interested in. This amount may be remitted on line as per the payment mechanisms specified by AITL like credit cards/ net banking / RTGS/NEFT/SWIFT or any other means of payment. Complete integration is required with the back end systems (ERP) and AITL has the flexibility to record the EMD amounts thus received in an appropriate General Ledger/Sub Ledger account as per business requirement. Payment of EMD for a specific plot of land must be a prerequisite in the system for the prospective party to participate in the online bidding process. An option must be provided to AITL for the bank charges, commissions or other intermediary payment charges to be paid either by the bidder or AITL.
FR 3.421	**EMD Traceability** The system must provide AITL complete traceability/visibility on a dashboard and an email sent to the prospective parties containing the following details: • AITL e-auction number • Name of buyer • Buyer registration number

	• payment transaction ref no • Date of transfer • Name of Bank • Name of Branch • City • Lot No.
FR 3.422	**EMD Refund** The system must provide the functionality for refund of the EMD of unsuccessful bidders by RTGS/SWIFT. The system must provide an option to AITL for the bank charges, commissions or other intermediary payment charges to be paid either by the bidder or AITL.
FR 3.423	**Minimum Price** The Minimum Price to be quoted by bidders as the start price plus an Increment value as defined by AITL users or its multiples indicated against each lot and/or plot of land.
FR 3.424	**Bidding Process** • Only eligible and Registered bidders shall participate in e Auction as per bidding schedule. • The bid value shall be the basic price per Sq. Yard/Sq Meter as prescribed exclusive of all applicable levies, Duties etc. Bidders shall quote in INR. The bidders shall quote in Rupees per Sq. Meter or Yard as per the prescribed unit of measurement for the land plot. • Each e-auction, is specific for a Lot/Plot of Land which would be a separate entity for bidding. Bidders have to bid separately for each e-auction lot.
FR 3.425	**E Auction** In addition to the requirements specified for E-Tender, the system must allow Bids and Counter Bids for each round of auction. The auction process may be online and only one bid per bidder should be allowed for each round. An auditable transaction reference for each bid should be generated. The system must cater for multiple bids per bidder.
FR 3.426	**E Auction Auto Bid** The system must provide for an Auto bid facility: In the auction, a bidder may give instruction to the computer to bid on his behalf every time by clicking on the “Auto bid” button. Once the bidder clicks on the “Auto bid” button, the computer will ask for incremental value and upper limit of bid. The bidder has to fill up these values and submit. An audit trail must be maintained for this functionality in the system.
FR 3.427	**System Generated Alerts Bidding** The system must generate an alert in case of any bid being equal to or more than 2 (two) times the current Highest Bid for a plot of Land, this should be displayed by way of a WARNING on the Bidder's screen before he confirms/submits.
FR 3.428	**E Auction Dashboard** The system must allow AITL users monitoring the process to view, for each lot/plot of land, on a user-friendly dash board, all the participating bidders and their bids. The AITL user must have the functionality to suspend/disable a particular bidder from the bidding process and/or suspend/discontinue the entire E-Auction without assigning any reasons.

	Additionally, the system must allow the AITL users to award the Lot/Plot of Land to a Bidder. The system must have a robust workflow to ensure that there are multiple signatories to the approval.
FR 3.429	**E-Auction Results/Status** The system must allow the results from the dashboard to be published on the Portal. Additionally, an email communication should be sent to all participating Bidders who are unsuccessful. For the successful bidder, the format of communication would be different and it would be confirmation of the award in such a case.
FR 3.430	**Schedule and Record Payments for a Plot of Land** The system must generate an allotment letter for the plot of land along with a payment schedule. The EMD deposit should be treated as an advance payment and at the option of AITL could adjusted with the first instalment. AITL user should have the option to specify the number and the amount due for each instalment. Additionally, the AEE system should record the payments made by a customer (allottee) against a plot of land and provide visibility of payment status at a plot level or customer level. Online integration of the E-Auction System with the ERP Finance Module is necessary.
Finance & Management Accounting	
General Ledger	
FR 3.431	Multi-currency functionality support and Indian GAAP (generally Accepted Accounting Principles) compliant ledger.
FR 3.432	Functionality to define chart of accounts at group and entity level.
FR 3.433	A robust journal with complete traceability of financial transactions. Entry deletion must not be allowed. Automatic reversal functionality must be provided for reversing transactions.
FR 3.434	Posting of Transactions and Opening & Closing Periods.
FR 3.435	Facility to create draft transactions with auditable transaction numbering feature.
FR 3.436	Automatic transaction posting feature.
FR 3.437	Feature to open and close financial periods.
FR 3.438	Feature for adjustment periods in addition to the normal 12 periods for posting transactions in any financial year.
FR 3.439	Feature to allow soft close and hard close of financial periods.
FR 3.440	Restrict transaction posting only to open periods.
FR 3.441	Capability to drill down into transaction details from period balances.
FR 3.442	System should have functionality to maintain plan financial statements for any business unit within a legal entity or at corporate group level.
FR 3.443	Facility to have hierarchical account structure.
FR 3.444	System should allow maintenance of multiple plans for any financial year .
FR 3.445	Provide the flexibility to record financial transactions for multiple legal business entities and generate required statutory financial statements/reports like Profit & Loss, Trial Balance, Balance sheet, reconciliation reports etc. as per AITL business needs for each entity.

FR 3.446	Provide functionality for automated consolidation of accounts with out of the box functionality for setting-off of inter business entity payables and receivables consolidation of investments and multi-currency valuation.
FR 3.447	Automatic generation of trial balance.
FR 3.448	Provide functionality for the user to define the format and contents of financial statements.
FR 3.449	Provide multiple reports as required by users for monitoring and control purposes.
FR 3.450	Functionality for Payments and Bank Reconciliation: • To prepare Cash management forecast • Prepare reconciliation statement for Bank transactions
FR 3.451	Functionality for incoming electronic payment and transfer of funds including net banking, credit cards or any other payment mechanism. Applicable for domestic (INR) and overseas payments in foreign currency.
FR 3.452	Functionality for outgoing electronic payment and transfer of funds and transfer of funds including net banking, credit cards or any other payment mechanism. Applicable for domestic in INR and overseas payments in foreign currency.
FR 3.453	Functionality to process cash and cheque payments with automatic handling of outstation cheques in Indian of foreign currency.
FR 3.454	Functionality for re-grouping of GL balances according to pre-defined rules for statutory reporting; system should provide necessary information for preparing year end schedules for audit purposes.
FR 3.455	Functionality for re-valuation of balances and open transactions in foreign currency according to local and global accounting standards.
FR 3.456	The system should be able to generate a payment acknowledgement as and when required.
FR 3.457	System should have functionality to manage travel management and other transactions related to employees; should have functionality to maintain account for each employee.
FR 3.458	Functionality for manual and automated cheque printing.
FR 3.459	Functionality for preparing a forecast with varying time horizons. Provision required for automatic bank reconciliation.
FR 3.460	Functionality for Taxation, duties and levies accounting of tax transactions, detailed information flow, challan preparation and filing of different tax returns according to federal as well as state government legal requirements.
FR 3.461	Functionality to maintain accounts as per Indian statutory requirements.
FR 3.462	Functionality to ensure Compliance with the GST procedures to be implemented in India.
FR 3.463	Functionality to define multiple tax structures on transactions.
FR 3.464	The system must provide planning functionality in the General Ledger with out of the box functionality of transferring planned data from Excel: • Multiple planners should be able to work on this task with authorizations assigned to each individual planner.

	• For balance sheet accounts the AITL users should be able to plan the balance sheet change values or the balance sheet values. • Each fiscal year should have functionality for multiple versions of plan data. • AITL users should be able to use templates which would provide the option of using previous plan or actual data from previous year as a reference. • Reporting functionality to compare actual and planned data. • Display totals of planned data and create planned financial statements. • Functionality to allocate/distribute planned data to other functions or organisational units. • Support bottoms-up or top down planning.
FR 3.465	The system should provide the required G/L reporting functionality as required by AITL users.
Accounts Payable	
FR 3.466	Multi-currency functionality.
FR 3.467	Functionality for automatic reconciliation of sub-ledgers with the control account in the General Ledger.
FR 3.468	User must be able to create/maintain Vendor master record. Common master data of vendors with procurement is required.
FR 3.469	Functionality to process one off payments for vendors with whom AITL does not intend to have a long-term business relationship and maintain a separate master data record.
FR 3.470	User defined facility to classify vendors in groups and assign separate number ranges. These number ranges could be assigned externally or internally by the business entity. The external number require flexibility to have alphanumeric characters.
FR 3.471	System should allow fast data entry of invoices based on purchase order etc.
FR 3.472	The system must allow the business entity to assign vendors to separate control accounts in the general ledger.
FR 3.473	System should provide functionality for electronic approvals of invoices based on preconfigured rules.
FR 3.474	Functionality to block process vendor payments in case of dispute at invoice level or vendor level.
FR 3.475	System must handle multiple modes of payment including electronic and must generate output as required by banks.
FR 3.476	System must have necessary controls for managing sensitive information for vendors e.g. vendors' bank accounts.
FR 3.477	Functionality for recording and monitoring of bank guarantees.
FR 3.478	System should provide functionality at master data level of vendors to restrict operations of these accounts only by a certain set of employees.
FR 3.479	System must allow monitoring of advances given to vendors.
FR 3.480	Functionality for processing of payments for vendors with automatic vendor account posting and clearing.

FR 3.481	Functionality for automatic system calculated TDS deductions for vendor payments.
FR 3.482	Functionality for automatic posting of input tax (GST or other existing) whilst vendor invoice processing.
FR 3.483	Functionality of automatically handling re-imbursement of expenses like transport, insurance during vendor invoice processing.
FR 3.484	Whilst processing payments either automatically or manually, for vendors, the system should allow the advances to be adjusted partially or fully.
FR 3.485	Functionality to issue credit/ debit notes by the system.
FR 3.486	Functionality for handling imports with T/T and L/C Process.
FR 3.487	Functionality for system generated letters to vendors for balance confirmations.
FR 3.488	Out of the box availability of reports for vendor reconciliations and other reports as per user requirement.
FR 3.489	Out of box functionality for online inquiries on vendor balances on various parameters and statuses.
FR 3.490	System should have a strong reporting functionality as per AITL needs that includes all statutory reporting, analysis of vendor master data, open invoices, overdue payments, payments made in advance, blocked invoices report etc.
Accounts Receivable	
FR 3.491	Multi-currency functionality is required.
FR 3.492	Functionality for automatic reconciliation of sub-ledgers with the control account in the General Ledger.
FR 3.493	User must be able to create/maintain Customer master record. Common master data of customers with sales/invoicing is a requirement.
FR 3.494	Functionality to process invoices of one time customers where AITL does not wish to maintain a master debtors record.
FR 3.495	Functionality to classify customers in groups and assign number ranges. These number ranges could be assigned externally or internally by the business entity. The external number range may have alphanumeric characters.
FR 3.496	The system must allow the business entity to assign separate control accounts for customers in the general ledger.
FR 3.497	Functionality to block posting customer accounts.
FR 3.498	System should provide functionality at master data level of customers to restrict operations of these accounts only by a certain set of employees.
FR 3.499	System must allow monitoring of advances received from customers.
FR 3.500	Automatic processing of receipts via cheque, electronic funds transfer or other means with auto posting of output tax which may be in the form of GST, VAT, sales tax, service tax or any other municipal levy. There could be business instances of more than one central tax, state tax or municipal levy.
FR 3.501	While processing receipts either automatically or manually, for customers, the system should allow the advances to be adjusted partially or fully. The posting to customer debtors account should be automatic with clearing of the required entries.

FR 3.502	Functionality to issue debit notes and/or credit notes as applicable with ability to provide discounts, rebates and/or levy charges.
FR 3.503	Functionality for automatic interest calculation for overdue payment. The system must allow the user to specify the interest rates for a customer or a group of customers.
FR 3.504	Functionality for automatic generation of reminder letters for overdue payments in the accounts receivable. The letter format should be user definable.
FR 3.505	System should have functionality to provide reports as required by AITL which includes for example open customer invoice, payments received (partial or full), ageing analysis per overdue dates.
Asset Financial Management	
FR 3.506	Functionality to generate automatic asset numbering as well as manual numbering.
FR 3.507	Functionality to maintain detailed information per asset item: asset description, asset class, asset serial number, asset bar code, location, asset main category and sub category, department/cost centre, custodian, employee number, purchase date, depreciation start date, service start date, vendor, PO reference, invoice reference, warranty start date, warranty end date, acquisition cost, salvage value, useful life and depreciation method and any other relevant asset information.
FR 3.508	Functionality to maintain collective information of low value assets like items of furniture.
FR 3.509	Functionality to define parent child asset relationships.
FR 3.510	Functionality to add additional upgrading cost to an existing asset. System should provide a report showing the history of upgrades and include the addition into the new depreciation runing over the remaining period of the asset. e.g. Capital construction projects.
FR 3.511	Functionality to capture work in progress (WIP)/construction in progress (CIP) assets and later convert them as normal assets and start depreciating.
FR 3.512	Functionality to add WIP/CIP expenditures to an existing CIP assets through the accounts payable system.
FR 3.513	Functionality in asset system that allows the asset to be marked as physical inventory tracking asset and further generate physical inventory reports.
FR 3.514	Functionality to split an asset into multiple assets.
FR 3.515	System should be able to depreciate assets using common depreciation methods: • Straight Line • Double Declining balance • Written down value method • User defined method of depreciation like based on number of hours
FR 3.516	Functionality to calculate depreciation based on groups of assets: • By Department • By cost centre • By Project • By business entity

FR 3.517	Functionality to recalculate depreciation on asset • Based on change in value • Based on change in depreciation schedule • Based on change in asset life
FR 3.518	Functionality to capitalize assets
FR 3.519	Functionality to perform “un-planned" depreciation
FR 3.520	Functionality to automatically process and post transactions: • Depreciation Expenses • Cost Adjustments • Any other transaction as per AITL business needs
FR 3.521	System should allow user definable depreciation formulas and also cater to multiple methods of depreciation for example relating to Income Tax, Companies Act etc.
FR 3.522	Functionality to define depreciation conventions, such as Mid-Month convention, End-of-the-Month Convention etc.
Asset Transfers	
FR 3.523	Functionality to transfer assets between: • Divisions/Departments/Cost Centres • Locations • Custodians • Projects • Work Package (within a project) • Job (specific activity within a work package)
FR 3.524	Functionality to transfer all or part of an asset.
FR 3.525	Functionality to transfer groups of assets.
FR 3.526	Functionality to generate transfer slips in case of asset transfers.
Asset Retirements	
FR 3.527	Functionality to fully retire.
FR 3.528	Functionality to partially retire.
FR 3.529	Functionality to retire by units.
FR 3.530	Functionality to retire by cost.
FR 3.531	Functionality to reinstate retired assets.
FR 3.532	Functionality to process sales of fixed assets with the Automatic creation of gain/loss transactions.
FR 3.533	Functionality to specify different retirement accounts for gains and losses.
Revalue assets	
FR 3.534	Functionality to revalue assets (change the basis of depreciation and net book value) and adjust the cost of an asset, e.g. capitalization of renovation cost, useful life, depreciation % and write off amounts.

FR 3.535	Functionality to revalue a single asset or group of assets based on percentage or value.
FR 3.536	Functionality to record and amortize revaluation reserve based on International accounting standards.
Physical verification	
FR 3.537	Functionality to maintain a physical control of assets and be able to track assets by serial number, asset number, custody number and project/ cost centre/ location.
FR 3.538	Functionality to create a Fixed Assets Verification Sheet, containing asset code, location, physical balance.
Insurance	
FR 3.539	Functionality to track asset insurance details such as sum insured, premium etc.
FR 3.540	Functionality to generate a report showing insurance expiry dates.
Reports	
FR 3.541	Generate fixed assets register by: • Department/Section • Location • Project • Business entity
FR 3.542	Provide functionality for asset sales and automatically calculate the resulting gain and/or loss on such asset sales.
FR 3.543	Projected Depreciation.
FR 3.544	Custodian.
FR 3.545	Cost Centre wise.
FR 3.546	Period depreciation reports – summary.
FR 3.547	Asset depreciation per period.
FR 3.548	Period.
FR 3.549	Generate asset depreciation register (detail and summary).
FR 3.550	Report on fixed asset transactions history (i.e., *fixed asset movements*).
FR 3.551	Generate unposted depreciation calculation report before transferring them to GL but after running depreciation in the assets module.
FR 3.552	Asset cost report.
FR 3.553	Asset report by major and minor category.
FR 3.554	Following activities should generate a report output: • Asset Transfer • Asset Disposal • Asset Retirement in the form of sale, scrap, write off etc. • Asset Addition
FR 3.555	Functionality to generate automatic reconciliation report for GL and depreciation register.

FR 3.556	Functionality to prepare Retirement Register by month / asset number: • By department • By location/region • By account • By account segment • By retirement type
FR 3.557	The system should provide the reports relating to Assets as per AITL user needs.
Management and Cost Accounting	
Planning Budgeting Funds and Grants Management	
FR 3.558	**Capital Investment Planning –** integrated with the requirement stated in Projects and Works Management the system should enable the AITL users to create a forecasted investment plan for obtaining funding approval from the relevant stakeholder/institutions.
FR 3.559	Maintain an auditable record of source of funds which can be in the form of Grants, Loans, Equity, Debentures or any other source of funds which be appropriate for AITL.
FR 3.560	Maintain Traceability of allocation of these funds for each project. For example, at AURIC infrastructure development would include projects relating to: Telecom, Power, Water and Water Treatment, Waste Management, Land Allocation & Roads, Traffic Management, Housing, Commercial Complexes, Social Facilities, Parks, Information Technology etc.
FR 3.561	Provide the functionality to grant approvals for individual projects and maintain and auditable record of the source of funding for each project.
FR 3.562	Provide functionality to record and track incoming payments received by AITL against approvals for investment plans sanctioned by relevant stakeholders (state Government, Central Government, foreign and domestic financial institutions etc.) against various Funds and/or Grants.
FR 3.563	Provide functionality to record and track utilizations of the funds against Funds/Grants approved by relevant stakeholders (state Government, Central Government, foreign and domestic financial institutions etc.) against various Funds and/or Grants.
FR 3.564	Functionality to maintain of record of the plan versus actual capital expenditure at project level.
FR 3.565	Functionality for tracking of utilization of funds at project level with multi-level roll-up functionality.
FR 3.566	Functionality to provide flexibility in reporting for budgeting and variance analysis.
FR 3.567	Functionality to provide flexibility in reporting of spend and utilization reports.
Management Accounting	
FR 3.568	System should have functionality to define internal organization structures for segment reporting and for internal reporting.
FR 3.569	Should have functionality to amend organization structure according to business needs with complete audit trail of changes done.
FR 3.570	System should have functionality to record business transaction for financial as well as for management account at the same time.

Costing	
FR 3.571	Functionality to capture and report costs against each dimension in the chart of account structure such as cost centre, unit, department, location, product, project etc.
FR 3.572	Functionality to define cost centres for performing responsibility accounting across the organization, including multiple legal entities under a common management control.
FR 3.573	Functionality to define various elements of costs for cost sheet preparation.
FR 3.574	Facility to pool costs and then allocate / reallocate costs to other cost centres / across organization based on predefined basis.
FR 3.575	Functionality to create flexible cost collectors to collect costs for specific purpose / objective.
FR 3.576	Functionality to settle such collected cost to another cost centre, asset or WBS element or project.
FR 3.577	Functionality to print various cost allocation schedules prior to the financial closing of the period.
FR 3.578	Functionality to allocate overheads either on a percentage basis or as quantified by the service providing department.
FR 3.579	Functionality to allocate indirect process unit costs to direct process units based on direct cost ratio.
FR 3.580	Functionality to rerun cost allocations when the underlying data changes.
FR 3.581	Functionality to combine the costs for several input sources and allocate in one allocation source through parameters.
FR 3.582	Functionality to allocate common costs across departments/ products / units based on predefined basis.
FR 3.583	Functionality for Provisions to add relevant taxes and duties wherever applicable.
FR 3.584	Functionality to reconcile costing reports with financial reports.
FR 3.585	Functionality to provide flexibility to accept new detail lines/parameters for preparation of cost sheets.
FR 3.586	Functionality to derive the costs centres or cost collectors automatically based on the normal accounting postings.
FR 3.587	Functionality to assign budget for these cost collectors.
FR 3.588	Functionality to track the actual costs and budget costs on these cost collectors.
FR 3.589	Functionality to support variance analysis between budget and actual across various periods.
FR 3.590	Functionality to set up avail Functionality control on these cost collectors and set up warning or error messages when the budget exceeds / matches the actual costs.
FR 3.591	Functionality to create these cost collectors for reporting purposes only as these costs cannot be allocated further.
FR 3.592	Functionality to compile the total costs in the primary cost collectors and settle the costs to other cost collectors.

FR 3.593	Functionality to create various reports about the costs collected in these cost collectors at various time periods and compare them with the budgets.
FR 3.594	Functionality to compute costs for inventory valuation purpose based on defined accounting policy.
FR 3.595	Functionality to support categorization of costs into fixed/ variable costs at process/product/cost centre levels or as required by users.
FR 3.596	Functionality to accept costs/rates on adhoc basis, where prices have not been finalized.
FR 3.597	Functionality to maintain mapping between chart of accounts and costing system along with cost centre/responsibility centre system.
FR 3.598	Functionality to allocate cost in the same original GL account Head to multiple cost centres or other cost objects.
FR 3.599	Functionality to assign and report on Fixed Assets allocated to Cost Centres.
FR 3.600	Functionality to capture depreciation for cost sheet preparation from the fixed asset module.
FR 3.601	Functionality to charge of Depreciation to assigned cost centres automatically, while posting Depreciation entries.
FR 3.602	Functionality to determine cost for any process with or without depreciation and interest component and Functionality to transfer relevant amount to subsequent process.
FR 3.603	Functionality to maintain cost sheets prepared on multiple basis for the same period for comparison purpose.
FR 3.604	Functionality to perform Cost allocations (plan/actual cost accounting) based on full costs. Costs are not split into fixed and proportional costs as only a consolidated entry is posted onto the cost collector, for example canteen costs.
FR 3.605	Functionality to allow to calculates wage costs using the fixed hourly rates determined in cost centre planning.
FR 3.606	Functionality to allow Standard costing and Marginal Costing.
FR 3.607	Functionality to do Activity based costing.
FR 3.608	Functionality to collect actual Labour / factory overheads based on the settings like activity allocations made in the system.
FR 3.609	Functionality to have Cost Centre Accounting, including itemized costing for specific business events like marketing campaigns or trade fair participation.
FR 3.610	Functionality to add one or more cost centres or one or more nodes of the standard hierarchy for Cost Centre.
FR 3.611	Functionality to get the breakup of costs by way of different accounts.
FR 3.612	Functionality to get itemization or details of the standard cost estimates, where we can get the breakup of costs in the required parameters.
FR 3.613	Functionality to consider the planned overhead costs in the standard cost estimates based on cost centre planning and activities.

FR 3.614	Functionality to consider various overheads like material overheads, production overheads and Admin overheads.
FR 3.615	Functionality to cost roll up from lower levels to higher levels of WBS for Projects.
FR 3.616	Functionality to maintain cost estimates for materials sent on sub-contracting.
FR 3.617	Functionality to estimate costs and maintain costs for previous, current and future period in the system.
FR 3.618	Functionality to cost the subcontracting materials and the status of material lying with Sub-contractors.
FR 3.619	The system should also provide other MIS or Management Accounting reports as per the needs of AITL users.
FR 3.620	Functionality for Real-Time Integration of Management Accounting with Financial Accounting for actual and planned data.
FR 3.621	System should have functionality to manage expenses incurred on work or jobs carried out for internal or external customer Detailed line item level details should be provided for actual and planned costs.
FR 3.622	System should provide functionality to plan internal and external resources for various categories of jobs.
FR 3.623	System should allow planning (and reporting) of various types of costs for different categories of jobs.
FR 3.624	System should have functionality to keep track of costs and resources consumed on maintenance of internal or customer assets.
FR 3.625	System should provide adequate control mechanisms for complete lifecycle management of a job or a work order; should have functionality to approve or reject a particular job or a type of expense for a job.
FR 3.626	The module shall have functionality to: • Define Chart of Accounts as per the applicable guidelines • Maintain Bank Account Details • Maintain Details of Vendors • Budget provisioning – Provision for Original and Revised Budget • Re-appropriation of Budget between accounting heads • Provision to records Receipts • Transfer of Receipts – cash/cheque to Bank Accounts • Record direct debit/ credit to bank accounts in books of accounts • Entry of Bills /Invoice Received from vendors • Authorization of bills as per the work-flow defined • Payment Vouchers once the payment is approved • Keep track of Cheque books and cheque leaves • Facility for cheque printing • Direct Payment upto specific limit • Journal Voucher Entry • Authorization of Journal Voucher • Contra Voucher Entry • Reversal of Vouchers

	• Provision for Bank Reconciliation at any point in time • Manage Deposits received from vendors, citizens • Keep track of Grants received and expenses made against the specific grant • Keep record of Investment made and interest accrued on the investments • Loans management • Advances management
FR 3.627	Functionality for maintaining Books of Accounts and Registers: • Cash Book, Bank Book, Cashier's Cash Book • Ledger – Single or Multiple account heads • Trial Balance, Income & Expenditure, Balance Sheet • Cash Flow Statement • Bill Register • Payment Register • Deposit Register • Investment Register • Loans Register • Advances Register
Purchasing and Inventory Management	
Purchase Requisition	
FR 3.628	Functionality to create automatically or manually Purchase Requisitions for goods and services. The functionality for automatic generation should be based on spares requirement for an equipment/location, stock level monitoring, due dates as project/ work package schedules, MRP or any other user defined mechanism.
FR 3.629	Functionality of employees (or authorized users) or departments to create requisitions and have visibility of PO's issued against these requisitions (including RFQ and RFP).
FR 3.630	Functionality to convert requisition to request for quotations (RFQ)/request for proposals (RFPs) automatically. RFQ/RFP should be attached to selected vendors based on past data/performance.
FR 3.631	Functionality to consolidate multiple purchase requisition from different departments.
FR 3.632	Functionality to monitor the status of purchase requisition raised.
FR 3.633	Functionality to attach documents (e.g. Word, excel, pdf etc.) with the header and lines of purchasing documents (PR, RFQ, RFP, Quotes, Proposals and PO).
FR 3.634	Functionality to raise Purchase Requisition against a project.
FR 3.635	Functionality to raise Purchase Requisition for service contract with vendors.
FR 3.636	Functionality to automatically create requisition if the quantity on hand goes below re order level.
FR 3.637	Approvals of these requisition should conform to the powers vested in signing authorities. Necessary workflows must be available to facilitate approvals on the system.
FR 3.638	Functionality to create requisitions for whole sale energy and water procurement by AITL.

Receive & Evaluate Quotation	
FR 3.639	Functionality to prepare Request for Quotation against a purchase requisition.
FR 3.640	Functionality to electronically send the request for quotation and link it to multiple suppliers.
FR 3.641	Functionality to enter the quotes received.
FR 3.642	Functionality to have an expiry date for the Quote.
FR 3.643	Functionality to Analyze Vendor's Quotations (Technically, Financially) on following criteria: • Lowest Price • Best Delivery • Best Technical Proposal • By assigning points on quality offered • Payment Term • Landed Cost (Freight etc.) • Relationship with Vendor (Agent, supplier etc.) • User definable criteria System should be able to evaluate the quotation/proposal on the basis of above criteria.
FR 3.644	Functionality to copy vendor's quotation/proposal into PO either as a whole or selected lines.
Purchase Order	
FR 3.645	Functionality to create Contracts and/or PO's for bulk purchase of water and electricity by AITL as applicable.
FR 3.646	Functionality to convert quotation/requisition to purchase order.
FR 3.647	Functionality to create multiple purchase orders against a single quotation/requisition.
FR 3.648	Functionality to create purchase order for goods and services which would include spares, essential services, office equipment and/or any other item as per AITL business needs.
FR 3.649	Functionality to create purchase order for service contracts with vendors and track the pending commitments made by AITL to each Vendor.
FR 3.650	Functionality to create long term contracts in the system with either a limit either on time period, quantity or value either a limit either on time period, quantity or value.
FR 3.651	Functionality to create multiple releases against the long term purchase contracts.
FR 3.652	Functionality to create replenishment automatically for specific items with respect to the inventory norms defined I.e. safety stock, reorder point, inventory turns.
FR 3.653	Functionality to enter the PO's in different currencies in the system.
FR 3.654	Functionality to record purchase order acknowledgement from vendor.
FR 3.655	Functionality to enter price, state taxes, central taxes, GST, municipal levies, payment terms, special discounts, delivery instructions, delivery schedule etc. in purchase order/release order.
FR 3.656	Functionality to set receiving tolerance limits in purchase order or service order.

FR 3.657	Functionality to set 2/3/4 way matching requirements in the purchase order.
FR 3.658	Functionality to send approved PO electronically to vendors (Fax, email etc.).
FR 3.659	System should allow reprint of PO with 'copy' marked on the print out.
FR 3.660	System should be able to capture information pertaining to freight, insurance, etc. at each line item selection as per the terms (CIF, FOB, etc.).
FR 3.661	Functionality to capture penalty clause in PO (% wise, daily rate and lump sum).
FR 3.662	Functionality to enter project details while creating purchase order and interface the details to project.
FR 3.663	Purchase order processing is part of the procurement of materials and services. Its primary purpose is to convert demands to purchase orders (with or without reference to a contract) or delivery schedules for a scheduling agreement and to monitor the fulfillment of these documents.
FR 3.664	MRP requirements linked to business plans and repair and maintenance programs.
FR 3.665	Prepare and dispatch RFQs/RFPs/RFIs.
FR 3.666	Consolidate discounts across orders under particular contracts.
FR 3.667	Consolidate dispatching PO's and PO lines against vendors.
FR 3.668	Requirement to separate out carriage and transport costs.
FR 3.669	Requirement to dispatch PO's via various methods i.e. web, email, fax, post.
FR 3.670	Functionality to assign Follow-up dates on purchase orders especially for delayed and/or critical deliveries.
FR 3.671	Functionality to record Comments for follow up activities.
FR 3.672	Functionality to track different stages of a purchase order (like - In-progress, approved, rejected, closed etc.).
FR 3.673	Functionality to follow up of shipment which are in transit by sea or air.
FR 3.674	System should have provision for registration of documents received, awaiting arrival of ship.
Receiving Good/Services	
FR 3.675	Functionality to track the receipt of bulk water and electricity supplied to AITL against the Contracts entered into by AITL with various authorities, electricity boards, undertakings, public sector enterprises. Alerts/ requisitions should be automatically generated by the system at AITL defined threshold levels before expiry of such supply contracts.
FR 3.676	Functionality to receive goods and services against a purchase order.
FR 3.677	Functionality to record inspection report for items.
FR 3.678	Functionality to update inventory on item receipt / post-inspection clearance for items with mandatory inspection requirements.
FR 3.679	Functionality to generate receiving document on receipt.
FR 3.680	Functionality to receive un-ordered receipts or substitute items with proper authorization as defined by business.
FR 3.681	Functionality to record multiple receipts against a single PO.

FR 3.682	Functionality to record serial number, expiry date and batch number during receipt for specific items (tracking item by serial number e.g. meters for water & electric tracking item by serial number e.g. meters for water & electricity).
FR 3.683	Functionality to record labor hours and material consumed by an internal employee or contractor against a maintenance work order. These entries must reflect in the costs accumulated against a specific work order.
FR 3.684	System should have provision for rejection of unacceptable items with creation of Discrepancy Report.
Invoice Receipt	
FR 3.685	The solution must accommodate various types of receipt - standard 3-way match, blanket (i.e. limit) order receipting, exemption on receipt for orders up to a specified value. Additionally, the user must have an option of a 2-way match where the vendor need not submit an invoice. The payments are cleared by comparing the G/R or service entry sheet against a PO or purchase contract.
FR 3.686	**Receiving an Incoming Invoice,** The Functionality to receive, enter, and check vendors' invoices for correctness. The Functionality to manually enter incoming invoices and automated procedures for creating invoices, such as the automated processing of receipts or goods and services.
FR 3.687	**Verifying an Incoming Invoice the Functionality to check** incoming invoices for correctness in terms of their content, prices, state taxes, central taxes, GST, municipal levies and arithmetic, thus defining the basis for the payment run. The price and conditions are compared to the conditions in the purchase order, or the invoiced quantity is compared to the received quantity. If differences exceed user defined limits, the invoice should be blocked automatically for payment. Tax calculation and processing of delivery costs are also to be integrated.
FR 3.688	The Functionality to for one person to process/verify the invoice and another person to approve the processing and processing of vendor invoices is required. Workflow functionality is necessary to control the process.
FR 3.689	**Release of Blocked Invoices** the Functionality to release invoices that have been blocked can be released for payment using a monitor function. The Functionality to automatically release of invoices for which the blocking reasons have been clarified. Workflow features support the release process.
FR 3.690	Requirement to create self-bill invoices against agreements or Contracts from within the solution.
FR 3.691	Requirement to reject invoices if they are not valid or legal documents.
Maintain Vendor Records	
FR 3.692	Functionality to maintain the following information per vendor: • Vendor code • Vendor name • Multiple contact names • Multiple addresses (PO Box, email, phone numbers, fax number, postal addresses) • Default payment/credit terms • Default currency

	• Multiple vendor bank account numbers • Default delivery options • Multiple Product description/Category • ISO Certification/Validity
FR 3.693	System to be able to classify vendors as registered/ unregistered and certified/ uncertified, international/domestic.
FR 3.694	System to be able to capture the rules on which the vendor is to be assessed.
FR 3.695	Functionality to automatically update vendor rating based on pre-defined rule.
FR 3.696	Functionality to maintain approved supplier lists for inventory items.
FR 3.697	Same entity can be both customer and vendor, link to be maintained and referred as related party.
FR 3.698	Functionality to have vendor specific payment terms.
Approval Hierarchies	
FR 3.699	Functionality to designate approval hierarchies to approve Purchase Requisitions, Purchase Orders and Vendor Quotations based on the following criteria: • Amount limit • Item ranges • Account ranges
FR 3.700	Functionality to send an electronic notification to approver to take action on the Purchasing document submitted for approval.
FR 3.701	Functionality to send an electronic notification on approval or rejection of purchasing document (PR, PO and Quotation) to initiator.
FR 3.702	Functionality to automatically forward document for approval to next person in hierarchy if the document is delayed beyond the specified time with a designation.
Purchasing MIS	
FR 3.703	Functionality to track the status of PR's with respect to PR log date, Item code, quantity etc.
FR 3.704	Functionality to track the status of PO's with respect to PO log date, Item code, quantity and expected time of arrival of the shipment.
FR 3.705	Functionality to generate report on pending PR/PO supplier-wise, item-wise and department-wise.
FR 3.706	Functionality to generate report when level stock on-hand below reorder level with information on PO pending, PR pending etc.
FR 3.707	System should have the Functionality to print summary of expected receipts.
FR 3.708	Functionality to print purchase register for the month.
FR 3.709	Functionality to generate reports on documents pending for approval on which no action has been taken for more than N number of days.
FR 3.710	Functionality to inquire / report on the item purchase cost history over a user defined date range.
FR 3.711	Functionality to generate receipt register.

FR 3.712	Functionality to perform ageing analysis for outstanding Purchase Orders based on cost centre, vendor etc.
FR 3.713	Functionality to generate statutory reports/returns as required by state government for filing sales tax and/or excise duty returns.
Maintain Inventory Items	
FR 3.714	Functionality to setup and maintain item codes with different segments.
FR 3.715	Functionality to maintain the following information for items but not restricted to: • Item code • Item descriptions • Purchase lead time per item/supplier • Vendor item code • Default purchasing unit of measure • Minimum stock level • Item Status (Active, Obsolete, Blocked etc.) • Expiry date • Serial Number and Batch Number (for serialized inventory tracking and batch tracking) • Barcode
FR 3.716	Functionality to group items into categories and sub-categories.
FR 3.717	System to be capable of linking the supplier item code with the item code in the item master.
FR 3.718	Functionality to maintain conversions between units of measure.
FR 3.719	System should have provision for serial-number control of items.
FR 3.720	System must support bar coding and have the Functionality to scan pre-printed form containing bar codes, quantities, and item descriptions.
Item Catalogues	
FR 3.721	Functionality to maintain catalogues item-wise and supplier-wise.
FR 3.722	Functionality to update catalogues periodically through catalogue imports.
Locations	
FR 3.723	System should support creation of multiple warehouse locations and attach type/ categories of transactions which the warehouse locations can support.
FR 3.724	System should have the Functionality to support warehouse area classification.
FR 3.725	Functionality to categorize locations and assign items to locations.
Maintain Kits	
FR 3.726	Functionality to define bill of materials/Kits.
FR 3.727	Functionality to explode bills and transfer individual items to.
FR 3.728	Functionality to combine individual items and issue the master item.
Maintain Stock Levels	
FR 3.729	Functionality to maintain minimum stock levels for items.

FR 3.730	Functionality to generate alerts if the quantity falls below pre-defined limits.
FR 3.731	Functionality to allow negative stock for specific items and record appropriate costing entries.
FR 3.732	Functionality to classify items based on ABC classification. ABC classification should be based on value of stock & value of movement within a year.
Item Costing	
FR 3.733	Supports the following costing methods: • Standard • FIFO/LIFO • Weighted average
FR 3.734	Functionality to track the item cost for all material transactions.
Transactions	
FR 3.735	Functionality to define transaction types and set pre-defined rules for each transaction type.
FR 3.736	Functionality to issue items against: • Internal requisition • Maintenance work order • Material requisition from projects • Or any other user defined requisition
FR 3.737	Functionality to generate pick-lists for all material issue.
FR 3.738	Functionality to generate pick list sequentially. (If the user goes to a particular area system should give all items to be picked from that area).
FR 3.739	Functionality to print location information on pick-slip.
FR 3.740	Functionality to inspect items on receipt.
FR 3.741	Functionality to Record quality issues and defect if any.
FR 3.742	Functionality to scan and record barcode information at the time of receipt.
FR 3.743	Functionality to upload Goods receipts voucher details from excel to the system.
FR 3.744	Functionality to record items returned from Projects to Inventory.
FR 3.745	Functionality to provide provision for ageing inventory.
Monitor Ageing Stock	
FR 3.746	Functionality to generate stock aging report based on the receipt date by: • Aging slots (in days) • Item-wise • Category-wise
FR 3.747	Functionality to generate stock ageing analysis based on the receipt date.
Physical Inventory & Cycle Counting	
FR 3.748	Functionality to generate count sheets based on user defined criteria: • Quantity, e.g. include items with quantity above 10 pieces

	• Value, e.g. include the items with unit value above 50K • Item Category • Location
FR 3.749	Functionality to sort the count sheets by: • Item • Location • Shelf / bin number • Functionality to perform a re-count if the stock difference is beyond pre-defined limits
FR 3.750	Functionality to identify the type of physical count adjustments as: • Shortage / Excess • Damaged (With percentage damage) • Non usable items (scrap)
FR 3.751	Functionality to monitor the items as count in progress, completed etc.
FR 3.752	Functionality to define the cycle count frequency per item, e.g. every 30 days.
FR 3.753	Functionality to freeze normal inventory transactions during physical count.
FR 3.754	The system should post the stock adjustments only after approval in system.
Forecasting	
FR 3.755	Functionality to perform min-max and re-order point planning.
FR 3.756	System should have the provision for using standard Inventory forecasting techniques.
Inventory MIS	
FR 3.757	Functionality to report the transaction statistics by type (e.g. number of receipt transactions, shipments, transfers, returns etc.) by product group and month.
FR 3.758	Functionality to generate material transaction register.
FR 3.759	Functionality to generate item movement report to track all transactions based on following criteria: • Period wide • Item wise • Category wise • Transaction type wise
FR 3.760	Functionality to generate damaged stock report.
FR 3.761	Functionality to generate stock expiry report period-wise.
FR 3.762	Functionality to track items reserved with reference.
FR 3.763	Functionality to track slow moving items based on following criteria: • Percentage movement • Period-wise • Item-wise • Category-wise • Transaction type wise

FR 3.764	System needs to provide a report at the end of each physical inventory/cycle counting/perpetual stock count indicating product category wise, item-wise, location wise, period-wise variances between the actual physical stock and stock in the system.
FR 3.765	Functionality to generate report on ABC classification based on stock value and movement in a year.
FR 3.766	Functionality to generate report on inventory balance on-hand with GRV details.
FR 3.767	Non-moving items for a selected period detailing complete history from receipt until the last issue.
E- Procurement	
General	
FR 3.768	The system must be able to log all the activities carried out on the system by any user.
FR 3.769	The administrator shall be able to make intelligent search on the log based on user name, time period, type of activity, etc.
FR 3.770	Audit trail of the entire system operations shall be maintained in secured environment.
FR 3.771	The E-Procurement system should adhere to stringent security norms like SSL, firewall and other security guidelines.
FR 3.772	E-Procurement system will have native integration with back-end functionalities for operational procurement, inventory management.
FR 3.773	E-Procurement system will be capable to handle both materials and services.
FR 3.774	The solution should have comprehensive business workflow engine to create and manage different kind of workflow requirements triggered by specific events.
FR 3.775	E-Procurement system should have comprehensive functionality for supplier evaluation.
FR 3.776	Supplier evaluation can be done based on past purchase transactions considering different parameter like price, quality, delivery, services etc. The score of these parameters could be calculated automatically by the system or entered manually.
FR 3.777	System will have provision to conduct supplier evaluation based on feedback from business users through questionnaire. The questionnaire can be triggered on specific events automatically by the system or by conducting a web-based survey.
FR 3.778	It shall have standard reporting formats available. Reports shall be available in these standard formats at any given time.
FR 3.779	The system must provide detailed drilled down reports.
FR 3.780	The system must enable user to configure/develop reports on different parameters for trend analysis, reports on supplier participation etc.
FR 3.781	Management of user IDs and password and setting up hierarchy levels and role definitions for different users.
FR 3.782	System will support multiple currencies.
FR 3.783	The system must provide a supplier administration module to add, delete, enable or disable the suppliers or supplier group.

FR 3.784	The system must provide for reports in both flat file and Excel formats.
FR 3.785	The E-Procurement system should have document collaboration facility among purchaser, bidders and suppliers. They should be able to share documents in a secured manner online. The upload, download and storage of the documents would be folder-based and easy-to-use.
FR 3.786	The solution will have in-built capability to create purchasing documents, legal contracts with clauses, terms & conditions etc. and stored in a structured manner. The output could be PDF MS Word or XML file.
FR 3.787	Functionality for empanelment/registration of suppliers on the portal.
FR 3.788	Provision to create different questionnaire for different product categories and services.
FR 3.789	Supplier will be able to register or apply for certain product or services themselves over internet by entering/answering basic questions.
FR 3.790	Based on supplier selection or application, a questionnaire can be sent to supplier in a secured manner to get more information.
FR 3.791	The quotations can be categorized.
FR 3.792	Questions can be answered through texts, checkboxes, yes/no with validity.
FR 3.793	Designated person can check and review answers of the questions and then approve or reject the registration request.
FR 3.794	There will be supplier directory to check different supplier with their statuses.
FR 3.795	Potential suppliers can be confirmed to be supplier of materials or services.
FR 3.796	Supplier will receive administrative login and password information so that they can maintain their own information online.
FR 3.797	After approval, supplier will be able to get notification for tenders, purchase order etc. to collaborate with purchaser.
FR 3.798	Suppliers will get administrative role to create other user ids for their organizations to carry out different purchasing activities according to different roles.
Contracts Management	
FR 3.799	Functionality to facilitate AITL, users and/or stakeholders to engage in full management of Contract Lifecycle from Contract drafting, review from multiple perspective, and creating a final Contract document.
FR 3.800	Functionality for AITL users to retain an overview of their contractual agreements of all sorts. These contracts may vary widely in terms of intended content as well as their possible legal and financial consequences for execution, renewal and denouncement.
FR 3.801	Availability of user friendly functionality to enable efficient contract management, tracking of contract deadlines, renewal, cancellation and reporting as well as cost assignment.
FR 3.802	The contract management solution shall integrate seamlessly within the ERP modules as well as the AEE solution.
FR 3.803	Functionality in the contract management solution to facilitate searching and managing contractual as well as financial data flow.

FR 3.804	Functionality for Template based contract development process.
FR 3.805	Functionality for enhanced contract reviews to reduce risk and enhance predictability, help business achieve higher profits in terms of time, money, stakeholder's satisfaction.
FR 3.806	Functionality for standardization contracts across the AITL organisation.
FR 3.807	Functionality to Build contracts basis prior experiences by applying learning through predictive & intelligent technology-led methodologies.
FR 3.808	Functionality for reduced turnaround time to review contracts with better consistency to provide better support to business.
FR 3.809	Functionality for digital repository of contracts throughout lifecycle to develop & leverage knowledge.
FR 3.810	Functionality for online legal support from experts to support AITL team on various aspects throughout contract lifecycle management.
FR 3.811	Functionality for capture and active management of contract master data of - any form main, individual and collective contracts, addendums, etc. - any type sales, purchase and rental contracts, service agreements, memberships, warranties, etc. - any category or type vendor and customer contracts, internal agreements, etc.
FR 3.812	Functionality for integration with Document Management System for all types of documents (documents stored in an optical archive and pc documents), mails, internal notes and url links.
FR 3.813	Functionality for tracing and alerts management for key dates as terms of notice, renewal dates and other terms or due-dates.
FR 3.814	Functionality for assignment of partners and contacts to predefined roles.
FR 3.815	Functionality for customizable contract status management.
FR 3.816	Functionality for activity and task management.
FR 3.817	Functionality for free definable user fields by contract types.
FR 3.818	Functionality for form / template based printouts.
FR 3.819	Functionality for data change history management (contract versioning, change documents, etc.).
FR 3.820	Functionality to adapt the user interface on contract type level by customizing.
FR 3.821	Functionality for the contract management solution should integrate seamlessly with the overall solution. The existing user authorization elements should be reused and tightly integrated.
FR 3.822	Functionality that the platform should be scalable to handle the load of an enterprise-wide contract management approach for AITL.
Operations, Maintenance and Asset Lifecycle Management	
Properties, Roads, Pipeline, Fibre Network	
FR 3.823	Functionality is required to define a location which is a logical representation in the package, that would represent a property or physical location where any equipment such as meter, value, transformers, switches are installed. A location may also represent a road or a channel where a pipeline is housed.

FR 3.824	Functionality to install any equipment or asset at a location as described above.
FR 3.825	Functionality to map the properties and plots in AURIC to a location in the package with the facility of external and internal number ranges for unique property id's. Land or Plots would be allocated for purposes like: Industrial, Commercial, Residential, Parks & Playgrounds, Educational Institutions & Schools, Hospitals, Police, Fire Services, Roads and Parking Lots, AITL administrative blocks/offices, facilities for supply of electric power, water, gas, telecom, sewage disposal etc. or any other purposes for which AITL wishes to allocate a plot of land. Online bi-directional integration (Create, Modify or Inquire) with the Land Management System (LMS) would also be required. Additionally, integration would also be required with the Document Management System (DMS). Data migration from the LMS to ERP would also be required as the LMS system is likely to Go Live before the ERP.
FR 3.826	Functionality for mapping roads on to location in the package which has linear characteristics.
FR 3.827	Functionality for mapping fibre network channels on to location in the package which has linear characteristics.
FR 3.828	Functionality for mapping pipelines on to location in the package which has linear characteristics.
FR 3.829	Facility to hierarchically structure the locations in the package with no limitations on depth of the hierarchy. This facility is required for mapping of land parcels or plots as per a location or colony in AURIC. Additionally, in a plot the location which would house the meter or the valve would also be at a hierarchical level below the plot.
FR 3.830	Facility to specify the Geographical Co-ordinates for each location/asset or equipment with online bidirectional integration with the GIS system.
Equipment Master	
FR 3.831	Equipment Master should capture the following information: • Equipment ID (With intelligence built in the code) • Manufacturer • Supplier (if Different from Manufacturer) • Serial number • Date of (Purchase, Manufacture, Installed, Overhauled etc.) • Equipment / Component Hierarchy (e.g.: An electric motor can be a component of a major equipment) • Warranty information (timeframe, conditions, company through which the warranty is held, expiration date) • Functionality to define common Faults / Equipment • Functionality to link or attach manuals, operating procedures, graphs and other files to equipment • Installed by • Associated cost, histories and failures of a serialized piece of equipment as it moves throughout a plant or facility • Functionality to track time-related information for Piece of Equipment based on parent Equipment

	➢ Time since new (TSN) ➢ Time since overhaul (TSO) • Functionality to input and track location of the Equipment / Components • Functionality to define multiple maintenance organizations within the company • Functionality to define list of spares required for an equipment
FR 3.832	The system should provide functionality to record equipment or assets related to the following: • Electricity substations, transformers, switches, circuit breakers, feeder lines and other electric network assets necessary for supply of power to AITL users. • Water pumping stations, storage tanks, purification plants, water mains, valves and other water network assets necessary for supply of clean water to AITL users. • Waste water drains, man-holes other waste-water network assets necessary for providing sewage facilities to AITL users. • Storm water drains and rain harvesting pipes and equipment. • Telecom network of fibre, cables and switches. • Street lights, traffic lights (future) and other traffic management/road management equipment (future). • Solid waste bins and sewage treatment equipment and plant. • Vehicles and other fixed assets like furniture, buildings, office equipment. • SCADA infrastructure will be interfaced to generate automatic alarms. • AMR infrastructure will be interfaced to generate automatic billing.
Resource Master	
FR 3.833	Functionality to record the details of maintenance engineers / technicians.
FR 3.834	Functionality to record skill sets against the employee record.
FR 3.835	Functionality to maintenance groups to assign responsibility of the equipment.
FR 3.836	Functionality to maintain hourly rates for resources.
Preventive / Predictive Maintenance	
FR 3.837	Functionality to create preventive / predictive maintenance schedules for all the equipment.
FR 3.838	Functionality to create preventive / predictive maintenance schedules for all the locations as logically defined in the system.
FR 3.839	Functionality to create preventive / predictive maintenance schedules for linear assets and their associated locations as represented in the package.
FR 3.840	Functionality to prepare preventive / predictive maintenance check sheets for each equipment / component. Predictive maintenance check sheets should have provision to record discrete values (E.g.: Current, Temperature, Vibration etc.).
FR 3.841	Functionality to define tolerance limits for key parameters like current, temperature etc. The limits should be equipment / component specific.
FR 3.842	System should have functionality to provide planned costs for all the planned work based on maintenance schedules.

FR 3.843	System should have necessary provisions to use master data properties to arrive at the planned costs and also must have integration with financials for reporting of both planned and actual costs.
FR 3.844	Functionality to create preventive / predictive maintenance schedules based on any of the following parameters.
FR 3.845	Operating hours (E.g.: For every 5000 hrs.).
FR 3.846	Time based (E.g.: Daily, Weekly, Bi-Weekly, Monthly, Quarterly, Yearly etc.).
FR 3.847	Combination of Operating hours / time (whichever comes first).
FR 3.848	User defined rules (E.g.: If the observations of predictive maintenance are beyond acceptable limits, new preventive maintenance can be scheduled).
FR 3.849	Functionality to designate a parent / child relationship based on type of maintenance (E.g.: Changing a pump requires various other maintenance operations to be performed).
FR 3.850	Functionality to automatically generate work orders based on the preventive / predictive maintenance schedule.
Notifications	
FR 3.851	System should have functionality to create notifications for planned and unplanned work The system should provide the creation directly on the ERP or through an online bi-directional interface with the, Portal, CFC, and/or Kiosk for any grievance, complaint, service request or any other reason. For example, these notifications could be related to: • Water or Electricity connections, fault repair etc. • Water and Waste Water Networks including water mains, valves, pumping stations, purification plants, filtering equipment, flow meters, drains, man holes etc. • Electricity Networks: including substations, transformers, circuit breakers, energy meters etc. • Service delivery relating to Water, Waste Water, Storm Water, Telecom. • Solid Waste collection and management. • Traffic, Road and Street Light Management. • Parks and Community Facilities. • Other reasons including complaints and grievances.
FR 3.852	System should allow creation of notification from multiple sources e.g. from portal / apps etc. whilst capturing all details of property customer etc as required by AITL.
FR 3.853	System should have capture the details of the complainant in case of reactive maintenance.
FR 3.854	System should have necessary functionality to capture the status of the service requests.
FR 3.855	System should maintain a complete audit trail from registering and managing of an incident to its conclusion.
FR 3.856	The system should provide functionality to automatically segregate the notifications with different notification types as per AITL needs and automatically route them to an appropriate resolver group or scheduler for further creation of a work order if required.

Work Orders	
FR 3.857	Functionality to automatically convert a notification into a work order. AITL requires functionality for multiple work order types as there would be multiple resolver groups and it is necessary to segregate and do reporting on the work orders based on the work order type. For example, these work orders could be related to: • Water or Electricity connections • Water and Waste Water Networks including water mains, valves, pumping stations, purification plants, filtering equipment, flow meters, drains, man holes etc. • Electricity Networks: including substations, transformers, circuit breakers, energy meters etc. • Fibre optic network • Service delivery relating to Water, Waste Water, Storm Water, Telecom • Solid Waste collection and management • Traffic, Road and Street Light Management • Parks and Community Facilities • Other reasons
FR 3.858	Functionality to generate notifications and/or work orders for the following types of maintenance: • Breakdown Maintenance • Preventive Maintenance • Predictive Maintenance • Incident Management • Inspection • Calibration / Testing Others (Modification, Major Overhaul, Design upgrades etc.). The user should be able to define the notification types.
FR 3.859	Functionality is required for managing Incidents like a Burst Water Mains, Major Fire or Power Break Down. Announcements and Messaging on Bulletin Boards would be required. Additionally, multiple citizens may call regarding the same incident, resulting in multiple work orders being raised thereby unnecessarily flooding the maintenance teams with work. In such an emergency situation, the system should prevent duplication of work orders.
FR 3.860	The system should allow creation of a planned as well as reactive maintenance work orders for a location as represented in the package.
FR 3.861	The system should allow creation of a maintenance work order for a linear asset and its associated locations as represented in the package.
FR 3.862	Automatic notification and/or work order creation for alarms raised via the SCADA system. If necessary, the MSI may have to develop a real-time interface to achieve this functionality.
FR 3.863	Automatic notification and/or work order creation if a user raises any problem with an AITL asset like a street light through the portal. If necessary, the MSI may have to develop a real-time interface to achieve this functionality.
FR 3.864	Automatic notification and/or work order creation if a customer services representative in the call centre raises any problem with an AITL asset like an open

	manhole or pot-hole in the road through the portal. If necessary, the MSI may have to develop a real-time interface to achieve this functionality.
FR 3.865	ERP system should be capable to accept breakdown requests through any means with complete status tracking of these work orders till resolution via the Portal. Functionality should be available to AITL users as there would instances where the work order (or part of a work order) is outsourced to a vendor or 3rd party for resolution or execution. Integration of Works Management with Procurement Functionality of the ERP is required as the Vendors would be required to perform the work against a long-term contract with a quantity or value limit or a single. purchase order.
FR 3.866	Functionality should be provided by the system, for furnishing work order level details whilst assigning work to Vendors. This would enable the Vendors to submit invoices and AITL to track maintenance and service delivery expenses with traceability of work performed at work order level.
FR 3.867	Drill down functionality is also required at work order level to verify the status of each task or operation which are included as a part of the work order.
FR 3.868	Functionality to have workflow routing for work orders.
FR 3.869	Functionality to track the status of a work order. System should be able to support the following status: • Initiated / Waiting for Approval / Prepared / Planned • Waiting for material • Released / open (equipment down) • Completed / Cancelled • Soft Closing / Finally Closed
FR 3.870	Functionality to include the following information in work orders: • Work Order Start and End Date • Type of work order (preventive maintenance, predictive maintenance, breakdown maintenance etc.). • Type of work (electrical, mechanical, etc.) • Equipment identification and description • Priority (E.g. Urgent, Normal etc.) • Designated duration of work order (start/end date and time in minutes) • Where was work performed (location, site) • Nature of the problem • Customer (requestor) and method of contact • Date of (Problem reported, work completed etc.) • Resources required (labor, materials, equipment and tools) • Resource ID numbers • Resource availability • Lockout / tag-out procedures • Required permits • Testing requirements (to validate repair) • Detailed work plan (tasks or operations to the performed, planned time & resources for each operation, task sequencing and dependencies). System

	should have functionality for automatic cost planning of a work order which would include planned overhead allocations. • Fully integrated real time capture in the work cost details: Actual usage (labor time by employee id, parts, equipment time, time to complete and date completed). Out of the box functionality is also required to periodically review the work orders for allocation of overheads and settlement of variances. • Description of actual work performed • System should have functionality to create quotations for the work that need to be charged to customer. Should be able to produce an itemized quotation. • System should have provisions to proceed or not to proceed with quotations depending upon customer's decision. • Should have functionality to bill the customer for services rendered and material consumed, must produce an itemized bill. • Equipment issues • Equipment condition • Cause of problem • Test results • Date and explanation of past work done on the equipment (type of work, nature of the work, completion time, employees who participated in the work). • Prepared by
FR 3.871	Functionality must be there to manage the warranty aspects of an equipment or any component or any spare part used in an equipment.
FR 3.872	System should have functionality to track components/ spares used in an equipment with details like serial number/ manufacturer etc. and must have functionality to manage any component / spare part movement with complete audit trail.
FR 3.873	Functionality to capture at work order level maintenance cost details like labor, costing of materials, services, overhead etc. (external or hired labor, specific maintenance group, etc.).
FR 3.874	Functionality to compare the actual labor hours entered by the technician to the standard labor hours estimated to accomplish the work.
FR 3.875	Functionality to calculate labor costs based on type of hours worked (regular, overtime, periodic, corrective, breakdown, reactive, equipment modification, etc. by target rate).
FR 3.876	Functionality to automatically generate notifications/work orders based on the preventive / predictive maintenance schedule.
FR 3.877	Functionality for configuration of a work order type, without any source code change of the ERP package.
FR 3.878	Functionality to create work orders with varying work order types depending on the nature of the customer grievances or calls.
FR 3.879	Functionality of automatic integration of the Customer Services Portal to maintenance notification and/or work order creation.
FR 3.880	System should have provision to print notification / work orders with detailed instructions for delivery of the job.

FR 3.881	System should have functionality to update customer about the progress of the job and information may be transmitted by different modes e.g. updates on portal or SMS or Status update on APP.
Maintenance History Management	
FR 3.882	Functionality to track general maintenance history data: • By Equipment Identification number, work order number etc. • By Location where service was done • By Maintenance Sections involved in the service
FR 3.883	Functionality to use maintenance history to assist in maintenance projections (i.e. resource usage during peak times).
FR 3.884	Functionality to track spare parts consumed against an equipment.
FR 3.885	Functionality for automatic updation of maintenance history for an equipment or location (as represented in the system) by a work order.
MIS	
FR 3.886	Functionality to generate downtime report with the following details: • Equipment details • Reason for failure • Corrective action taken • Spares consumed • Work-order details
FR 3.887	Functionality to generate downtime reports: • Equipment-wise • Location-wise • Year to date
FR 3.888	Functionality to generate reports on the following for each equipment: • Mean Time Between Failures (MTBF) • Mean Time to Repair (MTTR)
FR 3.889	Functionality to generate following reports for maintenance: • Number of work orders issued and closed per month • Types of work orders opened and closed per month • Number of work orders generated per department • Number of work requests awaiting approval (total, by work order owner and by department whose approval has not been received). • Regular versus overtime hours • Planned versus unplanned costs, hours, usage, etc. • Downtime of equipment per work order, year to date, previous year, etc. • Effective production hours per day • Cost rates by resources • Cost by work type • Maintenance schedule compliance as a percentage of maintenance planned or scheduled jobs completed in a month.

	• Number of work orders generated from PMs • Maintenance cost / Actual cost comparison for each equipment • Productivity measurement of manpower • Should have functionality to roll up planned / actual costs / planned hours/ actual labour hours consumed by different organization entities other than work order e.g. by department owning the asset. • Must have functionality to link technical assets with financial assets to provide asset lifecycle including non-cash expenses like depreciation.
FR 3.890	Functionality to measure and generate reports to monitor Levels of Service of a work order or a task associated with the work order.
FR 3.891	Functionality to generate an aggregated Levels of Service reports for various types of customer calls or work order types to monitor the performance levels of service delivery to stakeholder (citizens, industrialists, residents etc.).
Projects and Works Management	
FR 3.892	**Capital Investment Planning –** To enable investment lifecycle management starting from short term / long term capital investment planning based on organization structure or any alternative structure that represents capital investment control organization, investment ideas, approval or rejection of investment ideas; allocation of funds for approved projects.
FR 3.893	**Project**: To enable project managers to better identify, select, prioritize, and manage projects. Including key performance metrics on budgets, schedules, and staffing. Solution to provide a centralised view of performance and at-risk elements. To also enable project managers to work closely together with team members and management. The comprehensive project management solution should enable AITL project managers to manage schedules, resources, assigned documents and materials, costs, and budgets. Team members need to be notified via workflow when they need to fulfill their project-related tasks thereby facilitating monitoring and control. Should have functionality to manage capital related work as well as operational expenditure.
FR 3.894	**Scheduling Functions:** To be able to schedule forwards and backwards according to the relationships between activities. Constraints need to be taken into account, with earliest and latest dates calculated, and floats determined. System should have integration facilities available for interfacing between third party products e.g. MS Project or Primavera.
FR 3.895	**Document Management:** Integration for drawings, technical specifications and other relevant project documents.
FR 3.896	**Costs:** The ability to plan costs using easy cost planning or by making use of the network calculation of internal and external work, services, and procurement planned in activities that are automatically calculated. The ability to map projects to internal orders or cost planning elements (WBS) elements to plan costs based on resource staffing and cost rates. Should have provision to maintain multiple versions of planned costs including base project cost plans, revisions in planned costs i.e. forecasting, calculation of estimated cost to complete. Should maintain a complete audit trail of changes carried out to any type of planned costs.

	Must have provision to provide necessary restriction to different users for carrying out different activities related to planning of base costs and / or revision to original cost plans.
FR 3.897	Cost planning should have alternative options available from rough cut planning to detailed cost planning according to different stages of the project as the project progress.
FR 3.898	**Budget** the ability to control all expenditure during the execution phase. Additionally, the ability to break down the original budget into smaller packages of released budgets to allow an even more accurate availability control. System should have functionality to generate alerts based on pre-defined rule(s) in case of actual expenses or commitments exceed pre-defined limits.
FR 3.899	Resource and Time Management: The ability to assign resources and record time to resources assigned to any project or WBS- including for internal and external resources.
Project Execution	
FR 3.900	The solution must enable the execution of a project based on the project plan including creation of documents, simulation of alternative project structures and analytics using Project system.
FR 3.901	AITL wishes to implement collaborative access to project documentation.
FR 3.902	**Confirmation** The solution must enable confirmation of actual time and costs for projects. The times entered become the actual times and costs for the project. Full change and cancellation handling are required. Approval of the time entered by appropriate authority should be available.
FR 3.903	**Project-Oriented Procurement/ Repairs**: Purchase Orders for goods and services will need to support multiple projects/WBS. Similarly, a single work order for repairs at the workshop may service multiple projects/WBS. System should have capability to identify goods procured for a specific project.
FR 3.904	**Claim Management** AITL requires to track contract variations, change requests, e.g. scope, as well as handling claims and/or disputes, this will include costs and/or income. Should have functionality to manage the approvals for claims recorded.
FR 3.905	**Project Cash Forecast** During execution, need to integrate project cash management and provide accurate information on incoming and outgoing payments.
FR 3.906	**Project Progress:** analysis/earned value analysis will be needed to determine planned and actual project progress values. Need to provide information on the state of projects and how they are developing. Need to display milestone trend analysis with the relevant dates in a project at different report dates. This is required to analyze/forecast periodic statuses to include costs (e.g. actual, value of work done, forecast), income and outputs.
FR 3.907	**Progress Tracking**: Required to closely monitor the progress of tasks and activities and monitor project specific purchase orders. User should be able to raise as well as manage escalations as and when required.
FR 3.908	**Phase Approvals**: Required to protect phase approvals by a structured approval process including decision makers named by AITL corporate policies and digitally signed approval documents. Workflow is required to support an efficient and effective process.

FR 3.909	**Procurement Process** must be able to access data from across AITL departments and projects and consolidate the procurement process to provide a structured overview.
FR 3.910	**Project Reporting**: Need a flexible, comprehensive information system to monitor and control project data. Need to evaluate individual projects, partial projects, or multiple projects. Include overview reports and reports offering various degrees of detail is designed to meet the needs of both project management and ordinary project personnel. AITL wishes to analyse expenditure by asset types.
FR 3.911	**Project Structuring:** Required to create work breakdown structures (WBS) and networks, with their attendant activities and milestones. Structure a project using phases, tasks, checklists, and checklist items Integration may be required with external project scheduling package. System should have functionality to provide master project templates that can be used to create project structures especially for repetitive nature of projects.
FR 3.912	**Project Costs**: Required to plan costs using easy cost planning or by making use of the network calculation of internal and external work, services, and procurement planned in activities that are automatically calculable. Integration may be required with external project scheduling package.
FR 3.913	**Budget** Require budget availability controls for all project expenditure during the execution phase. Additionally, the original budget to be broken down into smaller packages of released budgets to allow accurate availability control.
FR 3.914	**Scheduling Functions** Requires scheduling capability of forwards and backwards task movements according to the relationships between activities. Constraints are taken into account, earliest and latest dates are calculated, and floats are determined. Additionally, require both bottom-up and top-down scheduling.
Project Accounting	
FR 3.915	Project Accounting: The solution must enable the precise planning, budgeting and monitoring of detailed activities costs of a project, both large scale such as building a treatment plant, and small scale projects. It is expected that Project accounting will fulfill different purposes in different phases of the project: • Help calculate the level of costs and the expected revenues when planning a project. • Once the costs have been approved, it will form the basis for allocating the budget. • During project execution, it must monitor and check variances in the costs. • Must meet the requirements of local accounting standards for construction related projects. Must assist the project manager to ensure that the project is executed efficiently, on time, and within budget - which he or she achieves by ensuring that the required resources and funds are available as and when needed. AITL requires to report benefit achievements by project categories.
FR 3.916	AITL requirement to analyze work in progress by planned asset class to ensure prompt recovery of capital taxation allowances.
FR 3.917	AITL requires to estimate, plan & capture OPEX impact of capital investment.
FR 3.918	AITL may have some assets where value requires calculating/grossing up as provided by 3rd party.

FR 3.919	Integrated Planning and Tracking: AITL requires detailed financial integration including budgeting, cost planning and actual costs confirmations and commitments from various sources.
FR 3.920	Settle Financial Data: required to transfers costs to Financial Accounting, Asset Accounting and Management Accounting to establish cost of equipment for use in maintenance decisions regarding economic value of renewal.
FR 3.921	Development Collaboration require to optimize a cross-enterprise asset/project development with internal and external teams including the sourcing of complex components. This requires a consistent central storage of all relevant data during the entire collaboration process and a secure integration of external partners and suppliers.
FR 3.922	Automatic generation of requisitions for procurement of materials and/or services required for a Project. The material/services should be made available to the project neither to too early nor too late.
FR 3.923	Goods receipt of material and/or services specific to a project should load the costs on to the WBS. The material thus received should be reserved for the particular project and not be issued for other purposes.
FR 3.924	Cost roll up: functionality should be made available to roll up costs from one WBS to another.
FR 3.925	**The Projects module shall provide functionality for:** • Classification of Works based on their types • Maintain Vendor details • Maintaining rate schedules and revising the same • Defining a Project with Work Breakdown Structure • Estimation and submission for review and approval by the competent authority • Technical Sanction • Administrative Approval as per the workflow defined • Integration with e-Tendering (provided by outsourced agency) • Awarding Work Order to a vendor • Facility to track the project status by project code through portal. • Facility to input / upload data upon the measurement/progress of work done. • Provision to enter site inspection details/report in the system or upload site visit report • Completion Certificate • List of Projects - Projects-wise, location-wise reports etc. • Project status report
Human Resource (HR) and Payroll System	
HR Management	
FR 3.926	Talent Management: Require the ability to consolidate all the strategic employee development processes spanning the employees' career with the company from hire to retire, including recruitment, education, career development, and performance management. This should also encompass the company view of employee

	development, identifying and tracking high potential employees to ensure future leaders can be effectively promoted from within and that successors are identified for key positions.
FR 3.927	Employee Self Service: Requirement is to enable employees to do such as access their records to check personal information and update likes of addresses, contacts, next of kin, bank details in lines with best practice. To enable people managers to process authority to recruit, authority to appoint, changes to terms and conditions and with built in work flows to enable forwarding for authorisations and governance and ultimately flowing to personnel records update and generation of appropriate letters or contractual change conformations.
FR 3.928	Manager Self Service: Requirement for people managers to process authority to recruit, authority to appoint, changes to terms and conditions and with built in work flows to enable forwarding for authorisations and governance and ultimately flowing to personnel records update and generation of appropriate letters or contractual change conformations.
FR 3.929	Case Management: Requirement to track progress of Absence Disciplinary and Grievance Cases and monitor performance of Unit/Team or Individual and with the requirement to attach Microsoft Word or Scanned Handwritten letters to Case files.
FR 3.930	Performance Monitoring: Requirement to categorise transactional queries and escalate to Team Leader where SLA's are in "amber" or "red" status requirement to produce metrics relating to activity work load by Team and Individual. Integration required with the customer interaction portal, which would provide the source data for the transactional queries.
FR 3.931	Requirement to capture details of contractors and consultants who might be paid through the procurement process via third parties.
FR 3.932	Workforce Analytics: Requirement the ability to produce metrics and Organisation charts relating to work force. Ability to do organisational modelling and workforce planning.
FR 3.933	Employee Performance Management: Requirement to provide a flexible framework to integrate corporate goals and strategies with team and individual goals as well as integrate management-by-objectives. It should also provide functionality Requirement to be able to tie compensation to performance.
FR 3.934	Requirement to be able to capture individual development plans to roll up to training plans.
FR 3.935	Requirement to allow individual training courses and development steps to be displayed and monitored.
FR 3.936	Requirement to be able to produce metrics to show the distribution of individual performance within teams, departments, organization.
FR 3.937	Require the ability for each employee to manage their career paths and aspirations, either through self-service capabilities or as a result of planning with their managers. This should include Requirement the ability to match profiles against positions to determine skill and knowledge gaps which in turn are linked directly to training plans to fill the necessary qualifications. Require the ability to build structured career paths to give the employee guidance as to what the career progression might be based on their job within the organization.

FR 3.938	Compensation and Benefits Management Requirement: to operate Flexi Benefits including the ability to make payments to 3rd parties for provided benefits.
FR 3.939	Requirement to manage pensions administration as per AITL policies and rules.
FR 3.940	Require the ability to streamline and integrate essential workforce processes such as employee administration, payroll, time management, absence recording, and legal reporting. This should enable the company to standardise and consolidate all workforce-related processes and data onto one platform, and ensure that adherence to local regulations and laws can be attained. Requirement to provide a central repository for employee data integrated fully with other business applications, especially maintenance and service delivery.
FR 3.941	Requirement to "electronically" file documents including handwritten scanned letters to an employee personnel record requirement to produce individuals, teams and departments attendance / absence matrix and to "count down" sick pay entitlement, raise necessary alerts and correspondence are all requirements.
FR 3.942	Time and Attendance: Requirement to optimise processes for planning, managing, and evaluating the working times and activities of internal and external employees via the Time Management capabilities.
FR 3.943	Requirement to link AITL overtime rules to payroll to enable paperless/e-enabled automated authorisation and processing for payment to enable employees and managers to view attendees, holidays etc.
FR 3.944	HR Processes and Forms: The ability to automate paper-intensive and time-consuming employee-related processes such as hiring, termination, organisational reassignment, and maternity leave. Data entry and flexible workflow templates are required to enable the AITL to handle routine workforce processes quickly.
FR 3.945	To allow users to create project teams based on skills and availability, monitor progress on a project, track time, analyze results, and much more. The solution should empower users to eliminate redundant or ineffective projects, optimize productivity through the smarter use of resources, and manage the workforce as efficiently as possible.
Payroll Management	
FR 3.946	Ability to maintain leave records for computation of increments/pay revision with retrospective effect.
FR 3.947	In addition to the standard payroll functions, the system should also comprise the following India-specific functions: • Indirect Evaluation • Basic Increments • Dearness Allowance • Housing • Car and Conveyance • Long Term Reimbursements • Fringe benefits • Income Tax • Third Party Deductions • Income from Other Sources • Tax on Arrears

	• Exemptions • Exemption on Leave Travel Allowance • Exemption on Medical Reimbursements • Exemption on Medical Insurance • Exemption on Child Education Allowance • Exemption on Child Hostel Allowance • Exemption on Other Allowances and Reimbursements • Exemption on Leave Encashment • Previous Employment Tax Details • Professional Tax • Provident Fund • Employee State Insurance • Labour Welfare Fund • Nominations • Minimum Net Pay • Recovery of Rounding off Amounts • Loans Enhancement • One Day Salary Deduction • Mid-Year • Termination Work Bench • Gratuity • Superannuation • Forms as applicable
FR 3.948	Ability to support configuration and parameterization of different pay components including facility to add/modify/delete pay components.
FR 3.949	Ability to maintain employee data cost centre wise.
FR 3.950	Ability to define pay structures at various levels and types (such as permanent, contract employees, consultants, trainees etc.).
FR 3.951	Ability to support calculation of different allowances based on user-defined criteria.
FR 3.952	Ability to maintain all pay related rules (user definable) for automatic maintenance/ updating of data.
FR 3.953	Facility to indicate carryover and partial recovery.
FR 3.954	Ability to generate monthly balance and cumulative balance position of various accounts related to payroll for user definable periods.
FR 3.955	Ability to support withholding of any amount recoverable from employee against salary, Gratuity and other dues payable to employee.
FR 3.956	Ability to enter, administer and perform payroll for company loans, Voluntary Deductions, Recurring Payments/Deductions and additional payments.
FR 3.957	Ability to prorate salary and allowance payment based on employee hire or resignation date.
FR 3.958	**The System must cater to:** • Keep records of Sanctioned Posts • Employment in case of Death of any employee - Compassionate recruitment

	• Capture Employee Data – Employee Master • Employee Promotions • Transfer of staff • Leave Management • Enquiry, Punishment Process • Annual Confidentiality report • Maintain Service Book
FR 3.959	**Payroll Process:** • Keep records of Sanctioned Posts • Employment in case of Death of any employee - Compassionate recruitment • Capture Employee Data – Employee Master • Employee Promotions • Transfer of staff • Leave Management • Enquiry, Punishment Process • Annual Confidentiality report • Maintain Service Book
FR 3.960	**Employee Self Service:** • Keep records of Sanctioned Posts • Employment in case of Death of any employee - Compassionate recruitment • Capture Employee Data – Employee Master • Employee Promotions • Transfer of staff • Leave Management • Enquiry, Punishment Process • Annual Confidentiality report • Maintain Service Book
FR 3.961	**Reports:** • Attendance Register • Employee Detail Register • Transfer Detail report • Employee Pay Slip • Salary Summary Individual Report • Professional Tax Report • Pay Comparison Report • Bank Report • Yearly Salary Sheet Report • Income Tax Deducted Report • TDS Reports • Form 16 • Payroll register • Performance Report Appeals • Grievance Report (status, date of event and final ruling)

	• Workers compensation • Disciplinary actions (paid/unpaid etc.) • Future leave approval (e.g., approved, deferred, rejected) • Leave status (vacation, sick, injury or any other user definable field)
Water Utility Management and Billing	
FR 3.962	**Customer Service Management:** Need to support all services oriented customer business processes. This includes the operation of customer facilitation centres with specific service processes such as customer billing, service order management, complaints & returns management, account & contact management and as follow-up process case management. An Internet-based self-service solution for occupants (lease holders or tenants) of a property or premise is also required. Hereinafter in reference to the detailed functionality related to water utilities, the term occupant includes lease holders as well as tenants.
FR 3.963	Service Order Management with Utility Billing: • Need service order management with billing to enable AITL to manage service businesses over the entire service life cycle process. • From service contact to create, assign processing and monitoring of service requests to the management of customer connections and installed equipment/devices. • Visibility of warranty and entitlements and the billing of time (effort) and materials spent on the work order. • To ensure service level targets are met, improve customer satisfaction. • Reduce costs and increase revenue by reducing the service-to-cash cycle. • Improve service quality through 24x7 customer service - support multichannel interaction - collaborate with customers. • Must be able to record and track all interactions with the customer no matter what the medium e.g. telephone or Fax etc. • All customer tracking information should be presented to the service agent in a simple and standardized format.
FR 3.964	Service Order Quotation: Need to offer a service order quotation before concluding the actual service order. This gives customers the opportunity to find out more about prices and delivery conditions before agreeing to the service order. Particularly important for Developer Services, Customer Side Leakage.
FR 3.965	Service Order Processing: • Need to allocate items to multiple external and internal recipients. These may be either billable or non-billable because of warranty claims, and they may stem from service orders or service confirmations. • Assign internal and external recipients when creating the service order or service confirmation. • When creating an amount allocation document, the bill-to party and invoice value are to be copied from the service order or service confirmation. Subsequently, the user will still be able to process or edit this data in amount allocation. • Functionality must allow for sign off / authority levels to be complied as per AITL policy.

FR 3.966	Service Confirmation Processing: Ability to confirm working times, materials used, and expenses for services performed. Plan these confirmation items in a service process (for example, a service order) or an in-house repair order. The field service representative should then be able to reference the work order for further action to complete the required business process.
FR 3.967	Billing: Need to create invoices in the name of occupants using one or more billing due list item. Ability to create the invoice with reference to the rate charged, delivery, or to the sales order. Additionally, need to create bill or invoices with reference to contracts.
FR 3.968	Service Contract and Quotation Analysis: Need to be able to monitor customer satisfaction with services performed under contracts. Identify contract products/services with a high net value and produce an overview of the value and volume of active service contracts. Report which particular contracts the service employees are responsible for. Functionality must support monitoring and reporting the appropriate levels of customer satisfaction.
FR 3.969	Service Order and Quotation Analysis: Need to be able to report on current order volumes and support forecasts about fluctuations in business volumes for the forthcoming year. Need to take measures, e.g., to plan resources according to seasonal peaks or offer customers special service packages during quiet periods. Report by Customer Sector and Segment.
FR 3.970	• Customer Service Processes: Must be able to support all occupant-related processes within our customer facilitation centre environment(s) or self-service through the portal. For instance a partial list of these processes would include: ➢ move in ➢ move out and if required refund of security deposit ➢ meter-reading ➢ entry ➢ bill correction • Customer Service Process (Collaborative): ➢ Instalment Plan Request ➢ Disconnections ➢ General Inquiry ➢ Billing Inquiry • Process New Connections request and management of security deposit: ➢ Budget Billing Request ➢ Convert a temporary water connection to a permanent connection • Process Temporary Water Connection request and management of security deposit • Customer Master Data Changes
FR 3.971	The system must allow the new connection request to be made by an lease holder of a premise or property. In case of an apartment block or building the property or premise may refer to an apartment.
FR 3.972	The system must allow a Move in/Move out process for an occupant for a property or premise.

FR 3.973	Identifying Account for Utility Service Processes: • During a customer contact, need to be able to use the multi-channel interface (telephone, E-mail, chat, and so on) to identify an account in the system. • Once account is identified and confirmed, the system provides customer information, such as the address, account balance, bills, dunning, credit, and information on past customer contacts. • Need to be able to initiate business processes for a customer in the customer facilitation centre. And in addition, identify the premise, contract account objects and associated service zones.
FR 3.974	Changing Account Data and Business Agreement Data: The call agent must be able to change account data or business agreement data. The system must allow the account and/or business agreement to be entered into with the occupant of a property or premise.
FR 3.975	Master Data Overview (Account, Business Agreement, Consumption): During a customer contact, call fact sheets for an account, business agreement, and specific consumption data for an account in the system. To provide quick overview of the existing data, and to allows selection of individual objects from the overview (such as a bill) to be displayed in detail.
FR 3.976	Processing Move-In: Be able to create a move-in in the Citizen Facilitation Centre (CFC) as well as via the portal.
FR 3.977	Processing Move-Out: Be able to create a move-out in the CFC as well as via the portal.
FR 3.978	Processing Move in/Out for Account: Be able to create a move-in/out for an account in the CFC as well as via the portal. The account for move-in and move-out remains constant but the premise changes.
FR 3.979	Processing Move In/Out for Premise: Be able to create a move-in/out for a premise in the CFC). The premise for move-in and move-out remains constant but the account changes.
FR 3.980	Entering Meter Readings: Ability to enter, check, and save the current meter reading. The meter reading may be estimated if an account cannot be accessed by a meter reader.
FR 3.981	Changing Budget Billing Plan: Ability to change the budget billing plan. This could be done by changing the budget billing amount or the meter reading.
FR 3.982	Bill Information/Bill Correction: Ability to add/change information to a bill and to correct it if the meter reading is incorrect.
FR 3.983	Malfunction Notification / Service Notification: Ability to create a malfunction notification in the system. There are different categories of malfunction (for example, meter not recording or recording inaccurate) with different reference objects (for example, connection object, apartment, meter).
FR 3.984	Functionality for the customer agent to escalate an exception.
FR 3.985	Managing Financial Inquiries in Facilitation Centre: Enable customer agents to handle all types of finance-related inquiries with customers by providing access to finance-related data e.g. in the Invoice Display, Payment List, history or reminders and Balance Forward List of the Account or Business Agreement confirmed. The customer agent must be able to access the account balance for the customer's

	business agreements in a customer contact and display additional information (e.g. next due instalment, last payment or the last dunning notice for the business agreement) as well as a list of documents/document items grouped by several grouping criteria (e.g. all open items, all items included in a reminder letter/communication).
FR 3.986	Processing Payments: Need to generate call lists from the reminder communication and reminder batch run, which are then available for use in the Facilitation Centre to chase customers by telephone/Internet and request payment for open items. Agents should be able to display the call list size, the period, or the duration of the call list, the number of customers, and the names of the customers who are to be called. They can also review the information to be obtained from the customer if the call list is assigned a script. The agents can gather information before they begin answering calls or calling customers themselves. Resulting from the conversation with the customer, and then take payments from the customer for the due items for chasing and create deferral for open items.
FR 3.987	Change Service Location Data: Need to be able to change all relevant service location data (connection object, premise, and point of delivery) during contact with a customer. After identifying the premise, the call centre agent should be able to access the maintenance view for the service location. Here, the agent can change the connection object address, add additional premise data, or determine the grid for the point of delivery, for example.
FR 3.988	Service Contract and Entitlement Management: Service contract and entitlement management enables all service entitlements – warranties, extended warranties, service contracts, and service level agreements to be defined and tracked. Service agreement terms can be adapted and created to suit the varying and diverse requirements of the customer base. When service calls are placed and service orders created the appropriate entitlement information is associated with that activity and can be checked by a service representative or via Web self-service at any time. Particularly used for Customer Side Leakage or Developer Services.
FR 3.989	Complaints and Returns Management: AITL requires complaints management which allows it to easily create, manage and track complaints and returns. Customers can request their preferred action including credit, refund, or replacement of the specified product and installation. Customer Agents are provided with all relevant information to make effective decisions and can take immediate action to comply with the customer request.
FR 3.990	Warranty Analysis: Need to provide information about the amount of products/services with or without warranty, and monitor expired warranties.
FR 3.991	**Collecting meter readings in the metering database**: The system shall have the ability to enter single meter reading as well as transfer meter reading from an external system.
FR 3.992	The system should also be capable of interfacing with Spot billing devices and Meter Reading Instruments for uploading such meter readings data including consumer meter readings. The data of all such meters will normally be downloaded on an external server.
FR 3.993	System should provide data validation checks to minimize data entry errors. It should incorporate user supplied logics to check variations in consumption and generate exceptions. After data entry, the system should generate an Exception Report for

	non-reading of meters due to any reason. It shall also highlight possible inconsistencies in the metering data. After handling of exceptions by the respective officials, the system should be updated with the result of exception handling. While validating, if the meter reading found low / unacceptable based on earlier readings/trends the system should issue a work order for checking and replacement of meter. If the work orders are not closed with valid reason system should escalate the issue till the same is resolved.
FR 3.994	**Data Review** The system should provide the facility for the designated officials to review the metering data as per utility defined criteria. In case any discrepancy is found, the system will allow the data to be edited, with proper access rights and audit trails.
FR 3.995	**Provision to interface with AMR** The system should be able to interface with Automatic Online Meter Reading devices. System should be capable to schedule and collect automatically readings from online connected consumer meters / zonal meters through automatic meter reading system. The system should generate exception in case meter reading found unacceptable after validation check.
FR 3.996	**Capturing Meter reading Data** The system should be capable of capturing meter reading data from a Meter Reading Book, handheld computers used for spot metering & billing for uploading and downloading the data. System should be capable to upload and download the data for a given set or group of consumers to Meter Reading Instruments (MRI)/Hand Held Computers (HHC) automatically. System should also keep log of MRI/HHC assigned to meter reader.
FR 3.997	**Validations for the spot metering and billing data update:** The system should be able transfer or update the meter reading validation logic to the MRI and spot billing machines. The system should have the flexibility of validating the data uploaded from the meter reading instruments. The validation would include restricting the customer data uploads to those that were indicated in the meter reader's schedule.
FR 3.998	**Prohibiting the wrong entry,** the system shall also have provision for prompting the Meter Reader at the time of entering wrong meter reading values in the spot billing machine.
FR 3.999	**Monitoring meter reading plan** The system should make it necessary for the meter readers to upload all the meter readings according to the route plan generated within the timeframe stipulated by the utility. Otherwise exceptions should be generated and further meter reading can be entered only after clearance from specified authority. The system should track and generate the exception reports, for each meter reader to establish performance measures and determine deviations if any. It may include number of meters planned, number of meters actually read per day, number of wrong readings, unread meters by reason etc.
FR 3.1000	**Monitoring Customer Exception** The system should be able to track customer behaviour in terms of exceptions. For example: The number of times a customer figures in the list of exceptions.
FR 3.1001	**Supporting meter reading on trust** The system should also have the facility if desired by utility to enter the meter reading as specified by the customer by telephone/ fax/ web portal and record that the same is customer-specified. All customers who provide a reading on trust, should be inspected by the Utility after a specified time period.

FR 3.1002	**Overdue alert** In case a meter reading becomes overdue (Utility specified criteria), the system would generate the necessary exceptions and alerts.
FR 3.1003	**Accepting change in metering cycle** The system should be in a position to cater to changes in the metering cycle.
FR 3.1004	**Capability to store data for a specified period** The system should keep past metering data online for a period specified by the Utility guidelines from time to time.
FR 3.1005	**Interfacing with spot billing and MRI instruments** The system will support data downloading to and uploading from handheld devices used for Spot metering & billing and MRI. The devices would provide information about the meter number, customer code, meter reader's employee number, meter reading with date and time stamping, and billing amount.
FR 3.1006	**Meter reading for temporary connections** The System should be capable of accepting opening, closing and intermediate meter readings for temporary connections for generation of bills for such connection.
FR 3.1007	**Final meter reading for closure of connection** For all kinds of disconnections (whether a customer requests for termination of connection or utility disconnects due to non-payment), the system should accept the terminating meter reading (which will be out of cycle in most cases) for generating the last bill.
FR 3.1008	**Lifecycle monitoring and testing plan for meters** System must be capable of capturing complete meter history (such as type, Make, Model, Batch, Catalogue Number of meter, its place of installation, cycle and record of calibration/testing) throughout meter's lifecycle, starting from arrival in stores till it is being scrapped or destroyed. System must be capable of capturing data like ordinary meter, electronic meter etc. System must be able to identify the meters, which are due for mass replacement or scheduled testing/calibrations and generate a work order for action by field staff. It is desirable that system should be able to interact with meter testing devices for obtaining test report.
FR 3.1009	Meter and Device Management: Require connection management processes for connection and device management infrastructure in transmission, distribution and metering companies. With the proposed installation of an Advanced Meter Infrastructure (AMI), it may be required to administrate and run remote and conventional meters in parallel. The system must provide the means to record meter details for a work order. Some examples of meter details are as follows: • Meter serial number • Date installed • Meter location • Meter size • Out-reader location • Manufacturer Type
FR 3.1010	**MIS generation** System should be capable to monitor and track the following : Meter reader's performance, Comparison of input versus expected consumption, variance in consumption for consumers etc.
FR 3.1011	**Tracking meter location** Current location of meter must be tracked i.e. in stores, under testing, at consumer premise, under overhauling etc. Data must be captured at appropriate locations and point of time to track the meter.

FR 3.1012	**Tracking meter status** The system will track the current status of the meter. Various options would include Correct Meter, Stuck-Up Meter, Sluggish Meter, Door Lock etc.
FR 3.1013	**Tracking meter/meter boxes Seals** Tracking & reconciliation of meter seals i.e. date, type no. of seals, sealed by condition of meter etc. including meter boxes.
FR 3.1014	**Maintain life cycle information linked to meter** The system shall have the ability to maintain life cycle information on meters. This includes information related to the purchase, movement, installation, inspection, testing and ultimately retiring/scrapping the meter.
FR 3.1015	**Maintain life cycle information linked to service point** The system shall have the ability to maintain life cycle information, including serial numbers on items that are linked to meters connections and service point.
FR 3.1016	**Editing capability** The system shall allow user to create copies of a given meter and its configuration and be able to edit individual copies as needed, e.g. when a new shipment of meter arrives.
FR 3.1017	**Tracking stock location** The system shall have the ability to maintain stock locations and asset inventory.
FR 3.1018	**Create meter identifier** The system shall associate each meter record with a permanent, unique identifier, determined by an authorized user. Duplicate meter identification numbers must be prohibited.
FR 3.1019	**Editing capability of recorded meter attributes** The system shall have the ability to add, update or delete data/attributes in all fields on the meter record. The ability to change a meter attributes from Billing to Non-Billing and vice versa.
FR 3.1020	**Procurement and Quality Management**: Requirement to purchase devices in a new device category. When the devices are delivered, to receive the goods and assign a serial number for each device (may be manual or automatically). Also sample check to determine whether the delivered devices meet requirements. If the check is successful, transfer the devices to the main stores. Requirement for management and classification of devices and meters. The system must be able to track meters throughout their lifecycle.
FR 3.1021	**Adding meter record in batches** The system shall have the ability to add meters one at a time or in batches of meters.
FR 3.1022	**Recoding individual meter test results** The system shall have the ability to maintain unlimited individual test results on each meter.
FR 3.1023	**Recoding a group of meter test results** The system shall have the ability to maintain unlimited test results on a group of meters to support the analysis of purchase decisions and the annual meter recall program.
FR 3.1024	**Record connection type** The system shall have the ability to describe the meter connection type.
FR 3.1025	**Record bar coding information** The system shall have the ability to maintain bar coding information.
FR 3.1026	**Defining different types of meters,** The system must provide the requirement to hold multiple meter types including compound meters, parent meters and sub meters. This functionality must cover all meter types like abstraction, flow meters, zonal meters.

FR 3.1027	**Manufacturer and calibration validity** The system shall have the ability to define manufacturer and calibration validity for a class of meters.
FR 3.1028	**Integration with other applications** The system shall have seamless integration with Meter Data Management application, Material management application, Asset Management application, Water Distribution Management Systems, Audit System and GIS.
FR 3.1029	**Record meter status/conditions** The system shall have the ability to track status of a device such as in-store, issued for installation, installed, sent for repair etc.
FR 3.1030	**Provision to assign document / text/ drawing related information** The system shall have the provision to assign document / text/ drawing related information to a meter/device.
FR 3.1031	**Record transactions** The system shall have the ability to record transactions related to meter installation, removal and replacements.
FR 3.1032	**Allocate/grouping** The system shall have the ability to allocate / group a meter with a zone or water mains.
FR 3.1033	**Define single level or multi-level relationship** The system shall have the ability to define single level or multi-level main meter and sub-meter relationship.
FR 3.1034	**Create meter hierarchy** The system shall be able to zone mains customer meter hierarchy and be able to do water leakage management. For this purpose the MSI may be required to develop a report or query.
FR 3.1035	**Define meter reading reason** The system shall have the ability to define meter reading reasons such as periodic meter reading, control reading, reading at move-in etc.
FR 3.1036	**Define and optimize meter route** The system shall have the ability to define and optimize route for the meter reader.
FR 3.1037	**Sequence meter route** The system shall have the ability to sequence routes.
FR 3.1038	**Transfer meter between route** The system shall have the ability to transfer single or a group of connections from one route to another.
FR 3.1039	**Provision to interface with GIS** The system shall have the ability to interface with GIS for generation of manual meter reading plan and optimal route planning.
FR 3.1040	**Attach note on meter reading** The system shall have the provision to include pre-defined notes from Meter reader in Meter reading result.
FR 3.1041	**Allocate expected consumption for a given period** The system shall have the provision to allocate expected consumption for a device for a given period which may be used in absence of any representative meter read for meter.
FR 3.1042	**Provision to create meter reading based on criteria** The system shall have the provision to create meter reading order for a customer or for large number of customers based on relevant selection criterion.
FR 3.1043	**Define estimation rules** The system shall have the ability to define rules for determining "estimated" reading.
FR 3.1044	**Define validation rules** The system shall allow user defined meter reading validations rules.

FR 3.1045	**Send failed reading based on rules** The system shall have the ability to send failed reads to responsible department based on defined process for validation.
FR 3.1046	**Minimize the data entry errors** The system shall have the provision to minimize the data entry errors by validating meter readings based on user defined rules.
FR 3.1047	**Audit trail of failed meter reading** The system shall have the ability to correct / release / reset / estimate a failed meter reading with audit trail.
FR 3.1048	**Record certification data** The system shall have the ability to hold certification validity data in the meter record.
FR 3.1049	**Accept interval data** The system shall have the ability to accept interval meter reading data from AMR system.
FR 3.1050	**Download consumption information** The system shall have the ability to download previous 12-month consumption information for any or all meters.
FR 3.1051	**Utilization of multiple formats for meter read input data** The system shall allow utilization of multiple formats for meter read input data. The responder shall specify the available formats in the proposed system.
FR 3.1052	**Conditions for meter reading accept/reject** The system shall have the ability for meter reading accept/reject conditions to be user defined.
FR 3.1053	**Extrapolate future interval values** The system shall have the ability to extrapolate future interval values that may be used for forecasting.
FR 3.1054	**Prepare customer usage profiles** The system shall have the ability to prepare customer usage profiles including charts and graphs.
FR 3.1055	**Create service orders from meter reading trouble codes** The system shall be able to create service orders from meter reading trouble codes.
FR 3.1056	**Define different frequencies for meter reading** The system shall have the provision to define different frequencies for meter reading.
FR 3.1057	**Generate paper route documents** The system shall have the ability to generate paper route documents.
FR 3.1058	**Manually enter readings from generated paper route documents** The system shall have the ability to manually enter readings from generated paper route documents in the exact same order as originally produced.
FR 3.1059	**Maintain meter reading notes** The system shall have the ability to maintain meter reading notes.
FR 3.1060	**Maintain reading codes** The system shall have the ability to maintain reading codes.
FR 3.1061	**Maintain Reading Instruction Codes and notes** The system shall have the ability to maintain Reading Instruction Codes and notes by Premise and be able to automatically send them to meter reading device.
FR 3.1062	**Maintain Meter Location Codes** The system shall have the ability to maintain Meter Location Codes.
FR 3.1063	**Maintain a complete audit trail of all changes** The system shall have the ability to maintain a complete audit trail of all changes to any data item activity.
FR 3.1064	**Instructions for auditing meter readings** The system shall have the ability to randomly or selectively produce instructions for auditing meter readings through service orders.

FR 3.1065	**Generate automatic letters/notices** The system shall have the ability to generate automatic letters/notices to customers.
FR 3.1066	**Capture the meter data from zonal meters.**
FR 3.1067	**Compare reading from consumer and zonal meters** The system shall have the ability to compare reading from consumer and zonal meters.
FR 3.1068	**Maintain different read types and billing selection priority** The system shall have the ability to maintain different read types and their billing selection priority (e.g. verified read, regular read etc.).
FR 3.1069	**Maintain locations and dates as meters move** The system shall have the ability to maintain locations and dates as meters move through the utility.
FR 3.1070	**Query and report on all meter physical locations** The system shall have the ability to query and report on all meter physical locations within the system.
FR 3.1071	**Maintain history** The system shall have the ability to maintain a history of readings, consumption and demand records.
FR 3.1072	**Display the Days of Services** The system shall have the ability to display the Days of Services (DOS) with the calculated consumption.
FR 3.1073	**Display cancelled calculated consumption** The system shall have the ability to display cancelled calculated consumption resulting from billing adjustment.
FR 3.1074	**Recognize multiple meter exchanges and perform consumption calculations** The system shall be able to recognize multiple meter exchanges and perform consumption calculations based on reads from both the old and new meters.
FR 3.1075	**Maintain relationships between consumption history and a customer, meter and premise.** The system shall have the ability to maintain relationships between consumption history and a customer, meter and premise.
FR 3.1076	**Store monthly demand data and corresponding charges** The system shall have the ability to store monthly demand data and corresponding charges.
FR 3.1077	**Display all relevant data and information related to a calculated consumption** The system shall have the ability to display all relevant data and information related to a calculated consumption, e.g. Reading Date, Charge Date, Days of Service, Billed Charges.
FR 3.1078	**Display the prorated consumptions** The system shall have the ability to display the prorated consumptions for each period separately.
FR 3.1079	GIS Grid reference required for meters.
FR 3.1080	Water Billing Customer Categories- the system must allow the category of the customer to be configurable like Domestic, Group Housing Society, Non Domestic, Industrial, Commercial, Agricultural, Fire Hydrants, Temporary, Govt Agencies etc.
FR 3.1081	Water Bills for a particular Customer Category: system must be configurable to accommodate different tariff rates. The Water Bill line items must clearly indicate the various components which make up the bill. In case the actual consumption during the billing cycle exceeds a certain threshold (configurable), the system should levy a surcharge either on the relevant bill component as per the applicable rate. The system must also allow revision upwards or downwards of rates along with effective dates with a record of the old rate history.

FR 3.1082	Surcharges and Rebates on components of Water Bills must be configurable. These could either be based on percentages or fixed amounts. In certain cases rebates or subsidies are given to specific customers and the system must cater to this functionality requirement. The system must also allow revision upwards or downwards of surcharges and rebates along with effective dates with an old record history.
FR 3.1083	Govt. Taxes and Levies: rates must be configurable and the system must automatically calculate the applicable amounts and apply them on the bills and if necessary show them as separate line items. The system must also allow revision upwards or downwards of such taxes and levies along with effective dates with an old record history.
FR 3.1084	Billing Cycle: the system must allow the billing cycle to be specified at customer master data level and/or customer category level. Further it should be possible to change the billing cycle applicable for a customer and/or customer category.
FR 3.1085	Security Deposit: the interest rate on the security deposit must be parameterized and the interest amount should be automatically calculated and credited to the customer account. AITL should have the option of either crediting the security deposit and/or adjust this interest in the bill. Depending upon the change in water consumption, the required security deposit should be recalculated and a demand note be raised for the additional amount. Alternatively a credit note be raised in favour of the customer in case of a decrease in the required security deposit.
FR 3.1086	Retrospective Billing: system must have the functionality for retrospective recalculation of the water bills and issue a revised billing. The differential credit or debit amount should be automatically refunded and/or adjusted in the subsequent bills.
FR 3.1087	Rebate for Number of Bills: system must allow a configurable rebate for a customer depending on the number of bills generated in a year.
FR 3.1088	Interest on delayed payments should be automatically calculated and debited to customer account as per an AITL specified rate of interest. For part month interest calculation the denominator of number of days in the month should be configurable either to thirty (30) or the actual days in the month.
FR 3.1089	Cheque/Cash Payment: for amounts above a certain configurable threshold the system must not accept cash payments.
FR 3.1090	Joint Invoicing: System must be configurable to handle electricity and water billing in one Invoice. System provides the ability to calculate and bill for all products and services on a single bill, including both metered and unmetered services.
FR 3.1091	Collective Billing: System must be configurable to manage the group billing / collective billing in one invoice and payment should be adjusted accordingly.
FR 3.1092	Billing Simulation: System must be configurable to generate billing based on estimation / reading for checking purpose.
FR 3.1093	Out sorting / Validation: System should be configurable to manage amount level validation at billing and Invoicing level and manual checks, block.
FR 3.1094	Billing reversal / Adjustment: System should be configurable to manage bill correction and adjustment in case of customer complaints / wrong bills.

FR 3.1095	Manual Billing: System should be configurable to address old bill / archive bill generation requirement.
FR 3.1096	Unscheduled Billing: System should be configurable to generate online billing for unscheduled cases like final bill online.
FR 3.1097	Proration Scenario: System provides the ability to prorate based on the number of days that are outside the normal billing schedule. For example, billing days between 25-35 days is billed, based upon 30-days consumption / service charges, or anything outside of that range is billed based on the actual number of days.
FR 3.1098	System has the ability to prorate for days less than system or user- defined number of billing days.
FR 3.1099	System provides the ability to prorate a new bill based on the number of days active.
FR 3.1100	System provides the ability to prorate a final bill based on the number of days active.
FR 3.1101	Bill Print: System should be configurable to take print in Batch or online as per bill printing requirement for schedule or unscheduled billing (online printing).
FR 3.1102	System provides the ability to bill for multiple meters at a single location.
FR 3.1103	System provides the ability to accommodate back billing for a single period with a user-defined start and end date.
FR 3.1104	System provides the ability to produce duplicate copies of the bill.
FR 3.1105	Budget Billing: System calculates the average billing amount over a user-defined period for past billings.
FR 3.1106	System calculates the same monthly payment while capturing actual readings.
FR 3.1107	System provides a user-defined month for account to be reconciled (trued up). Difference between the budget months calculated and payment to the actual amount to be billed.
FR 3.1108	System will provide for estimating should actual reads not be available.
FR 3.1109	System provides the ability to estimate entire billing cycles or routes with user-defined read date.
FR 3.1110	System will calculate the estimated bill based upon the read date, not the bill date, to determine number of days in billing cycle.
FR 3.1111	System will automatically mark services that have been estimated with a unique identifier.
FR 3.1112	System should have the functionality for advance billing (especially for unmeasured customer categories) as well as billing in arrears based on actual or estimated consumption.
FR 3.1113	**Analysis Reports:** • Demand analysis Report • Collections analysis Report • Revenue Recovery analysis Report • Water Supply effectiveness Analysis Report • Customer Service effective analysis Report
FR 3.1114	**Executive Management Reports:** • Consolidated view of operational profit & loss for all circle officers

	• Drill down from the Transaction level to reports right up to section level • Change the sorting order and view the report contents with the new sort order
FR 3.1115	**Consolidated Reports:** • Consumption and sales • Revenue realization, revenue improvement • Customer complaints and water leakage losses • Executive Summary Report • Demand Vs. Collection • Summary information Report • Commercial Performance Report
FR 3.1116	**Single Parameter Reports:** • Improvement Reports • Revenue Reports • Operations Reports
FR 3.1117	**Daily Reports:** Summary of % cumulative collections against correct month demand till date, last month.
FR 3.1118	**Revenue Collection Report:** • Demand raised for the month (As spot billing is done throughout the month cumulative progress is presented). • % cumulative collection against correct month demand, till date for this month and for the last month. • Monitoring of cumulative collection for the month till date against the demand raised.
FR 3.1119	Other Reports: Other reports as per the Client requirements arising from time to time during project life cycle.
FR 3.1120	**The System shall cover:** • Citizen Service: Application for New Water Connection • Water Connection details given by Citizen: ➢ Support Metered and non-metered connections ➢ Capture details of multiple lease holders with Aadhar no. ➢ Maintain details of usage, no. of families, no. of taps, connection size, plumber's name ➢ Billing address ➢ Property no. for which connection is being applied for • Water connection details given by department: ➢ Distribution line, road digging details if any, meter make, meter no., initial reading, maximum reading supported, and installation date ➢ Details of security deposit if any ➢ Generation of Work Order • Citizen Service: Closing of connection (Disconnection) • Citizen Service: Reconnection

	• Citizen Service: Change of lease holdership • Citizen Service: Change of usage • Citizen Service: Issuance of Duplicate Water Bill. • Citizen Service: No Due Certificate for arrears of water • Citizen Service: Meter Testing • Registration for Plumber. (New registration and Renewal of license) • Meter reading entry: ➢ Capture and print meter reading picture on bill ➢ Flexibility to capture meter reading at any instance irrespective of any fix reading schedule ➢ Facility to mark meter cut-off and restoration ➢ Handle scenarios where meter reading is not possible – meter is not working, stolen, tampered and apply standardized rules for calculating consumption and billing. • Meter reading data upload • Water Billing: ➢ Metered and non-metered billing ➢ Define billing schedule and billing cycles ➢ Support fixed rates, slab-wise rates or telescopic rates ➢ Support multiple tax/ charges ➢ Consider advance payments, penalty/ interest, arrears and rebate on early payments, meter rent where applicable ➢ Facility to generate bill for one connection/ multiple connections ➢ Pro rata Billing • Collection – handling rebate on early payments • Support for integration with Hand-held device for collections • Disputes registration and resolution • Facility to upload existing water connection records and outstanding as on cut-off date that is available in digital format • Data Entry of existing Water connection records and outstanding as on cut-off date that is not available in digital format • Reports ➢ Water Connection – List of consumers ➢ Plumber Register ➢ List of connections sanctioned ➢ Disconnection Register ➢ Security Deposits Register ➢ Meter Reading – based on various parameters ➢ Water Consumption statement for a period ➢ Advance Register ➢ Demand Register ➢ Collection Register ➢ Outstanding Register ➢ Top Defaulters as per criteria

Electrical Utility Management and Billing	
FR 3.1121	**Customer Service Management:** Need to support all services oriented customer business processes. This includes the operation of customer facilitation centres with specific service processes such as customer billing, service order management, complaints & returns management, account & contact management and as follow-up process case management. An Internet-based self-service solution for occupants (lease holders or tenants) of a property or premise is also required. Hereinafter in reference to the detailed functionality related to electric utilities, the term occupant includes lease holders as well as tenants.
FR 3.1122	Service Order Management with Utility Billing: • Need service order management with billing to enable AITL to manage service businesses over the entire service life cycle process. • From service contact to create, assign processing and monitoring of service requests. • To the management of customer connections and installed equipment/devices. • Visibility of warranty and entitlements and the billing of time (effort) and materials spent on the work order. • To ensure service level targets are met, improve customer satisfaction. • Reduce costs and increase revenue by reducing the service-to-cash cycle. • Improve service quality through 24x7 customer service - support multichannel interaction - collaborate with customers. • Must be able to record and track all interactions with the customer no matter what the medium e.g. telephone or Fax etc. • All customer tracking information should be presented to the service agent in a simple and standardised format.
FR 3.1123	Service Order Quotation: Need to offer a service order quotation before concluding the actual service order. This gives customers the opportunity to find out more about prices and delivery conditions before agreeing to the service order.
FR 3.1124	Service Order Processing: • Need to allocate items to multiple external and internal recipients. These may be either billable or non-billable because of warranty claims, and they may stem from service orders or service confirmations. • Assign internal and external recipients when creating the service order or service confirmation. • When creating an amount allocation document, the bill-to party and invoice value are to be copied from the service order or service confirmation. Subsequently the user will still be able to process or edit this data in amount allocation. • Functionality must allow for sign off / authority levels to be complied as per AITL policy.
FR 3.1125	Service Confirmation Processing: Ability to confirm working times, materials used, and expenses for services performed. Plan these confirmation items in a service process (for example, a service order) or an in-house repair order. The field service representative should then be able to reference the work order for further action to complete the required business process.

FR 3.1126	Billing: Need to create invoices in the name of occupants using one or more billing due list item. Ability to create the invoice with reference to the rate charged, delivery, or to the sales order. Additionally, need to create bill or invoices with reference to contracts.
FR 3.1127	Service Contract and Quotation Analysis: Need to be able to monitor customer satisfaction with services performed under contracts. Identify contract products/services with a high net value and produce an overview of the value and volume of active service contracts report which particular contracts the service employees are responsible for. Functionality must support monitoring and reporting the appropriate levels of customer satisfaction.
FR 3.1128	Service Order and Quotation Analysis: Need to be able to report on current order volumes and support forecasts about fluctuations in business volumes for the forthcoming year. Need to take measures, e.g., to plan resources according to seasonal peaks or offer customers special service packages during quiet periods. Report by Customer Sector and Segment.
FR 3.1129	• Customer Service Processes: Must be able to support all occupant-related processes within our call centre environment(s) or self-service through the portal. For instance a partial list of these processes would include: ➢ Move in ➢ Move out and if required refund of security deposit ➢ Meter-reading ➢ Entry ➢ Bill correction • Customer Service Process (Collaborative): ➢ Instalment Plan Request ➢ Disconnections ➢ General Inquiry ➢ Billing Inquiry • Process a New Connections request and management of security deposit: ➢ Budget Billing Request ➢ Convert a temporary water connection to a permanent connection • Process Temporary Water Connection request and management of security deposit • Business Partner Master Data Changes
FR 3.1130	The system must allow the new connection request to be made by a lease holder of a premise or property. In case of an apartment block or building the property or premise may refer to an apartment.
FR 3.1131	The system must allow a Move in/Move out process for an occupant for a property or premise.
FR 3.1132	Identifying Account for Utility Service Processes: • During a customer contact, need to be able to use the multi-channel interface (telephone, E-mail, chat, and so on) to identify an account in the system. • Once account is identified and confirmed, the system provides customer information, such as the address, account balance, bills, dunning, credit, and information on past customer contacts. • Need to be able to initiate the business processes for a particular customer

	in the customer facilitation centre. And in addition, identify the premise, contract account objects and associated service zones.
FR 3.1133	Changing Account Data and Business Agreement Data: The call agent must be able to change account data or business agreement data. The system must allow the account and/or business agreement to be entered into with the occupant of a property or premise.
FR 3.1134	Master Data Overview (Account, Business Agreement, Consumption): During a customer contact, call fact sheets for an account, business agreement, and specific consumption data for an account in the system. To provide quick overview of the existing data, and to allows us selection of individual objects from the overview (such as a bill) to be displayed in detail.
FR 3.1135	Processing Move-In: Be able to create a move-in in the Customer Facilitation Centre (CFC) as well as via the portal.
FR 3.1136	Processing Move-Out: Be able to create a move-out in the Customer Facilitation Centre as well as via the portal.
FR 3.1137	Processing Move in/Out for Account: Be able to create a move-in/out for an account in the Customer Facilitation Centre as well as via the portal. The account for move-in and move-out remains constant but the premise changes.
FR 3.1138	Processing Move in/Out for Premise: Be able to create a move-in/out for a premise in the Customer Facilitation Centre The premise for move-in and move-out remains constant but the account changes.
FR 3.1139	Entering Meter Readings: Ability to enter, check, and save the current meter reading. The meter reading may be estimated if an account cannot be accessed by a meter reader.
FR 3.1140	Changing Budget Billing Plan: Ability to change the budget billing plan. This could be done by changing the budget billing amount or the meter reading.
FR 3.1141	Bill Information/Bill Correction: Ability to add/change information to a bill and to correct it if the meter reading is incorrect.
FR 3.1142	Malfunction Notification / Service Notification: Ability to create a malfunction notification in the system. There are different categories of malfunction (for example, meter not recording or recording inaccurate) with different reference objects (for example, connection object, apartment, meter).
FR 3.1143	Functionality for the customer agent to escalate an exception.
FR 3.1144	Managing Financial Inquiries in Customer Facilitation Centre: Enable customer agents to handle all types of finance-related inquiries with customers by providing access to finance-related data e.g. in the Invoice Display, Payment List, history or reminders and Balance Forward List of the Account or Business Agreement confirmed. The customer agent must be able to access the account balance for the customer's business agreements in a customer contact and display additional information (e.g. next due installment, last payment or the last dunning notice for the business agreement) as well as a list of documents/document items grouped by several grouping criteria (e.g. all open items, all items included in a reminder letter/communication).
FR 3.1145	Processing Payments: Need to generate call lists from the reminder communication and reminder batch run, which are then available for use in the Customer Facilitation Centre (CFC) to chase customers by telephone/internet and request payment for open items. Agents should be able to display the call list size, the period, or the duration of the call list, the number of customers, and the names of the customers

	who are to be called. They can also review the information to be obtained from the customer if the call list is assigned a script. The agents can gather information before they begin answering calls or calling customers themselves. Resulting from the conversation with the customer, and then take payments from the customer for the due items for chasing and create deferral for open items.
FR 3.1146	Change Service Location Data: Need to be able to change all relevant service location data (connection object, premise, and point of delivery) during contact with a customer. After identifying the premise, the call centre agent should be able to access the maintenance view for the service location. Here, the agent can change the connection object address, add additional premise data, or determine the grid for the point of delivery, for example.
FR 3.1147	Service Contract and Entitlement Management: Service contract and entitlement management enables all service entitlements – warranties, extended warranties, service contracts, and service level agreements to be defined and tracked. Service agreement terms can be adapted and created to suit the varying and diverse requirements of the customer base. When service calls are placed and service orders created the appropriate entitlement information is associated with that activity and can be checked by a service representative or via Web self-service at any time.
FR 3.1148	Complaints and Returns Management: AITL requires complaints management which allows it to easily create, manage and track complaints and returns. Customers can request their preferred action including credit, refund, or replacement of the specified product and installation. Customer Agents are provided with all relevant information to make effective decisions and can take immediate action to comply with the customer request.
FR 3.1149	Warranty Analysis: Need to provide information about the amount of products/services with or without warranty, and monitor expired warranties.
FR 3.1150	**Collecting meter readings in the metering database**: The system shall have the ability to enter single meter reading as well as transfer meter reading from an external system.
FR 3.1151	The system should also be capable of interfacing with Spot billing devices and Meter Reading Instruments for uploading such meter readings data including consumer meter readings. The data of all such meters will normally be downloaded on an external server.
FR 3.1152	System should provide data validation checks to minimize data entry errors. It should incorporate user supplied logics to check variations in consumption and generate exceptions. After data entry, the system should generate an Exception Report for non-reading of meters due to any reason. It shall also highlight possible inconsistencies in the metering data. After handling of exceptions by the respective officials, the system should be updated with the result of exception handling. While validating, if the meter reading found low / unacceptable based on earlier readings/trends the system should issue a work order for checking and replacement of meter. If the work orders are not closed with valid reason system should escalate the issue till the same is resolved.
FR 3.1153	**Data Review** The system should provide the facility for the designated officials to review the metering data as per utility defined criteria. In case any discrepancy is found, the system will allow the data to be edited, with proper access rights and audit trails.

FR 3.1154	**Provision to interface with AMR** The system should be able to interface with Automatic Online Meter Reading devices. System should be capable to schedule and collect automatically readings from online connected consumer meters / Distribution Transformers meters through automatic meter reading system. The system should generate exception in case meter reading found unacceptable after validation check.
FR 3.1155	**Capturing Meter reading Data** The system should be capable of capturing meter reading data from a Meter Reading Book, handheld computers used for spot metering & billing for uploading and downloading the data. System should be capable to upload and download the data for a given set or group of consumers to Meter Reading Instruments (MRI)/Hand Held Computers (HHC) automatically. System should also keep log of MRI/HHC assigned to meter reader.
FR 3.1156	**Validations for the spot metering and billing data update:** The system should be able transfer or update the meter reading validation logic to the MRI and spot billing machines. The system should have the flexibility of validating the data uploaded from the meter reading instruments. The validation would include restricting the customer data uploads to those that were indicated in the meter reader's schedule.
FR 3.1157	**Prohibiting the wrong entry,** the system shall also have provision for prompting the Meter Reader at the time of entering wrong meter reading values in the spot billing machine.
FR 3.1158	**Monitoring meter reading plan** The system should make it necessary for the meter readers to upload all the meter readings according to the route plan generated within the timeframe stipulated by the utility. Otherwise exceptions should be generated and further meter reading can be entered only after clearance from specified authority. The system should track and generate the exception reports, for each meter reader to establish performance measures and determine deviations if any. It may include number of meters planned, number of meters actually read per day, number of wrong readings, unread meters by reason etc.
FR 3.1159	**Monitoring Customer Exception** The system should be able to track customer behavior in terms of exceptions. For example: The number of times a customer figures in the list of exceptions.
FR 3.1160	**Supporting meter reading on trust** The system should also have the facility if desired by utility to enter the meter reading as specified by the customer by telephone/ fax/ web portal and record that the same is customer-specified. All customers who provide a reading on trust, should be inspected by the Utility after a specified time period.
FR 3.1161	**Overdue alert** In case a meter reading becomes overdue (Utility specified criteria), the system would generate the necessary exceptions and alerts.
FR 3.1162	**Accepting change in metering cycle** The system should be in a position to cater to changes in the metering cycle. Metering in certain cases maybe time-of-day (TOD), hourly, daily, fortnightly etc.
FR 3.1163	**Capability to store data for a specified period** The system should keep past metering data online for a period specified by the Utility guidelines from time to time.
FR 3.1164	**Interfacing with spot billing and MRI instruments** The system will support data downloading to and uploading from handheld devices used for Spot metering & billing and MRI. The devices would provide information about the meter number, customer code, meter reader's employee number, meter reading with date and time stamping, and billing amount.

FR 3.1165	**Meter reading for temporary connections** The System should be capable of accepting opening, closing and intermediate meter readings for temporary connections for generation of bills for such connection.
FR 3.1166	**Final meter reading for closure of connection** For all kinds of disconnections (whether a customer requests for termination of connection or utility disconnects due to non-payment), the system should accept the terminating meter reading (which will be out of cycle in most cases) for generating the last bill.
FR 3.1167	**Lifecycle monitoring and testing plan for meters** System must be capable of capturing complete meter history (such as type, Make, Model, Batch, Catalogue Number of meter, its place of installation, cycle and record of calibration/testing) throughout meter's lifecycle, starting from arrival in stores till it is being scrapped or destroyed. System must be capable of capturing data like ordinary meter, electronic meter etc. System must be able to identify the meters, which are due for mass replacement or scheduled testing/calibrations and generate a work order for action by field staff. It is desirable that system should be able to interact with meter testing devices for obtaining test report.
FR 3.1168	**MIS generation** System should be capable to monitor and track the following : Meter reader's performance, Comparison of input versus expected consumption, variance in consumption for consumers etc.
FR 3.1169	**Tracking meter location** Current location of meter must be tracked i.e. in stores, under testing, at consumer premise, under overhauling etc. Data must be captured at appropriate locations and point of time to track the meter.
FR 3.1170	**Tracking meter status** The system will track the current status of the meter. Various options would include Correct Meter, Stuck-Up Meter, Sluggish Meter, Door Lock etc.
FR 3.1171	**Tracking meter/meter boxes Seals** Tracking & reconciliation of meter seals i.e. date, type no. of seals, sealed by condition of meter etc. including meter boxes.
FR 3.1172	**Maintain life cycle information linked to meter** The system shall have the ability to maintain life cycle information on meters. This includes information related to the purchase, movement, installation, inspection, testing and ultimately retiring/scrapping the meter.
FR 3.1173	**Maintain life cycle information linked to service point** The system shall have the ability to maintain life cycle information, including serial numbers on items that are linked to meters connections and service point.
FR 3.1174	**Editing capability** The system shall allow user to create copies of a given meter and its configuration and be able to edit individual copies as needed, e.g. when a new shipment of meter arrives.
FR 3.1175	**Tracking stock location** The system shall have the ability to maintain stock locations and asset inventory.
FR 3.1176	**Create meter identifier** The system shall associate each meter record with a permanent, unique identifier, determined by an authorized user. Duplicate meter identification numbers must be prohibited.
FR 3.1177	**Editing capability of recorded meter attributes** The system shall have the ability to add, update or delete data/attributes in all fields on the meter record. The ability to change a meter attributes from Billing to Non-Billing and vice versa.
FR 3.1178	**Procurement and Quality Management**: Requirement to purchase devices in a new device category. When the devices are delivered, to receive the goods and assign a

	serial number for each device (may be manual or automatically). Also sample check to determine whether the delivered devices meet requirements. If the check is successful, transfer the devices to the main storage location. Requirement to management and classification of devices and meters. The system must be able to track meters throughout their lifecycle.
FR 3.1179	**Adding meter record in batches** The system shall have the ability to add meters one at a time or in batches of meters.
FR 3.1180	**Recoding individual meter test results** The system shall have the ability to maintain unlimited individual test results on each meter.
FR 3.1181	**Recoding a group of meter test results** The system shall have the ability to maintain unlimited test results on a group of meters to support the analysis of purchase decisions and the annual meter recall program.
FR 3.1182	**Record connection type** The system shall have the ability to describe the meter connection type.
FR 3.1183	**Record bar coding information** The system shall have the ability to maintain bar coding information.
FR 3.1184	**Defining different types of meters,** the system shall have the ability to define different types of meters. For example; single-phase KWh meter, three-phase KWh meter, Demand meter etc.
FR 3.1185	**Define different types of registers** The system shall have the ability to define different types of registers in a device such as registers for recording consumption, on-peak consumption, off-peak consumption, active/reactive consumption, demand data etc.
FR 3.1186	**Record meter related equipment** The system shall have the ability to define other related equipment such as transformers, CT, PT, protection box etc. in the system.
FR 3.1187	**Capture meter related detailed information** The system shall have the ability to capture meter related detailed information such as number of registers, digital / analog display, unit of measurement, multiplication factor etc.
FR 3.1188	**Manufacturer and calibration validity** The system shall have the ability to define manufacturer and calibration validity for a class of meters.
FR 3.1189	**Integration with other applications** The system shall have seamless integration with Meter Data Management application, Material management application, Asset Management application, Energy Audit System and GIS.
FR 3.1190	**Record meter status/conditions** The system shall have the ability to track status of a device such as in-store, issued for installation, installed, sent for repair etc.
FR 3.1191	**Provision to assign document / text/ drawing related information** The system shall have the provision to assign document / text/ drawing related information to a meter/device.
FR 3.1192	**Record transactions** The system shall have the ability to record transactions related to meter installation, removal and replacements.
FR 3.1193	**Allocate/grouping** The system shall have the ability to allocate / group a meter with a transformer or feeder.
FR 3.1194	**Define single level or multi-level relationship** The system shall have the ability to define single level or multi-level main meter and sub-meter relationship.

FR 3.1195	**Create meter hierarchy** The system shall be able to maintain feeder-transformer-customer meter hierarchy and be able to do energy accounting. For this purpose the MSI may be required to develop a report or query.
FR 3.1196	**Define meter reading reason** The system shall have the ability to define meter reading reasons such as periodic meter reading, control reading, reading at move-in etc.
FR 3.1197	**Define and optimize meter route** The system shall have the ability to define and optimize route for the meter reader.
FR 3.1198	**Sequence meter route** The system shall have the ability to sequence routes.
FR 3.1199	**Transfer meter between route** The system shall have the ability to transfer single or a group of connections from one route to another.
FR 3.1200	**Provision to interface with GIS** The system shall have the ability to interface with GIS for generation of manual meter reading plan and optimal route planning.
FR 3.1201	**Attach note on meter reading** The system shall have the provision to include pre-defined notes from Meter reader in Meter reading result.
FR 3.1202	**Allocate expected consumption for a given period** The system shall have the provision to allocate expected consumption for a device for a given period which may be used in absence of any representative meter read for meter.
FR 3.1203	**Provision to create meter reading based on criteria** The system shall have the provision to create meter reading order for a customer or for large number of customers based on relevant selection criterion.
FR 3.1204	**Define estimation rules** The system shall have the ability to define rules for determining "estimated" reading.
FR 3.1205	**Define validation rules** The system shall allow user defined meter reading validations rules.
FR 3.1206	**Send failed reading based on rules** The system shall have the ability to send failed reads to responsible department based on defined process for validation.
FR 3.1207	**Minimize the data entry errors** The system shall have the provision to minimize the data entry errors by validating meter readings based on user defined rules.
FR 3.1208	**Audit trail of failed meter reading** The system shall have the ability to correct / release / reset / estimate a failed meter reading with audit trail.
FR 3.1209	**Record certification data** The system shall have the ability to hold certification validity data in the meter record.
FR 3.1210	**Accept interval data** The system shall have the ability to accept interval meter reading data from AMR system.
FR 3.1211	**Record user defined interval meter reading data** The system shall have provision to record meter reading in 5 min / 10 min / 15 min / 30 min / 60 min or user defined interval meter reading data.
FR 3.1212	**Download consumption information** The system shall have the ability to download previous 12-month consumption information for any or all meters.
FR 3.1213	**Set user-defined variance parameters** The system shall have the ability to set user-defined variance parameters (e.g. % for high and low consumption from the previous 12-month average).

FR 3.1214	**Utilization of multiple formats for meter read input data** The system shall allow utilization of multiple formats for meter read input data. The responder shall specify the available formats in the proposed system.
FR 3.1215	**Conditions for meter reading accept/reject** The system shall have the ability for meter reading accept/reject conditions to be user defined.
FR 3.1216	**Extrapolate future interval values** The system shall have the ability to extrapolate future interval values that may be used for forecasting.
FR 3.1217	**Prepare customer usage profiles** The system shall have the ability to prepare customer usage profiles including charts and graphs.
FR 3.1218	**Maintain life cycle information on metering transformers** The system shall have the ability to maintain life cycle information on metering transformers. This includes information related to the purchase, movement, installation and ultimately retiring the transformer.
FR 3.1219	**Associate each metering transformer record with unique identifier** The system shall associate each metering transformer record with a permanent, unique user defined identifier.
FR 3.1220	**Create service orders from meter reading trouble codes** The system shall be able to create service orders from meter reading trouble codes.
FR 3.1221	**Define different frequencies for meter reading** The system shall have the provision to define different frequencies for meter reading.
FR 3.1222	**Generate paper route documents** The system shall have the ability to generate paper route documents so subdivision office can use them for reading.
FR 3.1223	**Manually enter readings from generated paper route documents** The system shall have the ability to manually enter readings from generated paper route documents in the exact same order as originally produced.
FR 3.1224	**Maintain meter reading notes** The system shall have the ability to maintain meter reading notes.
FR 3.1225	**Maintain reading codes** The system shall have the ability to maintain reading codes.
FR 3.1226	**Maintain Reading Instruction Codes and notes** The system shall have the ability to maintain Reading Instruction Codes and notes by Premise and be able to automatically send them to meter reading device.
FR 3.1227	**Maintain Meter Location Codes** The system shall have the ability to maintain Meter Location Codes.
FR 3.1228	**Maintain a complete audit trail of all changes** The system shall have the ability to maintain a complete audit trail of all changes to any data item activity.
FR 3.1229	**Instructions for auditing meter readings** The system shall have the ability to randomly or selectively produce instructions for auditing meter readings through service orders.
FR 3.1230	**Generate automatic letters/notices** The system shall have the ability to generate automatic letters/notices to customers.
FR 3.1231	**Capture the meter data from meters at Feeders, and HT/LT Consumers** The system shall have the provision to capture the meter data from meters at Feeders, and HT/LT Consumers (if required).

FR 3.1232	**Compare reading from consumer and transformer /feeder meters** The system shall have the ability to compare reading from consumer and transformer/feeder meters.
FR 3.1233	**Maintain different read types and billing selection priority** The system shall have the ability to maintain different read types and their billing selection priority (e.g. verified read, regular read etc.).
FR 3.1234	**Maintain locations and dates as meters move** The system shall have the ability to maintain locations and dates as meters move through the utility.
FR 3.1235	**Query and report on all meter physical locations** The system shall have the ability to query and report on all meter physical locations within the system.
FR 3.1236	**Maintain history** The system shall have the ability to maintain a history of readings, consumption and demand records.
FR 3.1237	**Display the Days of Services** The system shall have the ability to display the Days of Services (DOS) with the calculated consumption.
FR 3.1238	**Display cancelled calculated consumption** The system shall have the ability to display cancelled calculated consumption resulting from billing adjustment.
FR 3.1239	**Recognize multiple meter exchanges and perform consumption calculations** The system shall be able to recognize multiple meter exchanges and perform consumption calculations based on reads from both the old and new meters.
FR 3.1240	**Maintain relationships between consumption history and a customer, meter and premise.** The system shall have the ability to maintain relationships between consumption history and a customer, meter and premise.
FR 3.1241	**Store monthly demand data and corresponding charges** The system shall have the ability to store monthly demand data and corresponding charges.
FR 3.1242	**Display all relevant data and information related to a calculated consumption** The system shall have the ability to display all relevant data and information related to a calculated consumption, e.g. Reading Date, Charge Date, Days of Service, Billed Charges.
FR 3.1243	**Display the prorated consumptions** The system shall have the ability to display the prorated consumptions for each period separately.
FR 3.1244	GIS Grid reference required for meters.
FR 3.1245	Electricity Billing Customer Categories- the system must allow the category of the customer to be configurable like Domestic, Group Housing Society, Non Domestic LT, Non Domestic High Tension, Industrial, Commercial, Agricultural, Metered Street lights, Unmetered Street Lights, Signals and Blinkers, Temporary, Govt. Agencies etc.
FR 3.1246	Electricity Bills for a particular Customer Category: system must be configurable to accommodate different tariff rates corresponding to the sanctioned slabs of energy load. The Energy Bill line items must clearly indicate the various components which make up the bill. In case the actual consumption during the billing cycle exceeds the sanctioned load by a certain threshold (configurable), the system should levy a surcharge either on the fixed portion and/or the variable portion as per the applicable rate. The system should be configurable such that the KVA shall be calculated on basis of actual power factor of the consumer, for the relevant billing cycle. The system must also allow revision upwards or downwards of rates along with effective dates with a record of the old rate history.

FR 3.1247	The system must allow chargeable energy rates to be variable depending on the time of day when the energy is consumed.
FR 3.1248	Surcharges and Rebates on components of Electricity Bills must be configurable. These could either be based on percentages or fixed amounts In certain cases rebates or subsidies are given to specific customers and the system must cater to this functionality requirement. The system must also allow revision upwards or downwards of surcharges and rebates along with effective dates with a old record history.
FR 3.1249	Govt. Taxes and Levies: rates must be configurable and the system must automatically calculate the applicable amounts and apply them on the bills and if necessary show them as separate line items. The system must also allow revision upwards or downwards of such taxes and levies along with effective dates with a old record history.
FR 3.1250	Billing Cycle: the system must allow the billing cycle to be specified at customer master data level and/or customer category level. Further it should be possible to change the billing cycle applicable for a customer and/or customer category.
FR 3.1251	Security Deposit: the interest rate on the security deposit must be parameterized and the interest amount should be automatically calculated and credited to the customer account. AITL should have the option of either crediting the security deposit and/or adjust this interest in the bill. Depending upon the change in sanction load, the required security deposit should be recalculated and a demand note be raised for the additional amount. Alternatively a credit note be raised in favour of the customer in case of a decrease in the required security deposit.
FR 3.1252	Retrospective Billing: system must have the functionality for retrospective recalculation of the energy bills and issue a revised billing. The differential credit or debit amount should be automatically refunded and/or adjusted in the subsequent bills.
FR 3.1253	Rebate for Number of Bills: system must allow a configurable rebate for a customer depending on the number of bills generated in a year.
FR 3.1254	Interest on delayed payments should be automatically calculated and debited to customer account as per a AITL specified rate of interest. For part month interest calculation the denominator of number of days in the month should be configurable either to thirty (30) or the actual days in the month.
FR 3.1255	Cheque/Cash Payment: for amounts above a certain configurable threshold the system must not accept cash payments.
FR 3.1256	Joint Invoicing: System must be configurable to handle electricity and water billing in one Invoice. System provides the ability to calculate and bill for all products and services on a single bill, including both metered and unmetered services.
FR 3.1257	Collective Billing: System must be configurable to manage the group billing / collective billing in one invoice and payment should be adjusted accordingly.
FR 3.1258	Billing Simulation: System must be configurable to generate billing based on estimation / reading for checking purpose.
FR 3.1259	Out sorting / Validation: System should be configurable to manage amount level

	validation at billing and Invoicing level and manual checks, block.
FR 3.1260	Billing reversal / Adjustment: System should be configurable to manage bill correction and adjustment in case of customer complaints / wrong bills.
FR 3.1261	Manual Billing: System should be configurable to address old bill / archive bill generation requirement.
FR 3.1262	Unscheduled Billing: System should be configurable to generate online billing for unscheduled cases like final bill online.
FR 3.1263	Proration Scenario: System provides the ability to prorate based on the number of days that are outside the normal billing schedule. For example, billing days between 25-35 days is billed, based upon 30-days consumption / service charges, or anything outside of that range is billed based on the actual number of days.
FR 3.1264	System has the ability to prorate for days less than system or user- defined number of billing days.
FR 3.1265	System provides the ability to prorate a new bill based on the number of days active.
FR 3.1266	System provides the ability to prorate a final bill based on the number of days active.
FR 3.1267	Bill Print: System should be configurable to take print in Batch or online as per bill printing requirement for schedule or unscheduled billing (online printing).
FR 3.1268	System provides the ability to bill for multiple meters at a single location.
FR 3.1269	System provides the ability to accommodate back billing for a single period with a user-defined start and end date.
FR 3.1270	System provides the ability to produce duplicate copies of the bill.
FR 3.1271	Budget Billing: System calculates the average billing amount over a user-defined period for past billings.
FR 3.1272	System calculates the same monthly payment while capturing actual readings.
FR 3.1273	System provides a user-defined month for account to be reconciled (trued up). Difference between the budget months calculated and payment to the actual amount to be billed.
FR 3.1274	System will provide for estimating should actual reads not be available.
FR 3.1275	System provides the ability to estimate entire billing cycles or routes with user-defined read date.
FR 3.1276	System will calculate the estimated bill based upon the read date, not the bill date, to determine number of days in billing cycle.
FR 3.1277	System will automatically mark services that have been estimated with a unique identifier.
FR 3.1278	System should have the functionality for advance billing (especially for unmeasured customer categories) as well as billing in arrears based on actual or estimated consumption.
FR 3.1279	**Analysis Reports:** • Demand analysis Report • Collections analysis Report • Revenue Recovery analysis Report

	• Power Supply effectiveness Analysis Report • Customer Service effective analysis Report
FR 3.1280	**Executive Management Reports:** • Consolidated view of operational profit & loss for all circle officers • Drill down from the Transaction level to reports right up to section level • Change the sorting order and view the report contents with the new sort order
FR 3.1281	**Consolidated Reports:** • Summary of the power purchase • consumption and sales • Revenue realization, revenue improvement • Customer complaints and commercial losses • Executive Summary Report • Demand Vs. Collection • Summary information Report • Commercial Performance Report
FR 3.1282	**Single Parameter Reports:** • Improvement Reports • Revenue Reports • Operations Reports
FR 3.1283	**Load Forecasting Reports:** • Short Term Load Forecasting Reports • Area Specific Load Forecasting reports
FR 3.1284	**Daily Reports:** Summary of % cumulative collections against correct month demand till date, last month.
FR 3.1285	**Revenue Collection Report:** • Demand raised for the month (As spot billing is done throughout the month cumulative progress is presented). • % cumulative collection against correct month demand, till date for this month and for the last month. • Monitoring of cumulative collection for the month till date against the demand raised.
FR 3.1286	Other Reports: Other reports as per the business requirements arising from time to time.
Integration and Interfaces	
FR 3.1287	The AITL functionality requirement is to create a SOA based enterprise framework to enable online integration for the various AEE components as per the solution proposed by the MSI. This framework must include: • ERP • E Governance System • Command and Control System • Document Management System • E Auction

	• Land Management System • Portal • Multi-channel communication interfaces which includes devices like desktops, laptops, tablets, mobile/handheld devices working on Android, Apple ,Windows or any other contemporary platform • Emails and SMS services • Web GIS • SCADA systems • Payment Systems(not limited to RTGS, PAYTM, BHIM, Credit Cards etc.) • Banks • Solid Waste Management System • Fleet Management Systems and Vehicle Tracking Systems • Systems relating to central and/ or state governments • Websites/portals of central and/or state governments • Systems owned by Vendors and/or City Operators • Police, Fire Brigade and other relevant state agencies • Systems/portal relating to any other domestic or international organisation as per AITL business needs • Any other system to be included in the proposed solution by the MSI and being implemented by other Contractors
FR 3.1288	Functionality should be provided for validation of data movement between source and target system.
FR 3.1289	Functionality should be provided to prevent duplicate updates of batch data files provided by external entities. The scope of this requirement should not be limited to the following illustrative example like reconciliation statements provided by Banks.
FR 3.1290	Not with standing anything contained in this RFP, the MSI solution cover all AITL business needs and should specify if the required interfaces needs to be bi-directional or uni-directional. During the course of the implementation there could be an AITL business needs which may arise which should be included in the MSI scope of work.
FR 3.1291	The AITL requirement is for online integration as a default. The MSI should propose a batch interface only because it is justified by business exigencies.

Foundation Layer

The Integration environment should focus on components that would help in realization of principles of Service Oriented Architecture (SOA). The architecture shall envisage a service delivery environment for creation of services that share the main concepts of services, service descriptions, the specification of an associated data model, and the use of a service contract to help in realization of combinational services via vertical integration. It shall also help in faster and cheaper deployment of new services for silo based applications. One of the key architectural principles while designing the solution for the SOA compliant architecture shall mostly be of out-of-box functionality and based on best practices in implementing a forward looking and future proof solution.

The details requirements of each layers/components & sub-components of system architecture are given below:

Access Channel	
FR 3.1292	Integrated Portal services shall be accessed online through Web, Mobile app and Kiosks via several end user devices (PC, Tablets, Smart-phones, etc.).
Presentation Layer	
FR 3.1293	The presentation layer i.e. User Interface would be used for the receiving and delivery information for to and from the end-user of the application. It should be responsive.
Single Sign On	
FR 3.1294	• Identity Provider: Active Directory Services (ADS). • SSO Application: Web application that provides a secure SSO Application Interface including interface and secure web services for Identity and Application management lifecycle. • Process Flow: Only upon successfully authentication, the end-user would land on the SSO Application wherein she/he would see a list of all the SSO-enabled applications. Once the authenticated user clicks on any application under the SSO Application, his/ her role/ access to that application is validated with Active Directory service in a secured manner and depending upon his/her role, access is denied/ granted to that application with the set of privileges mapped to the assigned role by that application. The user, after having finished his/ her work with the application, can go-back to SSO Application to select another application or directly Logout from the existing application. • The SSO application would also enable an authenticated user to review/ update his profile (self-service) using the SSO application.
Workflow Engine	
FR 3.1295	Workflow would be used with the automation of procedures where documents, information or tasks are passed among participants according to a defined set of rules to achieve, or contribute to an overall business goal. A workflow engine would manage and monitor the state of activities in a workflow, such as the processing and approval of various application forms, and determines which new activity to transition to according to defined processes.
ESB/Middleware	
FR 3.1296	• An Enterprise Service Bus (ESB) is a software architecture model used for designing and implementing communication between mutually interacting software applications in a service oriented architecture (SOA). • The ESB supports SOAP Based integration, including SOAP/HTTP, SOAP/JMS, and SOAP/HTTPS and XML messages. • The ESB supports message record/ replay capability, DFDL standards-based parser for text and binary data, many programming languages (Java, ESQL, PHP, C#, VB, F#, C++) including .Net, natively web services, Graphical Data mapping for transforming XML, text, and binary data, transaction management (Automatic, Commit, Rollback), SSL, SFTP, and LDAP etc. • The ESB provide robust transaction control capabilities including uncoordinated auxiliary transactions. • The ESB have the capability to support design, editing and manipulation of WSDL, through an integrated tooling.

	• The ESB provide an integrated testing tool with auto test the integration components developed and integrated development environment for development, test and deployment and debug. • The ESB also support TLS 1.1 & TLS 1.2 to offer strict security requirements.
Application Design, Development & Customization	
FR 3.1297	• Compliance with industry standards: Solution shall be compliant with industry standards (their latest stable versions as on date) wherever applicable. This will apply to all the aspects of solution including but not limited to design, development, security, installation, and testing. • Platform Flexibility: Open Standards and Interoperability (Usage of standard APIs) shall be considered Web-centric, multi-tier architecture shall be used. • Iterative Development: Iterative approach shall be used to develop a software system iteratively and incrementally, allowing developers and users to take advantage of lessons learnt during the development or earlier iterations of the system development. In the iterative development approach, the whole process of System Development typically iterates through all the phases of the System Development Life Cycle (SDLC), starting from gathering requirements to delivering functionality of a working release. • Compliance to SOA and EAI: Application shall be based on Service Oriented Architecture (SOA) and EAI. All modules of the application shall expose key functionality through Software APIs in form of SOAP & WS-* or JSON & REST etc. so that they can be consumed by other applications. • User Interface: The application's UI should be based on HTML5 standard only and should be compatible with all devices like Desktop, Smartphone and tablet etc. The application interface should be responsive.
FR 3.1298	Ensure applications execute proper error handling so that errors will not provide detailed system information, deny service, impair security mechanisms, or crash the system.
Technology Standard	
FR 3.1299	• Browser Compatibility: The Integrated Application should support common web and mobile browsers like Google Chrome, Internet Explorer, Firefox, Safari and Opera Mini etc. • Bi-Lingual Support: Application shall support at least Unicode 5.1/ 6.0 standard based Bi-lingual versions for user interface. It is expected to be in the Hindi and English (India) languages. • Anywhere Access: Application shall be deployed on state government cloud to enable anytime, anywhere access and to address auto sync/ save, efficiency, and peak load handling issues. Application shall be accessible on all popular devices (PC, mobile or tablets) and across all popular operating system platforms like Windows/ Apple for PCs and Android/ IOS for mobiles. The Integrated e-Office application should also function on the low bandwidth (64 Kbps/ GPRS). • Scalability, Reliability and Flexibility: The technology must be scalable with Department's emerging requirements and m information handling needs of the government increases. The architecture must be scalable and flexible for modular expansion. The IA shall plan and provide for horizontal scalability in such a manner that a new server can be added (or removed) dynamically, as and when required in future, without disturbing the normal functioning of

	production system. The vertical scalability in servers in terms of additional processors and RAM will have to be provided for handling future growth in transactions. • Interoperability: The system should be interoperable and should comply with open standards for easy integration. The entire system/ subsystem should be interoperable, in order to support information flow and integration. Operating systems and storage technologies from several suppliers must interact well with each other.
Security Standard	
FR 3.1300	• Application Access: Ensure applications processing data properly for authenticated users (through central authentication systems), specifically: SSO Login. Establish authorizations for applications by affiliation, membership, or employment, rather than by individual. If individual authorizations are used, these should expire and require renewal on a periodic (at least annually) basis. • Review: Conduct code-level security reviews with professionally trained peers for all new or significantly modified applications; particularly, those that affect the collection, use, and/or display of confidential data. Conduct annual security tests of Internet applications. • Security: application shall support both HTTP and HTTPS (SSL certificate shall be provided by MSI).
Enterprise Content Management (ECM) System / Document Management System	
FR 3.1301	Facility to scan and upload: • Paper documents • Photos • Email communication • Any Other Document
FR 3.1302	Documents in electronic soft form (pdf, txt, xls, doc, ppt, picture files, TIFF, JPEG, GIF, even Zip Files) System generated documents.
FR 3.1303	Ability to share documents scanned across several offices / departments.
FR 3.1304	The proposed system should have Out of the Box capability of Digital Asset management to manage rich media content files.
FR 3.1305	Automatically create multiple formats of a corporate image or video and create additional formats with various aspect ratio on ingestion.
FR 3.1306	Support multiple definitions of sets of renditions to be created for different classes of assets.
FR 3.1307	System should have support for management of image formats such as JPG, GIF, PNG, TIFF, PSD, and BMP; as well as output formats such as JPG, GIF, PNG, and PSD.
FR 3.1308	System should have support for video formats such as Flash, Real, Windows Media Format, QuickTime, and others. Image and Video metadata is extracted and associated with the content item as object metadata.
FR 3.1309	Ability to check the quality of the scanned image and make corrections/adjustments to improve the quality of the scanned image.

FR 3.1310	The ECM shall support temporarily storing the scanned images locally before uploading to the central server.
FR 3.1311	Ability to support quick scanning and indexing of bulk documents. Scanning through browser plug-in.
FR 3.1312	Ability to support automatic cropping / masking of whole/any part of the document. This ability should be user defined and also document wise.
FR 3.1313	It should be possible to scan and upload documents including pictures and images. Such document may be uploaded directly from third party premises over the web or from the office.
FR 3.1314	Ability to support Web based scanning.
FR 3.1315	It should be possible to set up and track both mandatory and non-mandatory documents.
FR 3.1316	Document types need to be pre-defined as a product / type of service / transaction type / workflow etc.
FR 3.1317	Confirm that the content was delivered and viewed as a proof of compliance with security policies.
FR 3.1318	Grant access to documents offline for a specified period of time while maintaining audit capabilities.
FR 3.1319	The system should have a native iOS and Android based mobile/tablet app for easy access of the information (document) while users are on the move.
FR 3.1320	Workflow for routing and tracking of documents, messages and Forms.
FR 3.1321	Create Ad-hoc or predefined routes for automatic document routing on sequential / parallel routes. This must be offered as a base and standard product.
FR 3.1322	All documents shall be organised in industry format. It shall have the facility to organise the documents according to last name, first name, size, type, date modified etc.
FR 3.1323	Facility of associating a note-sheet with the file enabling users to comment and review.
FR 3.1324	Facility of attaching documents and folders in work items.
FR 3.1325	Facility to act upon, forward, return or complete Work-items.
FR 3.1326	Support for referring Work-items to other users outside the pre-defined route.
FR 3.1327	Time –based/ Event -based reminders.
FR 3.1328	Provision of putting shared and secured notes for collaborative working on Work items.
FR 3.1329	Ability to support typical document imaging annotations which include:
FR 3.1330	Highlighting images and text in various colours to emphasize words or sections.
FR 3.1331	Redacting (blacking-out or whiting-out) images and text to preserve confidentiality.
FR 3.1332	Stamping images with words such as FAXED or CONFIDENTIAL, or with signatures denoting approval or denial.
FR 3.1333	Attaching sticky notes that contain additional comments.

FR 3.1334	An imaging system's security should control who can view.
FR 3.1335	Annotations such as highlighting, stamps or sticky notes, and who can see through redaction. All annotations should be overlaid and not change the actual image.
FR 3.1336	Ability to support Printing, faxing and e-mailing documents.
FR 3.1337	System must provide web-based administration tool and provide a single point of access for managing and administering all repositories, servers, users and groups regardless of their location across the enterprise.
FR 3.1338	The system will allow content syndication service via xml based feeds , email alerts etc.
FR 3.1339	The system should support versioning of contents, user should be able to access previous and next versions.
FR 3.1340	Should support storage of complete and multiple versions of content.
FR 3.1341	Should have major & minor release for draft & final release version of the document.
FR 3.1342	Should support the JSR 170, Java APIs/REST APIs/Web Service APIs that make content assets available to the application layer services or other Content Management (CM) solutions.
FR 3.1343	Should support for storage of any type of contents such as JPG, TIF, PDF, MS office files, audio, video, auto cad files etc.
FR 3.1344	The product should support single metadata store for modules such as Document Management, Web Content Management, Records Management and Digital Asset Management.
FR 3.1345	System should provide library services such as core content services, workflows, archiving, folders, content publishing, records management and security features.
FR 3.1346	Ability to support a single Security model for the content repository that is used to manage documents, records as well as web content.
FR 3.1347	Should have out of box support for standards like BPM/BPEL to address complex workflow requirements.
FR 3.1348	System should support for auditing for usage of content through audit trails.
FR 3.1349	System should provide support for scheduling indexing.
FR 3.1350	Provides ability for administrators to archive and backup content.
FR 3.1351	Should support for both centralized & distributed architecture.
FR 3.1352	Should support for content cache for remote client.
FR 3.1353	Should have policy-based, pluggable framework for reliability and secure access.
FR 3.1354	Should have a comprehensive access control functions, depending on the user role & access levels.
FR 3.1355	Should support simple as well as complex workflows along with escalation routing and monitoring policy as defined by user.
FR 3.1356	The proposed system should be able to classify any piece of content as a record.
FR 3.1357	Support for creation, declaration, classification, retention and destruction of business records.

FR 3.1358	System should provide audit trails and certificate of destruction.
FR 3.1359	System should provide the ability to freeze the records.
FR 3.1360	Product should provide records managers with a single view into all retention schedules, disposition actions, and audit histories, facilitating the process of identifying and declaring records.
FR 3.1361	System should allow for management of external content.
FR 3.1362	System should support adapters to external repositories for managing records, such as file systems, content repositories and e-mail archives.
FR 3.1363	Product should provide generic adapters that can be configured for integration with other applications and repositories.
FR 3.1364	It should have out of box components and integration options with Portal.
FR 3.1365	The system should provide ability to leverage multiple display templates for a content item.
FR 3.1366	System should support in-context web content contribution, preview, updates and approvals.
FR 3.1367	System should provide support for multi-site management.
FR 3.1368	The system must provide spell-checking functionality. The language of the dictionary must be able to be changed for content authors producing content in other languages.
FR 3.1369	The system must provide the ability to upload and associate media items to content items from within the content item authoring interface.
FR 3.1370	The system must provide the ability to preview content as it will appear on pages where it is added in production prior to it being published.
FR 3.1371	Enterprise Content Management System shall be integrated with web portal. Through this integration, Portal users like customers, vendors, industrialists etc. will get an interface to capture and upload documents into the ECM solution through the portal.
FR 3.1372	Enterprise Content Management System shall also be linked with ERP system to facilitate upload of documents by internal employees or external entities interacting with the system.
FR 3.1373	The system must have the capability to integrate with other core systems and any other business support systems at AITL as and when they are procured.

2.2.4 City Surveillance System including Automatic Traffic Counters and Classifiers (ATCC)

Overview

As part of the project, an all IP based video surveillance system shall be deployed across strategic areas of the Shendra. Objective of the surveillance system is to provide an integrated platform for enabling real-time communication between multiple departments responsible for safety and security across the city while creating an interactive response management system. Surveillance cameras shall be installed at all strategic locations including roads, intersections, public spaces/buildings, and other critical/sensitive facilities like AURIC Hall Building, AURIC Control Centre (ACC) Building and POP Rooms. All video captured from these locations shall be transmitted back to the AURIC Control Centre (ACC) for live viewing and performing pro-active monitoring and response management activities as part of city administration.

The primary purpose of the CCTV surveillance system shall be to provide proactive security as opposed to reactive security. This means that for every CCTV camera that will be installed as part of the project, there will be a certain objective. This objective may include – monitor, recognize, or detect. The CCTV surveillance system shall leverage city's fibre optic network for communication. All recording of the CCTV surveillance system shall be in such a way that there is no single point of failure. CCTV surveillance system shall support both edge analytics and central video analytics. The cameras implemented as part of this project shall be rated for operations in outdoor environment (for outdoor installations) and depending on the objective/application, shall be of different configurations i.e. PTZ, fixed cameras.

Throughout Shendra i.e. along city roads, intersections and at the entry/exit points of the city, CCTVs shall be co-located with the street light poles and Wi-Fi access points.

Along with CCTV Cameras, Automatic Traffic Counter and Classifier (ATCC) sensors shall also be installed at all entry/exit points of Shendra. ATCC shall be capable of automatically counting and classifying all types of vehicles under all lighting conditions.

As the CCTVs shall be co-located at the street light poles, same switch (as used for Wi-Fi) shall be used to backhaul to the ACC via dedicated fibre optic infrastructure. For connectivity, CCTVs will be connected to the nearest Point of Presence (POP) through a dedicated switch and fibre optic infrastructure. At the POP, there will be dedicated infrastructure like Network Video Recorder (NVR) that will be connected to the CCTV surveillance system for real-time recording purposes. Further, using the fibre optic infrastructure, real-time monitoring of CCTV surveillance videos shall be enabled at ACC video wall and workstations.

Exhibit 8: CCTV Rendering – Typical Intersection

BR - 4 Business Requirements

BR 4.1	City Surveillance System shall provide a secure and safe environment for the citizens by using intelligent video analytics and integrated platform forming part of decision support system.
BR 4.2	City Surveillance System shall support edge analytics or central analytics for pro-active monitoring.
BR 4.3	ATCC shall include capability to detect, count and classify traffic at all entry and exit locations for the purpose of managing traffic incidents.
BR 4.4	City Surveillance System shall enable real time recording of the video.
BR 4.5	CCTVs shall be co-located with the street light poles along with the Wi-Fi access points and leverage the same switch as the Wi-Fi access points.

FR - 4 Functional Requirements

The following are the functional requirements of the City Surveillance System:

FR 4.1	City Surveillance System shall consist of: • Fixed Cameras • PTZ Cameras; • Network Video Recorder (NVR) • Video Management System (VMS) including central software application • Automatic Traffic Counter and Classifier (ATCC) with Application • Camera Accessories i.e. Power Supplies, Cable, Connectors and associated accessories for an integrated system
FR 4.2	The cameras implemented as part of this Project shall be rated for operations in outdoor environment (for outdoor installations) and depending on the objective/application, shall be of different configurations including PTZ or fixed cameras.
FR 4.3	All the Cameras shall be IP based.
FR 4.4	Cameras shall have an integral receiver/driver that shall be capable of controlling pan-tilt, zoom and focus locally and also remotely from the AURIC Control Centre (ACC).
FR 4.5	All cameras shall support real-time video content analysis.
FR 4.6	All CCTV cameras shall be installed on streetlight poles except for multi-services digital kiosks where they shall be integrated.
FR 4.7	Indicative list of capabilities that AITL city surveillance system are as follows: • Real-time monitoring of City • Event based monitoring of City • Providing secured access to video at any time from any network location • Situation/Rule based alerts including early warnings for prevention and avoidance of unwanted incidents. • Automated response based on events including communication of alerts to relevant authorities like Fire, Hospitals, etc. for swift response in case of emergencies • Access to historic video data for investigative purposes • Real time traffic counting and classification for managing traffic incidents
Automatic Traffic Counting and Classification System	
FR 4.8	ATCC system shall require no separate gantry under all lighting conditions.
FR 4.9	The data from ATCC shall be used by various Government and private organizations (as per AITL discretion) to understand the existing traffic volume trends & patterns at the entry-exit points of Shendra.
FR 4.10	The ATCC System shall have integrated CCTV for counting and classification of vehicles in a real-time under live traffic conditions.
FR 4.11	The field of view of ATCC on a road stretch shall be able to cover from end to end of the traffic lane irrespective of the number of lanes on the particular road stretch.

FR 4.12	ATCC System at any point of time, shall provide a minimum of 5 classification levels viz. 2-wheeler, 3 Wheeler/Auto Rickshaws, Car/ Jeep, LCV/Truck and MAV at any given point in time.
FR 4.13	ATCC sensors shall capture the traffic data 24X7 lane wise, leg wise and transfer the traffic data to AURIC Control Centre (ACC) through fibre optic backbone in real time.
FR 4.14	Overall system shall work in an integrated fashion whereby data from the ATCC shall be continuously recorded, processed and transferred to ACC.
FR 4.15	ATCC CCTV with IR flash capable of capturing video during night/dark. Captured video should enable Client to identify and classify vehicles visually for comparative analysis purposes.
FR 4.16	ATCC should be able to count and classify the vehicles with minimum accuracy requirements for vehicles travelling between 45 kmph to 120 kmph speeds.
FR 4.17	The ATCC sub-system shall be capable of capturing at a minimum the following primary data points for each vehicle at any point of time: • Vehicle Count • Start Time • End Time • Leg/ road Location • Classification • Gap Time • Density • Headway • Occupancy • Vehicle Length • Speed
FR 4.18	The ATCC Sub-system shall be capable of sharing the data with any other sub-system in a real-time as per the requirement.
FR 4.19	The ATCC provider shall work closely with various other sub-system providers/vendors to share the required data in acceptable format to the other sub-system providers. As a minimum data exchange in XML, HTML and JSON formats shall be supported.
FR 4.20	The ATCC system shall have an operations monitoring dashboard, located at the control centre and shall enable monitoring by the operator.
FR 4.21	Monitoring dashboard shall show the status (connected/disconnected, faulty/working) of all logical devices (ATCC system) connected to a particular node when clicking on a node from the monitoring dashboard GUI.
FR 4.22	Access to monitoring dashboard shall be specific to the privilege of the user which can be defined in the system & shall be specific to a group/part of node locations.

Cameras with Built-in Video Analytics	
FR 4.23	The surveillance system shall support following Built-in-Analytics for the Cameras or using central analytics: • AutoTracker: To detect and track movement in the field of view. • Adaptive Motion Detection: To detect and track object that enter a scene and then triggers an alarm when the object enter a user-defined zone. • Abandoned Object: To detect objects placed within a defined zone and triggers an alarm if the object remains in the zone longer than the user-defined time allows. • Camera Sabotage: Triggers an alarm if the lens is obstructed. • Directional Motion: Generates an alarm in a high traffic area when a person or object moves in a specified direction. • Object Counting: To count the number of objects that enter a defined zone. • Object Removal: To triggers an alarm if the object is removed from a user-defined zone. • Stopped Vehicle: To detect vehicles stopped near a sensitive area longer than the user-defined time allows. • Intrusion Detection – Detect intrusion
FR 4.24	Event (alarm) Handling: • The camera shall be capable of recording an event as pre and post event images to on-board SD Media Card and on NVR. Events may be triggered using camera motion detection or from an external device input such as a relay. • When triggered from an external input or the camera's motion detector, the camera shall be capable of sending JPEG images via e-mail and/or sequences of images to an FTP server or on-board compact flash and NVR. • A relay output shall be available upon the activation of the camera's motion detector or external relay input. The relay output may also be manually activated from the live view screen.
Network Video Recorder (NVR)	
FR 4.25	NVRs shall be sized to provide minimum 30 days storage assuming recording of 24hrs a day, 7 days a week and 30 days a month at 4 CIF resolution. All NVRs shall be provided in an N+N configuration and shall be installed only at one POP and ACC.
FR 4.26	NVRs shall have in-built capabilities of recording video and audio streams directly from IP based cameras installed at field.
FR 4.27	NVRs shall be capable of reviewing video and audio streams on-demand using the supplied central software.
FR 4.28	NVRs shall be capable of storing all alarms generated as part of the CCTV surveillance system.
FR 4.29	NVRs shall be capable of supporting all recording of camera analytics.
FR 4.30	NVRs shall be network enabled for remote access, viewing, management and status monitoring. User Name and Password protection is required for access. The system must provide for remote administrator management of user names, passwords and management of definable end user rights.

FR 4.31	A network user/client interface software shall be supplied at no cost to AITL. The functional requirements of this client interface software will be reviewed and approved by AITL or their designate. This interface shall support a minimum of users at the ACC plus additional 20% as contingency.
FR 4.32	NVR Unit(s) shall provide fully configurable recording options to include, but not limited to: • Full record • Record on motion only • Variable frame rate • Variable resolution • Change of recording configurations e.g. event recording on receipt of an alarm globally and/or per camera • Enable audio/video recording on receipt of an alarm
Recording and Storage	
FR 4.33	The storage solution proposed is that the video feeds would be available for 30 days. After 30 days, the video feeds would be overwritten or archived unless it is flagged or marked by the Police or AITL for investigation or any other purpose. The video feeds of all relevant cameras capturing the incident in question would be stored until the Police or AITL deem it good for deletion.
FR 4.34	For incidents that are flagged by the Police, AITL or any court order, the video of the relevant portion from all relevant cameras should be stored/archived separately for investigation purposes and a committee at Authority can decide when this video feed can be deleted.
FR 4.35	The Recording Servers / System, once configured, shall run independently of the Video Management system and continue to operate in the event that the Management system is off-line.
FR 4.36	The system shall support the use of separate networks, VLANs or switches for connecting the cameras to the recording servers to provide physical network separation from the clients and facilitate the use of static IP addresses for the devices.
FR 4.37	The system shall support H.264 or better, MPEG-4 and MJPEG compression formats for all IP cameras connected to the system.
FR 4.38	The system should not limit amount of storage to be allocated for each connected device.
FR 4.39	The system shall allow for the frame rate, bit rate and resolution of each camera to be configured independently for recording. The system shall allow the user to configure groups of cameras with the same frame rate, bit rate and resolution for efficient set-up of multiple cameras simultaneously.
FR 4.40	Bandwidth optimization - The Recording Server / System shall offer different codec (H.264, MJPEG, MPEG-4, etc.) and frame rate (CIF, 4CIF, QCIF) options for managing the bandwidth utilization for live viewing on the Client systems.
FR 4.41	From the Client systems, the user shall have the option of having video images continually streamed or only updated on motion to conserve bandwidth between the Client systems and the Recording Server.
FR 4.42	The Recording Server / System shall support Camera devices from various manufacturers.

FR 4.43	The Recording Server / System shall support the PTZ protocols of the supported devices listed by the camera OEMs.
FR 4.44	The system shall support full two-way audio between Client systems and remote devices.
FR 4.45	Failover Support - The system shall support automatic failover for Recording Servers. This functionality shall be accomplished by Failover Server as a standby unit that shall take over in the event that one of a group of designated Recording Servers fails. The system shall support multiple Failover Servers for a group of Recording Servers.
FR 4.46	SNMP Support - The system shall support Simple Network Management Protocol (SNMP) in order for third-party software systems to monitor.
Video Management System (VMS)	
FR 4.47	Central software application to be installed at the ACC shall be able to run on any PC based on standard operating systems.
FR 4.48	Video Management System (VMS) shall be non-proprietary and open-ended to support integration with ACC platform.
FR 4.49	Central Application Server shall allow user to view live video stream.
FR 4.50	Software shall consist of a single client application and the client software shall not be dependent on, require any connection to, a central management or configuration server for security reasons.
FR 4.51	The system shall support a distributed architecture with no single point of failure.
FR 4.52	Video shall normally stream direct from recording server to client due to security reason.
FR 4.53	A client or any other operator shall ask “permission” to connect to a camera.
FR 4.54	There shall be no single management server. System management shall be distributed throughout the system.
FR 4.55	Recording failover shall be standard without need for additional license and/or hardware.
FR 4.56	It should be possible to record to multiple recorders at the same time.
FR 4.57	AITL’s workstations must remain “connected” to all recording devices simultaneously.
FR 4.58	Recording failover shall be standard without need for additional license and/or hardware.
FR 4.59	VMS/Camera shall allow the overlay of time and date and site information on live video panes, either on all panes, or selected pane only.
FR 4.60	VMS shall allow users to view live video and review recorded video at the same time.
FR 4.61	VMS shall be ONVIF compliant.
FR 4.62	Users shall be able to display any camera view (virtual preset).
FR 4.63	VMS shall allow users to review the hidden/privacy zone in live video if the user has the appropriate permission.
FR 4.64	Administrators shall be able to configure hidden/privacy zone on fixed cameras.
FR 4.65	VMS shall allow the display of analytics on video.

FR 4.66	Users shall be able to take a snapshot of one image or all images currently displayed and save as a bitmap or JPEG image to a configurable location. This should include zoomed images.
FR 4.67	Users shall be able to print a snapshot of an image displayed in a video pane direct on a printer (colour or grayscale, depending on printer).
FR 4.68	Users shall be able to replay currently viewed live video by a single mouse click for replays from 10, 15 or 30 seconds before current time or from alarm time.
FR 4.69	In the event of the video connection failing, the Video Management System shall display a clear error message with the option to also display the last video frame received.
FR 4.70	Option to view Surrounding Cameras: the system shall enable the operators to configure camera feed and based on group/ sub-group details, it's surrounding camera should be automatically displayed on separate pane based on alarms.
FR 4.71	Event Counting: The Video Management System/Smart City Platform shall allow users to view a count of analytics events on the video pane while video is being displayed. The System shall allow users to reset the event count for a camera.
FR 4.72	Live Video on Digital Monitors: • The Video Management System shall be able to display camera information in the On Screen Display (OSD) of a monitor: ➢ Camera name ➢ Date and time • The Video Management System shall support point to point connections between encoders and decoders for the following data: ➢ Video ➢ Audio transmit and receive • Users shall be able to specify whether a receiver is connected to monitor or VCR
FR 4.73	Audio in Live Video: • Users shall be able to listen to audio from multiple cameras through PC speakers. • Users shall be able to speak to one or more cameras through a PC microphone. • Users shall be able to mute a client speaker. • The Video Management System shall have an option to allow or prevent simultaneous listen and speak (full duplex audio). If full duplex audio is off, the direction of audio will be switched automatically when the user listens or speaks.
FR 4.74	PTZ Control: • All PTZ control shall be user-restricted. • Users shall be able to configure named preset positions with optional "tool tip" text. • Users shall be able to configure named custom commands with optional "tool tip" text. Commands can be per PTZ type or per camera, as required.

	• Users shall be able to simultaneously pan and tilt a PTZ camera displayed in a video pane in any direction and at varying speed by moving the PC mouse on the video pane. • Users shall be able to zoom a PTZ camera in or out using the PC mouse. • Users shall be able to simultaneously pan, tilt and zoom a PTZ camera displayed in a video pane or monitor using a joy stick on one of the supported CCTV keyboards. • Users shall be able to adjust the focus of a PTZ camera using the on screen PTZ controls or a CCTV keyboard: ➢ Focus near ➢ Focus far ➢ Auto-focus • Users shall be able to adjust the iris of a PTZ camera using the on screen PTZ controls or a CCTV keyboard: Open iris-Close-Auto-iris. • Users shall be able to move a PTZ camera to a preset position using the on screen PTZ controls or a CCTV keyboard. • Users shall be able to perform a custom command on a PTZ camera using the on screen PTZ controls (e.g. operate wipers.). • Users shall be able to enter the menu on a PTZ camera using the on screen PTZ controls or a CCTV keyboard (menu options navigated using pan and tilt.). • Users shall be able to hold onto connections to PTZ cameras to prevent other users taking control if not moved (overrides the 5 second timeout.). • Users shall be able to take control of a PTZ camera if user has a higher priority than the user currently moving it (overrides PTZ hold.). • Inform user when can't take control of a PTZ camera because another user with a higher priority is controlling it. • Users shall be able to show or hide the on screen PTZ controls. • The Video Management System shall support the following for cameras using the ONVIF interface or Camera Gateway: ➢ Pan, tilt and zoom control with mouse and joystick ➢ Go to preset ➢ Set preset
FR 4.75	Timeline and Calendar: • Users shall be able to view the recorded video footage for a camera along a timeline. They shall be able to expand and contract the timeline to show a larger or smaller time range and to scroll the timeline backwards and forwards to show different time periods. • Users shall be able to use the mouse wheel to both scroll and expand/contract the timeline. • For a camera, users shall be able to see summary information about how much recording footage is available from which NVR. • Users shall be able to change the playback NVR associated with a camera. • The Video Management System shall provide one-button click controls to go to the beginning or the end of available recording footage.

	• The Video Management System shall provide a calendar control to allow navigation to any year / month /day in the recording library. • The Video Management System shall provide a go to “today” control for getting current recording footage. • The Video Management System shall provide a go to “hour / minute / second” control. • The Video Management System shall display alarms related to the selected camera along the timeline including summary counts of the number of alarms in each time period. • The Video Management System shall display video bookmarks along the timeline. Bookmarks can either be those from a selected camera or from current bookmark query as displayed in the bookmark list.
FR 4.76	Playback on PC Screen or Video Wall: • The Video Management System shall play back video recorded in MJPEG, MPEG4 and H.264 formats. • The Video Management System shall replay footage in same video pane, or navigate to recorded video panes. • The Video Management System shall play back video from up to 25 cameras at once in a single video window. • The Video Management System shall play back each camera separately or synchronize to playback from the same time. • The Video Management System shall play back synchronized recorded audio with video in each video pane. • The Video Management System shall display time and date information on recorded video panes, either on all video panes, or on the selected pane only. This should be able to be set independently of the settings for live video panes. • The Video Management System shall play back video using the following standard VCR operations: ➢ Play-pause-fast forward at different speeds (x1/4, x1/2, x2, x4, x8, x16, x32, x64, x128). ➢ Rewind at different speeds (x1/4, x1/2, x2, x4, x8, x16, x32, x64, x128). ➢ Single frame forward-single frame back. • Users shall be able to move playback to a different time either using the timeline or entering a specific date and time. • Users shall be able to move playback to the time of the next alarm or bookmark or motion over threshold. • Users shall be able to digitally zoom up to 1000% and scroll replayed video. • Users shall be able to display analytics on video. • Users shall be able to take a snapshot of one image or all images currently displayed and save as a bitmap or JPEG image to a configurable location. This should include zoomed images. • Users shall be able to print a snapshot of an image displayed in a video pane direct to a printer (colour or grayscale, depending on printer.).
FR 4.77	Motion Search: • Users shall be able to find motion in recorded footage from a selected time and display a motion profile on the timeline.

	• Users shall be able to configure a region of interest for motion search. • The Video Management System shall support the following options for motion search: ➢ General motion search – for motion in any direction ➢ Museum mode search – for objects being removed from a scene. .
FR 4.78	Bookmarks: • Users shall be able to add a bookmark to a recording for a camera at a specified time. • Users shall be able to find bookmarks by a text string within the bookmark. • Users shall be able to produce reports of bookmarks and export to RTF or CSV formats. • Users shall be able to delete one or more bookmarks (if created by the same user). • Users shall be able to delete bookmarks created by any user. • The Video Management System shall ensure that bookmarks are held alongside recordings on the NVR, not on a user's PC. • Users shall be able to view recorded video associated with a bookmark. • It shall be possible for text information to be automatically fed into the IP Video System as Bookmarks via an SDK. • The Video Management System shall ensure that the text information is displayed in a scrolling bookmark comments window beside the playback window. • Detailed search options shall allow for filtering of bookmarks e.g. by time or text, by user. • Within the bookmark comments window the highlighted bookmark shall correspond to the current playback position. • Next and previous incident buttons shall automatically scroll the bookmark comments window keeping the highlighted text and associated video in synch. • In a live view pane, users shall be able to add a bookmark to the recording of that camera. • Users shall be able to view bookmarks as a transparent overlay on a live pane.
FR 4.79	Incident Export: • Users shall be able to export video clips from a selected camera or cameras within a site to a named incident. • Users shall be able to select the start and end times of the export by clicking and dragging on the timeline. • Time to export shall be no more than 30 seconds per hour of video recorded. • Users shall be able to queue video exports to be performed as a background process. • The Video Management System shall show progress and estimated time to completion in an export status window. • The Video Management System shall automatically digitally sign video clips on export.

	• Users shall be able to protect the original recordings to preserve the evidence. • Users shall be able to review incidents in a standalone incident player application, directly from CD. • Users shall be able to play back incidents with all the playback operations provided by the full Video Management System application. • Users shall be able to check and authenticate digital watermarks embedded within exported clips. • The Incident Player application shall be able to be run at the same time as the main Video Management System application so that users can easily verify the success of an export. • The Video Management System shall support the following ONVIF cameras and cameras streamed via Camera Gateway: ➢ Export of video recorded in MJPEG, MPEG4 and H.264 ➢ Playback of exported video in exported player • The Video Management System shall provide the option to include date and time on each frame of the recording when it is exported. • Administrators shall have the ability to restrict the location that users may export video files to.
FR 4.80	• Users shall have the ability to produce a simple easy to view video summary of an incident. • Users shall have the ability to export all video associated with this summary. • All video in this export should be fully watermarked.
FR 4.81	Playback on Monitors: • Users shall be able to play back recorded video on monitor from a selected time. • The Video Management System shall support basic play back operations on an analog monitor: ➢ Play ➢ Pause
FR 4.82	Audio in Playback: • Users shall be able to listen to audio recorded with video from all cameras being played back or selected cameras only. • Users shall be able to listen to audio streams without the need to display anything in the video pane. • The Video Management System shall support the following for 3rd Party cameras through ONVIF: ➢ Listen to recorded audio
FR 4.83	Users shall be able to start an instant recording from live video viewed in a video pane. They shall have the option to start recording video only or both video and audio.
FR 4.84	Users shall be able to configure the recording schedule for cameras on NVRs. Recording can be configured to be: • 24/7 • Timed (from minute to weekly schedules) • On alarm or event

FR 4.85	Users shall be able to specify the transport protocol to be used for recording (TCP, UDP, and Multicast.).
FR 4.86	Users shall be able to specify whether audio should be recorded with the video.
FR 4.87	Users shall be able to specify whether the recording should be protected when an alarm or event occurs (from a specified time before the alarm / event.).
FR 4.88	Users with appropriate permissions shall be able to enable or disable recordings temporarily.
FR 4.89	Users shall be able to delete recording schedules.
FR 4.90	Users shall be able to copy recording schedules from one camera to other cameras on the same or another NVR.
FR 4.91	The Video Management System shall support digital signing on exported clips.
FR 4.92	Users shall be able to find recordings within a specified time period.
FR 4.93	The Video Management System shall display a warning message if an NVR is unable to retain the number of days recording for which it was configured.
FR 4.94	The Video Management System shall support the configuration of failover NVRs for each primary NVR with the following options: • 1 to N: 1 primary NVR can have one or more failover NVRs • N to 1: multiple primary NVRs can have the same failover NVR • Continuous recording to primary and failover NVRs • Recording to failover NVR only when primary NVR fails
FR 4.95	The Video Management System shall automatically failover when a primary NVR is down.
FR 4.96	In addition, users shall have the option to manually failover, for example to allow for routine maintenance of a primary NVR.
FR 4.97	Users shall have the option to manually fail back to a primary NVR, with the option to restore the recording configuration from the failover NVR to the primary.
FR 4.98	The Video Management System shall support binary inputs on IP Cameras, encoders, decoders and alarm panels.
FR 4.99	The Video Management System shall support analytics alarm inputs, with separate events for each analytics filter.
FR 4.100	The Video Management System shall support alarm inputs from 3rd party systems.
FR 4.101	The Video Management System shall enable multiple alarm inputs (detectors) to be grouped into an alarm zone.
FR 4.102	The Video Management System shall support inputs (detectors) that do not cause an alarm to be generated.
FR 4.103	The Video Management System shall support ‘AND’ logic between detectors so that the alarm input is activated only when both detectors are activated with a defined time period.
FR 4.104	The Video Management System shall support detectors that are activated and deactivated by different inputs e.g. activate on a binary input from one device and deactivate on a binary input from another device.

FR 4.105	Users shall be able to sort the alarm information in various ways by clicking on column headings.
FR 4.106	The Video Management System shall support to configure alarm such that alarms are only generated on specific events.
FR 4.107	Users shall be able to configure the time schedule for each camera – different start and end times for each camera shall be supported.
FR 4.108	Users shall be able to define specific dates and times within time schedules so that exceptions for holidays etc. can be specified.
FR 4.109	The Video Management System shall enable the same time schedule to be applied to multiple cameras.
FR 4.110	Users shall have the option of restoring the previous view after an alarm has been cleared.
FR 4.111	Users shall be able to manually configure alarms.
FR 4.112	Users shall be able to identify false alarm inputs manually and users shall be able to easily enable/disable source of alarm post identification.
FR 4.113	Users shall be able to specify a priority for each alarm camera (1-10.).
FR 4.114	Users shall be able to configure the alarm sound for all alarm zones in a site or for each alarm zone individually. Sound can be from any .wav file and can be sounded once or repeated while the alarm is active.
FR 4.115	The Video Management System shall allow alarms to be configured to require text from a user at the point of acknowledging and at the point of clearing.
FR 4.116	The Video Management System shall allow operator to see instruction/procedure document (.html, text or URL) for an alarm. Operator may pull this procedure document when an alarm is triggered.
FR 4.117	Users shall be able to configure the actions that should be performed when an alarm occurs: • Show video from camera, camera view or salvo in specified monitors • Stop video when alarm cleared • Move camera to preset position • Send email to multiple recipients, with option to include snapshots • Perform a relay action automatically • Start recording one or more camera – records for specified duration • Auto-protect recording from a specified duration before the alarm
FR 4.118	The Video Management System shall support the following for 3rd Party cameras through native protocols and / or ONVIF: • Motion detection events • Record on motion • Video loss • Network loss • Change video quality on event, including frame rate, resolution and bitrate
FR 4.119	Users shall be able to configure an unlimited number of alarm groups each containing a set of alarm zones and/or detectors.

FR 4.120	For each user or user group, it shall be possible to associate one or more video panes with each alarm group. This should also include analog monitors.
FR 4.121	Users shall be able to choose a display mode for alarm video. As multiple alarms come in, the video can either be “cascaded” across the chosen viewing panes or “queued” behind the chosen viewing panes. As alarms are cleared, the associated video is cleared from the chosen viewing panes. Cascaded video can either remain in the same video pane until cleared, or can move to the first available pane as earlier alarms are cleared.
FR 4.122	The Video Management System shall clearly mark black screen monitoring viewing windows as being distinct from normal live view windows through background colour and icon.
FR 4.123	The Video Management System shall have permissions to determine which users or user groups get access to which alarm groups and which windows are used to display alarm video.
FR 4.124	Users shall be able to configure any of the available viewing panes or analog monitors as a spot monitor for viewing significant live footage.
FR 4.125	The Video Management System shall keep an audit record of what video was started and stopped in the spot monitor, by which user and what times.
FR 4.126	The Video Management System shall generate an alarm if any of the detectors within an alarm zone are activated.
FR 4.127	The Video Management System shall alert new alarms with flashing icon and optionally a sound.
FR 4.128	The Video Management System shall automatically perform the actions configured for the alarm zone or detector: • Show video from camera, camera view or salvo in specified video panes or monitors • Move camera to preset position • Stop video when alarm cleared • Send email to multiple recipients • Perform a relay action • Start recording one or more cameras • Auto-protect recording from a specified duration before the alarm
FR 4.129	When an alarm happens, the Video Management System shall be able to show live video from a camera on one pane and beside it show a looped replay/sequencing from just before the alarm to just after or as alternative, live to playback switching shall be supported.
FR 4.130	From a looped replay/sequencing, users shall be able to quickly jump to continuous replay from the alarm time.
FR 4.131	The users shall be able to display a map showing the location of the alarm.
FR 4.132	Users shall be able to view pending alarms in a list ordered by priority and time.
FR 4.133	Users shall be able to filter the alarm list to show alarms only from specific areas (sites and zones.).

FR 4.134	The Video Management System/Smart City Platform shall be able to display alarm procedure document for the alarm.
FR 4.135	The Video Management System/Smart City Platform shall allow users to acknowledge alarms, entering alarm response text as required.
FR 4.136	The Video Management System/Smart City Platform shall allow users to edit the alarm response text at any time before the alarm is cleared.
FR 4.137	The Video Management System/Smart City Platform shall allow users to clear alarms, entering alarm response text as required.
FR 4.138	Users shall be able to find historical alarms matching specified criteria: • Alarm type • Alarm state (new, acknowledged, cleared) • From site(s) • From alarm zones(s) • User(s) who acknowledged or cleared • Time range
FR 4.139	The Video Management System/Smart City Platform shall be able to escalate alarms to other user groups if the alarm is not acknowledged within a pre-defined time period.
FR 4.140	Users shall be able to produce reports of historical alarms and events and export to RTF or CSV formats.
FR 4.141	Users shall be able to view live or recorded video associated with the alarm.
FR 4.142	The Video Management System shall ensure that alarms are held on an alarm server, not on a user's PC.
FR 4.143	The Video Management System (VMS) shall support integration with external data sources.
FR 4.144	The VMS shall support up to 1 external data record every second.
FR 4.145	The VMS shall support up to 2 million data records.
FR 4.146	The VMS shall allow for the association of data records with video data.
FR 4.147	Integration shall be available via a freely available open interface. The interface shall be via a software development kit.
FR 4.148	Users shall be able to configure relay actions using binary outputs on IP Cameras, encoders and decoders.
FR 4.149	Users shall be able to configure relay actions using external outputs to 3rd party systems.
FR 4.150	The relay activation shall be triggered based on the event detected at field.
FR 4.151	The Video Management System shall support latched relay outputs.
FR 4.152	Users shall be able to associate relay actions with specific cameras so that the actions are readily available when video is displayed from that camera.
FR 4.153	The Video Management System shall perform relay actions on alarm and event.
FR 4.154	The Video Management System shall be able to perform relay actions on a time-schedule.

FR 4.155	The Video Management System shall automatically check for devices not on the network and notify users when not available.
FR 4.156	It shall be possible to define the users who get notified if devices become unavailable.
FR 4.157	The Video Management System shall scan for devices using any combination of IP broadcast addresses, individual IP addresses or ranges of IP addresses.
FR 4.158	Users shall be able to turn off scanning of devices.
FR 4.159	The Video Management System/NMS shall notify users when device times are not synchronized with the viewing PC (more than 60 seconds out).
FR 4.160	The Video Management System shall notify users of problems with NVRs. The notifications will be those supported by each NVR.
FR 4.161	Users shall be able to view the current status of an NVR with visual indicators showing whether each item is OK or indicates problems: • Total disk space • Minimum free disk space • Used disk space (total – free) • Percentage space used (used disk space / total disk space) • Any additional features supported by the NVR.
FR 4.162	Users shall be able to view reports for NVR/VMS and display the following information: • Start time of first recording • End time of last recording • Total size of all recording • Total duration of all recordings
FR 4.163	The Video Management System shall provide a support information tool, which gathers together log files and site database into a zip file.
FR 4.164	Users shall be able to configure named user groups. A group can be granted administrator rights: • Full (can configure everything) • Restricted (can configure everything except users and groups) • No configuration rights (limited user functions only)
FR 4.165	The Video Management System shall be able to hide administration options from normal users. The user interface shall be cleanly split into administrative functions and operational functions. Users who do not have administrative rights shall get a much simpler interface so that they are not confused by visible but disabled features.
FR 4.166	Users shall be able to configure named user accounts and allocate them to user groups.
FR 4.167	Users shall be able to enable and disable user accounts.
FR 4.168	Users shall be able to set-up a user to use either machine OS standard authentication or a password when he logs into the Video Management System.
FR 4.169	Users shall be able to limit the total number of video streams (live or recorded) that can be displayed at once on monitor.

FR 4.170	Users shall be able to allocate each user group or user a priority that is used when controlling PTZ cameras.
FR 4.171	Users shall be able to grant global permissions to user groups or users (global permissions do not apply to specific objects such as cameras): • PTZ hold (allows a user to keep control of a PTZ camera when not moving it) • Video lockout (allows a user to perform a video lockout on any site of camera)
FR 4.172	Users shall be able to grant permission for user groups and/or users to access any object in the system (sites, cameras, monitors, salvos, alarm zones, detectors and relays.) For each object access can be limited by function: • List – see object in the user interface • View – view video from cameras, sequences, salvos and guard tours • Transmit audio (speak) to a camera • Playback recording from a camera or salvo • Record – make an instant recording of a camera • Export video clips or take snapshots from a camera • Control a PTZ camera • Display video on a monitor or video wall or activate a relay • Respond to alarms from an alarm zone • Video cum Audio (live or playback) – receive video/audio from a device • Set and unset an alarm • Isolate and restore a detector • Configure presets and access the camera menus
FR 4.173	Users shall be able to reset access permissions on individual objects to use the access permissions.
FR 4.174	Users shall be able to configure application settings specific to each PC, including: • Enable or disable scheduled tasks • Location for snapshot images • Format of snapshot image (bitmap or JPEG) • Folder for snapshot image • Replay incident in live or Playback view • Use software or hardware assisted video renderer • Enable or disable use of a CCTV keyboard • CCTV keyboard type • Resize text on video panes in proportion to video pane size • Video pane icon size (normal, medium, large) • Select icon size on video panes in proportion to video pane size • Date / time display on video panes (none, all, selected) • Load bookmarks on startup • Spot monitor (external monitor or specified video pane) • Protect recordings by default when exporting • Write date and time on exported recordings
FR 4.175	Users shall be able to prevent simultaneous listen and speak (full duplex audio).

FR 4.176	Users shall be able to configure the use of buffered playback when reviewing recordings.
FR 4.177	Users shall be able to enable or disable alert messages.
FR 4.178	Users shall be able to log into the Video Management System manually.
FR 4.179	It shall be possible to start the Video Management System from the command line with the following options: • Username and password • Normal, full screen or video-only modes • Site database
FR 4.180	The Video Management System shall allow users to log out and log in without closing the application.
FR 4.181	The Video Management System shall have an option to require all users to re-enter their password when logging out or automatically logout based upon time-out.
FR 4.182	Users shall be able to change their own password (if given write permission to the site database).
FR 4.183	Administrator users shall be able to lockout all other users preventing them from viewing or recording video from a selected camera or all cameras in a selected site.
FR 4.184	The Video Management System shall support an audit trail that can log user actions to an industry standard database e.g. SQL Server.
FR 4.185	Users shall be able to specify the authentication method to be used between the client application and the audit trail database: • Local user password • Windows user password
FR 4.186	The audit trail shall log the following user actions to the audit trail database: • User logged on • User attempted to log on and was denied access • User logged off • User acknowledged an alarm • User cleared an alarm • User received an alert message (e.g. device not available) • User denied playing back a recording or playback failed • User took control of a PTZ camera • Export recordings • Protect recordings • Manual start or stop recording • Creation, deletion or editing items stored in the Video Management System configuration database • User created a bookmark
FR 4.187	The audit trail shall log the following information for each entry in the audit log: • Date and time that the user performed the action in UTC • Name of the user performing the action

	• DNS name of computer running in ACC • The name of the application writing to the log • A string naming the type of action performed e.g. Log on • Name and matrix number of the object that the action applies to e.g. camera name and number • Further information about the action, in a structured form e.g.: “Alarm Time: 16-Feb-06 10:11:41, Alarm Response: False alarm” • Severity (applies to error message received log entry only)
FR 4.188	The user shall be able to export a report from the audit trail database into a standard reporting tool, e.g. Excel.
FR 4.189	The Video Management System shall discover IP Video devices on a network either by broadcast address or unicast addresses for each device.
FR 4.190	The Video Management System shall allow configuration of IP Video System devices via their web configuration interface.
FR 4.191	The Video Management System shall enable configuration of devices, in particular encoder settings on IP cameras and encoders.
FR 4.192	Administrators shall be able to view video from each stream at the same time as making changes to the media parameters on an encoder to aid configuration.
FR 4.193	Administrators shall be able to upgrade the firmware on IP Video System devices - multiple devices can be upgraded in one go through the system.
FR 4.194	Administrators shall be able to create a hierarchy of sites and sub-sites for organizing cameras and other items by location.
FR 4.195	Administrators shall be able to set the time-zone on a site - different sites can each have their own time zone.
FR 4.196	Users shall be able to reorder sites under their parent site (sites are ordered by number).
FR 4.197	The Video Management System shall be able to automatically create a site hierarchy within a site database containing IP Video System devices visible on the network.
FR 4.198	Users shall be able to create sequences and salvos within the sites, set up 24/7 recording for each camera and enable video loss and network loss alarms.
FR 4.199	Users shall be able to add cameras, monitors, alarm panels, alarm servers and NVRs to sites by dragging and dropping, selecting from a list or manually entering the IP Address and name.
FR 4.200	Users shall be able to remove devices from sites.
FR 4.201	Users shall be able to enter a localized display name for cameras, monitors, alarm panels, alarm servers and NVRs which overrides the name stored on the device.
FR 4.202	The Video Management System shall enable a copy of the configuration database to be cached locally on each user workstation to ensure continuity of operation when a connection to the central database is not available.
FR 4.203	The Video Management System shall support a configuration database that is divided into multiple ‘segments’, e.g. one segment for each site. The Video Management System shall allow each segment to be configured and accessed independently.
FR 4.204	The Video Management System shall support user access permissions so that only authorized users can access specific segments.

FR 4.205	When the configuration database is divided into segments, the Video Management System shall allow all sites to monitored e.g. from a central monitoring facility.
FR 4.206	Users shall be able to create one or more maps for each site by importing an image for the background. The following image formats shall be supported: • Bitmap (BMP) • JPEG (JPG) • Portable Network Graphics (PNG) • AutoCAD drawings (DWG) • GIS
FR 4.207	Users shall be able to add links to other maps.
FR 4.208	Users shall be able to reposition items by drag and drop or entering specific coordinates.
FR 4.209	Users shall be able to add cameras to map.
FR 4.210	Users shall be able to specify the field of view for each camera.
FR 4.211	Users shall be able to add detectors to map.
FR 4.212	Users shall be able to specify the amount of detail displayed for each object including icons, matrix numbers and labels.
FR 4.213	Colour schemes shall be configurable to make text and fields-of-view more visible.
FR 4.214	The map shall be fully scalable with zoom and pan supported under mouse control.
FR 4.215	Users shall be able to displays the previous maps viewed (back, forward).
FR 4.216	Users shall be able to link to any map from any map.
FR 4.217	The map should be viewable on a separate monitor from the main video(s).
FR 4.218	Users shall be able to display live and recorded video from any camera on a map.
FR 4.219	Users shall be able to view video from some or all of the cameras on a map.
FR 4.220	Users should be able to click on the field-of-view of any camera to view the video.
FR 4.221	Where fields-of-view overlap, clicking on the convergent area should result in all cameras being displayed.
FR 4.222	Activated alarms shall be visually represented on the map.
FR 4.223	Where detector/zones areas have been configured, these should be visually represented as being in an alarmed state.
FR 4.224	Where detector/zones areas have been configured and in an alarmed state, the user should be able to start video from all cameras associated with that zone by clicking on it.
FR 4.225	Users shall be able to: • Manage alarms from a map • Clear alarms • Acknowledge alarms • View Video associated with an alarm • Isolate/restore alarms • Configure Cameras/Detectors

FR 4.226	Users shall be able to trigger events to binary outputs on cameras or encoders.
FR 4.227	The Video Management System shall include a restricted access version of the video viewing and replay application that prevents all users from accessing the setup screens.
FR 4.228	The Video Management System shall provide a restricted access site database management utility, which prevents creation of new site databases.
FR 4.229	The Video Management System shall provide a restricted access version of the video viewing and replay application, which prevents all users from modifying the audit log configuration even if they have an administrator login.

TR - 4 Technical Requirements

Fixed and PTZ Camera, Lenses and Mounts	
TR 4.1	The camera control shall comply with the latest release of Open Network Video Interface Forum (ONVIF) standards.
TR 4.2	The camera shall include an integral receiver/driver. The receiver/driver shall be capable of controlling pan-tilt, zoom and focus locally and remotely from the ACC.
TR 4.3	The camera shall incorporate AGC circuitry to provide for compensation at low light levels.
TR 4.4	The lens shall be integrated with the camera.
TR 4.5	Video output resolution shall not be less than 1920x1080 pixels.
TR 4.6	The camera shall be capable to produce minimum 25 frames per second (fps).
TR 4.7	The camera shall provide automatic white balance, automatic exposure, automatic gain control, electronic shutter, and backlight compensation.
TR 4.8	The camera shall be a true day/night cameras with mechanical IR cut filter.
TR 4.9	The camera shall be capable of providing a high contrast colour picture with a full video output at a minimum illumination as mentioned in the specifications.
TR 4.10	All cameras shall capture high definition video, compress the video using H.264 technique and transmit real-time using fibre optic based communications system.
TR 4.11	The cameras shall capture audio and compress using G.711 technique and transmit real-time using fibre optic based communications system.
TR 4.12	All cameras shall support on-board real-time video content analysis.
TR 4.13	All cameras shall support both Constant Bit-Rate (CBR) and Variable Bit-Rate (VBR) options.
TR 4.14	The camera shall support up to 2 video profiles, each providing independent configuration of bitrate, framerate and resolution.
TR 4.15	The camera shall support video compression up to 6Mbps.
TR 4.16	The camera shall support audio compression using the G.711 compression algorithm, streaming @ 32Kbps per channel sampled at 8KHz or 16KHz with a 16bit resolution.
TR 4.17	The camera shall support on-board storage via micro SDHC slot and card with a minimum capacity of 64 GB.

TR 4.18	All cameras shall have integral in-built adaptive IR technology. For fixed cameras, the IR shall support a range of at least 50m and for PTZ it shall support a range of at least 200m moving with zoom (adaptive).
TR 4.19	For Fixed Cameras: • The fixed camera shall provide a minimum focal length range of 2.8-10 mm compensated with a minimum 12x digital zoom and shall be remotely controllable from the camera control transmitter at ACC. • The fixed camera shall capture video using 1/3" progressive scan CMOS or better. • Fixed Camera resolution shall be 2048 x 1536 or better.
TR 4.20	For PTZ Cameras: • Camera shall have capabilities of PAN of 360° continuous. • Camera shall have capabilities of Tilt of 180°. • Lens of 6mm-129mm with minimum 20X optical and 12X digital zoom. • PTZ camera shall capture video using minimum 1/3" type CMOS sensor or better. • It shall support resolution of 1920x1080 or better. • Camera shall support tilt of 100° either side. The tilt capability shall include both the horizontal (level view) and vertical (downward view) position. If the camera travels beyond straight down, automatic image flip circuitry shall prevent the display of an inverted image. • The pan and tilt mechanism shall be an integral part of the camera. • Pan speed shall be upto 160°/s and Tilt speed upto 120°/s.
TR 4.21	There shall be a minimum of 100 assignable automatic preset positions.
TR 4.22	There shall be a minimum of 8 definable privacy zones.
TR 4.23	All cameras shall provide effective 24/7 imaging performance for CCTV surveillance applications.
TR 4.24	All cameras shall provide user control, with remote configuration for functions including streaming and compression settings, exposure, white balance, flicker control, picture size, cropping/privacy, brightness, sharpness, saturation, day-night switching point, frame rate, image rotation, snapshot, dynamic bandwidth allocation and motion detection.
Network Video Recorder (NVR)	
TR 4.25	The Network Video Recorder (NVR) will be connected via a Gigabit Ethernet network.
TR 4.26	NVR shall be of N+N configuration with RAID 6 configuration.
TR 4.27	All equipment shall be designed to provide a usable life of not less than 15 years.
TR 4.28	The NVRs/Windows tools shall have a self-diagnostic feature including disk status, CPU usage and network status.
TR 4.29	The NVRs shall be support interface using 10/100/1000BaseTX. It shall support a total throughput of at least 700 Mbps.
TR 4.30	The NVR shall be powered using 100-240VAC/50Hz.
TR 4.31	Each NVR unit shall be maximum of 2U height.

TR 4.32	The NVR shall support Windows platform.
TR 4.33	The NVR shall be capable of digitally sign exported video to ensure chain of trust.
TR 4.34	The NVR shall have failover and redundancy built in with seamless playback without manual intervention.
TR 4.35	The NVR shall support a minimum of 200 recorded video streams and 20 playback streams with minimum playback of 400 Mbps.
TR 4.36	All equipment shall be modularly upgradeable so that it does not need to be replaced in its entirety to increase memory capacity, to upgrade processing performance, or to reconfigure I/O options.
TR 4.37	Provisions to protect all equipment and components from common vandalism, theft and physical abuse shall be included.
TR 4.38	Normal state (non-alarm) recording configuration to provide for “Detection” and as follows: • Resolution HD • Normal Frame rate of 25 FPS
TR 4.39	Alarm state recording configuration to provide for “Recognition” a and as follows: • Resolution of HD • Frame rate of 25 FPS • Alarm state recording of one track of audio at 32 Kbit
Central Application	
TR 4.40	The software shall be able to run on any PC based on industry standard OS.
TR 4.41	The software shall support ONVIF compliant cameras and devices.
TR 4.42	The software shall show live video from IP Cameras and Video Transmitters in MJPEG, MPEG4 and H.264 formats.
TR 4.43	The software shall support cameras with resolutions ranging from Standard Definition, High Definition (HD) and up to 5 Megapixel.
TR 4.44	The software shall show video across 4 displays per workstation - each display can have up to 25 viewing panes.
TR 4.45	The software shall allow configuration of the video and audio stream settings for each user, depending on the support hardware.
TR 4.46	Users shall be able to change the video pane layout in each of the 4 screens independently: • Grid layouts: 1x1, 2x2, 3x3, 4x4, 5x5 • Widescreen layouts: 2x3, 3x4, 4x6 • Hotspot layouts based on 3x3, 4x3, 4x4, 5x5 larger pane in top, left • Hotspot layouts based on 4x3, 4x4, 5x5 larger panes in centre
TR 4.47	Users shall be able to change the aspect ratio in each of the 4 video windows independently in order to display Standard Definition or High Definition video. Choose between: • Widescreen (16:9) • Standard (4:3)

TR 4.48	Users shall be able to move any image from one display screen to another via drag-and-drop.
TR 4.49	Users shall be able to digitally zoom up to 1000% and also digitally scroll live video from any camera using the mouse wheel.
TR 4.50	The software shall allow the display of objects detected via analytics on the video (up to 10 at once).
TR 4.51	Users shall be able to view stream statistics on all current video streams, including the following information: • Frame rate • Resolution (SIF, 2SIF, 4SIF,720p, 1080p, 5MP) • Current bit-rate
Automatic Traffic Counter and Classifier System (ATCC)	
TR 4.52	The CCTV based Automatic Traffic Counter and Classifier System (ATCC) shall have the capability of vehicle presence detection & classification at intersections as well as at free flow roads.
Traffic Data Collection	
TR 4.53	The system shall also be cost effective solution for traffic data collection, queue detection and traffic flow monitoring on highways and inter-urban roads.
TR 4.54	It shall be used for temporary or permanent application both.
TR 4.55	The System shall have IP-addressable video detection sensor. Streaming video at full frame rate shall be available for system and traffic monitoring. The system shall be configurable to view and control the system both on-site and remotely.
TR 4.56	The system setup shall be quick-and-easy.
TR 4.57	There shall be single download tool to download the integrated traffic data and traffic events from multiple sensors.
TR 4.58	The system shall have the facility to monitor the traffic data, events and viewing maps through the graphical user interface, it is possible to create maps in order to have an overview of all installed sensor systems. By double clicking on a camera, to get live streaming video from the selected sensor. There shall be an event stack which can groups all the traffic data & traffic events.
TR 4.59	The system shall have the capability to capture vehicle count (per lane and per vehicle class).
TR 4.60	The system shall have the capability to capture vehicle speed (per lane and per vehicle class).
TR 4.61	The system shall have the capability to capture vehicle occupancy (per lane).
TR 4.62	The system shall have the capability to capture vehicle Gap time (per lane).
TR 4.63	The system shall have the capability to capture vehicle Headway (per lane).
TR 4.64	The system shall have the capability to capture vehicle different Classification (two wheeler, three wheeler, car, bus, trucks etc.).
Sensor System Components	
TR 4.65	The single sensor shall cover up to minimum 4 lanes.

TR 4.66	The system shall have the capability to connect minimum 4 sensor at a time.
TR 4.67	The electronic shall be din rail mountable and shall have the lock and key facility.
TR 4.68	The system shall have the capability to connect with local computer.
TR 4.69	The local computer software shall have the compatibility of system configuration, viewing, recording, data collecting & monitoring.
Viewing and Recording	
TR 4.70	The system shall have the built-in webserver from which one can easily view the video stream.
TR 4.71	The system shall have capability of recording & downloading of the video, also it shall have the recording playback facility using standard NVR and VMS being provided as part of the Project.
ATCC Server	
TR 4.72	Please refer to the Server Specification as mentioned under IT Infrastructure Section 2.2.11.3.
General	
TR 4.73	All CCTV cameras shall support Power over Ethernet (PoE and PoE+). ATCC system shall preferably support PoE or PoE+. Alternatively, ATCC system shall support 24VAC/24VDC or 230 VAC operation.
TR 4.74	The camera shall use an Ethernet 10/100Base-TX network interface with RJ45 connector.
TR 4.75	The camera and the associated equipment shall support communication protocols IPv4, IPv6, TCP, UDP, HTTP, HTTPS, DHCP, IGMP, ICMP, ARP, SNMP, Telnet, FTP, NTP, RTSP, and RTP as a minimum.
TR 4.76	The camera shall incorporate a built-in web server, built-in FTP server, and a built-in FTP client.
TR 4.77	The cameras shall have, at a minimum, the following configurable features: • Image resolution • Frame rate • Image quality adjustments (brightness and contrast) • Source and destination IP address settings • UDP port number • Bandwidth limits • Unicast and multicast settings, and • Support for two (2) simultaneous unicast streams
TR 4.78	The cameras shall support at the minimum three individually configured video streams. The cameras shall be capable of three or more simultaneous streams with one of the streams being in H.264 format.
TR 4.79	All cameras shall have an operating temperature range of 0°C to +55°C at humidity: 5% -90% RH.
TR 4.80	The environmental housing shall be of suitable size and provide a temperature controlled atmosphere for the camera, lens and receiver-driver.

TR 4.81	The housing shall allow for easy disconnect of all external cables.
TR 4.82	The housing, mounting arm and the dome camera installed assembly shall be suited to withstand wind gusts of 150 km/h.
TR 4.83	The housing for CCTV shall meet the IP66 for protection.
TR 4.84	Operating Temperature for NVR shall be 10°C to +35°C.
TR 4.85	The cameras shall have a Mean Time Between Failure (MTBF) of at least 100,000 hours.

2.2.5 Multi-Services Digital Kiosks and Emergency Communications

Overview

Multi-Services Digital Kiosks will be deployed across Shendra to give the citizens access to various services via one integrated platform. This will be a dedicated and fixed structure which will include Wi-Fi access point, emergency call button, charging points, solar panels, access to citizen services including capabilities to make payments for citizen services and bills using touch screen, static advertising around three (3) faces, Smart Card Reader and CCTV. Multi Services Digital Kiosks shall be installed at strategic locations such as AURIC building, public parks, Exhibition Pavilion, etc.

Architecture

Multi-Services Digital Kiosk shall be connected with the ACC using the fibre optic infrastructure. A switch shall be housed inside each multi-services digital kiosk from where the data will be backhauled to the nearest POP over the fibre optic infrastructure. A conceptual architecture for the same has been presented in Exhibit 9 below.

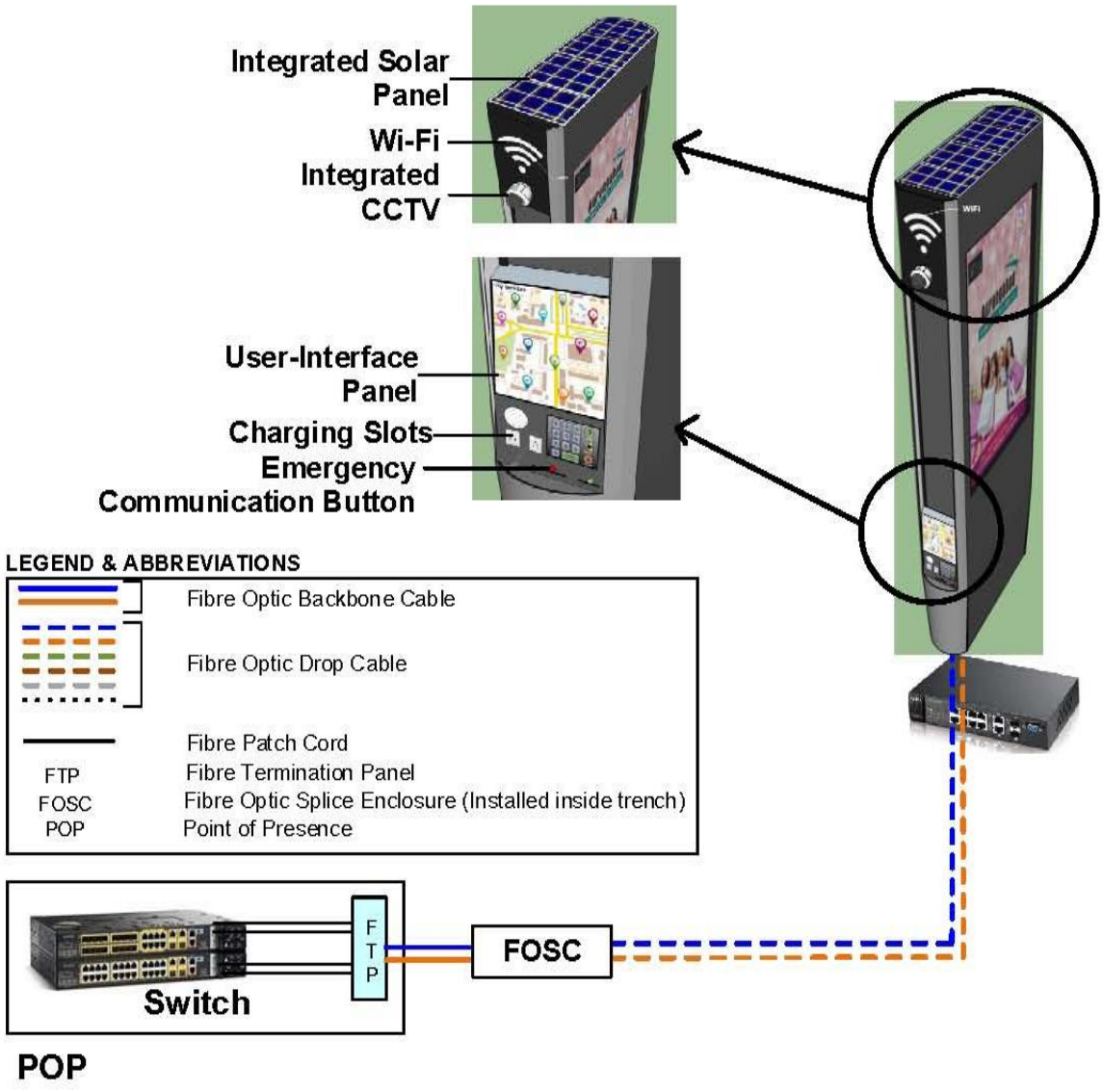


Exhibit 9: Conceptual architecture for Multi-Services Digital Kiosk

BR - 5 Business Requirements

BR 5.1	Multi-Services Digital Kiosk shall provide various services and information to citizens, visitors, as well as AITL staff, integrated using one common platform.
BR 5.2	Multi-Services Digital Kiosk shall also be the contact point for citizens who are not connected to smart phones or e-mail.
BR 5.3	Multi-Services Digital Kiosk shall be deployed at strategic locations such as AURIC Hall, Exhibitions Pavilion, etc.
BR 5.4	Using the Multi-Services Digital Kiosk, citizens shall be able to avail multiple city services integrated via the e-governance platform plus shall provide the capability for bill payments.
BR 5.5	Multi-Services Digital Kiosk shall include the following in one integrated structure – emergency call button, touch screen for citizen services with payment options (integrated with e-wallets, debit and credit card), smart card reader for smart card (with additional security features such as PIN), integrated CCTV, Wi-Fi and Solar Panel with batteries, plus additional space for static advertising/promotions.
BR 5.6	Multi-Services Digital Kiosk shall also include capabilities for providing services to differently abled users.

FR - 5 Functional Requirements

FR 5.1	Multi Services Digital Kiosks shall have integrated: • Emergency Call Button • PTZ CCTV • Wi-Fi access point • Ability to pay bills using e-wallet, debit card and credit card • Touch Screen for availing citizen services with in-built interactive platform • Integration with environmental sensors to display information from various sensors • Solar Panel with batteries • Charging Slots • Static Advertisement around three faces • Microphone • Speaker • Keypad for entry of PIN for authentication • Smart card reader • Printing of any receipts All these components shall be supplied as part of the integrated multi services digital kiosk.
FR 5.2	Multi-Services Digital Kiosk's power requirements shall be met by an integrated solar panel as backup source of power (with runtime of 2 hours) with support of UPS along with raw power for primary operations. The solar panel batteries shall be installed within the housing of the kiosk in an integrated manner.

FR 5.3	Multi-Services Digital Kiosk shall be fixed units, embedded inside the ground that shall be weatherproof, IP 55 rated, and rated for performance for outdoor technology street furniture.
FR 5.4	Multi-Services Digital Kiosk enclosure shall have the space to house all the hardware equipment required for the Multi-Services Digital Kiosk including switches, solar panel, batteries, printer for receipts and other associated accessories. All the wiring shall be concealed within the Multi-Services Digital Kiosk enclosure and shall not be visible from outside.
FR 5.5	The Emergency call button shall have the capability to trigger emergency communications with ACC. As the Emergency Call Button is pressed, the call should land up to the operator at the ACC from where it may be routed to the concerned department.
FR 5.6	The integrated PTZ CCTV shall have the capability of recognition. Operator at the ACC shall be able to monitor the live feed from the CCTV. When the emergency button is pressed, the PTZ camera shall automatically focus on the person using the button with a video feed at the ACC.
FR 5.7	The Multi-Services Digital Kiosk shall have in-built charging slots i.e. two (2) USB ports and one (1) three pin standard plug port.
FR 5.8	The user-interface panel shall built-in capacitive touch screen for interactive purposes including but not limited to: • Maps and navigation services i.e. displaying routes across Shendra. • Information about AURIC along with e-governance services from AITL. • Environmental related information via integration with environmental sensors. • Places near me services which may include hotels, government offices, shops, tourist attraction, etc. • Information about the events. • Emergency contact numbers such as hospitals, police, fire, etc. • Integration with e-governance system. • Integration with digital wallets, credit and debit cards for payments.
FR 5.9	Multi-Services Digital Kiosk shall have a capabilities for making digital payments for: • Utility Bills for government services such as electricity, water, Wi-Fi, etc • Citizen services • Tickets for the events around the city • Any other AITL supported activity/event
FR 5.10	Multi-Services Digital Kiosk shall have in-built receipt/ticket printer.
FR 5.11	Multi-Services Digital Kiosk shall have in-built speakers and microphone for making an emergency call to/from the ACC and a keypad for accepting user input.
FR 5.12	The Multi-Services Digital Kiosk shall have the space for providing the static advertisement around three (3) faces.
FR 5.13	The Multi-Services Digital Kiosk shall be multilingual i.e. it shall support languages such as English, Hindi and Marathi.
FR 5.14	The Multi-Services Digital Kiosk shall have ECB and touch panel at an average height of 1.5m above ground.

TR - 5 Technical Requirements

Multi-Services Digital Kiosks	
TR 5.1	Multi-Services Digital Kiosk's enclosure shall be made of metal or stainless steel fabric and shall be IP 65 rated. It shall be built to last in outdoor environment to support the Project operating conditions.
TR 5.2	Metal sheet of the Multi-Services Digital Kiosk housing shall be made in a minimum 16 gauge that can be powder coated as per the required colour choice.
TR 5.3	Multi-Services Digital Kiosk's enclosure shall have space to put all the required hardware including switches and associated accessories.
TR 5.4	Multi-Services Digital Kiosk's shall have PTZ Camera mounted on the top of the Kiosk Enclosure. For PTZ Camera Specifications, Please refer to the City Surveillance System Section 2.2.4.
TR 5.5	The Camera shall be automatically focused towards the citizen upon pressing of ECB button and shall focus on the user who activated the ECB call with a video feed display at the video wall at the ACC. The ECB call can only be disconnected from the ACC level.
TR 5.6	The control centre operator shall able to monitor the video of the user who triggered the ECB.
TR 5.7	Multi-Services Digital Kiosk shall also have integrated Wi-Fi access points. For Wi-Fi Access Point Specifications, Please refer to the City-Wide Wi-Fi Section 2.2.2.
TR 5.8	The Multi-Services Digital Kiosk shall also have integrated solar panel with batteries.
TR 5.9	The Multi-Services Digital Kiosk shall have the capability of integrated payment through which citizens can make digital payment of city services like payment of bills, booking of event tickets, take receipt print of payments etc.
TR 5.10	The Multi-Services Digital Kiosk enclosure shall have integrated receipt printer for taking printout of bills payments receipt and events tickets etc.
TR 5.11	The Multi-Services Digital Kiosk shall have in-built speakers and microphone. Speakers shall be able to deliver clear stereo sound. Microphone shall be able to isolate the main sound source and minimize background noise. At any time, the speakers shall have an output audio of at least 10 dB above ambient noise.
TR 5.12	Multi-Services Digital Kiosk shall have proper ventilation arrangement for heat removal.
TR 5.13	Multi-Services Digital Kiosk shall have proper in-built wiring arrangement with spike proof power socket.
TR 5.14	Multi-Services Digital Kiosk shall have two (2) service doors with security key so that it can be easily accessed from there.
TR 5.15	Multi-Services Digital Kiosk shall be either fixed to ground or have shoes to hold it on a smooth surface.

TR 5.16	All electrical components shall have quick-disconnect terminals for easy service or removal. All wiring shall be concealed within the Multi-Services Digital Kiosk enclosure and shall not be visible from the outside of the unit.
TR 5.17	Multi-Services Digital Kiosk shall be equipped with sufficient tamper-proof mechanisms to ensure detection at ACC in case of physical tampering to the Kiosk.
TR 5.18	Multi-Services Digital Kiosk shall be upgradable through a central system remotely over internet.
TR 5.19	It shall be possible to monitor critical parameters related to health of kiosk device remotely using the network.
Interactive user panel for Information of City Services	
TR 5.20	The panel shall have built-in capacitive touchscreen for interactive applications with required supporting software for dynamic content management from various sources connected to the system. The content management system shall include content from (but not limited to) – e-governance platform, services billing, AITL organized/supported events, data from environmental sensors, digital advertising and promotions (provided as part of the content management system), city news and information, among others.
TR 5.21	The touch screen shall be all-glass with a transparent metallic conductive coating.
TR 5.22	The touch screen monitor shall have a min. resolution of 1280 x 1024 or better with screen size of minimum 24”.
TR 5.23	The screen shall support wide viewing angle, low power consumption, high contrast ratio, high aperture ratio, short response time.
TR 5.24	The content displayed on the panel shall be direct sunlight readable and shall support the feature of auto brightness control.
TR 5.25	The touch screen shall have the embedded thin client with quad core CPU 4GB memory, 32 GB Flash, 100 GB of secondary storage for local storage with required OS.
TR 5.26	The touch screen monitor shall be capable of withstanding most surface contaminants and must be ASTM-D-1308-02 and ASTM-F-1598-95 compliant.
TR 5.27	The touch screen monitor shall be NEMA 4X / IP66 rated and complete water-resistant seal compatible. It shall be capable of operating in outdoor rated environments and shall have a rugged screen.
Emergency Call Box	
TR 5.28	The ECB shall be integrated with the multi-services digital kiosk and shall be monitored at the ACC.
TR 5.29	At the ACC, graphical display of the locations of the ECBs mounted on the multi-services digital kiosk shall be provided at the workstations to control, configure and manage ECBs at a minimum.
TR 5.30	The ECB shall be auto-dial operation and shall be capable of automatically answering incoming calls.
TR 5.31	The ECB shall communicate over 10/100/1000 BaseTX copper signal ports over Ethernet.

TR 5.32	The ECB shall support SIP based Voice over Internet Protocol (VoIP) communications standard.
TR 5.33	The ECB shall have network connectivity for monitoring via Web access (HTTP), SNMP, and shall provide the capability of e-mail notification of alarm conditions. Multiple alarms of the conditions shall be provided automatically.
TR 5.34	The ECB shall have automatic adjustment of output volume of audio based on ambient noise detection. At any given time, the sound output from ECB speaker shall be 6-10 dB above ambient noise.
TR 5.35	The call from ECB shall only be disconnected at the ACC. The user shall not have the capability to disconnect the call from the ECB itself.
TR 5.36	The ECB button shall be circular, red in colour and the panel shall have clear label of 'Emergency Call Button'.
Digital Payments	
TR 5.37	The Multi-Services Digital Kiosk shall have the capability for digital payments like electricity bills, water bills, Wi-Fi recharge/coupon, Payment of penalties (Challans, etc.), payment for any city supported events, etc.
TR 5.38	The Multi-Services Digital Kiosk shall accept all digital payments including credit card, debit card and e-wallets.
TR 5.39	The Multi-Services Digital Kiosk shall have option for taking printout of bills payments receipt and events tickets etc. through integrated receipt printer.
TR 5.40	The digital payments for Multi-Services Digital Kiosk shall comply with all the revenue/financial departments' norms and conditions for such online financial transactions in India and shall adhered to all such norms and conditions.
Smart Card Reader	
TR 5.41	Multi-services digital kiosk shall have the capability of reading citizen specific smart card reader as an identity check for availing services.
TR 5.42	Multi-services digital kiosk shall be able to read the smart card from mobile phones, tablets and paper prints.
TR 5.43	The smart card reader shall be supported by a second level of authentication i.e. OTP via SMS at user registered number or similar that shall be inserted by the user using the keypad at the kiosk.
Electrical	
TR 5.44	The Multi-Services Digital Kiosk shall be powered by 12/24/48VDC input as per the design requirements to support powering using solar as the primary power. Raw power will be provided for secondary power. The ECB inside the multi-services digital kiosk shall be powered using PoE or PoE+.
TR 5.45	The Multi-Services Digital Kiosk shall communicate over RJ45, HDMI/DVI and USB.
TR 5.46	The Multi-Services Digital Kiosk shall support operating temperature range of 0°C to +60°C with ambient relative humidity of 10-95% non-condensing.
TR 5.47	The ECB shall have a MTBF of at least 100,000 hours.
TR 5.48	The touch screen monitor shall have a MTBF of at least 50,000 hours.

2.2.6 ICT Interface for Smart Solid Waste Management with CAD/AVL

Overview

The Smart Solid Waste Management System for Shendra shall consist of the following components:

- Automatic vehicle tracking and computer aided dispatch for waste collection vehicles;
- RFID based system for bin tracking;
- Wireless bin sensors for bins;
- Static Weigh Bridge, Barrier Gate and CCTV Surveillance System at Solid Waste Management Site; and
- Central application among other components.

Waste bins (to be provided by Others) will be placed at strategic locations throughout the Project area. Ultrasonic sensors shall be installed in some of these waste bins, which will then optimize the city's waste collection operations by real-time monitoring of bin fill-level. Using a CAD/AVL system installed as part of the waste collection trucks, optimization of bin collection vehicle routes and vehicle scheduling along with the assignment of vehicles will be undertaken via this system. When the waste fill-level of any particular bin crosses the pre-defined threshold level, the sensor shall automatically send signal to the respective gateway via M2M network and from the gateway the data shall be backhauled at the ACC. Through the aid of sensors installed inside the bins, the operator at the ACC shall be able to monitor the fill level of the particular bin in real time which is then connected to the central system for dispatch of collection vehicle. In addition, there will be RFID tags installed on bins and RFID Readers installed on waste collection trucks/ waste collection personnel for tracking of waste collection from the bins. Solid waste management disposal site shall be equipped with the Static Weigh Bridge, Barrier Gate and CCTVs for tracking of waste disposal by the truck.

The process flow chart process for this has been presented in Exhibit 10 below.

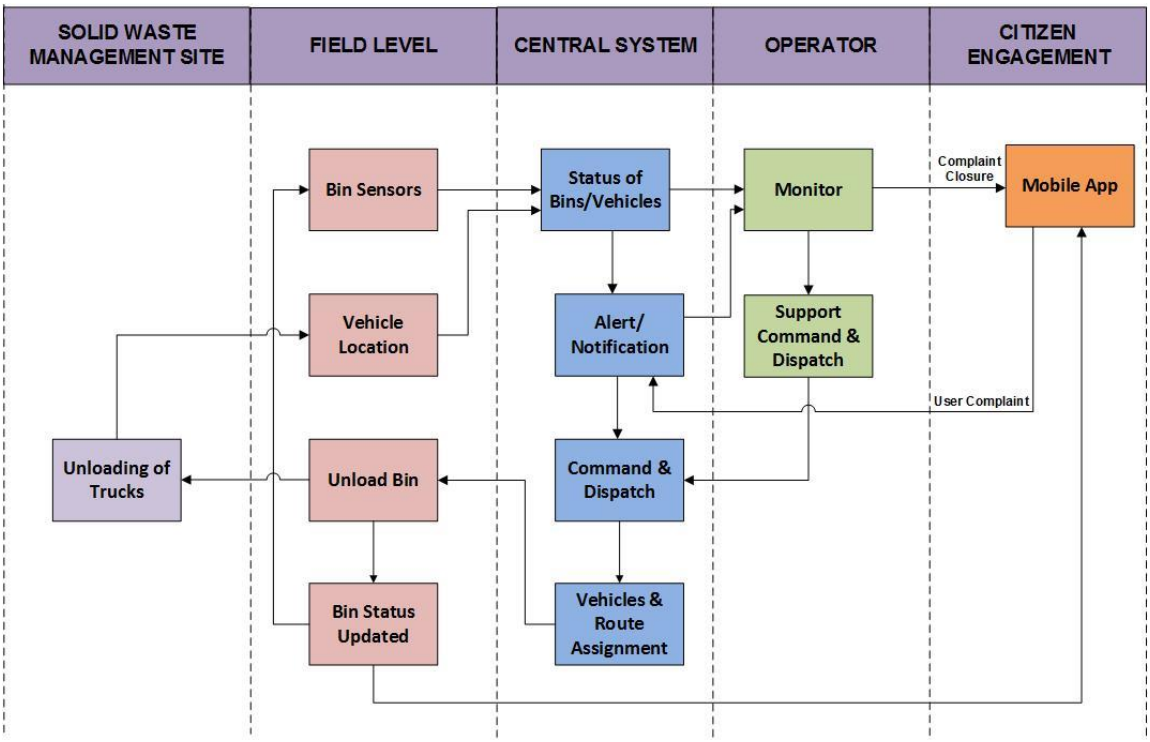


Exhibit 10: Process Flow Chart

Architecture

The overall concept of operations and architecture for deploying smart solid waste management system has been described below:

- The bin sensor installed at the waste collection bin shall transmit the real-time M2M signal to the ACC through the Gateway;
- As the defined bin threshold level is reached, the waste collection truck shall be directed towards the bin via optimized route through Computer Aided Dispatch (CAD) System;
- Real time monitoring of the truck's location and route shall be done through Automatic Vehicle Locator (AVL) system;
- As the truck collects the waste from the bins, same shall be notified to the ACC via RFID system;
- After the waste collection, the truck shall be routed to the solid waste management site via optimized route through CAD;
- As the truck enters the solid waste management site, the truck shall be weighed through static weigh bridge system. The information of the truck (i.e. weight of the waste, vehicle details like vehicle class and registration number, truck entrance time, etc.) shall be recorded and transferred to ACC on real-time basis. Once this process is successfully completed, the barrier gate shall be opened and the truck shall proceed to unload the waste. This process shall be monitored through the CCTV surveillance system;
- As the truck unloads itself at the solid waste management site, this shall be notified to the ACC and the new route shall be directed to truck for collection of waste;
- At ACC, all the collection processes shall be supervised on real-time basis through GIS dashboard/smart waste management software platform at the control centre. The information collected at ACC can be monitored and analysed to optimize the collection, transportation, processing and disposal processes;
- Citizen shall be able to file a complaint regarding the waste accumulation in the city. As soon as the complaint will be filed by the citizen, the operator at the ACC shall be notified with the same and the required action shall be taken;
- AITL shall have the access to this system. AITL shall be able to monitor and track the status of solid waste collection, review trends and average scenarios for various areas, review the status of citizen complaints, etc.

The overall conceptual architecture has been presented in Exhibit 11 below.

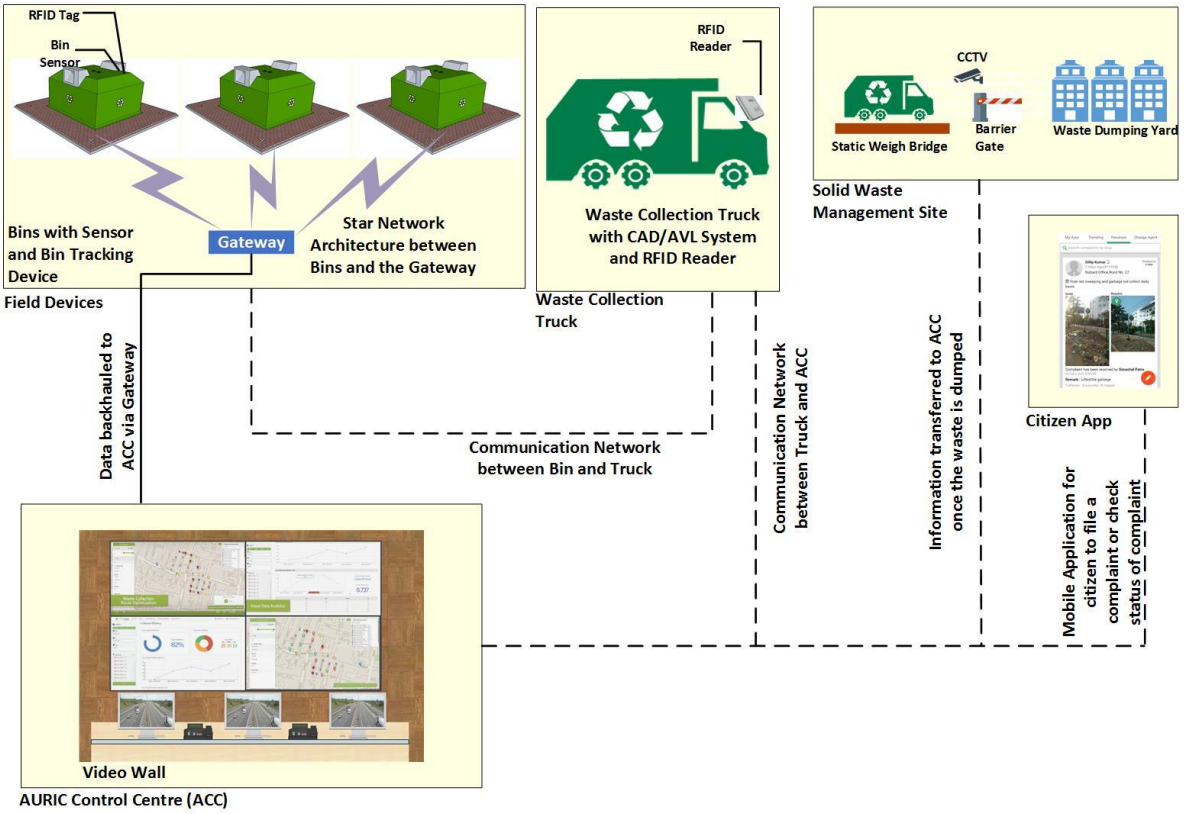


Exhibit 11: Conceptual System Architecture for Solid Waste Management System

BR - 6 Business Requirements

BR 6.1	The smart solid waste management system shall enable the level of solid waste, recycled waste, to be remotely monitored using wireless sensors installed inside the waste bin.
BR 6.2	The waste collection shall then be managed via a web portal from ACC.
BR 6.3	RFID based system shall allow real-time tracking of waste collection system.

FR - 6 Functional Requirements

FR 6.1	Bins shall be equipped with the identification sensors i.e. bin tracking devices with a unique ID. As the waste collection truck unload the bin, the bin identification sensor shall share its ID & location to the ACC for identification purposes.
FR 6.2	Bins shall have in-built RFID tags that are read with the RFID reader installed on trucks/ waste collection personnel.
FR 6.3	Gateways supporting M2M communications shall be provided for backhaul requirements of the solid waste management. The sensors deployed shall communicate only with authorized networks and shall not hook to rogue networks. The specifications of the Gateways can be found under Section 2.2.1 – Wireless Gateways.

Integration at AURIC Control Centre (ACC)	
FR 6.4	ACC shall be able to monitor the fill level of respective bin in real time.
FR 6.5	The Computer Aided Dispatch (CAD) system shall enable communications with the nearby truck regarding the location of filled bins along with the shortest route guide to approach the bin through GPS/AVL system on base station installed at truck.
FR 6.6	The RFID system shall send real-time information of bin tag reading information through 3G/GPRS at the time of waste collection to ACC.
FR 6.7	Static Weigh Bridge system at the solid waste management site shall send the real-time information of the waste collection truck i.e. weight of the waste, vehicle details like vehicle class and registration number, truck entrance time, etc.) to the ACC via city-wide fibre optic infrastructure.
FR 6.8	As the truck unloads itself at the solid waste management site, this shall be notified to the ACC and the new route shall be directed to truck for collection of waste through CAD/AVL.
FR 6.9	Operators located at the ACC shall be able to use the central monitoring software i.e. centrally managed system which shall be able to perform the following function: • Graphical user interface • Monitoring and detection • Control and response • Information dissemination; and • Reports generation
Software Application	
FR 6.10	The software application shall be developed on a GIS map based platform on which geo-location of all the bins and collection vehicles shall be displayed in real time. This application shall be built on the AVL application being developed as part of the overall AVL system.
FR 6.11	The application should have the following features: • Geo-fencing reporting portal • Spatial database and integration with the data captured for geographic queries and normal data queries
FR 6.12	Monitor the performance of entire waste collection system and to improve the maintenance activities to reduce downtime and thus improving the efficiency of the system.
FR 6.13	Allow establishment of a proactive solid waste management system via data analytics. For example, in case of a major event in the city, such systems shall be used to plan the required waste collection, which will be higher than normal. This planning shall include providing additional bins in the event area, quicker collection and potential integration with other systems such as CCTV which can help monitor the even real time.
FR 6.14	Generate analytical reports in order to improve the efficiency of the system in near future. Through this feature, effective planning and management of solid waste management services shall be done by tracking the total waste generated, type of waste generated and identification of higher waste generation areas.

FR 6.15	Publishing of various MIS reports consolidating the work done by AITL including but not limited to: • Daily, weekly, monthly reports (database) on item-wise, dept. wise and activity wise details. • Consolidated Report generation on solid waste management site activity. • Other reports as generated through integration with AEE and ACC systems.
FR 6.16	Generate schedules using Computer Aided Dispatch (CAD) system predictive algorithms.
FR 6.17	The software platform shall be able to visualize the capacity of each trash bin and shall indicate it with different colour codes. For example, green colour to signify that the waste container has plenty of space, and red colour to give an indication to the operator that the threshold level of a particular bin has been reached and collection is required.
FR 6.18	The platform shall also be able to assist in defining the optimal collection routes for the trucks which will help in reducing the collection time of the waste by the trucks thus reducing the unnecessary traffic of trucks in the city
FR 6.19	The platform shall have built in security for data capturing and transfer including devices used i.e. restricting to the authenticated devices only.
FR 6.20	Encryption techniques if used for data security shall be of minimum 128-bit encryption.
CAD	
FR 6.21	The waste collection truck shall be directed towards the bin/waste management site through Computer Aided Dispatch (CAD) System.
FR 6.22	Optimized route shall be shared with the waste collection truck via CAD.
AVL	
FR 6.23	Movement of all the vehicles will be tracked by a central AVL.
FR 6.24	The AVL application software should have facility to read / integrate / capture the GPS data of the vehicle.
FR 6.25	Different kind of MIS report shall be generated from the application software for vehicle tracking.
FR 6.26	There should be a provision of third party application integration / new application software developed by the SI for the above purpose.
FR 6.27	For AVL Software Specifications, please refer to the Automatic Vehicle Location (AVL) System Section 2.2.8.
Solid Waste Management (SWM) Site	
FR 6.28	At the time of unloading the waste at the solid waste management site, ACC shall be notified that the truck has been unloaded at the site and it can be further directed to a new route for collection of waste. This shall be done by geo-fencing of a particular location, waste collection truck's entry or exit at the solid waste management site can be tracked at the ACC in real time.
FR 6.29	The solid waste management site shall have weighing facility which includes a static weigh bridge integrated with barrier gate, Fixed and PTZ camera. As the waste

	collection truck enters the solid waste management site, the waste will be weighed at static weigh bridge before unloading.
FR 6.30	The individual truck weighing related data shall be transfered to the ACC in real time.
FR 6.31	The application shall have the functionality of calculation of charges to be paid to the collection agency against the weight of the waste at collection site and shall able to generate the daily, weekly and monthly etc. vehicle wise billing report to be paid to collection agency.
FR 6.32	The system shall be capable to identify & report against any fraud related to waste weight and its billing.
Waste Management Facilities	
FR 6.33	The application must record the clear demarcation of the waste, dump-yard and its related facilities through GIS mapping, geo fencing and geo-tagging.
Service Level Agreement (SLA Module)	
FR 6.34	The Application must enable the mapping of the existing Service Level Agreement with all the involved stakeholders for the solid waste management. Prospective MSI may contact AITL office to understand the SLA terms before submission of their bids.
FR 6.35	The Application should map the payment and penalty calculation as specified in the SLA.
FR 6.36	Should interact with the other relevant modules to calculate correct remuneration and penalty as per the prevailing contracts.
FR 6.37	Module should be made configurable to enable the modification of rates of penalty and payment if needed.
City App	
FR 6.38	Solid waste management system software shall be integrated with AITL city application and portals for citizen engagement and grievance redressal along with mobile reporting by AITL officers. Through the application and portal, citizen shall file complaints in context to accumulation of garbage at any particular location within the city. Typical complaints include overflowing of bins or wastes gathered at roads or public places. As soon as any user files a complaint, the operator at the ACC shall be notified for the same and shall take required action within a time frame. The mobile application shall provide the user facility to check the status of their complaints, such as what action has been taken in response to their complaint along with a backend system (integrated with the city ERP) that allows automatic escalations from a governance perspective.
FR 6.39	Real time solid waste information such amount of solid waste collected in a designated period, amount of solid waste recycled etc. shall be uploaded on the citizen portal as part of Open Data initiative.
AITL	
FR 6.40	To track the collection and disposal process, AITL shall have access to this system. Through the system, AITL shall be to monitor and track the status of the solid waste collection, review trends and average scenarios for various areas, get automated notifications for any citizen complaints, and ultimately have the ability to better plan the overall solid waste collection system in terms of inventory of bins and collection trucks based on real-time demand analysis.

TR - 6 Technical Requirements

RFID System	
RFID Readers	
TR 6.1	RFID Reader shall have operating frequency range of 865 MHZ to 867 MHZ.
TR 6.2	The RFID reading range of the transceiver antenna mounted on the vehicle at an average height of 3m above the road surface shall be upto 5m.
TR 6.3	RFID Reader antenna type shall be Circularly Polarized.
TR 6.4	RFID Reader shall comply with the protocols: EPC Gen 2, ISO 18000-6C and shall comply with the general conformance requirements of the standard.
TR 6.5	RFID Reader enclosure shall be light weight.
TR 6.6	RFID Reader technology deployed should have the capability to optimize read rates for the bin identification application and adapt to instantaneous noise and interference level.
TR 6.7	RFID Reader shall have capability of diagnostic and reporting tools.
TR 6.8	The firmware should be upgradable to support future protocols.
TR 6.9	Reading of Tag & EPC memory for at least 2 tags per second for a moving vehicle with a speed limit of up to 40 kilometres/ hour.
TR 6.10	It shall support RF Power of minimum 0~30dBm and shall be software programmable.
TR 6.11	RFID readers shall communicate over TCP/IP and GPRS or higher.
TR 6.12	It shall support communication interface RS232 at minimum.
TR 6.13	Readers shall be IP 65 rated.
TR 6.14	RFID readers shall be capable of withstanding standard material handling vehicle environments. It shall meet or exceed MIL STD 810F.
TR 6.15	Readers shall be powered by Vehicle DC Power 12 to 60V, 4.5A maximum.
RFID Tags	
TR 6.16	The tag shall be anti-metal, and can be mounted on the metallic surface.
TR 6.17	The tag shall be high temperature resistant and shall be capable of withstanding harsh or challenging conditions.
TR 6.18	The tag shall have long read and write distance.
TR 6.19	The tag shall be durable, reusable.
TR 6.20	The frequency range of the tag shall be between 865~867MHz.
TR 6.21	The tag shall support operation mode of Fixed Frequency or FHSS Software Programmable.
TR 6.22	The tag protocol shall be ISO 18000-6C & EPC CLASS1 GEN2.
TR 6.23	The tag memory configuration shall be EPC: 96bit (H3) and User: 512bit (H3).
TR 6.24	The tag material compatibility shall be metallic and non-metallic substrates.

TR 6.25	The read range (m) on metal surface shall be max. 7.5m for Fixed Reader and max. 3m for handheld reader.
TR 6.26	The Mounting of tag shall be of screw, rivet, superglue, ribbon, double faced adhesive tape type.
TR 6.27	Tags shall be IP 68 rated.
Bin Sensors	
Bin Volume Sensors	
TR 6.28	The ultrasonic bin level sensor shall be used to sense the distance from the mounting point to the bottom of the garbage bin or collection truck to measure fill levels. The sensor shall have in-built M2M communications capability for data transfer between sensor & ACC.
TR 6.29	The sensor shall sense distance of minimum 3 metres.
TR 6.30	The sensor data shall be used to obtain the fill level of the waste bins.
TR 6.31	The sensor shall be IP67 rating (water & dust proof) and shall be capable to operate in conditions inside waste bins. These waste bins may be solid waste, wet waste, industrial waste, or others as per the site conditions.
TR 6.32	The sensor shall be easily mountable on the waste bin.
TR 6.33	The sensor shall have supporting Lithium-ion battery pack with a minimum working life of 10 years.
TR 6.34	The sensor should send automatic alarm to the ACC when the battery is about to run out of charge.
Sensor Processing Unit	
TR 6.35	The sensor processing unit shall be the on-board processing unit of the bin level sensors.
TR 6.36	The unit shall take input from the ultra-sonic bin level sensor.
TR 6.37	The unit shall process the input from level sensor (bin) into desired output format and transmit back to the central system via M2M communications.
TR 6.38	The unit shall send minimum 10 times or more (as required) data per day to the central software. This data pulling shall be user configurable.
TR 6.39	The unit shall send the data to central server when the bin & waste collection truck shall be 30%, 50%, 75% and 90% filled with different level of alarms as configured by the user. Once the bin & waste collection truck would be emptied, it shall send the signal to central software to confirm the same.
Barrier Gate	
TR 6.40	The barriers shall be capable of full lane open from a close state in less than 0.9 seconds.
TR 6.41	The housing and any mounting frame shall be fabricated from corrosion-resistant materials.
TR 6.42	It shall be IP 55 rated.
TR 6.43	The barrier shall be driven electrically.
TR 6.44	The barrier motor shall not be damaged when the barrier is blocked in any position

TR 6.45	Exit barriers shall have presence detectors independent system to prevent barrier arms coming down on vehicles while passing.
TR 6.46	Barrier shall be in the form of infrared units and dedicated embedded loops.
TR 6.47	Apart from the barrier arm, the mechanism may not have any moving protrusions that pose a risk to persons standing in close proximity to the barrier.
TR 6.48	The barrier arm shall be fabricated from a light, corrosion resistant material readily and inexpensively available in India.
TR 6.49	The barrier arm shall further have a protective mechanism whereby controlled fracture of the barrier arm occurs without damage to the housing or motor in the event of frontal collision.
TR 6.50	Preference will be given to non-destructive break-away mechanisms. Further, there shall be a protection mechanism to detect the presence of vehicles to avoid accidental hitting on the vehicles, whenever the boom is triggered for closing.
TR 6.51	Suitable power supply scheme shall be implemented by the supplier to feed the Exit barrier to protect the source from being damaged due to electrical surges / spikes injected by the dynamic (inductive) load.
TR 6.52	Further, the drive shall be so designed as to the damping factor is just sufficient for the drive to operate the booms without any jerks during open / close to avoid freak hitting by the exiting vehicles.
TR 6.53	Barrier arms shall have retro-reflective red stripes in accordance with the local traffic sign standards.
Static Weigh Bridge (SWB)	
TR 6.54	Digital road weighbridge model number as per weights and measures department : confirming to BIS 9281 standards based upon 8 load cells resting on I beam section and MS Plates platform size of 18 m x 3m 120 Tonnes.
TR 6.55	Structure type: Modular made of RS joists bolted with expansion joints as per BIS 2062 SAIL / TATA.
TR 6.56	Top deck Plates: Mild steel as per BIS 2062 SAIL.
TR 6.57	Load cells: Rocker Column type stainless steel with self-aligning principle.
TR 6.58	Load cells Mounting: MS galvanized with built in pad plates.
TR 6.59	Digital Weight Indicator: stainless steel housing with front panel calibration in accordance to W&M department and Model approval.
TR 6.60	Junction Box: stainless steel IP 65 built in surge protection.
TR 6.61	UFD: Outdoor display Board Stainless steel with LED for viewing in all-weather condition.
TR 6.62	Printer: • The printer shall be Laser Jet Printer • Print speed shall be 30ppm minimum (letter) • Printer resolution shall be 600 by 600 dpi or better with Resolution Enhanced Technology • The printer processor shall be 266 MHz • Printer memory shall be minimum 16 MB • The printer shall have atleast one Hi-speed USB 2.0 port

TR 6.63	Software – Weight management and picture capture with GVW, DTM stamp, direction, material, source destination.
TR 6.64	SWB shall have the capability to work as standalone as well integrated system.
TR 6.65	Structure Material: The platform shall comprise of medium beams sections of SAIL/TATA as per BIS 2062 with 100% overloading capacity. Platform design would be universal i.e. the weighbridge can be used in Both Pit / Pit less type application. Furnishing 2 Epoxy coats to prevent any rusting, external weather conditions.
TR 6.66	Structure which can be fully expandable & relocatable and be used for a Pit or Pit less type foundation in case of relocations in the future. The Structure should have approval from any recognized institution IIT / NPL / designed as per Staad – III. Approx. Structural Weight – 11 Tonnes.
Fixed and PTZ camera	
TR 6.67	Please refer to the CCTV Specifications as mentioned under City Surveillance System Section 2.2.4.
SWM System Workstation	
TR 6.68	For SWM Workstation Specifications, Please refer to the operator workstation specification as mentioned under IT Infrastructure Section 2.2.11.1.
AVL System for Solid Waste Management System	
TR 6.69	Please refer to the Automatic Vehicle Location (AVL) specification as mentioned under Section 2.2.8.

2.2.7 Environmental Sensors

Overview

Environmental parameters, specifically air and noise pollution, are a major concern for the citizens and administrators of any city. As Shendra aspires to also be an environmentally sustainable smart city, integrated environmental monitoring stations comprising of various sensors shall be implemented in Shendra. The objectives of the system include:

- Integrated ambient air and noise pollution monitoring stations comprising of various environmental sensors for monitoring and trending of various ambient air and noise parameters;
- Tracking of Shendra's contribution to environment with respect to these parameters and adjusting any framework for the city;
- Environmental sensors shall be integrated with ACC for central monitoring and analysis;
- Environmental sensor parameters shall be available through City Portal and Applications for citizens as part of 'open data' initiative and to create citizen awareness.

BR - 7 Business Requirements

BR 7.1	Integrated ambient air and noise pollution monitoring stations comprising of various environmental sensors shall be implemented in Shendra for monitoring and trending of various ambient air and noise parameters.
BR 7.2	Environment monitoring shall be done for tracking that the pollution and noise levels are within the acceptable limits.
BR 7.3	Display of parameters to citizens to create awareness and support 'open data' initiatives.
BR 7.4	Establish frameworks for regulating these parameters in terms of any supporting initiatives for maintaining acceptable levels.
BR 7.5	Central monitoring at ACC, city application, website and digital display screen (at AURIC Hall) in an integrated manner.

FR - 7 Functional Requirements

FR 7.1	Environmental sensor station shall monitor following parameters and include the following integrated sensors inside one station: • Carbon Monoxide (CO) sensor • Ozone (O_3) sensor • Nitrogen Dioxide (NO_2) sensor • Sulfur Dioxide (SO_2) sensor • Carbon Dioxide (CO_2) sensor • Particulate/SPM Profile (PM_{10}, $PM_{2.5}$, and TSP) sensor • Temperature sensor • Relative Humidity sensor • Wind Speed sensor

	• Wind Direction sensor • Rainfall sensor • Barometric Pressure sensor; and • Noise sensor.
FR 7.2	Environmental Sensor station shall be housed in a compact environmentally rated outdoor enclosure. It shall be an integrated module which shall monitor overall ambient air and noise quality among other parameters as detailed in point above.
FR 7.3	Environmental sensor station shall be ruggedized enough to be deployed in open air areas such as streets and parks.
FR 7.4	Mounting of the environmental sensor module shall be co-located on streetlight pole or shall be installed on a tripod stand or a standalone pole.
Digital Display Screen (DDS)	
FR 7.5	DDS will be installed at identified strategic location and will be used for display environmental parameters along with other promotional messages. The integrated DDS software application will allow user to publish specific messages & general informative messages.
FR 7.6	DDS shall be integrated with the environmental station for automatically displaying information from environmental sensors.
FR 7.7	A DDS software system shall be provided to the ACC for message preparation monitoring and control of the DDS. The DDS will communicate with ACC using an IP based network.
FR 7.8	DDS software application will provide the normal operator to publish predefined sets of messages (textual / image) along with information from environmental sensors.
FR 7.9	DDS software application will accommodate different access rights to various control unit functionalities depending on operator status and as agreed with the client. Software should be GUI based, and capable to handle upto 10 DDS signage. User should be able to select desired location in Map and this should enable user to see the live status of that specific DDS.
System Software	
FR 7.10	Environmental sensor station shall have a pre-installed software.
FR 7.11	Software shall display real time and historical data in chart and table views for dashboard view of the Client.
FR 7.12	Software shall display trends of environmental parameters based on user specific time periods.
FR 7.13	It shall be possible to configure and calibrate the sensors through the software from a remote location.
FR 7.14	Alarms shall be generated for events where the environmental parameters breaches the safe or normal levels.

TR - 7 Technical Requirements

Carbon Monoxide (CO) Sensor	
TR 7.1	CO sensor shall measure the carbon monoxide in ambient air.
TR 7.2	Range of CO sensor shall be between 0 to 1000 PPM.
TR 7.3	Resolution of CO sensor shall be 0.01 PPM or better.
TR 7.4	Lower detectable limit of CO sensor shall be 0.040 PPM or better.
TR 7.5	Precision of CO sensor shall be less than 3% of reading or better.
TR 7.6	Linearity of CO sensor shall be less than 1% of full scale or better.
TR 7.7	Response time of CO sensor shall be less than 60 seconds.
TR 7.8	Operating temperature of CO sensor shall be 0°C to 60°C.
TR 7.9	Operating pressure of CO sensor shall be ±10%.
Ozone (O_3) Sensor	
TR 7.10	O_3 Sensor shall measure the ozone in ambient air.
TR 7.11	O_3 Sensor shall have a range of at least 0-1000 PPB.
TR 7.12	Resolution of O_3 sensor shall be 10 PPB or better.
TR 7.13	Lower detectable limit of O_3 sensor shall be 0.001 PPB or better.
TR 7.14	Precision of O_3 sensor shall be less than 3% of reading or better.
TR 7.15	Linearity of O_3 sensor shall be less than 1% of full scale.
TR 7.16	Response time of O_3 sensor shall be less than 60 seconds.
TR 7.17	Operating temperature of O_3 sensor shall be 0°C to 60°C.
TR 7.18	Operating pressure of O_3 sensor shall be ±10%.
Nitrogen Dioxide (NO_2) Sensor	
TR 7.19	NO_2 Sensor shall measure the Nitrogen dioxide in ambient air.
TR 7.20	NO_2 Sensor shall have a range of at least 0-10 PPM.
TR 7.21	Resolution of NO_2 sensor shall be 0.001 PPM or better.
TR 7.22	Lower detectable limit of NO_2 sensor shall be 0.001 PPM or better.
TR 7.23	Precision of NO_2 sensor shall be less than 3% of reading or better.
TR 7.24	Linearity of NO_2 sensor shall be less than 1% of full scale.
TR 7.25	Response time of NO_2 sensor shall be less than 60 seconds.
TR 7.26	Operating temperature of NO_2 sensor shall be 0°C to 60°C.
TR 7.27	Operating pressure of NO_2 sensor shall be ±10%.
Sulfur Dioxide (SO_2) Sensor	
TR 7.28	SO_2 Sensor shall measure the Sulfur dioxide in ambient air.
TR 7.29	SO_2 Sensor shall have a range of at least 0-20 PPM.
TR 7.30	Resolution of SO_2 sensor shall be 0.001 PPM or better.

TR 7.31	Lower detectable limit of SO_2 sensor shall be 0.009 PPM or better.
TR 7.32	Precision of SO_2 sensor shall be less than 3% of reading or better.
TR 7.33	Linearity of SO_2 sensor shall be less than 1% of full scale.
TR 7.34	Response time of SO_2 sensor shall be less than 60 seconds.
TR 7.35	Operating temperature of SO_2 sensor shall be 0°C to 60°C.
TR 7.36	Operating pressure of SO_2 sensor shall be ±10%.
Carbon Dioxide (CO_2) Sensor	
TR 7.37	CO_2 Sensor shall measure the carbon dioxide in ambient air.
TR 7.38	CO_2 Sensor shall have a range of at least 0-5000 PPM.
TR 7.39	Resolution of CO_2 sensor shall be 1 PPM or better.
TR 7.40	Lower detectable limit of CO_2 sensor shall be 10 PPM or better.
TR 7.41	Precision of CO_2 sensor shall be less than 3% of reading or better.
TR 7.42	Linearity of CO_2 sensor shall be less than 2% of full scale.
TR 7.43	Response time of CO_2 sensor shall be less than 60 seconds.
TR 7.44	Operating temperature of CO_2sensor shall be 0°C to 60°C.
TR 7.45	Operating pressure of CO_2 sensor shall be ±10%.
Particulate Profile Sensor	
TR 7.46	Particulate profile sensor shall provide simultaneous and continuous measurement of PM_{10}, $PM_{2.5,}$ SPM and TSP (measurement of nuisance dust) in ambient air.
TR 7.47	Range of $PM_{2.5}$ shall be 0 to 230 micro gms / cu.m or better.
TR 7.48	Range of PM_{10} shall be 0 to 450 micro gms / cu.m or better.
TR 7.49	Lower detectable limit of particulate profile sensor shall be less than or equal to 1 µg/m3.
TR 7.50	Accuracy of particulate profile sensor shall be <± (5 µg/m3 + 15% of reading).
TR 7.51	Flow rate shall be 1.0 LPM or better.
TR 7.52	Operating temperature of the sensor shall be 0°C to 60°C.
TR 7.53	Operating pressure of the sensor shall be ±10%.
Temperature Sensor	
TR 7.54	Temperature sensor shall have the capability to display temperature in °Celsius.
TR 7.55	Temperature range shall be -10° to +100°C.
TR 7.56	Sensor accuracy shall be ±0.3°C (±0.5°F) or better.
TR 7.57	Update interval shall be 10 to 12 seconds.
Relative Humidity Sensor	
TR 7.58	Range of relative humidity sensor shall be 1 to 100% RH.
TR 7.59	Resolution and units of relative humidity sensor shall be 1% or better.
TR 7.60	Accuracy of the sensor shall be ±2% or better.

TR 7.61	Update interval shall be less than 60 seconds.
TR 7.62	Drift shall be less than 0.25% per year.
Wind Speed Sensor	
TR 7.63	Wind speed sensor shall have the capability of displaying wind speed in km/h or knots.
TR 7.64	Range of sensor shall be 0-60 m/s.
TR 7.65	Accuracy of wind speed sensor shall be ±5% or better.
TR 7.66	Update interval shall be less than 60 seconds.
Wind Direction Sensor	
TR 7.67	Range of the wind direction sensor shall be 0° to 360°.
TR 7.68	Display resolution shall be 16 points (22.5°) on compass rose, 1° in numeric display.
TR 7.69	Accuracy shall be ±3% or better.
TR 7.70	Update interval shall be 2.5 to 3 seconds.
Rainfall Sensor	
TR 7.71	Rainfall sensor shall the capability of displaying level of rainfall in inches and millimeter.
TR 7.72	Daily Rainfall range shall be 0 to 99.99” (0 to 999.8 mm).
TR 7.73	Monthly/yearly/total rainfall range shall be 0 to 199” (0 to 6553 mm).
TR 7.74	Accuracy for rain rates shall be up to 4”/hr (100 mm/hr) or ±4% of total.
TR 7.75	Update interval shall be less than 60 seconds.
TR 7.76	0.02” or (0.5mm) of rainfall shall be considered as a storm event with 24 hours without further accumulation shall end the storm event.
Barometric Pressure sensor	
TR 7.77	Barometric pressure sensor shall have the capability of displaying barometric pressure in Hg, mm Hg and hPa/mb.
TR 7.78	Range of barometric pressure sensor shall be 540 hPa/mb to 1100 hPa/mb.
TR 7.79	Elevation range of the barometric pressure sensor shall be -600 m to 4570 m.
TR 7.80	Uncorrected reading accuracy shall be ±1.0 hPa/mb at room temperature or better.
TR 7.81	Elevation accuracy shall be ±10’ (3m) to meet equation accuracy specification or better.
TR 7.82	Overall accuracy shall be ±0.03" Hg (±0.8 mm Hg, ±1.0 hPa/mb) or better.
TR 7.83	Update interval shall be less than 60 seconds.
Noise Sensors	
TR 7.84	Noise sensor shall detect the intensity of the ambient sound in a particular area.
TR 7.85	Nosie Sensors shall be installed for the outdoor applications.
TR 7.86	Noise sensor shall be able to identify the areas of high sound intensity ranging from 30 dBA to 120 dBA.

TR 7.87	Noise sensor shall have resolution of 0.1 dBA.
Air Quality Monitoring Station Software	
TR 7.88	Software shall be pre-installed on every built system.
TR 7.89	It shall be possible to connect to the station using internet browser on computer tablet or mobile without any need of installing software for viewing information.
TR 7.90	Software shall display real-time and historical data in chart and table views.
TR 7.91	Software shall display trends of environmental parameters based on user specified time periods.
TR 7.92	It shall be possible to configure and calibrate the sensors through the software from a remote location.
TR 7.93	Software shall display and export sensor diagnostic information.
TR 7.94	User shall be able to change sensor module settings through the software and from remote locations.
TR 7.95	Administrator shall be able to manage access privileges for only authorized users.
TR 7.96	Alarms shall be generated for events where the environmental parameters breaches the safe or normal levels.
TR 7.97	It shall be integrated at the ACC for the purposes of monitoring, display of information and control of the system.
Digital Display Screen (DDS)	
TR 7.98	The DDS shall be installed at location identified by Client. The DDS shall be outdoor rated.
TR 7.99	DDS shall have be True Colour. Text on the DDS shall be readable in bright sunlight.
TR 7.100	The pixel pitch of DDS shall be minimum 5mm.
TR 7.101	The lattice density of DDS shall be minimum 27000 dots/square meter.
TR 7.102	The viewing distance shall be between 4m to 30m. The screen size shall be proposed accordingly to ensure that the character height is at least 50mm.
TR 7.103	The average power consumption shall not exceed the 740W/square meter.
TR 7.104	The horizontal view angle shall be > 140 degree.
TR 7.105	The working temperature shall be between 0 C to +60 C & humidity shall be between10% to 90%.
TR 7.106	The DDS shall have a Power Supply unit to support AC 110-240 V.
TR 7.107	The MTBF of DDS shall not be less than 100,000 hours.
TR 7.108	The grey scale shall be 16 bit per colour.
TR 7.109	The Brightness shall be 5500 cd/square meter.
TR 7.110	The blind spot rate shall be minimum < 0.00001.
TR 7.111	The IP rating shall be minimum IP65 for front and IP 54 for rear.
TR 7.112	Message shall be readable even in broad daylight without any shade & displayed image shall not appear to flicker to the normal human eye (>5500 cd/m2).
TR 7.113	The Display capability of DDS shall be fully programmable, full colour, full matrix, LED displays & shall have Alpha-numeric, Pictorials, Graphical & video capabilities.

TR 7.114	The Display Language shall be support both pictograms and bilingual (English and Devanagari) text.
TR 7.115	The Display Front Panel shall utilize a front face that is smooth, flat, scratch-resistant, wipe-clean & shall be 100% anti-glare.
TR 7.116	The message Creation shall be through both ACC Application and locally.
TR 7.117	The DDS shall support Multilingual (Marathi/English/Hindi etc.) languages and all fonts supported by Windows.
TR 7.118	The DDS shall have the facility of auto dimming adjusts to ambient light level.
TR 7.119	The Display size of DDS shall be minimum 70 inches diagonal.
TR 7.120	The DDS shall have the access control mechanism so that the usage is regulated.
TR 7.121	The DDS shall be wall, Pole & gantry mounted. The mounting accessories shall be the part of DDS.
TR 7.122	The DDS shall have automatic on/off operation.
General	
TR 7.123	Each environmental sensor shall be housed in modules and further integrated into one single enclosure.
TR 7.124	The design shall be modular in nature which shall have the capability to add additional environmental sensors in the future into the enclosure.
TR 7.125	Data of all the environmental sensor shall be available on the same software interface.
TR 7.126	It shall be possible to remove or replace individual sensor modules without affecting the functioning of rest of the system.
TR 7.127	It shall be possible to mount the air quality monitoring station to a pole, tripod or wall mounting brackets.
Environmental Requirements	
TR 7.128	Enclosure shall be rugged weather proof IP65 rated and shall house the power modules, thermal management system, embedded PC and user configured analyser modules as well.
TR 7.129	Environmental operating range shall be 0°C to +60°.
Electrical Requirements	
TR 7.130	Power requirements of the system (environmental station and DDS) shall 220-240 VAC, 50Hz. It shall have an in-built NEMA 5-15P plug factory installed.
TR 7.131	All modules inside the enclosure shall operate from 12VDC power. The MSI shall be responsible for any power conversions required for operations of this system.
Networking requirements	
TR 7.132	Environmental station and DDS shall support communications by Ethernet (RJ45) or Fibre optic communications.

2.2.8 Automatic Vehicle Location (AVL) System

Overview

For efficient city operations, it is essential for city operators to monitor the location of fleet of city vehicles. Specifically in the case of mission critical emergencies, vehicle tracking is imperative for a swift, prompt and efficient response. Through integration of AVL systems with

city vehicles, response route optimization and calculation of response time for the city vehicles can also be done. This greatly improves the service of city operations.

The vehicle and resource categories to be covered under this package are:

- **Emergency Vehicles:** Fire, police and ambulances shall be tracked for ensuring dispatch can happen in a proactive manner.
- **Municipal Vehicles:** Tracking of the water and other municipal vehicles shall be tracked to enhance efficiencies and improve decision making. Process management of people, vehicles and other components involved shall be monitored.
- **Solid Waste Management Vehicles:** Tracking of vehicles integrated with computer aided dispatch.

Components of AVL system include:

- On-Board equipment such as GPS antenna;
- AVL application software for tracking and monitoring vehicles along with managing alerts;
- Integration with ACC for vehicle tracking.

Note that the AVL system software shall be common for all vehicles including solid waste, water, police, fire, ambulance, etc.

BR - 8 Business Requirements

BR 8.1	For the purpose of monitoring location of vehicles, AVL system shall be deployed by for various municipal vehicles across different departments, solid waste management and first responders.
BR 8.2	Using the AVL system, proactive monitoring and dispatch of vehicles can be enabled for efficient city operations.
BR 8.3	The AVL application shall be common for all field vehicles and systems.

FR - 8 Functional Requirements

FR 8.1	AVL system shall provide precise real time tracking and monitoring of vehicles. It shall include an integrated application for tracking of all vehicles.
FR 8.2	AVL system shall be integrated with the ACC for vehicle monitoring and tracking.
FR 8.3	AVL system shall have the capability track vehicle availability and response times.
FR 8.4	AVL system shall have the capability for route optimization of vehicles.
FR 8.5	AVL system shall have the capability or providing incident management and alerts. Major, medium and minor alerts shall be available in a convenient, easy to use manner in the software.
FR 8.6	The application shall consist of an accurate GIS map of the region with layers for roads, landmarks, geographic features, etc. Location of vehicles shall be available on the GIS maps.
FR 8.7	The AVL system software shall provide the flexibility to support various user modes and user preferences including map views, alert configurations and default settings.

FR 8.8	The operator shall be able to review on the map display the chronological sequence of reported locations for a specified vehicle over a specified time period.
FR 8.9	The software shall provide controls to view the entire sequence of reported locations from the beginning of the time period or to step through the sequence incrementally forwards or backwards.
FR 8.10	All incoming and outgoing data shall be stored for retrieval, analysis, display and printing.
FR 8.11	The AVL system shall include an operations monitoring dashboard located at the ACC & monitored by the operator.
FR 8.12	Alarms shall be raised if any vehicle loses connection or breaks down during operation.
FR 8.13	AVL system shall have MIS reporting capabilities. Some expected reports include: • Monthly summary reports broken down by vehicle and route type • Vehicle locations, date and time • Schedule adherence reports • Vehicle bunching report • Driver performance report consisting of harsh acceleration, harsh deceleration, over speeding, mileage etc. • Fraudulent activity reports with the hardware (Tampering reports) • Faults and errors • Vehicle trip reports • System exceptions reports • System performance and activity reports

TR - 8 Technical Requirements

AVL System for Vehicle Tracking System	
Central System Software	
TR 8.1	Data shall be retained in a historical database for use by management to plan and assess system performance, and to address inquiries, conflicts and related issues.
TR 8.2	When there is a request for the any services, the operator shall be able to locate the route and current location of the vehicle.
TR 8.3	System shall allow the operator to track the status of vehicle at any point of time during the call or at stationary condition.
TR 8.4	System shall allow the operator to send any informational message to the driver at any point of time on its vehicle On Board Unit (OBU).
TR 8.5	The OBU shall also allow the driver to send any informational message to control centre.
TR 8.6	The AVL Application software shall be both LAN and web-based.

TR 8.7	All communications and AVL data shall be stored in a manner that allows direct access by the software for at least 90 days. Facility shall be provided to support archive and restore.
TR 8.8	The system shall store AVL time-related data at the same resolution received for a period of 12 months and at a resolution of no more than 10 seconds for any data older than 12 months period.
Maps	
TR 8.9	The central software shall incorporate maps to support the functionality, comprised of a selection of individually selectable theme layers (e.g., streets, water features, parks, major buildings).
TR 8.10	The system shall have a GIS based base map for the Project at a scale of at least 1:2500 or better resolution acceptable to the Client operationally.
TR 8.11	The system shall include mechanisms to allow for periodic independent updates to the central software maps.
TR 8.12	The software shall allow users to view the map, including a selectable combination of the source map layers and new layers, at various user-defined zoom levels.
TR 8.13	The AVL Application GUI and the map should interface to provide extensive alerts required for real-time operational support.
TR 8.14	The Alerts shall be easily identified on the map through double-clicking of the alert. Location playback features shall be available on clicking of Alerts.
Location Playback	
TR 8.15	The operator shall be able to review on the map display the chronological sequence of reported locations for a specified vehicle over a specified time period.
TR 8.16	The software shall provide controls to view the entire sequence of reported locations from the beginning of the time period or to step through the sequence incrementally forwards or backwards.
TR 8.17	The system shall allow replay for a single vehicle, selected set of vehicles or all vehicles on the selected map view for selected time period.
TR 8.18	System shall consist of multiple features for location playback to allow variable speeds and time period selections for ease of replaying.
TR 8.19	The system shall allow selection of any time period for the historical data.
TR 8.20	The replay data shall include location and headway adherence data.
TR 8.21	All users accessing the AVL software shall be able to access the playback function.
TR 8.22	The system shall allow the ability to use playback without exiting from the current operational view.
TR 8.23	The system shall be able to store a playback in a format that can be exported for viewing on any computer.
Data Logging and Retrieval	
TR 8.24	All incoming and outgoing data shall be stored for retrieval, analysis, display and printing.
TR 8.25	The system shall allow all such data to be retrieved, even if it has been archived.

TR 8.26	This historical information shall include all reported and derived data for vehicles (including at minimum the date/time, vehicle, route, location data, schedule adherence data, headway adherence data, station/stop arrival predictions); and all central software user logons and logoffs.
TR 8.27	The system shall include a means of archiving transaction data, or restoring data from an archive, while the system is in operation.
AVL GUI Requirements	
TR 8.28	The central system shall be delivered with a fully functioning Graphical User Interface (GUI).
TR 8.29	The GUI shall be based on standard windows controls or equivalent.
TR 8.30	All screens with non-paging data shall open and populate with data within 3 seconds.
TR 8.31	All screens with paging data shall open and populate with the initial data within 3 seconds and thereafter page updates shall be retrieved within 1 second.
TR 8.32	Dragging the cursor bar for a scrollable list shall cause instantaneous redisplay of the list in time with the movement of the cursor bar.
TR 8.33	All the system vehicles shall be shown concurrently in the GUI with both static and real-time data as parameters.
TR 8.34	Multiple configurable views of the GUI shall be available for the dispatcher that shall be available for retrieval through a dropdown list.
Operations Monitoring Dashboard/Console Requirements	
TR 8.35	The AVL system shall include an operations monitoring dashboard located at the ACC & monitored by the operator.
TR 8.36	This dashboard shall have relevant schematic layouts with On-board unit connected & shown on the GUI with real-time status.
TR 8.37	The various nodes when online & offline shall be represented in different colour schema on the GUI of the operator.
TR 8.38	If any particular node becomes disconnected from the ACC, the same shall raise an alarm to the operator GUI & appropriate action shall be taken for rectification of the same.
TR 8.39	The monitoring dashboard shall show the status (connected/ disconnected, faulty/working) of all logical devices connected to a particular node, when clicked on a node from the monitoring dashboard GUI.
TR 8.40	In case of any fault in the devices connected to a node, or connectivity failure with a node, a pop-up message shall appear on the monitoring dashboard workstation. The operator has to acknowledge the pop-up message & report the type of fault to the maintenance team & shall record the details to the assigned team /individual into the system.
TR 8.41	Access to the monitoring dashboard shall be specific to the privilege of the user, which can be defined in the central system & shall be specific to a group of node locations (e.g., a set of OBU and/or combination of node types).
System Security Requirements	
TR 8.42	The central system & ACC Work-stations shall only be accessible by authorized persons, controlled using login and password protection.

TR 8.43	It shall be possible to create multiple user classes with different privileges.
TR 8.44	The system shall maintain a transaction log that records all users that access reports, the reports accessed, edits and changes to the database and the system logon and log-off times.
TR 8.45	The transaction log shall maintain this information for a minimum of one year. Editing data in the log shall be possible only to the highest class of system user and shall be flagged in the reports generated.
TR 8.46	The system security shall provide features to maintain data integrity, including error checking, error.
TR 8.47	Verification features shall be provided to ensure that all system-created files are uniquely identified, and that no files are lost or missed during data transfer.
TR 8.48	Verification features shall be provided to confirm that there has been no data loss at any point in the transfers.
TR 8.49	Features shall be provided to automatically detect, correct and prevent the propagation of invalid or erroneous data throughout the system.
TR 8.50	All systems, sub-systems and devices shall only allow access to authorized user classes.
TR 8.51	All security breach detections shall be confidential, and accessible only to users of the appropriate class.
TR 8.52	The Central System shall be capable of data communication with all system components in real-time.
TR 8.53	The central computer system shall manage all device activity including data storage and processing.
TR 8.54	All active equipment shall have an internally maintained date and time clock synchronized at a time interval via the communications controller with the Central System date and time clock.
TR 8.55	The time synchronization application in the device shall have the capability to adjust the minimum time interval to update itself with the central system time and date, and shall be able to update time every minute (configurable) with the central system.
TR 8.56	All mobile equipment shall operate with a real-time data connection to the central system via the communications (GPRS/3G) network.
TR 8.57	If the data connection to the central system is temporarily lost, all equipment shall seamlessly switch to an offline mode in which all data is temporarily stored in internal memory and transmitted to the central system as soon as the data connection is re-established.
TR 8.58	All equipment shall have sufficient memory to operate in offline mode, with no loss of data, for no less than 168 hours.
TR 8.59	The central software shall provide over-the-air updates & firmware updates to all devices, separate from other immediate critical updates.
TR 8.60	The systems shall be driven by configurable parameters and should provide the flexibility for maximum configuration. The configurations shall be for, but not limited to: • Time based messages • User Groups and users privileges

	• Addition & deletion of OBU's • Configurable messages in English and Hindi languages • Reports access
TR 8.61	The system shall handle all exceptions. Exceptions can be, but not limited to: • Triggers for panel opening of any equipment • Default message shall be configurable in case of the lost central connectivity
TR 8.62	The system shall handle all degraded conditions, including not limited to: • Any supplied equipment not functional • Power failures • Data Connection lost • Central Server down
TR 8.63	The system shall provide an automated Fault Monitoring Mechanism to generate reports identifying the faults of the equipment if any on a daily basis. The Fault Monitoring System shall have as a minimum the following capabilities: • Setting up of automatic and manual alerts • Automatic fault detection & Reporting • Fault Status reports • Fault Closure reports
TR 8.64	These reports shall be non-editable & shall have real time access to the Fault Monitoring Mechanism with user privileges of the highest level.
Scalability/Future Operational Requirements	
TR 8.65	The central software shall be scalable to accommodate minimum 100 vehicles without any modifications to the central software except minor configuration changes, with the details of how scalable the system is provided.
TR 8.66	The on-board unit shall be able to integrate easily using open protocols with any other on-board equipment or systems.
MIS Reports Requirements	
TR 8.67	The software shall provide standard reports based on the CAD/AVL data. Some expected standard reports are: • Service hours and mileage • Speed reports • Alerts reports • Driver performance reports
TR 8.68	The software shall have the capability to generate reports based on exceptions as per thresholds set by the staff for various AVL components.
TR 8.69	All reports must use standard reporting tools (e.g., Crystal Reports or MS Access) and have the ability to export data into file formats that can be exported to and edited with standard office software (e.g., Microsoft Word, Adobe Acrobat and Excel).
TR 8.70	The standard reports shall include: • Monthly summary reports broken down by vehicle and route type • Vehicle Location by date/time, location, and other parameters

	• Driver performance report consisting of bin skipping, harsh acceleration, harsh deceleration, over speeding, etc. • Fraudulent activity reports with the hardware (Tampering reports) • Faults and errors • Vehicle trip reports • System exceptions reports • System performance and activity reports • Training and Testing • Snapshot / Incident Replay
TR 8.71	It shall be possible to aggregate data (filter) for reporting, at a minimum, by: • Date/Time • Origin • Destination
AVL On-Board Unit (OBU) Requirements	
TR 8.72	The installed OBU shall not cause injury or obstruction to passengers or crew.
TR 8.73	A timer shall be provided with OBU so that the OBU can be switched off after a variable set period after the vehicle ignition is switched off. The timer shall help protect the life of the vehicle battery, while ensuring file transfers happening in the depot after the vehicle ignition is switched off.

2.2.9 Other In-Facility Systems

2.2.9.1 Building Management System

Overview

Building Management Systems (BMS) will be implemented in all the POP rooms across Shendra as part of Shendra smart city ICT components. Building management system shall provide a central platform over which various mechanical and electrical parameters of the building (e.g. power feeder system, HVAC, DG sets etc.) shall be monitored, controlled and automated in an integrated manner.

BMS shall be integrated with ACC for central monitoring and control of all the POP rooms from a single location.

BR - 9 Business Requirements

BR 9.1	BMS shall be installed at all the POP rooms in Shendra.
BR 9.2	BMS shall enable building managers to monitor, control and automate various systems in the building via an integrated platform from a central location.
BR 9.3	BMS shall provide cross system communication inside the building to achieve intelligence in the building.
BR 9.4	BMS shall provide proactive maintenance of the building's systems.
BR 9.5	Provide details regarding energy accountability of the building based on different parameters.
BR 9.6	BMS shall provide visibility and control of the connected systems from a centralized workstation and from a remote location via a web based interface.
BR 9.7	Monitor and annunciate anomalies in system operations for efficient operations of the building.
BR 9.8	Minimal human intervention for regular operations of BMS.
BR 9.9	Monitor electricity consumption trends and usage for systems.
BR 9.10	Provide an integrated platform at the workstation that shall allow various users to view and modify various parameters in the system based on respective authorization.
BR 9.11	Integrate BMS or IP enabled fire alarm system at the ACC for all plots where the respective BMS or IP enabled fire alarm system shall be provided by the respective plot developer.

FR - 9 Functional Requirements

Building Management System (BMS)	
General	
FR 9.1	BMS shall provide the following functionalities as a minimum but not limited to: • Monitoring and control of building automation (cooling/heating control, ventilation control) • Monitoring and control of internal and external lighting in the building

	• Monitoring of electrical power distribution system through multi-function meters • Monitoring of DG Parameters (as applicable) • Integration with the Fire detection and alarm system • Monitor and manage energy consumption throughout the building for the purpose of tracking quality and usage of electricity • Integration with video surveillance system inside POP and ACC • Integration with access control • Monitoring and control of UPS
Key functionality of BMS system	
Integration with Other systems	
FR 9.2	**Integration with HVAC System:** Monitor ON/Off status and generate alarms. Monitor temperature being maintained by the AC.
FR 9.3	**Integration with Lighting System:** • Functionality: ➢ Lighting control through time based sensors • Control Required: ➢ MCCB On/Off command for internal and external lighting ➢ Scheduling of On/Off of lights through BMS software • Monitoring Required: ➢ MCCB and On/Off status
FR 9.4	**Integration with Electrical Power Distribution System:** • Monitoring and Control functions for electrical power distribution system is as follows: ➢ Maximum demand monitoring ➢ Break status monitoring ➢ Trip status monitoring ➢ On/Off status • Breaker On/Off, trip Monitoring on a real-time basis • Status to be monitored (ON/OFF/Trip Status and relay indications and alarm): ➢ HT and LT Boards ➢ ON/OFF station at all other panels ➢ Transformers to be monitored ➢ Trip status
FR 9.5	**Integration with DG Parameters (as applicable):** • DG Sets to be monitored • Monitoring of following parameters to be done: ➢ DG On/Off status ➢ Frequency ➢ Trip status

	➢ Engine fail to start (U/V Trip) ➢ Alternator field failure ➢ Alternator fail to built-up voltage ➢ DG Trip due to earth fault ➢ DG Trip due to overload ➢ DG Room Temperature ➢ Inlet Cooling Water Temperature ➢ Outlet Cooling Water Temperature ➢ Cooling water flow OK ➢ Day tank low/high ➢ HSD Tank low/high ➢ DG over speed feedback ➢ Low lube oil pressure ➢ Common engine fault alarm ➢ Auto synchronizing panel breaker status ➢ Battery weak ➢ Battery low voltage alarm ➢ PLC controller failure alarm ➢ Emergency stop operated ➢ Reversed power ➢ Oil pressure ➢ Common shutdown • Control: ➢ Auto sync panel breaker On/Off control ➢ Emergency stop • Field Devices: ➢ Day tank and HSD tank fuel level measurement using tank level sensors ➢ Day tank and HSD tank flow measurement using flow switch sensors ➢ Fuel tank temperature monitoring
FR 9.6	**Integration with Fire Alarm and Detection System:** IP based Fire alarm system shall integrate with the BMS and the status of the fire detection system shall appear on BMS.
FR 9.7	**Integration with UPS:** UPS shall be integrated with BMS via open protocols. Monitoring of following parameters shall be done via BMS: • Battery voltage • DC voltage • Battery charging/discharging status • Estimated time before shutdown during battery discharge • Battery charging/discharging current • Load on bypass • UPS in maintenance

	• Rectifier failure alarm • Inverter failure alarm • Battery discharge status • Low battery warning alarm • Low battery shutdown alarm • Battery disconnect alarm • Overload alarm • Fan failure alarm • Power fuse failure alarm • Output over/under frequency alarm • Static switch unable alarm • Bypass not available alarm; and • Common alarm
FR 9.8	**Integration with Energy Monitoring System:** • The energy monitoring software shall be a web-enabled monitoring system intended to monitor the entire electrical distribution infrastructure, from incoming utility feeds to low voltage distribution points. • The system shall be designed to monitor and manage energy consumption throughout the facility, whether within a single building or across a network of buildings, to improve energy availability and reliability, and to measure and manage energy efficiency. • Software required for energy monitoring shall be an integral part of BMS and shall provide a seamless user experience for managing all systems integrated with the BMS. • Key features shall include: ➢ Data acquisition for metering devices, sensors and other intelligent electric devices. ➢ Graphical, real time displays of electrical distribution system for monitoring of voltage, current, power, frequency, THD, power factor, individual harmonics etc. ➢ Reporting tools with standard report templates which shall include billing reports, energy usage reports, trend reports, energy comparison reports, alarms and exception reports etc. ➢ Power Quality Analysis ➢ Energy Analytics and Measurement ➢ Energy Budgeting ➢ Energy predictive analysis ➢ Interactive historical data display and trending ➢ Demand Limiting / Load Rolling ➢ Real Time Data Tables with Standard Views ➢ Interactive Alarm Analysis with Standard Views ➢ Power Factor monitoring and reporting ➢ Interoperability with disparate devices and systems; and ➢ Third Party Device Integration through Modbus RTU and Modbus TCP protocols

FR 9.9	**Integration with Video Surveillance System:** • For a comprehensive BMS and to provide a uniform view of all systems, video surveillance with a fully IP based Network Video Recording (NVR) system shall be integrated with the BMS. This shall work in conjunction with access control and intrusion detection system to provide one-stop security solution. • BMS shall start recording video stream upon triggering from intruder alarm system and access control system. • The integrated system shall be used through the video surveillance system's own User Interface Client and also through the integrated user interface of the BMS system. • Following functionalities shall be supported by BMS upon integration with video surveillance system: Web usage and client application both shall be supported; ➢ The BMS shall support receiving of real time values, trends, alarms and event logs from the connected systems. Different levels of logs (e.g. warning, error, info) shall be available. ➢ The BMS shall support modification of set points, time schedules and manual (override) controls in the connected systems. ➢ BMS shall support an event mapping mechanism for triggering of functions, e.g. starting video recording and turning on lights from events like unauthorised access attempt. ➢ BMS shall include centralized alarm dispatching features for all connected systems, using e.g. SMS and email. The system shall support triggering of functions based on the events from the other connected systems. ➢ The BMS shall be modular in structure, consisting of services, which are flexible to add, configure and to update.
FR 9.10	**Integration with Access Control System:** • The Access Control shall be intended to control physical access to premises and detects unauthorized access. The Access Control shall ideally be implemented as one unified system with smart network controllers and interface panels. • Access control system has the capability to classify users so that they can have access only to spaces where they are allowed to enter according to programmed time schedules. • Access Control shall be integrated with the BMS in order to provide a unified solution for security management. • Following functionalities shall be supported by BMS upon integration with access control: ➢ Access control and intrusion system shall be monitored through a graphical user interface. Web usage and client application both shall be supported. ➢ The BMS shall support receiving of real time values, trends, alarms and event logs from the connected systems. Different levels of logs (e.g. warning, error, info) shall be available. ➢ The BMS shall support modification of set points, time schedules and manual (override) controls in the connected systems. ➢ The BMS shall be modular in structure, consisting of services, which are flexible to add, configure and to update.

FR 9.11	**Integration with DG Synchronization, Auto Load Control and Auto Mains Failure Panel:** Integration shall be with DG Synchronization, auto load control and auto mains failure panel to give status to BMS.
System Architecture	
FR 9.12	Overall system architecture shall be as following: • Management Level for system monitoring and management • System Level for intelligence of the system and data aggregation; and • Field Level for industry standard sensors, actuators, peripherals etc.
FR 9.13	Building Management System shall consist of Administration and Programming Control Station, Ethernet network controllers, software, a family of Standalone Digital Control Units (SDCUs) consisting of field DDCs, field devices and sensors, along with a complete system of electrical interlinking wiring to fill the intent of the specification.
FR 9.14	BMS shall support open protocols such as BACnet/IP, LonWorks, and/or Modbus protocol.
FR 9.15	BMS shall provide a graphical, operator interface that allows for instant access to any connected system through a BMS software and web based standard browser.
FR 9.16	Following features shall be offered by BMS software: • Alarms • Automatic monitoring • Help facility • Logging • Report generation • Time scheduling • Data storage • Point History and Trending • Totalization • Web based software
External Integration	
FR 9.17	BMS shall integrate with AURIC Control Centre (ACC) in AURIC Hall building.
FR 9.18	All monitoring and control functionalities present at the BMS shall be made available at the ACC.

TR - 9 Technical Requirements

General	
TR 9.1	Building Management System (BMS) shall incorporate industry standard operating systems, communication networks and protocols. The system shall be designed to be completely modular in structure and freely expandable at any stage.
TR 9.2	Overall system architecture shall be as following: • Management Level for system monitoring and management

	• System Level for intelligence of the system and data aggregation; and • Field Level for industry standard sensors, actuators, peripherals etc.
TR 9.3	Each layer of the system shall operate independently of the next level up, in order to allow for fault tolerant system functionality. Most importantly, the System Level shall operate independently without support from the Management Level.
TR 9.4	Building Management System shall consist of Administration and Programming Control Station, a family of Standalone Digital Control Units (SDCUs) consisting of field DDCs, field devices and sensors, BMS software and web-based graphical interface. The BMS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility as specified in this bid document.
TR 9.5	BMS shall consist of an Enterprise Server, which enables multiple DDCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single workstation simultaneously for operations and engineering tasks.
TR 9.6	For Enterprise reporting and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Generating Application shall be installed on a BMS computer
TR 9.7	The system shall be support BACnet/IP, LonWorks, and/or Modbus protocol.
Standard Network Support	
TR 9.8	All DDCs, Workstation(s) and Servers shall be capable of residing directly on the Client's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the DDCs, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs.
System Expansion	
TR 9.9	The BMS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
TR 9.10	Web-Based BMS operation shall be supported directly by the DDCs and require no additional software.
TR 9.11	The system shall be capable of using graphical and/or line application programming language for the DDCs.
Workstation Requirements	
TR 9.12	The control station shall support 30 days of recording of BMS data.
TR 9.13	Please refer to the Workstation specification as mentioned under IT Infrastructure Section 2.2.11.1.
General Administration and Programming Workstation Software	
TR 9.14	System architecture shall be truly client-server in that the Workstation (Control Station) shall operate as the client while the DDCs shall operate as the servers. The client is responsible for the data presentation and validation of inputs while the servers are responsible for data gathering and delivery.

TR 9.15	The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.
Web Based BMS Requirements	
TR 9.16	Any user on the network can access the system, using the following: • Internet Explorer 11 or better • Mozilla Firefox • Google Chrome
User Interface	
TR 9.17	The operator panel on a workstation shall provide the primary interface for operator access to the BMS while also providing a tool for the annunciation of alarms and the reporting function. The operator shall have the option of switching between a text based and graphic based user interface at any time. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups.
User Security	
TR 9.18	The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator.
TR 9.19	The sets of capabilities shall range from View only, Acknowledge alarms, Enable / disable and change values, Program, and Administer. The system shall allow these capabilities to be applied independently to each and every class of object in the system. The system shall allow a minimum of 10 users to be configured per workstation.
Help Facility	
TR 9.20	Software shall be provided to facilitate programming and storage of the system operation manuals in the hard-disk. The operation manual shall be retrieved by Online Help mode so as to enable the operator to self-learn the system operation, command, or function as and when needed.
TR 9.21	The facility shall contain both text and graphics to provide information about the selected function directly.
Alarms	
TR 9.22	The software shall be capable of accepting alarms directly from controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) shall be integrated into the overall alarm management system and shall appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
TR 9.23	Multiple priority levels of alarm shall be made available. Priority levels shall be deemed Critical Alarms and Non-critical (general) Alarms. Critical alarms shall take precedence over non-critical alarms, and high priority over low priority under normal operations.

TR 9.24	It shall be possible to automatically provide details on alarms to authorized users via emails and SMS facilities.
Logging	
TR 9.25	It shall be possible to log the status or value of system points at regular intervals or on change of state and store this on hard-disk at any of the workstation.
TR 9.26	It shall be possible to archive this information for future reference.
Report Generation	
TR 9.27	Standard reports shall be provided that shall be operator selectable to appear on the operator workstation and any selected printer on the network.
TR 9.28	Each report shall be capable of being automatically viewed/emailed to a user/recipient in Microsoft Word, Excel, and/or Adobe .pdf format.
TR 9.29	Reports can be of any length and contain any point attributes from any controller on the network.
TR 9.30	Image management functionality shall be possible to enable the system administrators to easily upload new logos or images to the system.
TR 9.31	The utility profile shall display the total consumption, measured peak for the current period and the previous period.
TR 9.32	Report generation tool shall display trending information of various building operations.
Data Storage	
TR 9.33	A history file capability shall be provided to allow automatic storage of certain records plus allow the operator to selectively direct critical real time system data and activity to a mass storage device for later recall and analysis.
TR 9.34	It shall be possible to access software packages so that the operator may format display or printouts in the form of: • Spread sheets • Bar charts • Curve plots
TR 9.35	History files shall be the source data for stored trend reports to be used for records and system analysis.
Time Scheduling	
TR 9.36	There shall be real time clock facility to help in time scheduling. The scheduling feature shall not be dependent on a central database or an operator workstation.
TR 9.37	From the workstation, it shall be possible to configure and download schedules for any of the controllers on the network.
Point History	
TR 9.38	For every analog and digital point in the system, point history shall be maintained.
TR 9.39	The system shall provide point history graphs for analog/digital points.
Point Trend	
TR 9.40	BMS shall be capable of point trending.

TR 9.41	Trend samples shall be displayed in either tabular or graphical format. A minimum of eight trended points shall be able to be displayed concurrently on a graph or report.
Totalization	
TR 9.42	For every digital point, the system shall be able to calculate: • Cumulative on-time • Cumulative off-time
TR 9.43	For every point, analog and digital, the system shall be able to calculate: • Cumulative time in alarm • Cumulative time overridden by operator • Cumulative time offline
Audit Trail	
TR 9.44	The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
Database Manager	
TR 9.45	BMS shall include a database manager to allow the data to be managed on an integral and non-redundant basis. It shall be able to make additions and deletions to database, without affecting the existing data.
Web Based BMS Operator Software:	
TR 9.46	General: • Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network via an IP address or dedicated webpage. • The system shall be able to be accessed on site via a mobile device environment with, at a minimum, access to overwrite and view system values.
TR 9.47	Graphic Displays • The browser-BMS interface must share the same graphical displays as the Control Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser's graphics shall support commands to change setpoints, enable/disable equipment and start/stop equipment.
TR 9.48	Alarm Management • Through the browser interface, a live alarm viewer identical to the alarm viewer on the control workstation shall be presented, if the user's password allows it. Users must be able to receive alarms, silence alarms, and acknowledge alarms through a browser. If desired, specific operator text must be able to be added to the alarm record before acknowledgement, attachments shall be viewable, and alarm checklists shall be available.

Direct Digital Controller (DDC)	
IP based Direct Digital Controller (DDC) Hardware Requirement	
TR 9.49	All the controllers should be UL listed and BTL certified supporting to BACnet Protocol, LonWorks or Modbus. In case, controller is not BTL certified, equivalent or higher certification shall be required.
TR 9.50	The controllers shall support BACnet, LonWorks or Modbus (all) on native backplane.
TR 9.51	DDC's shall have 20% as overall spare capacity & at least one spare of each type of port shall be provided.
Direct Digital Controllers (DDC) Capabilities	
TR 9.52	Controllers shall combine both network routing functions, control functions, and server functions into a single unit.
TR 9.53	Controllers shall provide the interface between the field control devices, and connect with the control station.
TR 9.54	Controllers must be able to perform the following energy management functions as a minimum: • Time & Event programs • Holiday Scheduling • Optimum start and stop program • Night purge • Load reset • Zero energy band • Duty cycle • Enthalpy analysis and control • Run Time Totalization • Sequencing and Optimization • Exception scheduling
TR 9.55	Each DDC must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.
BACNet Fieldbus and BACNet SDCUs	
TR 9.56	**Networking** IP Network: All devices that connect to the WAN shall be capable of operating at 10 megabits per second or 100 megabits per second.
Integration Interface	
TR 9.57	BMS shall interface with AURIC Control Centre (ACC) at the AURIC Hall Building.
TR 9.58	All monitoring and control functionalities present at the BMS shall be made available at the ACC.

Field Input / Output Devices	
TR 9.59	**List of Field Devices** BMS shall optimize the performance of the building systems based on the input from field sensors. Field sensors to be decided and installed by the MSI as approved by the Client.
Enclosures and Panels	
TR 9.60	Enclosures for Controllers and Electrical Panels: All the controllers shall be housed in Lockable Vandal proof boxes which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust and vermin proof and suitable for the climatic conditions.
Data Communication	
TR 9.61	The communication between IP controllers shall be via a dedicated communication network as per manufacturer's standards. Controller microprocessor failures shall not cause loss of communication of the remainder of any network. All networks shall support global application programs, without the presence of a host PC.
Testing	
TR 9.62	All the certificates and test reports submitted by MSI should be from UL/NABL approved labs.

2.2.9.2 Access Control System

Overview

Access Control System will be implemented in all the POP rooms and AURIC Control Centre (ACC) as part of Shendra smart city ICT components. Access Control system is intended to control physical access to the premises and detection of unauthorized access. Access control system shall be a combination of card based and fingerprint system along with attendance management system.

Access Control System shall be integrated with the BMS which in turn shall integrate with ACC.

Business Requirements

BR 9.12	Access control system shall be an integrated solution that consists of hardware and software designed to control entry into selected areas and manage movement of personnel within. The system shall be designed to increase security by defining access permissions based on area and time for each user and maintaining a log of all events.
BR 9.13	Access Control System shall also calculate entry and exit time of authorized personnel through attendance system for work time calculation.
BR 9.14	Access Control System along with integrated attendance system shall be installed at al ACC and all POP rooms across Shendra.

Functional Requirements

Access Control System	
General	
FR 9.19	The Access Control System shall be intended to control physical access to premises and detects unauthorized access. The System shall be implemented as one unified system with smart network controllers and interface panels.
FR 9.20	Access control system has the capability to classify users so that they can have access only to spaces where they are allowed to enter according to programmed time schedules.
FR 9.21	Access Control System shall comprise of: • Automated Card based access control at designation areas, doors, utility rooms, control room. • The system shall support attendance management based on entry and exit time for all employees and staff. • A card reader that shall respond with the secure card format that communicates to a controller. • A Controller with access control software which shall indicate valid/invalid cards and authorization rights assigned to gain or deny access into restricted areas. • Automated locks for opening or closing of gates. • A workstation with access control software for management and monitoring at ACC.
FR 9.22	All operations and interfaced shall be IP based.
FR 9.23	The Access Control System shall be of open-architecture, PC-based system on a unified platform.
FR 9.24	The main function of the Access Control System shall be to control and monitor all designated access to the selected doors, areas inside ACC and POP buildings.
FR 9.25	The system shall be provided to control access into designated security controlled doors only by personnel with a valid access card and finger-print and within valid time schedule. All access cards and finger-prints shall be authenticated against the central and/or local database before granting access.
FR 9.26	All designated security controlled doors shall be fitted with a suitable card reader and fingerprint sensors.
FR 9.27	The Access Control System shall allow control of door entry access both by a proximity or contactless smart card reader and from the Access Control System workstation.
FR 9.28	Access Control System shall have a finger-print scanner which at the entry for personnel to register its entry and exit time for work-time calculation.
FR 9.29	Access Control System shall offer a highly efficient and automated solution that allows operators to quickly identify an alarm scenario.
FR 9.30	All interfaces within the Access Control System shall be based on TCP/IP network protocol connectivity over the corporate intranet/ internet/ LAN/WAN.

FR 9.31	System shall have a modular design and provide expandability in the following areas: • The system shall be designed to allow foreseeable organizational changes and procedural changes beyond current plans. • Additional hardware units shall easily be added without any modification to the existing hardware, software and network configuration.
FR 9.32	The Access Control System shall be a multi-tasking and multi-users based head end running on a distributed TCP/IP network.
FR 9.33	The system shall be designed to provide alarm gathering, monitoring, handling, reporting, full logging including the performance and activities of the operators within the secured areas of the building. It shall also provide monitoring and control of inputs and outputs both locally and remotely (e.g. in different Buildings).
FR 9.34	The system shall be a flexible and user-friendly workstation providing user(s) with a Graphical User Interfaces (GUIs) for alarm monitoring and control. Such GUIs shall be the core of the entire system that includes mapviewer with alarm list and a Video Verification module for surveillance and recording video streams.
FR 9.35	All door access activities shall be logged into the central database. Any unauthorized attempt or invalid card used shall be reported to the system, including door held and forced opened alarm as priority alarms.
FR 9.36	Access Control System shall have a video verification module. With the Video Verification module, live images from the camera installed at the door location shall be displayed at GUI (Graphical User Interface) during door alarm activation and access request. It shall also be possible to select live view of the camera to view the person's face before activating (manually unlocking the door via icon control on the GUI) and granting during door access request. Video feed from CCTV surveillance system shall be integrated with the system via an integrated Building Management System (BMS) platform.
FR 9.37	The system shall also include a feature to display the last 5 access requests from an specified entrance with last name, first name, database picture, timestamp and event type (authorized, card is unknown, card is blocked, etc.).
FR 9.38	Reports shall always be readily available and AITL or their designate shall be able to request for the reports on exactly what information from the report is required with the use of event filters.
FR 9.39	All access doors shall have an emergency break-glass door release installed to unlock the door for exit in the event of emergency. In addition, all dedicated doors along the escape route shall automatically open during fire alarm activation.
FR 9.40	System shall monitor and record in a logbook all movements and activities at each control point.
FR 9.41	System shall provide configuration and programming of access groups, where each access group contains a list of control points or access doors to which a card holder has authorized access.
FR 9.42	System shall provide configurable time schedules to have the flexibility for programming automatic locking and unlocking of any access controlled doors, as well as activating and de-activating of card holder settings for restricting any access groups from entering certain areas with the pre-programmed time model.

FR 9.43	The time schedule shall include holiday facilities to allow user programming for public holidays and user definable special holidays. All schedules shall be definable by day, hours and minutes.
FR 9.44	System shall be designed such that any point of failure within the system shall not affect the normal operation of the other sub-systems. It shall continue to operate even if the connection with the management software is not present.
Integration Requirements	
FR 9.45	Access Control System shall be interfaced with the Building Management System (BMS) for integrated monitoring and control of all the building utilities.
FR 9.46	Access control system shall be interfaced with IP based CCTV surveillance system via integrated Building Management System (BMS) to provide automatic camera call up and pre-sets as well as scene display through the use of a graphical user interface and simple point and click action; as also for event storage with Picture clip for further analysis and reports.
FR 9.47	Access Control system shall be interfaced with HR Management System of the designed ERP system for attendance management and work-time calculations.

Technical Requirements

System Architecture	
TR 9.63	The Access Control System server shall be provided and structured based on centralized server architecture.
TR 9.64	The CPU provided for the Access Control System server shall be reliable and robust in construction to perform all the necessary functions and management of all subsystems.
TR 9.65	Database for the system shall reside within the same server hardware.
TR 9.66	All alarms processing, logging, operator's response, data entry/input, graphical user interface and other system operations and management functions shall be performed at the workstations connected to the access control system network.
TR 9.67	System servers and workstations shall be connected using a standard IP network over the corporate Intranet or dedicated Internet/ LAN/WAN.
TR 9.68	System shall allow the configuration for information access permissions, that is, user/operator profile for the access on the master records, the permissions shall restrict to: • Read only • Read, write, change, and delete • Change the current location of persons • Change the access authorizations of persons
TR 9.69	System shall allow the configuration for information access permissions, that is, user/operator profile for the access on event data, the permissions shall restrict to: • View own messages • View all messages without personal data • View all messages

TR 9.70	System shall allow the configuration for information access permissions, that is, user/operator profile for the access to the Configuration dialog.
TR 9.71	System shall allow the configuration for information access permissions, that is, user/operator profile for door management.
TR 9.72	System shall allow the configuration for information access permissions, that is, user/operator profile for the access on video applications and devices, the permissions shall restrict to: • Persons • Can use alarm verification • Can use video verification • Video devices • Can use the specified group(s) of cameras • Video functions • Can use live video • Can use the archive of video streams • Can record and export video streams
TR 9.73	System server shall act as the source that provides time synchronization to all sub-systems.
TR 9.74	System shall be as such that any failure of any sub-systems shall not affect all the other sub-systems. This shall also apply to any loss of power supply or suffer a loss in communications due to a break in the communication loop. In any case, each sub-system shall continue to function in a fully operational state with no loss of functionality.
TR 9.75	System shall have a modular structure that allow for future system expansion with minimum cost and disruption to the existing operational system. Such upgrade shall not make use of or compromise the spare requirement specified or utilizing or sharing any of its functions.
Access Control Software	
TR 9.76	The software shall have a modern interface, attractively designed and convenient to use.
TR 9.77	System Software proposed shall provide English descriptions and messages using both text based menus and graphical icon displays.
TR 9.78	Software shall be capable to support the following: • Active card holders • Card readers • Access groups • Time schedules • Fingerprints • Entry and exit times for attendance management • Video channels • Door window sensors • Motion sensors • Glass break sensors

	• Mapviewer floor plans • Map links • Magnetic locks • Electronic locks • Alarms • Other devices
TR 9.79	The software shall also allow the programming of individual operator's permissions. Permission regarding personal data shall be configurable to the following: • Read only • Read, write, change and delete • Change the current location of persons • Change the access authorizations of persons
TR 9.80	Permission regarding event log messages shall be configurable to the following: • View own messages • View all messages without personal data • View all messages
TR 9.81	Special permission for the configuration dialog shall be configured via software.
TR 9.82	Special permission for door management shall be configured via software.
TR 9.83	Permission regarding video application and devices shall be configurable to the following: • Can use alarm verification • Can use video verification • Can use the specified group(s) of cameras • Can use live video • Can use the archive of video streams • Can record and export video streams
TR 9.84	System software shall provide a simple way for the system administrator to configure entrances selecting from a list of pre-defined door models. The following list of door models shall be provided by the system: • Door with entry and exit reader • Door with entry reader and request to exit button • Door with entry or exit reader • Elevator with floor control • Mantrap • Door with combined arm/disarm IDS function.
TR 9.85	Software shall be capable of issuing area lockdown commands for providing quick method of sealing off areas. It shall be able to disable card readers and exit requests at any given area.
TR 9.86	System software shall provide the capability entering cardholders into the database. Basic info such as first name, last name, badge number, access authorization, cardholder's image, membership etc. shall be configured through software.

TR 9.87	System software provided shall allow card personalization. That is, it shall include a tool for designing badges that supports the importing of bitmaps, text and database fields, such as name or badge number for creating of corporate badge designs printable on a standard card printer that come with a Windows compliant printer driver.
TR 9.88	Software shall be capable of group authorization. Grouping of entrances that consist of one or more readers shall be possible, where one entrance can exist in several groups. A cardholder shall be assignable directly to any of the Access Authorization groups.
TR 9.89	Software shall allow incorporating of access authorizations with time models. The assigned time model defines the time when an access authorization is active at an entrance or entrance group.
TR 9.90	Software shall provide the ability for defining of logical areas, which could be single room, groups of rooms, entire floors where access control points/entrances could be assigned to.
TR 9.91	Software shall allow the blocking of cardholders, for example by validity period.
TR 9.92	Administration of visitors shall be provided by the Access Control System management software in the same database.
TR 9.93	The following information should be assignable to a visitor: • Identification number • Access authorizations
TR 9.94	System operator shall also be able to send remote commands or activate controls manually from the workstation when requested such as, unlocking and re-locking of access controlled door/s, or resetting of detectors.
TR 9.95	The software shall also contain a map viewer. This map viewer shall provide a graphical presentation of the premises or object by means of floor plans, object pictures or any desired graphical representation. Map viewer shall show real time status of system hardware.
TR 9.96	On the maps entrances and cameras can be positioned as a graphical icon. These graphical icons will display the location of the device in the map and the actual status of the device. Clicking any of the devices automatically shows the controlling commands available for the respective device. Control commands are automatically linked based on device type.
TR 9.97	Software provided shall allow the definition of floor access authorizations at designated lifts, and assign them to card holders. If a cardholder presents his card at the elevator reader, the system shall activate the elevator floor buttons the cardholder has authorized access.
TR 9.98	Access control readers shall be allowed to be configured additional as time and attendance readers. The booking events are stored in a separate file to export them for use in other applications.
TR 9.99	There shall be no limitations on the number of PC workstations, readers and alarm inputs.
TR 9.100	The software shall have the ability to perform scheduled automatic database maintenance and backup tasks at user selected intervals and ability to configure the amount of history stored in the active database.

TR 9.101	The software shall have the ability to produce the following report types: system and alarm event reports, user reports, hardware configuration settings, access level reports, employee time & attendance reports.
TR 9.102	The reports shall be available in Adobe PDF, MS Work and MS Excel formats.
TR 9.103	Report filters must be convenient and user friendly: allow operator preview user photos, content of access levels, hardware settings and time zone configuration.
TR 9.104	Dynamic search function shall be present in all windows of the software: search results shall be narrowed automatically as a key phrase is being entered. I.e. after entering characters “xy” the program shall locate and display all records containing these characters, and after typing in more characters shall refresh the results automatically.
TR 9.105	The software shall use an industry standard database engine and currently supported by the manufacturer.
TR 9.106	The software shall have the ability to automatically display photos and additional information about users as they enter/exit through doors.
TR 9.107	The software shall facilitate integration with other systems of the building.
TR 9.108	The software shall store information and provide reports about visitors and appointments.
Alarm Handling and Management	
TR 9.109	System software shall have support for central alarm monitoring and management. System shall provide the operator a simple and efficient way to handle any incoming alarms.
TR 9.110	Only authorized operator with the valid login username and password shall be able to access and operate the system. Once successfully login, the operator shall only see all the alarm and event messages destined to him for monitoring and processing based on his user login access profile.
TR 9.111	Software shall provide a wide range of standard alarm and event states. The following alarms/events shall be supported at a minimum: • Card unknown • Card not authorized • Card outside time profile • Access timeout • Door open time exceeded • Door opened unauthorized • Door blocked • Tamper alarm controller • Tamper alarm reader • Finger-print error • Duress alarm code • Access denied • Card blacklisted • Glass break • Motion detection in protected areas • Other individual alarm extensions

TR 9.112	All incoming alarms at the system GUI workstation shall contain a comprehensive alarm message.
TR 9.113	All alarm/events shall be logged in the central system event log files together with all assigned alarm documents for a complete reporting.
TR 9.114	Audible alarms through PC shall be generated at time of alarms.
TR 9.115	The alarm message shall also the capability to show live video images from the Video Verification camera installed at the alarm location such that, the operator can have first time view of the site situation if required.
Intelligent Controller	
TR 9.116	Controllers shall be IP enabled. Controller shall be completely field upgradeable or by remote access on IP Network without changing the software or effecting any database information.
TR 9.117	Controllers shall have the capability for remote diagnostics.
TR 9.118	Controllers provided shall be of modular design with a download software built-in so that the application program can be easily changed and downloaded without the physically touching the controller itself.
TR 9.119	Controller memory shall store database that has a capacity with a minimum of 5,000 cardholders (upgradeable to 100,000).
TR 9.120	Controller modules shall be support the monitoring and control of two (2) readers, with either or combination of various types of readers, keypads and Biometric Readers in any types and combinations.
TR 9.121	Controller shall support and include a standard Compact flash (CF) memory card for storing cardholder data and access events. The CF memory card must capable of being read using a standard card reader connected to a computer, if the access controller fails.
TR 9.122	Controller shall generate a transaction record and save them in its memory for every alarm, they include: • Time/date of occurrence and restoration • Location of alarm sensors
TR 9.123	The networked controller / reader interface device shall be capable of supporting the following: • Two way interface with or without PIN keypads • Two clock and data readers • Two Finger-print readers
TR 9.124	All system parameters including card numbers, finger-prints, access levels, time schedules, holidays and operations modes shall be stored in controller memory and not affected in case of a power loss.
TR 9.125	The connection from the controller to the system server running the management software shall preferably by Ethernet or RS-485.
TR 9.126	Operation of controller shall be completely independent of the PC or “Master controller”. Should the PC or the communication link fail, the users should not be affected in any way and all functions should continue working.

TR 9.127	The controller shall support data transfer rates up to 100 Mbps and shall have IPSec/IKE encryption and authentication. Encryption (up to 192-bit) and authentication shall be enabled for communication to and from workstations and controllers. Controller shall utilize Internet Protocol Security (IPSec) and Internet Key Exchange (IKE) for its encryption to assure tamperproof communications over the Ethernet.
Proximity Card Reader	
TR 9.128	The proximity card reader provided shall be of ruggedized design, sealed in weatherized polycarbonate enclosure to withstand harsh environments for both indoor/outdoor used and provide a high degree of vandal resistance.
TR 9.129	Transmit frequency of proximity card reader shall be 125 kHz.
TR 9.130	The proximity card readers shall have a read range of at least 3”.
TR 9.131	The response time to unlock the door after a card is presented to the card reader shall not exceed 1.0 second +/- 0.5 second.
TR 9.132	The card reader unit shall have an integral keypad with beeper, multi-colour LEDs.
Contactless Smart Card Reader	
TR 9.133	The Smart card reader provided shall be of ruggedized design, sealed in weatherized polycarbonate enclosure to withstand harsh environments for both indoor/outdoor used and provide a high degree of vandal resistance.
TR 9.134	The smart card reader shall be based on contactless smart card 13.56MHz technology for connection to the access controller with Wiegand interface.
TR 9.135	The data transfer between the contactless smart card reader and smart card shall be encrypted.
TR 9.136	The contactless smart card readers shall have a read range of at least 2.4”.
TR 9.137	The response time to unlock the door after a card is presented to the card reader shall not exceed 1.0 second +/- 0.5 second.
TR 9.138	The card reader unit shall have an integral keypad with beeper, multi-colour LEDs.
Proximity Card	
TR 9.139	The proximity cards shall be similar in size and thickness as standard credit cards or bank ATM cards.
TR 9.140	The proximity cards shall operate on 125 kHz.
Contactless Smart Card	
TR 9.141	The contactless smart cards shall be similar in size and thickness as standard credit cards or bank ATM cards.
TR 9.142	The smart cards shall be of contactless technology operating on 13.56 MHz.
Attendance Management System	
TR 9.143	The system shall support automatic attendance management based on entry and exit times logged by the employees/staff.
Door Contact Switches	
TR 9.144	Magnetic contact switches shall be provided to monitor the status of each card reader controller door and auxiliary door.

TR 9.145	Such Door contact Switches shall be either built in to the EM Lock (Feedback type EM Lock), or shall be individual equipment as per the building design.
Request to Exit Devices	
TR 9.146	Request-to-exit devices shall be provided to allow a person to exit an access controlled door.
Electronic Locking Devices	
TR 9.147	Electronic locking devices shall be provided to lock (secure) and unlock (unsecure) each card reader controlled door and auxiliary door.
TR 9.148	Electronic Locking Devices shall be capable of being activated from either the RRE (Remote Reader Electronics) or the Access controller.
Sirens/Strobes	
TR 9.149	The system shall include sufficient interior alarm sirens to provide an audible alarm warning throughout the protected space; more than one siren may be required.
TR 9.150	The Siren shall be made from a tough polycarbonate housing and shall be weatherproof.
TR 9.151	An LED indicator unit shall be built into the Siren to act as a visible deterrent and indication that the system is active. The LEDs will slowly and alternately flash whether the system is Armed or Disarmed.
TR 9.152	When an alarm occurs the LEDs shall flash rapidly together.
TR 9.153	The tamper switch shall be present which shall trigger an alarm if any attempt is made to remove or interfere with the Siren.
Workstation	
TR 9.154	Please refer to the Workstation specification as mentioned under IT Infrastructure Section 2.2.11.1.
Integration Interface	
TR 9.155	Integration provision such as gateways, SDK/API shall be provided for integration with Building Management System (BMS) for integrated monitoring and control of Access Control System along with other building utilities.
TR 9.156	Integration shall take place through open building automation protocols such as BACnet IP, Lonworks, Modbus or TCP/IP.
TR 9.157	Via integration with BMS, access control shall also have the capability to leverage building’s CCTV surveillance system for pro-active monitoring of the building.
TR 9.158	Access Control system shall be interfaced with HR Management System of the designed ERP system for attendance registration and work-time calculations.
Electrical	
TR 9.159	The device shall be powered by 220-240VAC/50Hz or 12/24/48VDC input as per the design requirements.
Communications	
TR 9.160	All interfaces within the Access Control System shall be based on TCP/IP network protocol connectivity over the corporate intranet/ internet/ LAN/WAN.

TR 9.161	The hardware shall support open architecture. Communication protocols shall be available to system integrators and software development companies in order to protect Client from being constrained to a single brand of hardware or software.
Environmental	
TR 9.162	The device shall support operating temperature range of 10°C to +40°C.
Reliability	
TR 9.163	The Access Control System shall have a MTBF of at least 100,000 hours.

2.2.10 Solar Panel with Batteries

2.2.10.1 Pole Mounted Solar PV Module

Overview

The solar PV module shall include solar panel, controller, batteries, etc and shall provide the primary power to all field devices (i.e. ruggedize switches) mounted on the existing streetlight pole, as required to support the power connectivity needs of this Project. Solar PV module shall be installed at all streetlight poles that have co-located field equipment.

BR - 10 Business Requirements

BR 10.1	The solar PV module shall be used to fulfil the independent power requirement of field devices with battery bank and network switch mounted on streetlight pole as required.
BR 10.2	All field equipment mounted on streetlight poles and kiosks, and provided as part of this Project shall use solar panel as primary source of power. The raw power shall act as a backup in-case the solar panel is not able to meet the performance requirements because of limited availability of sunlight.
BR 10.3	The capacity of batteries required shall be calculated based on the equipment load and run-time.
BR 10.4	The vision is that some of the field equipment like switch and Wi-Fi AP can be covered with the solar PV module installed at the streetlight pole. The idea is that the solar panel can be used to hide these equipment from human eye.
BR 10.5	Since the primary source of power to field switch and other equipment will be solar, all power conversions and ensuring the respective field switches and equipment can be powered by solar will be factored in while proposing the respective equipment.
BR 10.6	At all points where solar will be the primary power, secondary source of power will be raw power. The solar PV module shall ensure that there is seamless transfer between solar power and raw power for every connected equipment without any damage to the equipment or any downtime.

FR - 10 Functional Requirements

FR 10.1	The solar panel shall have crystalline silicon high power solar cells and must have a certificate of testing conforming to IEC 61215 Edition II/ IEC 61730/ TUV Safety Class-II/ BIS 14286 from an NABL (National accreditation board for testing & calibration laboratories) or IECQ (International Electro-technical Commission Quality Assessment System for Electronic Components) accredited Laboratory.
FR 10.2	The module efficiency shall not be less than 14 %.
FR 10.3	The module should be supplied with screw less hollow section frame and should have limited extended warranty of minimum 25 years.
FR 10.4	The terminal box on the module shall be designed for long life out door operation in harsh environment and shall have a provision for opening for replacing the cable, as required.
FR 10.5	The Battery shall be Lithium Ion (Lithium Iron Phosphate $LiFePO_4$) maintenance free C-10, specifically tested for solar applications, with a minimum rating of 12V/ 24V at

	C-10 discharge rate and shall conform to the latest BIS/ International standards and must have a certification of CE, RoHS & UN 38.3. The battery shall be in an isolated and waterproof casing with IP56 protection and have a minimum calendar life of 10 years.
FR 10.6	Any left out specification for the Solar PV widget shall be as per the latest MNRE Guidelines for off-grid and decentralized solar applications.
FR 10.7	Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.
FR 10.8	All components (Solar panel, batteries, switching unit and solar controller) must match each other in terms of voltage and intensity of current, and shall be compatible with each other.

TR - 10 Technical Requirements

TR 10.1	The Solar PV module shall be as per the configuration specified below: • Type of cell: Mono/ Multi crystalline silicon • Front Face: Tempered Glass (Low Iron) • Encapsulate: Ethylene Vinyl Acetate • Frame: Anodized Aluminium • Cell Temperature: 25^0C • Irradiance: 100 mW/cm^2 AM 1.5Power (Pm) (nominal): As per the design requirements
TR 10.2	Protective devices against surges at the PV module shall be provided. Low voltage drop bypass diodes shall be provided and if required, blocking diode(s) may also be provided.
TR 10.3	The PCB containing the electronics should be capable of solder free installation and replacement.
TR 10.4	Depth of discharge (DOD) of battery shall be minimum 95% i.e., 95 % of the rated capacity of the battery should be between fully charged and load cut off conditions. MSI shall mention the design cycle life of batteries at 100% and 80% depth of discharge (DOD) at ambient temperature upto 40^0C.
TR 10.5	Battery shall have minimum 2000 cycles at 100% DOD & 3000 cycles at 80% DOD.
TR 10.6	The self-discharge of the batteries shall be less than 3% per month at 20^0C and less than 6% per month at 30^0C.
TR 10.7	Battery shall have minimum backup of 6 hours.
TR 10.8	Any cabinet provided as part of the PV module shall be a vented, acid proof and corrosion resistant powder coated metallic cabinet (IP 55 rated) made of CRCA sheet of 2 mm thickness with lockable arrangements. The cabinet shall be supplied with suitable mounting arrangement on pole.
TR 10.9	The system shall have two indicators, green and red. The green indicator shall indicate the charging under progress and should glow only when the charging is taking place. It shall stop glowing when the battery is fully charged. Red indicator shall indicate the battery “Load Cut Off” condition.

2.2.11 IT and Other Common Infrastructure

IT Infrastructure

2.2.11.1 Operator Workstations

The operator workstations shall be specifically installed for the operators at the command and control centre. Other than this, there will also be a need to provide regular workstations. The specification for all the workstations (including operator workstation) shall be common. The only difference between an operator workstation and a workstation shall be that for an operator workstation, the workstation unit will be installed at the rack room.

TR - 11 Technical Requirements

Workstations	
TR 11.1	The workstations shall have a wireless optical mouse with USB connection complying with FCC and CE norms.
TR 11.2	The workstation shall be Energy star 5.0/BEE star certified.
TR 11.3	The workstations shall have a 107 Quiet Key English wireless keyboard with USB connection.
TR 11.4	Keyboards, Mouse and accessories shall be connected via respective signal extender as required.
TR 11.5	Workstation shall have a standard audio sound card and speakers.
TR 11.6	The workstations shall have an Intel Core i7–3770, quad core processor with 3.40 GHz or better or equivalent 64 bit x 86 processor.
TR 11.7	The workstations shall have at least 8 GB DDR3 memory @ 1600 MHz.
TR 11.8	The workstations shall have a min. of 4 DIMM slots supporting upto 32GB ECC. One DIMM Slot must be free for future upgrade.
TR 11.9	The workstations shall have a min. 1 TB SATA III hard disk @ 7200 RPM or higher.
TR 11.10	The workstations shall have shall a colour LED monitor of minimum 21” diagonal non-glare screen and a dual AMD Radeon HD 7470 full height video adapter with VGA, DVI, and HDMI ports or better.
TR 11.11	The workstations shall have graphic accelerator of ATI Rage Pro/AGP graphics accelerator, 4 MB SDRAM.
TR 11.12	The graphics card shall have a minimum resolution of 2560 x 1440 with 5ms response time or better specifications.
TR 11.13	The workstations shall have a DVD multi burner and Dual Layer DVD-RW as an internal optical drive or better.
TR 11.14	The workstations shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows 8 or better.
TR 11.15	The workstations shall have at the minimum ports: 1 serial, 6 USB 2.0 or higher with 2 in the front, integrated autosensing RJ-45 network interface, and Line-In/Mic In and Line-out/speaker Out (3.5 mm) audio in/out jacks.
TR 11.16	The workstations shall have an expansion bus of 3 PCI Slots; 4 ISA Slots (3 slot shared).

TR 11.17	The workstations shall have Microsoft Office Professional and Antivirus.
TR 11.18	Other pre-loaded software (open source/ free) shall be Latest version of Adobe Acrobat Reader, Scanning Software (as per scanner offered). These software shall be pre-loaded (at the facility of OEM or any other location) before shipment to Authority offices/locations.
TR 11.19	The AC input power shall be 230 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 11.20	The workstations shall have a dual port 1 Gbps Ethernet network interface card.
TR 11.21	The workstation shall be operational in temperature between ten degrees Celsius (10°C) to thirty degrees Celsius (30°C).
TR 11.22	The workstation shall be loaded with advanced antivirus, antispyware, desktop firewall, intrusion prevention (comprising of a single, deployable agent) which can be managed by a central server.

2.2.11.2 Communication Cabinets with Racks

FR - 11 Functional Requirements

Communications Cabinets with Racks	
FR 11.1	The cabinets shall be installed inside the POP rooms and ACC.
FR 11.2	The cabinets shall be capable of accommodating all the network devices to support the design requirements.
FR 11.3	All cabinets shall be designed to carry the anticipated load of all equipment that shall be installed inside the cabinet including having at least 30% spare capacity per rack.
FR 11.4	All cabinets shall be provided with standard accessories including vertical and horizontal cable manager, lights, fans, and power bars as needed to support the design requirements of this Project.

Technical Requirements

Communications Cabinets with Racks	
TR 11.23	The cabinets shall be capable of accommodating all the network devices to support the design requirements and shall include at least size 42U racks.
TR 11.24	All cabinets shall be supplied with standard 19” wide rack mount assemblies that shall allow for mounting of standard rack-mount equipment.
TR 11.25	All cabinets shall be supplied with standard lockable doors.
TR 11.26	The cabinets shall be IP55 rated.
TR 11.27	All cabinets shall have provision for cable entry from top & bottom of rack with knock-off, pre-punched marked openings.
TR 11.28	All cabinets shall have vertical cable managers in front with suitable accessories on each side of the rack with covers for concealed wiring within the rack.
TR 11.29	Front door shall be made of Tinted toughened glass and should be lockable.

TR 11.30	All cabinets shall have equipment mounting frame (rail notches) for mounting of equipment.
TR 11.31	Shelves for equipment placement shall be provided as required.
TR 11.32	All cabinets shall be designed to carry the anticipated load of all equipment that shall be installed inside the cabinet with at least 30% spare per rack.
TR 11.33	All cabinets shall be provided with standard accessories including vertical and horizontal cable manager, lights, fans, and power bars as needed to support the design requirements of this Project.
TR 11.34	The rack shall have ventilation louvers or uniform perforations on side panel & rear door & equipment cooling with fans (4nos.) housed in fan trays.
TR 11.35	Two strips each with minimum 8 numbers of 5A/15A, 230 VAC power outlets with MCB, inbuilt surge suppressor & line filter for conditioned power output shall be provided.
TR 11.36	The device shall support operating temperature range of 5°C to +40°C.
Outdoor Enclosure (as needed)	
TR 11.37	Minimum 6RU weather proof NEMA 4X/IP65 compliant UV resistant outdoor metallic enclosure in conformance with DIN 41494.
TR 11.38	Vandal proof design with single side door and with minimum IP 55 compliant industrial lock.

2.2.11.3 Servers

Technical Requirements

TR 11.39	Servers will be provided to support local processing and storage as per the requirements of this RFQ cum RFP.
TR 11.40	A sufficient number of physical servers shall be provisioned such that their CPU, RAM, and other key server component performance do not individually exceed 50% utilization individually.
TR 11.41	The MSI shall provision sufficient amount of storage to support the operational needs. The storage on-site shall be for at least 30 business days post which the storage can be migrated to cloud otherwise detailed in the RFQ cum RFP.
TR 11.42	The server shall have Dual Processor Intel Xeon E5-2600 Series or better.
TR 11.43	The server shall have 8 GB of RAM and 3 TB of storage. The memory shall be scalable to double the capacity configured.
TR 11.44	The server shall include a Network Controller, 2 Gigabit Server Adapters with TCP/IP Offload Engine one standalone and one embedded on the motherboard.
TR 11.45	The Server shall include (6) PCI-Express x4 and (2) PCIe interfaces 64-Bit/133MHz.
TR 11.46	The Server shall include at least 5 - USB 2.0 or higher (preferable) compatible ports.
TR 11.47	The Server shall include 2-Hot plug redundant power supplies and cooling fans.
TR 11.48	The Server shall have an Optical Drive 48x SATA CDRW/DVD Combo Internal Drive.

TR 11.49	The Server shall include 1 Serial port and 1 VGA (+1 front VGA on rack models).
TR 11.50	The Server chassis shall be rack mountable and include rack mounting hardware.
TR 11.51	The Server shall include a RAID 5 storage controller supporting up to (8) hot-plug Serial-attached SCSI (SAS) drives.
TR 11.52	The Server shall include hard drives based on volume of data to be stored. The transaction data storage requirements shall be estimated based on total transactions & related calculations as per the functional requirements.
TR 11.53	The Operating System shall be Licensed version of 64 bit latest version of Linux/ Unix/Microsoft® Windows based Operating system.
TR 11.54	Suitable commercial off-the-shelf antivirus software shall be provided for the duration of the contract.
TR 11.55	The central system server shall have a hot standby to mitigate any risk of failure in central system which halts the system performance.
TR 11.56	Server shall be designed to provide a fully redundant and fault tolerant system and shall be available for 99.99% or greater. The unscheduled down time shall be less than 0.01%.
TR 11.57	Server shall be provided with the link load balancers as needed to optimize the overall IT infrastructure operations.
Link Load Balancers	
TR 11.58	Link Load Balancers shall be appliance based solution with minimum 64 bit speed core architecture and purpose built hardware for overall high performance. It shall have a minimum of 64 GB RAM and at least 8x10G SFP+ ports. It shall have minimum of 120 Gbps throughput. Shall support security features like reverse-proxy firewall, sync-flood and denial of service attack protection from day one. It shall support multiple Internet links in active-active load balancing and active-standby failover mode.
TR 11.59	Link Load Balancers shall support built-in failover decision/health-check conditions. It shall also support failover and High Availability (HA) requirements. It shall have redundant power supplies. Shall support script based functions support for content inspection, traffic matching and monitoring of HTTP, SOAP, XML, diameter, generic TCP, TCPS.
Server Load Balancers	
TR 11.60	Server Load Balancers shall be multi-tenant hardware with multicore CPU support. It shall support minimum four (4) virtual instances and shall be scalable to 16 instances on the same appliance. Shall have minimum of 10 Gbps of system throughput for atleast one of the virtual instance to support multiple load balancing and security functions. Shall have minimum of 8x10G SFP+ interfaces from day one. Shall have security features like reverse-proxy firewall, sync-flood and denial of service attack protection from day one.
TR 11.61	Server load balancers shall support script based functions support for content inspection, traffic matching, and monitoring of HTTP, SOAP, XML, diameter, generic TCP and TCPS.

Other Common Infrastructure

2.2.11.4 Uninterruptable Power Supply (UPS)

Overview

The UPS unit shall be provided at each POP rooms and ACC rooms (Command and Control Centre and Rack Room) to backup entire AITL devices & switches, emergency lights and Fire detections system. UPS system shall provide a redundant power supply to the following needs:

- Servers and important network and storage equipment;
- Access control, Fire Detection & suppression system and surveillance system.

BR - 11 Business Requirements

BR 11.1	The UPS unit shall be provided with external batteries as needed to support the run-time requirements.
BR 11.2	All AITL equipment installed at POP and ACC shall be connected on the UPS.
BR 11.3	The quantity of batteries required for the UPS, shall be calculated based on the equipment load and run-time.
BR 11.4	The UPS units shall provide backup power to critical load. In addition, UPS shall also provide cleansed power to these equipment.

Functional Requirements

FR 11.5	The UPS unit shall be 3:1 Phase on-line UPS with extendable rack system.
FR 11.6	The UPS design shall ensure that a single component/ device failure shall not result in failure of the entire UPS system. The design of UPS System shall be modular to permit easy maintenance.
FR 11.7	The various overload capacities of inverters, static switch, and step down transformer/voltage stabilizer as specified herein are the minimum requirements.
FR 11.8	The UPS system to be supplied by the MSI shall have maximum humming noise level of 65 DB one meter away from the UPS cabinets. This shall not exceed 69 dBA measured 5 feet from surface of the UPS.

Technical Requirements

TR 11.62	The MSI shall provide the calculations to support the UPS rating and number of batteries as part of the Bid submission. UPS shall be provided as N+1 redundant configuration.
TR 11.63	The UPS unit shall include Valve Regulated Sealed Maintenance Free Lead Acid Batteries shall be used with a 20 hours discharge rating with a typical lifetime of five (5) years and minimum reserve time of four (4) hours under full load conditions. The battery system design shall be provided with necessary devices to prevent deep discharge beyond recommended limits to prevent the batteries discharging beyond

	end cell voltage specified by the battery maker. The connections from battery to battery shall be by using copper bus bar strips.
TR 11.64	The UPS unit shall provide an output of 230V AC 50 Hz. If the rating of UPS increases above 15KVA at particular location, it should be consider as 3:3 phase UPS and specification should be considered accordingly. If the rating is below 15KVA, it remains as 3:1 phase UPS. The MSI shall be responsible for any conversions needed to support this output configuration.
TR 11.65	The UPS and batteries shall be mounted in a separate cabinet & the enclosure shall be under lock & key, utilising the minimum possible space and arranged in an aesthetic manner.
TR 11.66	The UPS shall be of True online with double conversion topology. It shall support an output power factor at full load as 1.
TR 11.67	The UPS shall have a microprocessor-based unit status and control display with the status and alarm indicators displayed on the status LED indicator and LCD display.
TR 11.68	The UPS unit shall have load level indicators that display the approximate electrical load placed upon the UPS. The UPS unit shall have a row of battery level indicators that display the approximate battery capacity.
TR 11.69	The UPS shall have self-diagnostic functionality to detect any failure/fault in the UPS system and shall display the same on the LCD display of the UPS.
TR 11.70	The UPS unit shall have a minimum of the following LED indicators: UPS Mode: On-line, Backup/Battery and Bypass; Over Load Indicator: This will display when UPS is running on overload; Battery Status Indicator: This will illuminate when battery is low or faulty/disconnected; and System Fault: This will illuminate when there is some fault or interruption in UPS.
TR 11.71	The UPS unit shall have minimum of the following audible alarms: Line Failure: This will be audible when required input electrical supply to UPS is not available; Battery Low: This will be audible when battery voltage falls below the threshold value; Bypass Mode: This will be audible when UPS is running on bypass mode; and System Fault: Audible alarm will be generated when any fault is detected in the UPS system.
TR 11.72	The UPS unit shall have following readings on the LCD panel as minimum: Voltage and frequency Levels: This shall display input and output voltage and frequency levels; Battery Voltage: This shall display battery voltage in Volts; Load: This shall display the load connected in percentage to the UPS output; and Temperature: This shall display the internal temperature of UPS unit for overheating.
TR 11.73	The UPS unit shall include full-time protection from sudden voltage increase with inrush protection and AC line filtering.
TR 11.74	UPS shall provide an overload alarm and circuit breaker designed to operate at an overload of 200% surge.
TR 11.75	The UPS unit shall include Ethernet communication port to support remote management and monitoring capabilities using SNMP including alarm contacts and

	remote shutdown. Remote monitoring and testing software shall be included. The manufacturer shall provide all SNMP traps.
TR 11.76	The UPS unit shall be capable of starting without input power. The unit shall start up and operate from the battery, with output frequency same as the last operating frequency.
TR 11.77	The UPS unit shall include automatic restart. Upon restoration of utility AC power after complete battery discharge, the UPS shall automatically restart and resume operation.
TR 11.78	The UPS unit shall be enclosed to prevent accidental contact with energized parts.
TR 11.79	The UPS unit shall have a built-in input fuse and/or a circuit breaker for protection from over voltage and current variations.
TR 11.80	The UPS unit shall provide an over voltage shutdown and shall have overvoltage protection.
TR 11.81	The UPS unit shall provide short circuit shutdown protection.
TR 11.82	External battery charger (if required) for the specified battery bank shall be provided. The battery charger shall automatically recharge the battery.
TR 11.83	The external battery charger shall be provisioned to be mounted in the cabinet or UPS itself. Except this, no separate space will be provided for mounting of the external charger.
TR 11.84	The UPS unit shall be compliant to IEC 62040-1 safety standards as a minimum.
TR 11.85	The UPS system shall have an operating temperature of 0 degrees to 40 degrees C.
TR 11.86	Any field UPS system (as per MSI's design) shall be supplied with an environmentally rated cabinet for installation of the UPS and batteries. The cabinet shall have a rating of IP 55. The cabinet shall be supplied with in-built fans and proper ventilation as needed to ensure that the temperature inside the cabinet does not exceed 40 degrees C at any given point in time.

2.2.11.5 Data Security

The smart city network architecture shall adopt an end-to-end security model that protects data and infrastructure from malicious attacks, thefts, natural disasters, etc. The architecture shall be implemented in such a way that the system is protected from hackers and other threats. The data security system shall address security policies, hardware and software, along with the connectivity between the field device and the respective application.

Note that the client at its discretion may have the authority to carry a security audit of the entire system during the course of the Project or post implementation at regular intervals.

Functional Requirements

Functional Requirements	
FR 11.9	An end-to-end data security system shall be provided for strong and reliable security for the entire fibre infrastructure, active electronics, Wi-Fi system, surveillance system, and other field equipment, software and hardware.
FR 11.10	Overall, the IT architecture shall refer to the architecture suggested by National Institute of Standards and Technology (NIST) and CSA's (Cloud Security Alliance) Cyber Security Guidelines for Smart City Technology Adoption.

FR 11.11	Firewall shall be implemented to ensure network security of the complete system.
FR 11.12	Security services used to protect the overall solution shall include: identification, authentication, access control, administration and audit, as per industry standards and protocols.
FR 11.13	System shall support advanced user authentication mechanisms including digital/e-certificates, biometric authentication, e-signatures, etc. and shall have compliance with all state level and national level initiatives.
FR 11.14	Security design shall support industry standards based identity management system, security of physical and digital assets, data and network security, backup and recovery, along with disaster recovery system.
FR 11.15	The system shall be capable of detecting denial of service (DDoS) and remediation.
FR 11.16	The system shall include industry standards based firewall and antivirus, and shall provide content filtering, tracking, lockdown, and malware detection and prevention capabilities.
FR 11.17	The MSI shall ensure that the security policy is maintained and updated as per the latest industry standards including ISO 27001, BS 7799 and BS 15000 guidelines.
FR 11.18	Message exchange between various applications should be fully encrypted and authenticated. Any applications hosted on cloud should talk to the applications hosted on cloud only through predefined APIs.
FR 11.19	All applications hosted on cloud should support multi-tenancy with adequate authentication, encryption and role based access control mechanism.
FR 11.20	All communications to the devices and their respective management applications shall happen through the Project specific network. Adequate security checks to protect the data shall be implemented as part of the overall data security.
FR 11.21	Any wireless sensors implemented as part of the Project shall only communicate to authorized wireless networks and shall not connect to rogue networks. This shall be in compliance with the guidelines as published by Department of Telecom (DoT).
FR 11.22	Wireless layer of the network shall be segmented for public use and for city utilities by using VPN or separate networks in the wired core.
FR 11.23	All traffic from city equipment/sensors to the application servers shall be encrypted Secure Socket Layer (SSL) and authenticated prior to sending any information. The data at rest or in transmit must be encrypted.
FR 11.24	All authentication of sensors in the network shall happen at the time of implementing the sensors and adding them to the system and shall be based on physical characteristics of sensors like MAC ID, Device ID, etc.
FR 11.25	The field equipment shall not have any physical interface for administration. Monitoring of systems and networks shall be undertaken remotely.
FR 11.26	The POP facilities shall have the following – firewall, intrusion detection and intrusion prevention systems, web application firewalls, behavioural analysis systems for anomaly detection, correlation engine, denial of service prevention device, advanced persistent threat notification mechanism, etc.
FR 11.27	All applications implemented as part of the Project shall undergo static and dynamic security testing before implementation and shall be continuously tested with respect to security on a regular basis at least once a year.

FR 11.28	All information that flows on the network should be encrypted to ensure safety and privacy of confidential data. The devices at each endpoint of the network should be authenticated (using mechanisms based on attributes like passwords).The authentication system used on these endpoint devices shall ensure that only authorized users are sending data over the network and there is no rogue data that is sent to the control systems to generate false alarms or sabotage the systems.
FR 11.29	Care shall be taken while transmitting confidential information over public networks to other government agencies with a prior permission from the concerned authority.
FR 11.30	Confidential information not being actively used, when stored or transported in computer-readable storage media (such as magnetic tapes or CDs), shall be stored securely under lock and key.
FR 11.31	Unauthorized disclosure of data shall be protected when computers are sent out for repair or used by others within or outside ACC and the data could be deleted. All data stored on hard disks shall be backed up and erased via user-transparent processes.
FR 11.32	All the internet activity shall be logged and monitored, and appropriate network devices shall be deployed so that access controls and related security mechanisms could be applied.
FR 11.33	Any system attacks should be well defended at device level and overall system level and shall include anti-virus mechanism. All system logs shall be properly stored and archived for future analysis.
FR 11.34	Data Security System shall be able to provide a complete network management for the Client. It shall monitor and report the performance, utilization, status, vulnerabilities and failures in the network in real time. It shall also monitor and manage access control and policy, security breaches and shall prevent detects and attacks on the network.
Data Integrity:	
FR 11.35	Data integrity must be ensured with a high level of requirement.
FR 11.36	Stability of data over time and in the procedures of physical media data shall be guaranteed and the protection of data content shall be ensured.
FR 11.37	Audit Trails: The application shall allow the management of compliance audit following the international standards for as appropriate for a Smart City.
FR 11.38	All acts of creation / modification / deletion must be registered with user identification and time stamp. Additionally, there must be an auditable trace of user sign-on and user sign-off with details of IP Address, Date, Time etc. The records must be accessed using specific and legible statements irrespective of the programming language.

Technical Requirements

Firewall	
TR 11.87	Firewall shall consist of stateful firewall and stateless filters.
TR 11.88	Firewall shall have the capability for proactive network attack detection.
TR 11.89	Firewall shall prevent replay attack.

TR 11.90	Firewall shall have min. 6 10/100/1000 Base-T GE ports; 4 x 10G SFP+ ports and shall be expandable as required.
TR 11.91	Firewall shall have a unified access control with functionalities such as: • TCP reassembly for fragmented packet protection • Brute force attack mitigation • SyN cookie protection • Zone based IP spoofing • Malformed packet protection
TR 11.92	Firewall shall have an Intrusion Prevention System (IPS) with following features: Stateful Operation: • TCP Reassembly • IP Defragmentation • Bi-directional Inspection • Forensic Data Collection • Access Lists Signature Detection: • Customer signatures creation • Custom signatures • Dynamic signature update • Automatic signature sync Alerts and updates: • Alerting SNMP • Log File • Syslog • E-mail • Daily and emergency updates Security Maintenance: • 24/7 Security Update Service • Real-time and History reports of Bandwidth usage per policy • Protocol anomaly detection • IPS attack pattern obfuscation • User role based policies • User based application policy enforcement • Provision for external bypass switch
TR 11.93	Firewall shall have a file-based antivirus with following feature: • Antispyware • Anti-adware • Anti-keylogger • Anti-malware • Antivirus • Anti-spam • Scanning of OP3, HTTP, SMTP, IMAP, FTP protocols

	• Signature database • Integrated enhanced web filtering • Content filtering – based on MIME type, file extension and protocol commands • Redirect web filtering
TR 11.94	Firewall shall have following user authentication capabilities: • Third party user authentication: RSA secure ID, LDAP, RADIUS • RADIUS accounting • XAUTH VPN, Web based, 802.X authentication • PKI certificates
TR 11.95	Firewall shall have the following additional capabilities: • VPN functionalities with 2000 simultaneous VPN tunnels • Encrypted throughput: minimum 800 Mbps • Concurrent connections: up to 100,000
Antivirus	
TR 11.96	Antivirus shall be able to detect and block malicious software in real time, including viruses, worms, spyware, Trojan horses, adware, and Rootkit etc. It shall provide zero-day detection technology.
TR 11.97	Antivirus shall protect the system from multiple forms of anomalous network behavior that is designed to disrupt system availability and stability.
TR 11.98	Antivirus shall be able to identify infections by name, category, severity, hosts and user etc.
TR 11.99	Antivirus shall be able to report Bot incidents by specific malicious activity (spyware, IP scanning, spam etc.). The antivirus shall have built in intelligence and co-relation capability to inspect, detect and block active and dormant bots.
TR 11.100	Antivirus shall be able to block devices based on Windows Class ID. Devices shall include USB, Infrared, Bluetooth, Serial Port, Parallel Port, Fire Wire etc. Antivirus shall block or give permissions for such devices.
TR 11.101	Antivirus shall protect transmission of data being sent to hacker system who has spoofed their IP or MAC address.
TR 11.102	Antivirus shall scan email traffic including email client like Outlook.
TR 11.103	Antivirus shall include content filtering and data loss prevention.
TR 11.104	Antivirus shall have features to prevent peer to peer sharing, streaming media, games and other applications from internet.
TR 11.105	Antivirus shall have built in URL filtering.
TR 11.106	Antivirus shall provide standard and customised reports.

2.2.11.6 Databases

Any commercially available database like Oracle/Informix/MS SQL /DB2 shall be provided along with license and support and upgrade costs.

Functional Requirements

Databases	
FR 11.39	Database License should be un-restricted and perpetual, to prevent any non-compliance in an event of customization & integration.
FR 11.40	Databases shall support multi hardware platform.
FR 11.41	Database shall provide standard SQL Tool for accessing the database. The tool should be able to monitor, maintain and manage the database instance, objects, and packages.
FR 11.42	Database shall have built-in backup and recovery tool, which can support the online backup.
FR 11.43	Database shall be able to provide database level storage management mechanism, which should enable the availability by means of creating redundancy, automatically balance the data files across the available disks, i/o balancing across the available disks for the database for performance, availability and management.
FR 11.44	Database shall support for central storage of data with multiple instances of database in a clustered environment access the single database/multiple database.
FR 11.45	Should be an enterprise class database with the ability to support connection pooling, load sharing and load balancing when the load on the application increases.
FR 11.46	Database shall provide native functionality to store XML, within the database and support search, query functionalities.
FR 11.47	Database shall have built-in DR solution to replicate the changes happening in the database across DR site with an option to run real-time reports from the DR site without stopping the recovery mechanism.
FR 11.48	Database shall have Active-Passive failover clustering with objectives of scalability and high availability.
FR 11.49	Database shall provide mechanism to recover rows, tables when accidentally deleted. The mechanism should provide ways and means of recovering the database.
FR 11.50	Database shall provide functionality to replicate / propagate the data across different databases.
FR 11.51	Ability to add nodes to cluster with no downtime with-out unloading/reloading data.
FR 11.52	The RDBMS should support partitioning feature in table level object.
FR 11.53	Database shall provide native functionality to store XML, Images, Text, Medical Images, CAD images within the database and support search, query functionalities.
FR 11.54	Database shall include tools for enterprise class high availability solution like monitoring performance, diagnose and alert for problems, tuning bottlenecks, resource monitoring and automatic resource allocation capabilities.
FR 11.55	RDBMS must support the SQL queries or latest applicable standard for queries.

FR 11.56	Database shall provide security mechanism at foundation level of the database, so that the options and additions to the database confirm the security policy of the organization without changing the application code. Shall confirm to security evaluations and conformance to common criteria.
FR 11.57	Database shall provide control data access down to the row-level so that multiple users with varying access privileges can share the data within the same physical database.
FR 11.58	Database shall support for enhanced authentication by integrating tokens and biometric technologies.
FR 11.59	Database shall provide functionality for classifying data and mediating access to data based on its classification for multi-level security and mandatory access control, manage access to data on a "need to know" basis.
FR 11.60	Database shall be having native auditing capabilities for the database. Should support optional Audit Capability to store the audit records in separate audit store with monitoring & reporting for multiple databases to detect any security breaches.
FR 11.61	Database shall be having built-in provision to Administer database / database clusters, Monitor performance, Maintain database, Backup and recovery, Recovery management, Disaster recovery management.
FR 11.62	The Management tool should provide advisory-based performance tuning tool which help to tune the queries or objects, SQL analysis, SQL access.
FR 11.63	The enterprise database should provide single web-based console for management of the database.
Restart and Recovery	
FR 11.64	Availability of recovery/restart facilities of the DBMS.
FR 11.65	Automated recovery/restart features provided that do not require programmer involvement or system reruns.
FR 11.66	Program restart should be provided from the point of failure.
FR 11.67	Ability to manage recovery/restart facilities to reduce system overhead.
FR 11.68	Provides extra utilities to back up the databases by faster means than record by record retrieval.
FR 11.69	Provides clear error reporting, recovery and logging.
FR 11.70	Describe recovery strategies that needs to be in place.
FR 11.71	System should support mirroring for DRP.
Backup Procedures	
FR 11.72	Describe Backup Procedures you plan to deploy.
FR 11.73	Describe backup application(s) your proposed solution use.
FR 11.74	Provide details of data backup and restore processes and procedures for all data elements.
FR 11.75	Provide details of automated archiving procedures to copy active data to storage media when archive 'age' is reached.

Error Handling	
FR 11.76	Ability to trap a transaction failure through: • Application Software • DBMS • Availability of manual containing all system error messages and correction procedures
System Control	
FR 11.77	Provide details of the 'Audit trail' facility for your proposed solution.
FR 11.78	Should provide adequate auditing trail facility.
FR 11.79	System should record the date and time stamp for all records.
FR 11.80	Ability to track terminals from where the system is accessed.

2.2.12 Hosting – On-Premises and Cloud

The hosting requirements of the project shall be met via a hybrid architecture that includes:

- On-premises; and
- On-Cloud.

Overall, the objective of this architecture is to optimize the number of on-site servers without compromising the overall performance of the system. AITL through a cloud service provider shall provide the hosting infrastructure i.e. servers with OS for hosting all applications and services that will be implemented on-cloud. The following indicative systems are envisaged to be hosted on-cloud:

- ERP;
- E-Governance;
- Smart City Platform (Historian);
- Solid waste management, CAD and all AVL systems;
- Environmental Sensors.

For the above mentioned system, the Bidders may propose any additional servers required for local processing and storage as per the respective solution as part of the Bid. Apart from the above mentioned systems, all other systems are expected to be hosted on-site. For all hosting on-site, the MSI will provide the required infrastructure as part of the project. The server specifications for the hosting infrastructure on-site can be found under section 2.2.11.3 covered as part of the IT Infrastructure.

As part of the Bid submission, the Bidders shall provide detailed hosting requirements in terms of servers and storage that will be required for hosting the respective applications and services on-cloud. In addition, the Bidders shall also provide details on the bandwidth requirement of the connectivity link required between Shendra and the respective cloud service provider facility.

MSI is required to provide an overall solution meeting the below mentioned minimum requirements for various applications. It is expected that all applications for on-cloud hosting shall support cloud ready architecture.

Application	High Availability/ Clustering	Single sign on	Back up	DR (minimum production capacity)	RTO	RPO	Expected Response Time in Seconds
ERP	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	3
E-Governance functionalities	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	3
Portal	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	2
Website	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	2
DMS	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	3
Kiosk Software	No	No	Yes	Yes (Min 50%)	60 Mins	15 Mins	2
Mobile Apps	No	No	Yes	No	60 Mins	15 Mins	3
Smart City Platform (historian data)	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	2

Application	High Availability/ Clustering	Single sign on	Back up	DR (minimum production capacity)	RTO	RPO	Expected Response Time in Seconds
CAD and AVL Software	No	No	Yes	Yes (Min 50%)	60 Mins	15 Mins	3

Application	High Availability/ Clustering	Single sign on	Back up	DR (on-site)	RTO	RPO	Expected Response Time in Seconds
Smart City Platform	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	3
CCTV Surveillance	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	3
Any other Application deployed on-site	Yes	No	Yes	Yes (Min 50%)	60 Mins	15 Mins	3

2.2.13 AURIC Control Centre (ACC)

Overview

AURIC Control Centre (ACC) will be the 'nerve-centre' of AURIC city that will assist in enhancing efficiencies of city operations and management. ACC will help in making the city operations intelligent, integrated and efficient.

ACC leverages information provided by multiple city systems, which further helps in providing an integrated, seamless, proactive and comprehensive response mechanism for day-to-day city operations and challenges. It includes the city command and control centre with the necessary hardware and software to support city operations. An essential feature of the ACC is a smart city platform which is a combination of system layers that when combined make use of Big Data, ICT and other infrastructure, advanced computing, analytics, and visualization to enhance a city's intelligence while normalizing the data. In addition, it provides a tool for the city to better manage the services it provides to its citizens.

Note that the OEM of the smart city platform shall comply with the following requirements:

- OEM shall be a publicly listed company with a registered office in India.
- OEM should have minimum 500 employees on company payroll.
- OEM should have ISO-9001 quality certification.
- OEM should have 24x7 technical assistance support in India. Support should be through online website and phone number for registering service request.
- OEM should provide online developer program tools that help city produce new applications and/or use solution APIs to enhance or manage existing solution.
- OEM proposed solution shall be implemented across at least 3 places globally.

There are a number of functions and systems that will be managed out of the ACC. Depending on the type of system and the respective functions, they may be monitored and/or controlled from the ACC, and will have the option of sharing a feed to another agency as required via the ACC. Note that the electrical, street lighting, water and wastewater systems will be provided by Others and have been explained as part of other sections of this RFQ cum RFP. These systems will be SCADA based using their respective individual system deployments and will only be integrated at the ACC for critical alarms and functionality. It is not expected that there is an entire duplication of these systems for the purposes of monitor and control at the ACC.

System	Monitor	Control	Feed sharing (External)
Electrical system including metering	✓	✓	
Street lighting	✓	✓	
Water (including metering) and Wastewater	✓	✓	
Solid Waste Management	✓	✓	
Environmental Sensors	✓	✓	
City Surveillance	✓	✓	
Emergency Communications		✓	
Fire	✓		✓
Police (CCTV)			✓
Ambulance and other Vehicles	✓		
e-Governance	✓	✓	

System	Monitor	Control	Feed sharing (External)
ICT infrastructure – Wired & Wireless	✓	✓	
Facilities management – AITL building	✓	✓	
Facilities management – Non-AITL buildings (BMS)	✓		
Transit & Traffic Management (Future)	✓	✓	✓
Education	✓		
Healthcare	✓		
Kiosks	✓	✓	

A high level overview of the Project specifically for interaction with the ACC is presented as part of Exhibit 12 below.

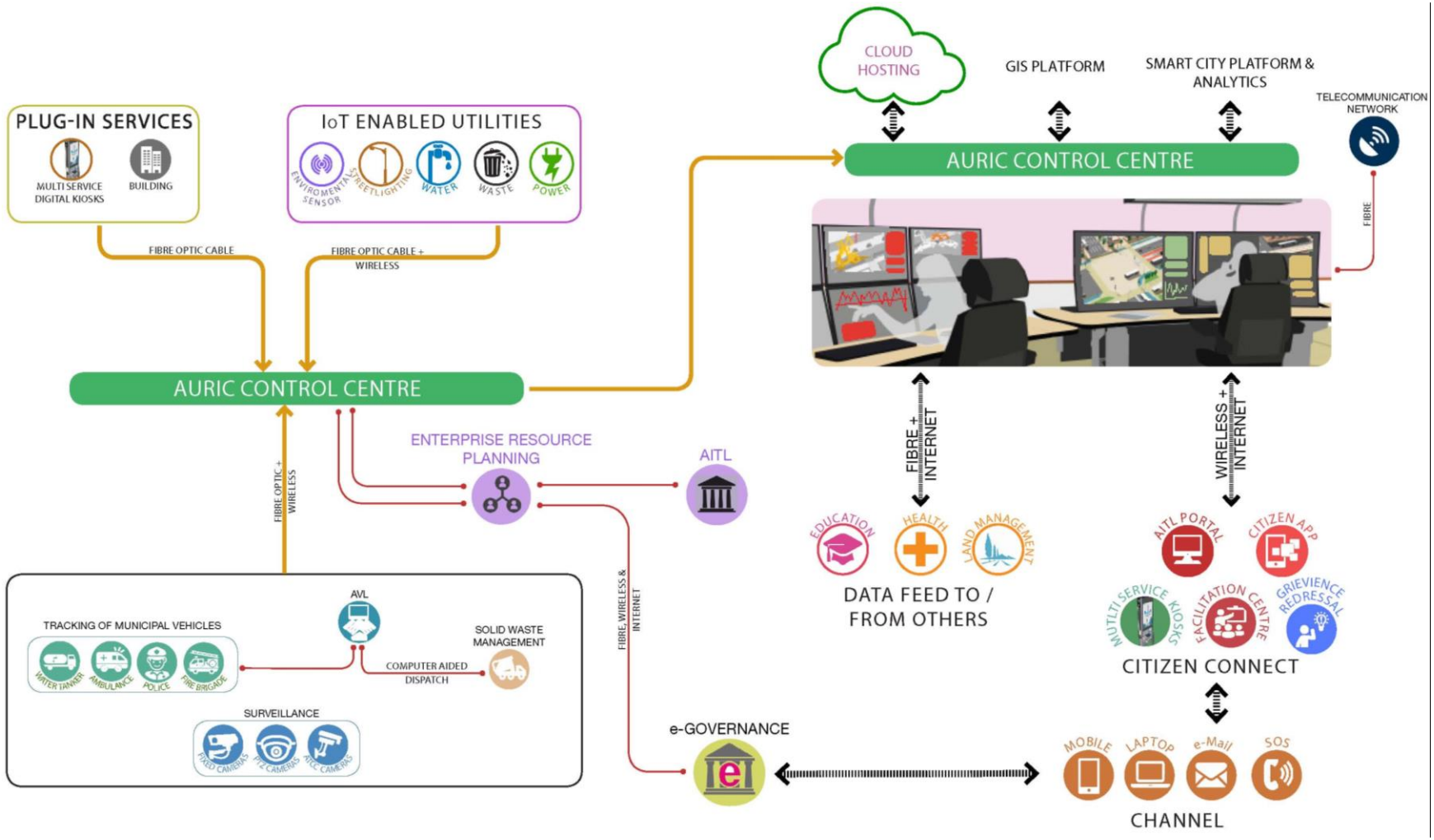


Exhibit 12: Project Interaction with ACC

Exhibit 13 below presents an indicative functional diagram of the logical connections between various components at the ACC. A brief description of each component is presented below. Note that some of these components are being provided as part of other sections of this RFQ cum RFP while some may be provided by Others. As part of the ACC, there are few components that are also required as part of this RFQ cum RFP.

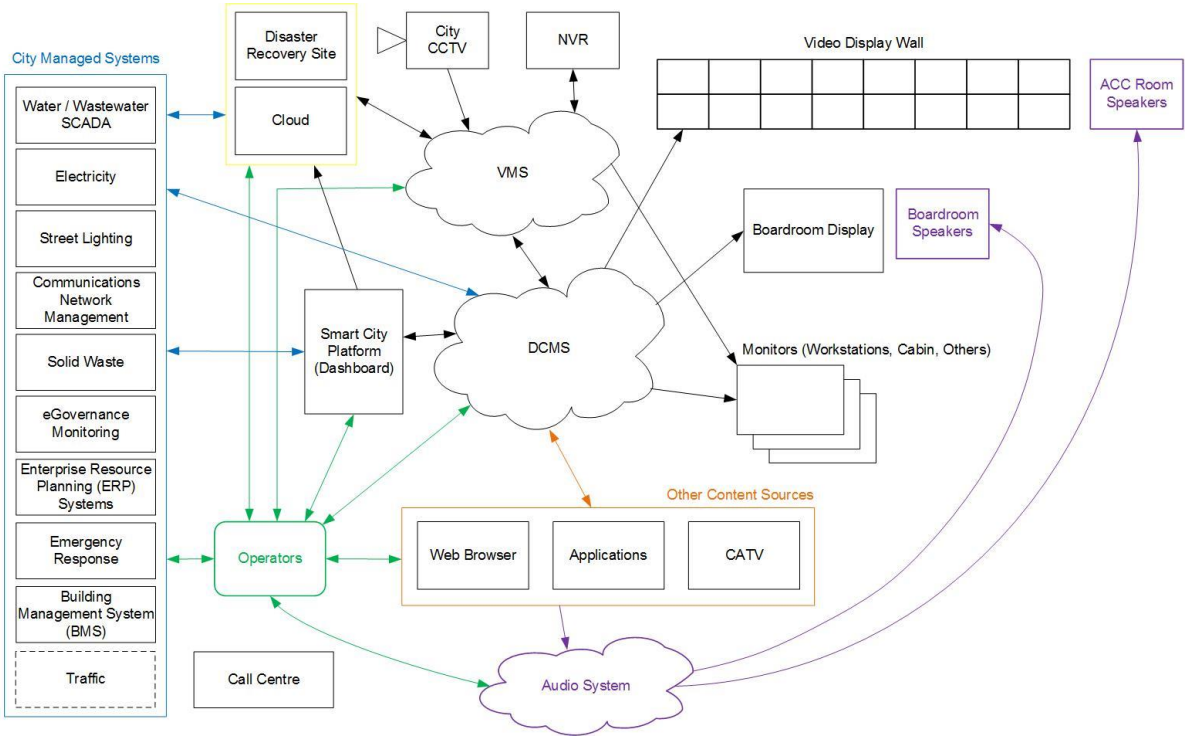


Exhibit 13: Functional diagram of the ACC

- Applications and Web Browsers – Multiple software applications shall be a content input into the ACC Systems.
- Audio System and Speakers – A system of audio components to provide annunciations in the operations and boardroom spaces within the ACC.
- Boardroom Display – Large format LED monitor shall be provided in the boardroom.
- Call Centre – A 24 x 7 call centre shall be setup to support city operations. The call centre shall have the capability of expansion as required to support City Services
- CATV – Cable TV shall be an input source into the ACC Systems. This content source shall be managed by the DCMS and be available anywhere in the ACC. Inputs such as weather, news, etc can be obtained via this CATV feed.
- City CCTV Cameras and ATCC – These are the primary video inputs into the Video Systems.
- City Managed Systems – Content for a number of city systems to be managed and monitored at the ACC.
- Cloud and Disaster Recovery Site – Are external to the City limits and used for system applications and data storage for some of the systems.
- DCMS – The Display Content Management System shall manage all networked visual content throughout the facility, including the video display wall and the boardroom display. This system will manage a dashboard for City Management Systems to be displayed and monitored on the video wall.

- Monitors – Consist of operator monitors, cabin monitor, and other displays that are connected to the ACC network.
- Network Video Recorder (NVR) – Network video recorders shall be dedicated for recording and archiving of camera video.
- Operator Workstations – These workstations shall be dedicated for ACC System use at the operator consoles. They are the point of control for the various systems at the ACC.
- Smart City Platform – Various smart city dashboards, Key Performance Indicators (KPI's), and analytics that are available as display visuals to aid city operations and better manage the City. This platform will also input and output feeds from other systems and agencies such as fire, education, healthcare, etc.
- Video Display Wall – The Video Display Wall shall be located in the Operations Room and shall be the primary visual display for operators at the ACC.
- Video Management System – The Video Management System shall manage CCTV streaming video, PTZ control, and video archiving.

Exhibit 14 below is a simplified infographic that illustrates various systems and information flow of a Smart City Platform. The smart city platform shall take feeds/inputs from various sensors, citizens, real-time systems, processed data and legacy data to enable proactive monitoring, analytical prediction and cross-system communications for making an intelligent city. In terms of analysis, using this platform, the city shall achieve statistical and predictive analytics, big data analytics, business intelligence and real-time event processing. Through this platform, various 'mined' information shall be shared with city officials and citizens in the form of reports, dashboards, standard APIs and open-data.

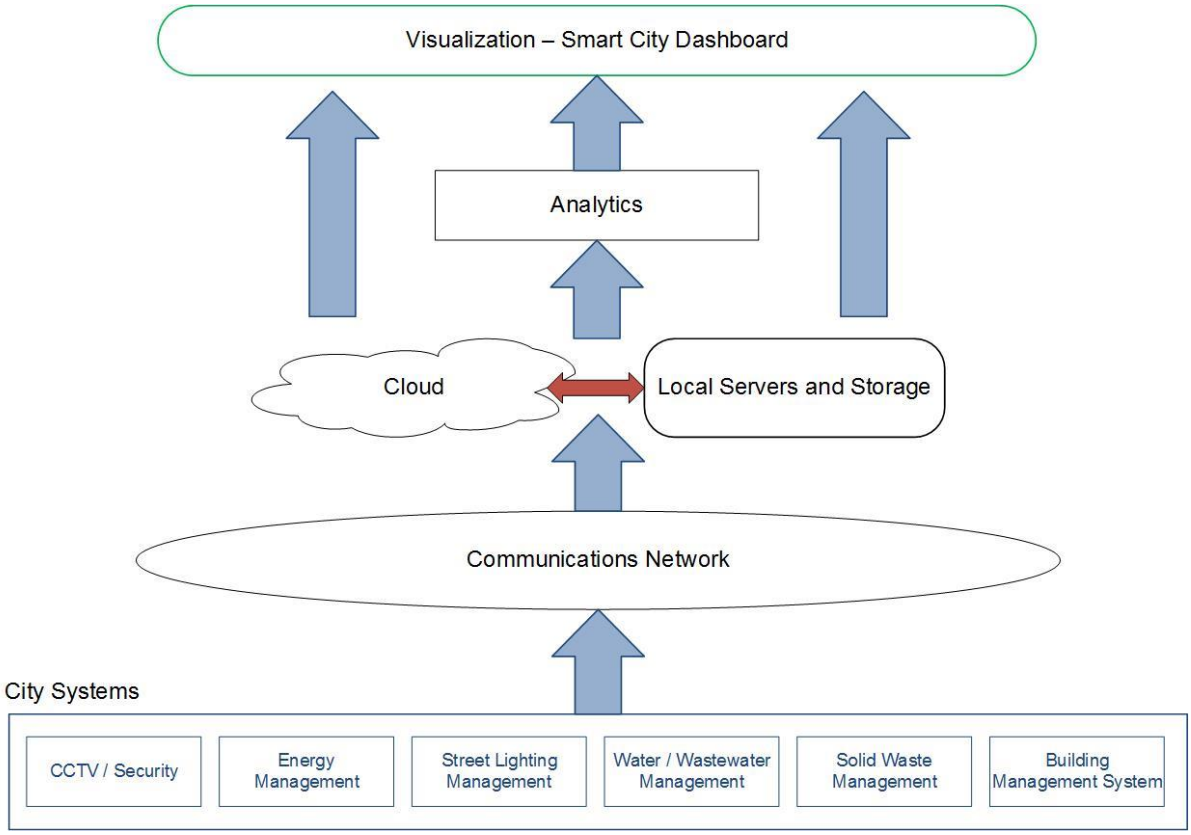


Exhibit 14: Systems and Information flow of a Smart City Platform

As illustrated in Exhibit 15 below, there are five (5) key layers:

Exhibit 15: Functional Layers of Smart City Platform

Smart City Platform Layer	Description
City Systems	These are independent systems for managing and/or monitoring a specific set of equipment, sensors, etc. (e.g. Water IoT, CCTV cameras, Wi-Fi, Streetlighting, BMS, etc.).
Communications Network	This primarily consists of network hardware such as fibre communications backbone, network switches, Wi-Fi Access Points, etc.
Data Centre and Disaster Recovery Centre	Central hardware where system applications and big data are stored and retrieved. This includes a combination of data hosted on cloud and some on-site data processing and storage as per the requirements of this RFQ cum RFP.
Analytics	This layer provides the real intelligence for a city. Analytics correlate data across two or more independent systems (cross-system intelligence) and supports both predictive and prescriptive analytics.
Visualization	Visual information that is typically displayed and monitored at a central location. Visual outputs for a smart city platform originate both directly from city systems and the analytics layer. For Shendra, visualization will primarily be at the ACC along with visualization using web portals, and applications.

BR - 13 Business Requirements

The following section covers the Business Requirements of the ACC:

BR 13.1	ACC shall act as the ‘nerve’ of AURIC and shall assist AITL in enhancing efficiencies of city operations and management.
BR 13.2	ACC shall include command and control centre, cabin and boardroom space along with a dedicated rack room.
BR 13.3	ACC shall enable cross-system and cross-agency coordination to monitor, operate and manage the city in an integrated manner.
BR 13.4	Using the smart city platform, different agencies/departments of AITL shall be able to monitor and utilize information of other departments for delivering services in an integrated and more efficient manner.
BR 13.5	The smart city platform shall be able to normalize the data coming from different devices of various OEMs. It shall support integration with multiple vendors.
BR 13.6	The data store function shall acquire data both automatically and manually. Automatic data acquisition shall be met through industry-standard data transports. Data Acquisition via Dynamic Data Exchange (DDE) and OLE for Process Control (OPC) along with other proprietary transports shall also be supported.
BR 13.7	All systems being provided as part of this RFQ cum RFP and by Others (mentioned in this RFQ cum RFP) shall be integrated at the ACC as per the requirements of the Project.

BR 13.8	Through the smart city platform, AITL shall have capabilities for various visualization and analytics of city operations. These analytics shall be achieved via cross-system integration of various systems and as per the standard operating procedure discussed and agreed upon with the Client. Analytics shall include both prescriptive and predictive analytics.
BR 13.9	ACC shall provide reporting capabilities for city administrators to keep record of city operations.
BR 13.10	The systems at ACC shall ensure that integrity and confidentiality of all information gained is secure at all times.
BR 13.11	The smart city platform shall be the integration point at which data from across the city converges for processing. This shall allow all information to be managed within the same network, eliminating many communication problems that are faced by siloed systems and networks.
BR 13.12	The ACC shall be rated for 24x7 operations.
BR 13.13	ACC shall have shift based operations for an overall 24x7 support.
BR 13.14	Integrate with other SCADA/IoT based systems including water and wastewater, electrical and streetlighting (providing by Others) at the ACC for monitoring and control of these systems. Note that these SCADA based systems shall be primarily monitored and controlled from their respective system. However, the smart city platform shall provide the capabilities to AITL operators to visualize all attributes and override the control of these systems as per the defined standard operating procedures for critical functionalities only.
BR 13.15	Integrate all systems being provided as part of this RFQ cum RFP.
BR 13.16	Integrate all systems from ACC to a central GIS platform being provided as part of this RFQ cum RFP and as detailed in the e-governance section.
BR 13.17	Since the ACC shell is of glass, shadowing of glass using sensors shall be provided for one wall of the shell which is approximately 450 sq.ft. Using this shadowing, AITL shall be able to make the glass totally opaque or adjust the transparency as per the requirements. All other sides of the glass shall be made permanently opaque.
BR 13.18	Smart city platform will not necessarily duplicate all functionality derived out of individual system specific applications but will monitor and integrate various features using which an intelligent city operations can be achieved.
BR 13.19	Since the ACC will be common for both Shendra and Bidkin, it shall be scalable to accommodate future growth and support hardware and software additions and upgrades. The MSI shall ensure additional 50% spare capacity for future integrations.
BR 13.20	The overall work shall be in reference to standards published as per ISO 37120 and World Council of City Data (WCCD).
BR 13.21	ACC Software should have Location engines for geographical, Device engine for aggregation of sensors data, Data & Analytics engine for storing data feeds from the device engine & external data sources and Service management to performs service management, Subscription engine for user roles authentication with global standards.

FR - 13 Functional Requirements

This section presents both the functional requirements and indicative standard operating procedures that are required for each of the system being integrated at the ACC.

FR 13.1	ACC shall provide a holistic and real time view of all city operations on a video wall along with individual views on operator workstations.
FR 13.2	ACC shall enable monitoring, control and automation of various city operations in order to ease and organise city operations.
FR 13.3	ACC shall enable system and cross system analytics through smart city platform in order to make city operations intelligent.
FR 13.4	ACC shall leverage information provided by multiple city systems in order to provide an integrated, seamless, proactive and comprehensive response mechanism for day-to-day city operations and challenges.
FR 13.5	ACC shall provide real time dashboards, visualizations, KPIs, historical trending, analytics and other intelligent features to facilitate city operations analysis by city administrators.
FR 13.6	ACC shall provide alarm features for immediate notification to city administrators in case critical event occurs in the city.
FR 13.7	The Digital Content Management System (DCMS) provided as part of ACC will manage and drive all visual content to the various display devices, including the video display wall. All city systems will display content through the DCMS.
FR 13.8	The operators will also manage and control various systems, and dispatch to system maintenance staff. They will be responsible for monitoring and managing all integrated city systems out of the ACC.
FR 13.9	The Smart City Platform shall normalize, analyse and use this data for efficient operations and management of the city.
FR 13.10	All workstation units of the operator workstations shall be installed at the central rack rooms so that space at the ACC operator desks can be optimized. The operators and other personnel operating from the ACC shall only have displays, keyboard and mouse at their workstation desks.
FR 13.11	Shadowing of one side of the glass shall be enabled using sensors and using the room control panel. Using this feature, AITL shall be able to completely make this glass opaque or change the transparency of a particular section of glass to meet any operational requirements of the Project.
FR 13.12	The platform shall receive direct feeds and raw data from the AURIC City Systems. City Systems shall include the following: • Building Management System (BMS) • Education • e-Governance and ERP • Emergency • Healthcare • Power & Water IoT/SCADA • Smart Solid Waste • Street Lights

	• Environmental Sensors • Surveillance • Telecommunication Network • IoT • Any other system being provided as part of this RFQ cum RFP. It shall also receive, normalize and make good data received from social media integration. It is required that the platform supports both structured and unstructured data inputs.
FR 13.13	Direct connections and data from devices / systems shall include real-time City Systems data, KPIs and video feeds from CCTV cameras.
FR 13.14	Visual data from City Systems shall be integrated into the platform user interface and directed to the display content management system for display on the video display wall and boardroom monitor.
FR 13.15	The platform shall be capable of managing/monitoring data and visualizations for all City Systems.
FR 13.16	The platform shall be capable of managing/monitoring all city functions. These functions shall be incorporated into the platform with a single user interface.
FR 13.17	The platform shall support integration with all other systems being provided by others as part of this Project and as provided by other Contractors.
FR 13.18	Some of the systems shall have their respective SCADA system for monitoring and control. Using the smart city platform, visualizations of all data received from these SCADA systems is possible. However, only critical functionality defined using the SOPs shall be enabled using the smart city platform for the purposes of monitor and control of these systems.
FR 13.19	The platform (or an integrated component of the platform) shall be capable of performing data consolidation, normalization, and cross system analytics.
FR 13.20	The platform shall be user configurable and compatible with all standard industry protocols for individual systems. It shall be the only system through which all data consolidation, normalization and cross system and individual analytics shall be performed for all city systems.
Water and Wastewater	
FR 13.21	Communicate locations of personnel, equipment, outage information and safety measures with internal and field personnel.
FR 13.22	Communicate member requests with appropriate internal and field personnel.
FR 13.23	Perform IoT operations as required by line personnel.
FR 13.24	Administer IoT programming and data collection functions.
FR 13.25	Utilize the IoT system to monitor system statistics.
FR 13.26	Dispatch water and wastewater service requests to the appropriate internal and field personnel using the ERP system.
FR 13.27	Provide distribution automation programming support as needed.
FR 13.28	Assist in gathering information for reporting needs (broad reports, departmental benchmarks, etc.)

FR 13.29	Track progress of water and wastewater service requests against pre-determined KPIs.
FR 13.30	Report back to client and contract staff on progress of each water and wastewater service request and close out service requests when completed using the ERP system.
FR 13.31	Maintain asset information held in the database using GIS and ERP system.
FR 13.32	Monitor trunk infrastructure in terms of leaks, breaks, etc.
FR 13.33	Update site specific water and wastewater files and other documentation for helpdesk compliance.
FR 13.34	Billing for services using the ERP system.
Facilities Management and Building Management Systems (BMS)	
FR 13.35	Interface with the Building Management Systems (BMS) installed in ACC and other key AITL buildings for monitoring and control of all the building systems and parameters available through the BMS.
FR 13.36	Interface with all the Building Management Systems (BMS) or IP enabled fire alarm system installed in non-AITL buildings for monitoring of essential parameters.
FR 13.37	Log calls/jobs on the helpdesk database utilizing helpdesk software (inquiries may be received by telephone, facsimile, email or in person).
FR 13.38	Allocate and dispatch work orders to directly employed (or subcontracted) maintenance team.
FR 13.39	Take ownership of the preventative maintenance (PM) schedule and track reactive maintenance (RM) service requests using the ERP system.
FR 13.40	Track progress of PM and RM service requests against pre-determined KPIs.
FR 13.41	Report back to client and contract staff on progress of each PM and RM service request and close out service requests when completed using the ERP system.
FR 13.42	Maintain asset information held in the database using the ERP system.
FR 13.43	Update site specific facilities management files and other documentation for helpdesk compliance.
FR 13.44	Dispatch of emergency services.
FR 13.45	Create awareness within the city for energy consumption and utilization via information received from smart meters and other SCADA based trunk infrastructure.
Power Network	
FR 13.46	Monitoring of smart power meters for various parameters.
FR 13.47	Monitor trunk infrastructure in terms of outages, leaks, etc.
FR 13.48	Monitoring of outage or tampering alerts for smart power meters.
FR 13.49	Log calls/jobs on the helpdesk database utilizing helpdesk software (inquiries may be received by telephone, facsimile, email or in person).
FR 13.50	Dispatch outage and power quality calls to the appropriate internal and field personnel using the ERP system.

FR 13.51	Track progress of outage and power quality service requests against pre-determined KPIs.
FR 13.52	Report back to client and contract staff on progress of each outage and power quality service request and close out service requests when completed using the ERP system.
FR 13.53	Maintain asset information held in the database using the ERP system.
FR 13.54	Update site specific power files and other documentation for helpdesk compliance.
FR 13.55	Billings using the ERP system.
FR 13.56	Create awareness within the city for energy consumption and utilization.
Solid Waste Management (SWM)	
FR 13.57	Monitoring of the smart waste management system web application real-time level information for containers as well as the automatic warning system which notifies when containers require attention.
FR 13.58	Real-time monitoring of solid waste collection vehicles.
FR 13.59	Log calls/jobs on the helpdesk database utilizing helpdesk software (inquiries may be received by telephone, facsimile, email or in person).
FR 13.60	Dispatch waste management service request calls to the appropriate internal and field personnel.
FR 13.61	Track progress of waste management service requests against pre-determined KPIs.
FR 13.62	Report back to clients and contract staff on progress of each waste management service request and close out service requests when completed.
FR 13.63	Maintain asset information held in the helpdesk database.
FR 13.64	Update site specific waste management files and other documentation for helpdesk compliance.
FR 13.65	Billing and payments associated with the waste collection agency as applicable using the ERP system.
Communications Network	
FR 13.66	Monitoring of the smart telecommunications management system for issues and outages (including any alarms) in terms of passive infrastructure for non-AITL and both active and passive infrastructure for AITL.
FR 13.67	Monitoring and control of the city Wi-Fi infrastructure.
FR 13.68	Monitoring and control of all actives implemented as part of the AITL infrastructure.
FR 13.69	Log calls/jobs on the helpdesk database utilizing helpdesk software (inquiries may be received by telephone, facsimile, email or in person) using the ERP system.
FR 13.70	Dispatch telecommunications service request calls to the appropriate internal and field personnel using the ERP system.
FR 13.71	Track progress of telecommunications service requests against pre-determined KPIs.
FR 13.72	Report back to client and contract staff on progress of each telecommunications service request and close out service requests when completed using the ERP system.

FR 13.73	Maintain asset information held in the helpdesk database using the ERP system.
FR 13.74	Update site specific telecommunications files and other documentation for helpdesk compliance.
FR 13.75	Billings and collections from telecom service providers for revenue sharing using the ERP system.
City Security	
FR 13.76	Accurately and promptly observe, monitor and operate closed circuit television (CCTV) cameras and related equipment, and, where necessary direct Police Officers to real time incidents.
FR 13.77	To identify, report, and record anything suspicious, in line with ACC procedures.
FR 13.78	To operate surveillance equipment ethically and in accordance with training, policy and procedures, manufacturer's instructions and relevant legislation.
FR 13.79	To ensure all equipment is functioning correctly, carry out equipment checks as required and report all faults to relevant personnel, carry out basic non-technical system maintenance as required.
e-Governance & ERP	
FR 13.80	Monitoring of the status of e-Governance systems located at various Multi-Services Digital Kiosks /sites throughout AURIC as well as through the online system.
FR 13.81	Integrate with citizen card via both QR code generation and reading system.
FR 13.82	Log calls/jobs on the helpdesk database utilizing helpdesk software (inquiries may be received by telephone, facsimile, email or in person) using the ERP system.
FR 13.83	Dispatch e-Governance Multi-Services Digital Kiosks /site service request calls to the appropriate internal and field personnel.
FR 13.84	Track progress of e-Governance Multi-Services Digital Kiosks /site service requests against pre-determined KPIs.
FR 13.85	Report back to client and contract staff on progress of each e-Governance Multi-Services Digital Kiosks/site service request and close out service requests when completed using the ERP system.
FR 13.86	Maintain asset information held in the helpdesk database using the ERP system.
FR 13.87	Update site specific e-Governance Multi-Services Digital Kiosks/site files and other documentation for helpdesk compliance.
FR 13.88	Monitor key performance indicators for ERP system in terms of billing, finance, HR, procurement and other modules.
Street Lighting	
FR 13.89	Monitoring of circuits, central control and automation while integrating with the feeder panel based street lighting system.
FR 13.90	Log calls/jobs on the helpdesk database utilizing helpdesk software (inquires may be received by telephone, facsimile, email or in person) using the ERP system.
FR 13.91	Dispatch staff for service request calls using the ERP system.
FR 13.92	Maintain asset information using the ERP system.

Environmental Sensors	
FR 13.93	Monitor key inputs from pollution sensors, noise sensors, particle sensors, etc.
FR 13.94	Create awareness within the city based on dynamic inputs received from sensors and display output to various interfaces including city application, multi-services digital kiosks and digital screen.
FR 13.95	Inputs to various regulations and permissions as needed in terms of carbon content, and content of other particles and gases in around Shendra.
Multi-Services Digital Kiosks and Emergency Communications	
FR 13.96	Interface with emergency communication modules in multi-services digital kiosks for monitoring and action on emergencies reported by citizens.
FR 13.97	Interface with police, fire and ambulance as needed for emergency services.
FR 13.98	Real-time monitoring of emergency dispatch vehicles.
FR 13.99	Receives and evaluates calls, emails, and online form submissions from internal and external customers requesting information on City services, procedures, activities, resources, and programs in support of the 24-hours-per-day/7-days-per-week; provide information and assistance in an efficient manner.
FR 13.100	Assesses nature or urgency of the issue; determines and establishes priority of call; resolves the issue or escalates and/or transfers call to appropriate staff/agency as necessary.
FR 13.101	Identifies the type of service being requested by listening, asking relevant questions, evaluating information obtained, and determining City services available to successfully handle the request.
FR 13.102	Creates or researches customer information in the Customer Relationship Management (CRM) system; records information on all customer inquiries or problems; provides updates on previously created cases.
FR 13.103	Follows system and department-specific procedures to create service requests and work orders in specialized department software systems.
FR 13.104	Conducts research using various City and public resources to provide customers with complete, accurate, and thorough answers to requests for information, inquiries, and/or problems.
FR 13.105	Dispatches calls in accordance with established procedures and policies using a computerized dispatch system, including determining priority of calls and contacting and sending appropriate response unit.
FR 13.106	Observes and complies with departmental policies and procedures, customer service quality standards, and compliance guidelines.
Education	
FR 13.107	Monitor key ratios (KPIs) that will be important inputs for economic indicators.
FR 13.108	Monitor any bus-level infrastructure like CCTV, and location of buses as required.
Healthcare	
FR 13.109	Monitor key ratios (KPIs) that will be important inputs for economic indicators.
FR 13.110	Monitor location of ambulances by obtaining feeds from the healthcare facility owners.

AVL System	
FR 13.111	AVL System: Vehicle location monitoring for the following vehicles shall be done at ACC: • Water/Wastewater service vehicles • Firefighting vehicles • Ambulances • Solid waste management (also include CAD) • Police vans • Any other client owned vehicle
Analytics and Visualizations	
FR 13.112	Through the smart city platform, various critical functionalities including historian, trending, analytics, visualizations, dashboards etc shall be achieved. The analytics required for the smart city platform shall be integrated with the overall solution. Analytical capabilities of the platform shall include streaming data analytics, data quality, reporting and data exploration, forecasting, predictive and prescriptive analytics and optimization.
FR 13.113	Smart city platform shall be capable of communicating with various types of sensors/devices and their management platforms/applications for single/multiple services irrespective of the OEM, software and applications that they support. Data exchange between various sensors and their management applications shall strictly happen using this platform making it one true source of data abstraction, normalization, correlation and enabling further analysis. Adequate security checks and mechanisms shall be provided as part of the platform to ensure data confidentiality and limit any unauthorized access.
FR 13.114	ACC shall make use of cross-system data analytics from historian and real-time information received from independent systems through smart city platform to aid in the operations and management of city services.
FR 13.115	The platform shall have ability to synthesize, analyse and integrate data from all City systems. It should provide analytical insights for running real time sensors and to decision makers for policy making and optimized decision making.
FR 13.116	The platform shall have the ability to generate alarms based on user provided inputs as defined in the SOPs.
FR 13.117	Analytic outputs shall be derived from historic and real-time information received from the various city systems. The analytic outputs shall also support forecasting based on various inputs and shall support setting of targets for various parameters.
FR 13.118	ACC shall have integration and deployment capabilities for web, applications, real time dashboards, business intelligence, workflow, event management, KPIs, monitoring and resource optimization along with integration with analytics.
FR 13.119	ACC shall be able to support rule engine for multiple event correlation, What-if analysis tools, threat detection tools, capabilities for integration with social media platforms.
FR 13.120	ACC shall be capable of alarm management functionalities such as: • Targeting: Locate the sensor in GIS display which has detected the security risk or has malfunctioned and include automatic coloured notifications

	• Alarm description: basic information about nature of alarm • Device: Name of sensor or system • Acknowledgement and dismissal of alarms • SOPs: list of activities which needs to be carried out by operator for category of alarms • Provision of filter of alarms • Archiving of alarms • Searching of alarms
FR 13.121	ACC shall be capable of audit trail functionalities for user activities in order to effectively track response time on events by integrating with the ERP system.
FR 13.122	Reporting function shall be a part ACC dashboard visualization tool. It shall provide information about current status of the ACC on functions performed. Following functionalities shall be supported by Reporting Module as a minimum: • Reporting module shall offer a library of “statement”, “report” and “predefined dashboards” which can be easily modified as per AITL needs. • It shall allow the design of new reporting templates (creation of new fields, graphical formats, flat tabular formats, calculations, sorting, totals, sub totals, combination of existing reports etc.). Moreover, the users should be able to export/import data for/from external applications not limited to for example excel/ MS-access, for specific reports. • It shall allow creation or insertion of graphics into the generated documents or reports or dashboards. Nevertheless, “developing customer documents” must be within the reach of the users. • Print outs shall be available on paper (A4 and A3) and in an electronic file format, as text files in column, Microsoft Word, Microsoft Excel or Adobe PDF document. In addition to the Microsoft suite of products, compatibility should also be ensured with the corresponding open source equivalent suite of office products. • Generating recurring reports should be automated.
FR 13.123	ACC shall be capable of analytics for various city systems in order to provide operators and city administrators with situational awareness and an understanding of historical trends. For instance, baselining of frequency and nature of registered complaints shall be done along with response time to address them. Analytics can also enable program administrators to quickly determine eligibility for benefit programs and match the right services to citizen needs, prevent fraud and waste of funds, as well as be used for planning purposes.
FR 13.124	ACC shall be capable of analytics for city systems where it shall develop insight into possible future conditions or events. Analytics shall measure the efficacy of services delivered and also help operators and city personnel to test scenarios. For instance, in case of heavy fire emergencies, it shall be able to predict response time of firefighting and ambulance vehicles to these emergencies based on inputs from tracking systems.
FR 13.125	Energy and Water Optimization shall be present where algorithms shall optimize energy and water use with input from weather forecast, electricity pricing, future energy demands, water reservoir levels, etc and leverage integration from SCADA based network being provided by Others.

FR 13.126	Healthcare and Education analytics shall be present where ERP data shall assist healthcare and education planning (e.g. number of schools, hospital beds) along with integration with citizen smart card.
FR 13.127	ACC shall be capable of crowd management and analytics where detection/scheduling of crowd gathering shall influence Wi-Fi bandwidth management, solid waste management, street lighting, first responders preparation, etc.
FR 13.128	ACC shall support vision of crowd sourcing and analytics of data from various platforms i.e city application and webportal among others for the purposes of empowering citizens.
FR 13.129	Capability of asset management where ERP data and connected vehicle information shall assist with scheduling of vehicle maintenance or determining if a renewal of assets is required.
FR 13.130	On receiving a fire or emergency alarm from BMS, ACC shall automatically alert firefighting authorities using automatic notifications. ACC shall also alert medical facilities for dispatch of ambulances and to make necessary provisions in hospitals for victims.
FR 13.131	ACC shall have the capability to take environmental condition feed from meteorological department or cable TV or any other applicable inputs. In case of rain predictions, ACC shall automatically alert departments for preventive maintenance of water logging issues.
FR 13.132	Display of Standard Operating Procedures (SOPs) shall be available where step-by-step instructions based on Client's policies and tools to resolve the situation shall be presented to operator in a quick and easy way for operator to verify the situation.
FR 13.133	The platform User Interface (UI) shall provide the operator an ability to control the configurations of city systems via applications installed and integrated on the platform, or via remote control applications that allow remote modifications of the city systems' facilities.
FR 13.134	The platform UI shall allow operators to configure the windows displayed on the executive dashboard. It shall also allow the users to change the workflow of systems.
FR 13.135	The platform graphical user interface (GUI) shall present information on standard workstations. It shall have the following capabilities: • Able to present management data such as dashboards, alarm and alerts, resource management information, incident information in colour coded, clear, simple and unambiguous, logical format. • Colour coding on the platform application GUI shall represent the different status of a task or incident/alert. • GUI layout and arrangement of windows shall be user customizable. • Be able to present information and distinguish between an early warning or anticipation type set of data and emergency or crisis operating mode.
FR 13.136	The platform shall be capable of presenting information in a browser based format such that it is accessible from any terminal connected to the ACC with a web browser. The supported browsers shall include but not limited to IE, Chrome, Firefox and Safari. In addition, the platform shall also be able to present information on mobile devices such as tablets and smartphones while maintaining the basic UI features.

FR 13.137	The platform shall provide user and subscription management by providing different tier of user categorization, authentication, authorization and services based on the subscriptions.
FR 13.138	Part of the visualization at the Shendra ACC will include monitoring a set of relevant ISO 37120 indicators. Some sample indicators are provided below: • Assessed value of commercial and industrial properties as a percentage of total assessed value of all properties • Primary education student/teacher ratio • Total residential electrical energy use per capita (kWh/year) • Energy consumption of public buildings per year (kWh/m²) • Fine particulate matter (PM2.5) concentration • Number of in-patient hospital beds per 100,000 population • Percentage of the city's solid waste that is recycled • Green area (hectares) per 100,000 population • Percentage of city population with potable water supply service • Total domestic water consumption per capita (litres/day)
FR 13.139	Analytic capabilities are envisaged to understand the real-time and batch data to act with intelligent decisions. The analytics shall integrate both with historical and real-time streaming data from water, energy, parks, street lighting, and batch data from AEE applications, among others responding to citizen-provided information.
FR 13.140	Automatically detect when citizen services are needed as indicated but not limited to the following: Water treatment plant issues, water quality degradation and water flow analysis for recycling. It should include: • Distributed water management - Industrial & Residential (neighborhood) Water Consumption Forecasting, Waste Water Quality Assessment, Treatment Effectiveness and Recycle Water usage is important. • Real time streaming analytics on tweets and social media events, blogs, grievances and discussion portal with data quality and content categorization. • Dynamically sense the citizen environment and mitigate government service disruptions through social media and other citizen data. • Healthcare and Education analytics shall be present where ERP data shall assist healthcare and education planning including the following but not limited to: ➢ Patients trends ➢ Disease Trends ➢ Identifying relationship with patient demographics location and disease trends ➢ Modeling mortality rate. • Provide proven intelligence system for planning and asset maintenance for Smart Electricity Grid which is envisaged to be with 100% underground cable network: ➢ Enable Peak Load Profiling for understanding system peak, feeder and transformer peak.

	➢ Network hierarchical Load Forecasting capabilities with advance algorithms to handle meter data and SCADA/Historian data that can integrate weather data such as temperature. It should also support end-use models for the industrial city and establish the linkage with production details of the industries and the industry setup and bulk load commissioning. ➢ Provide predictive modeling for transformer fault and cable fault with analysis of Real Time Streaming Analytics on IoT Data for alarms / alerts on Asset Conditions based on predictive model. ➢ Provide proven intelligence to integrate AMI / AMR data, Billing Data and other data sources to detect non-technical loss to generate. ➢ Provide system reliability dashboard with SAIDI/SAIFI/MAIFI/CAIDI parameters on an hourly basis across the areas, feeders and up to the transformer level with linkages with failure and investment data. • Public Security Analytics: ➢ Enable the law enforcement to identify the area of security concerns. ➢ Forecast the man power required for surveillance in high risk area. ➢ Identify hidden areas of security concerns. ➢ Profile each area based on the type of predominant crime.
FR 13.141	The smart city platform shall be a single, integrated platform that shall provide seamless metadata exchange and single administration interface.
FR 13.142	The platform shall provide capabilities of integration with big-data and shall provide in-memory analytics capabilities.
FR 13.143	The centralized analytics shall take an enterprise approach by supporting analytics throughout the infrastructure including from cloud/on-premises to edge and any point in between.
FR 13.144	Streaming analytics capabilities shall include machine learning streaming capabilities such as regressing, decision tree, filtering live stream data, etc.
FR 13.145	The smart city platform shall have capabilities of visual monitoring of event streams, configure real-time dashboards for analytical ACC, interactive filters, and query dynamic live stream with support of automatic notifications through SMS, email and other alerts.
FR 13.146	The memory engine shall provide various types of dashboards and capabilities that allow drilling down on the dashboards and interlinkages of report objects and integration with GIS.
FR 13.147	The platform shall use leading text analytic solution to synthesize feedback comments and provide actionable intelligence.
Video Display Wall	
FR 13.148	Video display wall content will not be switched frequently and shall be displayed real-time. It shall be rated for 24x7 operations.
FR 13.149	Functionality of centre zone for common viewing, for example map of the city can be enlarged and copied to the centre of the display wall for general reference.
FR 13.150	Option to create multiple layouts shall be present.

FR 13.151	Video display wall shall be integrated with Display Content Management System (DCMS) so content managed in the DCMS can be displayed on the video wall.
FR 13.152	Ability for all CCTV video, CATV, web pages, IoT and all other display content to be routed to the board room.
FR 13.153	Ability to manage the content within the boardroom or at the operators' consoles.
FR 13.154	Ability to add content from an ACC workstation or boardroom computer.
FR 13.155	The video display wall product selected shall be durable for optimal use in a 24/7 operational mode.
FR 13.156	The focus of the design characteristics are ergonomics for the various viewers, quality and stability of the images, uniformity across the whole area, availability of the system, limited maintenance and low disruption of the control room operations.
FR 13.157	Video display wall shall be capable of displaying High Definition (HD) content.
FR 13.158	Gaps between screens shall be negligible to view HD graphics on multi screens.
FR 13.159	Auto calibration feature shall be provided to avoid periodic maintenance.
FR 13.160	There shall be a user interface for all settings and operational parameters.

Following infographic i.e. Exhibit 16 presents the overall summary (indicative) of the critical functions and systems for the ACC. Using the ACC and smart city platform, it is expected that cross system analytics is achieved at the ACC. Some examples of these cross system analytics include adapting the solid waste management system and city Wi-Fi network around the convention centre based on schedule information received from the convention centre, getting feed for a water pipe burst and informing citizens for any road closures, etc.

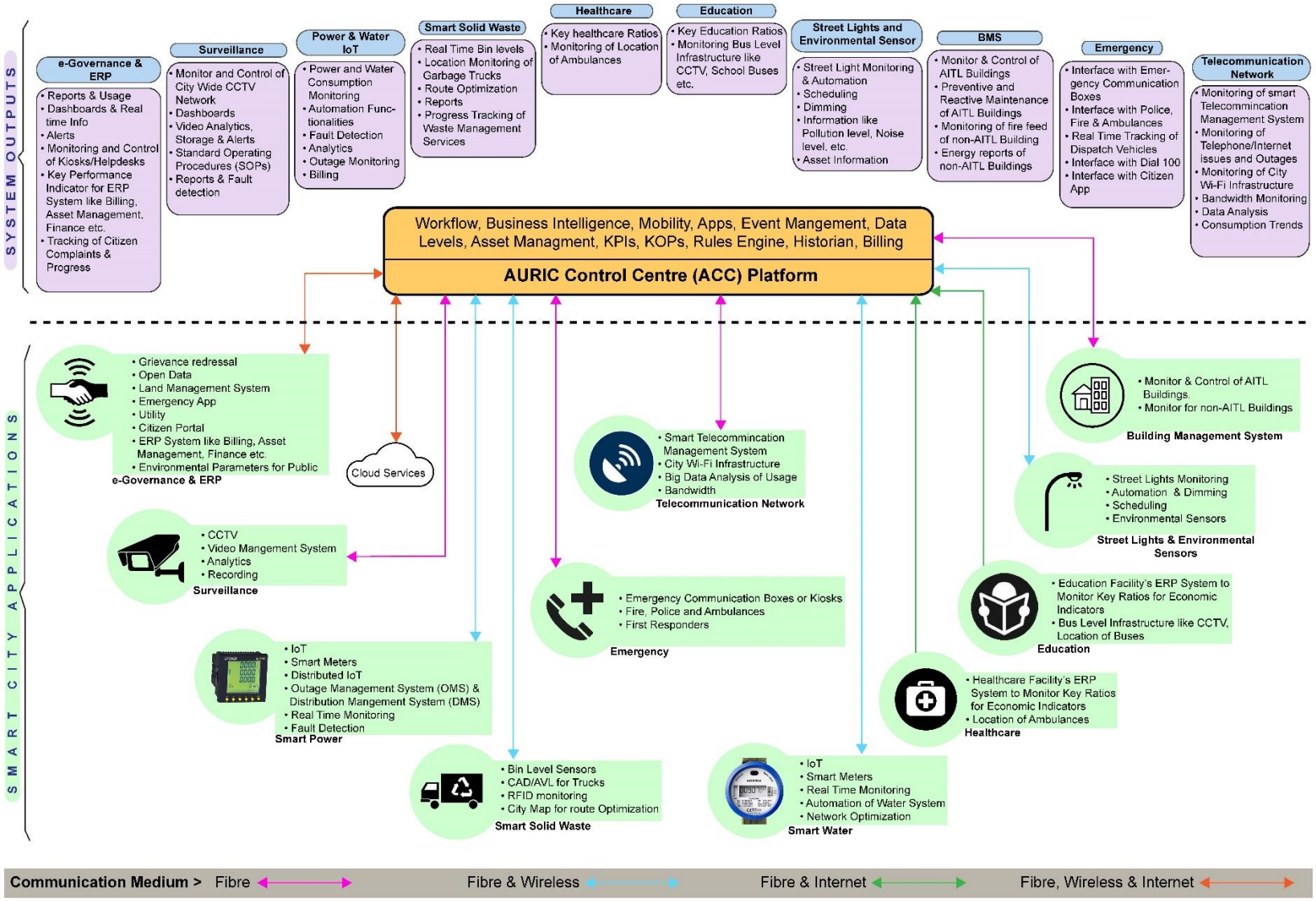


Exhibit 16: Overall Summary of the Critical Functions and Systems for the ACC

TR - 13 Technical Requirements

Video Display Wall (VDW)	
TR 13.1	The VDW shall be made up of DLP™ rear-projection cubes. Each DLP™ display cube shall measure 70 inches in diagonal. It shall include all controllers required for its operations.
TR 13.2	The native resolution of each Visual Display Unit / Rear Projection Module should be 1920 X 1080 pixels (Full HD) and should have Laser as its light source with ultra-thin configuration.
TR 13.3	The light source lifetime of the laser shall be at least 100,000 hours.
TR 13.4	The brightness uniformity of the VDM shall be >95%.
TR 13.5	The project engine of VDW shall be rated for performance in project conditions.
TR 13.6	The Rear Projection Module shall have laser as its light source.
TR 13.7	The screen shall have adjustable low inter screen gap 2 mm or lesser to give seamless viewing experience.
TR 13.8	The Cube shall have inbuilt redundancy in power supply and laser light source.
TR 13.9	The dashboard shall be capable of simultaneously displaying one (1) to one hundred (100) independent sets of information on the video display wall. Specific outputs to be displayed shall be chosen by operators.
TR 13.10	The VDW shall include video walls mounted close to each other to give a seamless viewing experience.
TR 13.11	Each cube of the VDW shall have its own IP address and on-board web server to provide standard information like status and health.
TR 13.12	The VDW shall be the primary visual information point to see CCTV videos, incident alarms, IoT screens, network health conditions, GIS maps, and any application running on city systems.
TR 13.13	The VDW shall provide a collaborative visual for operators and management to work and coordinate on various tasks in different situations.
TR 13.14	The VDW product selected shall be durable for optimal use over a long time in a 24/7 operational mode.
TR 13.15	The VDW shall provide image uniformity across the whole display area.
TR 13.16	The VDW shall have system availability with limited maintenance and low disruption of the operations room operations.
TR 13.17	The VDW shall be capable of displaying high definition (HD) and standard definition (SD) content.
TR 13.18	The VDW shall provide minimum viewing angles of: • Horizontal - ±35 degrees • Vertical - ±27 degrees
TR 13.19	Auto colour and brightness management mechanism to be provided.
TR 13.20	The VDW shall have a user interface for all settings and operational parameters.

TR 13.21	The VDW shall support with enhanced brightness of at least 500 cd/m² to accommodate ambient light expected inside the room.
TR 13.22	The VDW units shall be new and current to the manufacturer's product line. The units shall not be discontinued products.
TR 13.23	Each VDW unit shall have front-access to the projection modules and internal components of the cubes for maintenance purposes.
TR 13.24	The brightness uniformity of each display cube and across the entire VDW shall be at least 95%.
TR 13.25	The video display cubes shall have anti-reflective screens in order to reduce reflection and glare on the display wall.
TR 13.26	The VDW shall not daisy chain video communications from one display cube to another. There shall be a direct video connection from the display content management system to each display cube.
TR 13.27	All video display cubes shall have a consistent image quality and brightness across the display wall.
TR 13.28	The VDW will have at least one (1) female DVI-I/HDMI input connector.
TR 13.29	The VDW shall have 10/100/1000 copper Ethernet communications port.
TR 13.30	A pedestal shall be provided to support the VDW. If the manufacturer's standard pedestal does not comply with the height requirement, the MSI shall supply a custom setup.
TR 13.31	The support structure shall be with a laminate finish.
TR 13.32	The support structure shall have open internal space for equipment.
TR 13.33	The support structure shall have easy to open front access covers.
TR 13.34	The MSI shall provide lateral support for the VDW. If fixations are required behind the VDW, the MSI shall propose and design an appropriate support system.
TR 13.35	The VDW pedestal shall be physically secured to the concrete floor of the building. It shall not sit on top of the raised floor.
TR 13.36	Each VDW projection engine shall be modular having input module and optical engine separate" to introduce more competition.
TR 13.37	The VDW shall allow for easy maintenance of modules, colour sync systems, etc. where downtime is no greater than 60 minutes.
TR 13.38	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz. Power consumption of each cube shall be less than 350W.
TR 13.39	The VDW shall have an operational temperature between ten degrees Celsius (10°C) to forty degrees Celsius (40°C).
TR 13.40	The VDW shall have a relative humidity of 20 to 80%, non-condensing or better.
TR 13.41	The VDW shall be of sufficient design, manufacturing and operational quality to provide twenty-four (24) hours, seven (7) days a week mission critical functionality.
TR 13.42	The VDW shall have redundancy of critical components like light module, and power supplies.

Display Content Management System (DCMS) or Video Wall Management System	
TR 13.43	The DCMS shall include the VDW controller for the Operations Room VDW and a system to manage the visual content.
TR 13.44	The DCMS shall be able to display visual content on any network attached display device.
TR 13.45	The DCMS shall be able to input, manage, and distribute visual content..
TR 13.46	The DCMS shall be able to decode, transmit, manage, and display the following formats of digital streaming video: • MPEG-4 • H.264
TR 13.47	The DCMS shall treat the VDW as a single display. It shall act as a single canvas with no pixel separation.
TR 13.48	The DCMS shall have the ability to create multiple spaces for different users to control display content. The DCMS shall be able to create a minimum of six (6) distinct operator controlled display areas. These display areas cannot cross over into another. The display areas can be created anywhere within the VDW.
TR 13.49	The DCMS shall be able to create display layouts for any sized display, including boardroom monitor and the operations room display. The DCMS shall be able to save a minimum of one hundred (100) display layouts for every display device within the ACC.
TR 13.50	The DCMS shall be able to manage users and roles. The DCMS shall have an administrator role to have master control of all functions.
TR 13.51	The DCMS shall be able to separate the video wall into variable sized sections so that system defined users can manage only their portion of the video wall. Users not belonging to a particular group managing another portion of the video wall shall not be entitled to change layouts and sources.
TR 13.52	The DCMS shall be able to stretch, re-position, and resize any video source on any display device.
TR 13.53	The DCMS shall be supplied with a user interface (UI) independent of other systems.
TR 13.54	The DCMS shall have a seamless interface within the VMS UI of the CCTV.
TR 13.55	The DCMS shall be accessible on any networked workstation or networked monitor with OPS on the ACC network.
TR 13.56	The DCMS shall be able to create and edit user groups. DCMS permissions for users and user groups shall be customizable. At a minimum the definable permissions shall include UI function rights, viewing access rights, source list access rights, and display access rights.
TR 13.57	The DCMS shall include an administrator role that shall be able to manage system configuration, sources, user groups, and user authentication.
TR 13.58	All users on the DCMS shall have a password-protected login.
TR 13.59	The DCMS shall be able to display a minimum of two hundred (200) independent visual sources simultaneously on the VDW in the Operations Room. The sources shall be of HD or 4CIF resolution.

TR 13.60	The DCMS shall be able to display a minimum of twenty (20) independent visual sources simultaneously on all boardroom or auxiliary display device. The sources shall be of 4CIF resolution.
TR 13.61	The DCMS shall be able to add borders to individual original video content source.
TR 13.62	The DCMS shall be able to display a minimum of ten (10) web browser applications without the use of screen capturing from an external network source.
TR 13.63	The DCMS shall be able to select and display any region of a multi-monitor display on a DCMS connected source. For example, if an operator has three (3) monitors, the operator can select monitors one (1) through two (2) for display on the VDW, while leaving monitor 3 for local display only.
TR 13.64	Visual content from networked sources shall be transmitted and displayed with no pixel loss or degradation.
TR 13.65	The DCMS shall be able to accept a minimum input of four (4) CATV video sources;
TR 13.66	The DCMS shall be able to search for networked video sources.
TR 13.67	The DCMS shall have the ability to accept and use General Purpose Interface (GPI) triggers from the AITL's systems to activate pre-set image configurations.
TR 13.68	The DCMS workstation client software shall run on an industry standard-based operating system.
TR 13.69	The DCMS shall be able to run a minimum of twenty (20) workstation client software instances simultaneously.
TR 13.70	The DCMS shall have the ability to self-monitor and provide alerts to the administrator and designated users via e-mail.
TR 13.71	The DCMS shall have a SDK and API openly available without charge for future integration with third party applications.
TR 13.72	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.73	The DCMS shall support 10/100/1000 Ethernet communications for device management and other communication.
TR 13.74	All DCMS hardware shall have an operational temperature between ten degrees Celsius (10°C) to forty degrees Celsius (40°C).
TR 13.75	The DCMS shall have redundancy of critical components to support a twenty-four (24) hours, seven (7) days a week mission critical functionality.
Video Wall Management Software	
TR 13.76	The software should be able to pre configure various display layouts and access them at any time with a simple mouse click or schedule/timer based.
TR 13.77	The software should enable the users to see the desktop of the graphics display wall remotely on the any PC or above connected with the DCMS and Video Wall over the Ethernet and change the size and position of the various windows being shown.
TR 13.78	The software should enable various operators to access the display wall from the local keyboard and mouse of their workstation connected with the DCMS and Video Wall on the Ethernet.

TR 13.79	The software should copy the screen content of the workstation connected on the Ethernet with the DCMS to be shown on the Display wall in scalable and moveable windows in real time environment.
Boardroom Monitor	
TR 13.80	The display shall utilize LCD with backlit LED technology.
TR 13.81	The display shall be seventy inches (70”) diagonal at minimum.
TR 13.82	The display shall have a native resolution of UHD resolution.
TR 13.83	The display shall have an aspect ratio 16:9.
TR 13.84	The display shall display a minimum contrast ratio of 1500:1.
TR 13.85	The display shall be equipped with a media USB for direct plug and play from USB
TR 13.86	The display shall have a built-in or external tuner.
TR 13.87	The display shall be a commercial grade product.
TR 13.88	The display shall have a built-in low profile speaker.
TR 13.89	The display shall have a typical brightness greater than 300 cd/m^2.
TR 13.90	The net weight of the display shall be less than 100 Kgs.
TR 13.91	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.92	The boardroom monitor shall equipped with at least one (1) of each input format including HDMI, Display Port, and Ethernet (RJ45).
TR 13.93	The boardroom monitor shall be operational in temperature between ten degrees Celsius (10°C) to forty degrees Celsius (40°C).
Collaboration System	
TR 13.94	The collaboration system shall be user friendly with no more than 3 steps for setup.
TR 13.95	The collaboration system shall be able to transmit HD video and audio.
TR 13.96	The collaboration system shall have security encryption protocols in safe and secure wireless transmission of data.
TR 13.97	The collaboration system shall support auto scaling to fill entire screen of any display size.
TR 13.98	The collaboration system shall support a local LAN connection between transmitter and receiver, without having to ride on corporate LAN, and still maintaining capability to connect to corporate LAN as needed.
TR 13.99	The collaboration system shall be is a small form factor easy for installing in small tight spaces.
TR 13.100	The collaboration system shall support mobile connection via app.
TR 13.101	The collaboration system shall not require software to be downloaded in user laptop or computer to allow sharing of contents.
TR 13.102	The collaboration system shall have the capability to accept software update through network.
TR 13.103	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.

TR 13.104	The collaboration system shall communicate via its own independent Wi-Fi or network LAN.
TR 13.105	The signal transmitter and receiver pair shall be operable between 10°C and +40 °C / 10% to 90%, non-condensing.
Teleconferencing System	
TR 13.106	The Teleconferencing System shall use a telecommunications channel to link people at multiple locations.
TR 13.107	The Teleconferencing System shall be interactive to provide two-way communications.
TR 13.108	The Teleconferencing System shall have conference phone with speaker that delivers performance required for the application and area.
TR 13.109	The Teleconferencing System shall use an audio signal processor that serves as the platform for the teleconference to integrate with the room audio system and control system.
TR 13.110	The Teleconferencing System shall have feature set for SIP-based VoIP platforms.
TR 13.111	The Teleconferencing System shall reduce listener fatigue by turning ordinary conference calls into crystal-clear interactive conversations.
TR 13.112	The Teleconferencing System shall deliver high-fidelity audio from 160 Hz to 22 kHz.
TR 13.113	The Teleconferencing System shall capture both the deeper lows and higher frequencies of the human voice for conference calls that sound as natural as being there.
TR 13.114	The Teleconference phone shall feature a large multi-line high-resolution LCD display with at least 3’ screen size and at least 4 line keys. All IP phones shall be IPv4 and v6 compliant and shall be compatible with the EPABX that will be procured as part of this project.
TR 13.115	The phone shall be able to store contacts with quick dial feature.
TR 13.116	The teleconferencing system shall have configurable software.
TR 13.117	The Teleconferencing System shall support network power (POE) or DC power supply.
TR 13.118	The Teleconferencing System shall support 10/100/1000 Ethernet network.
TR 13.119	The Teleconferencing System shall be operational in temperature between ten degrees Celsius (10°C) to forty degrees Celsius (40°C).
Video Conferencing (VC) System	
TR 13.120	The VC system shall allow live visual connection between two or more people residing in separate locations for the purpose of communication. The VC system shall be integrated with the EPABX system being provided as part of this project.
TR 13.121	The VC system shall be flexible, provides interactive content collaboration to distant teams.
TR 13.122	The VC system shall support transmission of full-motion video images and high-quality audio between 2 or more locations.

TR 13.123	The VC system shall support multipoint videoconferencing which allows three or more participants to sit in a virtual conference room and communicate to each other.
TR 13.124	The VC system shall have the following capabilities: white boarding, annotating, and application sharing from a computer or tablet. All shall be included as part of a comprehensive, collaborative video session.
TR 13.125	The VC system shall have innovative facial-tracking algorithms/push-to-talk option to accurately frame all room participants.
TR 13.126	The VC system shall support 16:9 and 4:3 aspect ratio, automatic gain control, and intelligent audio mixing.
TR 13.127	The VC system shall support multiple video sources.
TR 13.128	The VC system shall have the capability to zoom in and follow the person speaking.
TR 13.129	The VC system camera shall offer brilliant visual clarity with a HD sensor, and shall be available with 12x zoom and a wide-angle lens adapter.
TR 13.130	Participants shall be able to have the following feature controls using Remote Control or GUI of video system or through the video conferencing MCU: • Mute My Line / Unmute My Line • Increase Broadcast Volume / Decrease Broadcast Volume • Mute All Except Me / Cancel Mute All Except Me • Change Password • Mute Incoming Participants / Unmute Incoming Participants • Play Help Menu • Enable Roll Call / Disable Roll Call • Roll Call Review Names / Roll Call Stop Review Names • Terminate Conference • Start Personal Layout • Change To Chairperson • Increase Listening Volume / Decrease Listening Volume • Override Mute All • Start Recording / Stop Recording / Pause Recording • Secure Conference / Unsecured Conference; and • Show Number of Participants
TR 13.131	The VC system camera shall be mountable on flat panel display or on a shelf in the cart.
TR 13.132	Controls of the VC system shall be accessed via the room control system to maintain a single source for control.
TR 13.133	The VC system shall include a codec, camera, microphone with option to extend additional microphone/s and remote controller for user control.
TR 13.134	The VC system UI shall be intuitive and easy to use.
TR 13.135	The VC system shall support following video standard protocols: • H.261/H.263/H.264 AVC • H.263/H.264 video error concealment

TR 13.136	The VC system shall have at a minimum, the following audio and video inputs; • 2 x camera • 3 x USB Any converters required for video display shall be provided by the MSI.
TR 13.137	The VC system shall have at a minimum, the following other interfaces; • 2 x USB 2.0
TR 13.138	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.139	The VC system shall use 1 x 10/100/1000 Ethernet and support IPv4 and IPv6.
TR 13.140	The VC system shall be operational in temperature between ten degrees Celsius (10°C) to forty degrees Celsius (40°C).
Monitors	
TR 13.141	The monitor shall be of LED flat panel screen technology with following size; • 24-inch diagonal • Widescreen format (16:9 aspect ratio) • Thin bezel not exceeding ½ inch • HD 1920x1080 resolution • Minimum input of 1xDP, 1x HDMI, 1xDVI • Energy Saving • Allow tilt and swivel motion • Black colour
TR 13.142	The monitor shall have high refresh rate to eliminate screen flicker causing eyestrain and headache.
TR 13.143	The monitor shall support the same refresh rate as the workstation video card.
TR 13.144	The monitor shall have response time sufficient to limit ghosting in video, in particular on detail video monitor.
TR 13.145	The monitor shall have accurate depiction of colour to enable distinction of colour coding used in display content, and video monitors).
TR 13.146	The monitor shall have highly focused distortion-free images, to enable accurate reading of map detail and distinction of items close to one another on display content.
TR 13.147	The monitor shall have even level of brightness across entire screen.
TR 13.148	The monitor shall have good colour convergence on all points of screens; no bleeding out of colours at the edges of characters.
TR 13.149	The monitor shall have anti-glare screen.
TR 13.150	The monitor shall have adjustment controls (e.g., brightness/contrast) easily accessible, easy to locate and easy to use.
TR 13.151	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.152	The monitors shall be operational in temperature between ten degrees Celsius (10°C) to forty degrees Celsius (40°C).
TR 13.153	The monitor shall be designed for Designed for 24/7 operations over 5 year period.

Ceiling Speakers	
TR 13.154	The ceiling speakers shall have high power and high sensitivity with extended frequency responses.
TR 13.155	The ceiling speakers shall have wide, controlled constant directivity dispersions for optimum coverage.
TR 13.156	The ceiling speakers shall have output of at least 15W peak. They shall have in-built amplifiers or shall be supported by an external amplifier.
TR 13.157	The ceiling speakers shall have a conical coverage pattern of at least 105 degrees (1kHz – 6 kHz).
TR 13.158	The ceiling speakers shall be in a colour to match the ceiling and surrounding interior design.
TR 13.159	The ceiling speaker shall have a diameter not greater than 8.5”.
TR 13.160	MSI shall quantify and space speakers to provide full audio coverage within the operation room and boardroom.
TR 13.161	The ceiling speakers shall follow the manufacturer recommendation for connectivity.
TR 13.162	The Ceiling Speakers shall automatically adjust the output audio level based on ambient noise. This may require either in-built noise sensors with the ceiling speakers or an independent ambient noise monitoring system.
TR 13.163	The ceiling speakers shall be operational in temperature between ten degrees Celsius (10°C) to forty degrees Celsius (40°C).
Room Control System including Panel	
TR 13.164	The boardroom and the operations room shall have their independent room control systems. All systems including shadowing, lighting, HVAC, audio etc being provided as part of the ACC shall be integrated using this room control panel.
TR 13.165	The room control systems shall support a minimum of 7” touch panel display.
TR 13.166	The touch panel displays shall support a resolution of 1920 x 1080.
TR 13.167	The touch panel displays shall be desk mount with a cradle.
TR 13.168	The touch panel displays shall be wireless.
TR 13.169	The touch panel interfaces shall be intuitive and easy to use.
TR 13.170	The touch panel displays shall support full battery operations.
TR 13.171	The touch panel displays shall support full motion video preview and monitoring.
TR 13.172	The room control processors shall support secure industry standard communication protocols.
TR 13.173	The room control processors shall support the required number of ports for connection with variety of device following contract documents.
TR 13.174	The room control processors shall support 10/100/1000 Base-T.
TR 13.175	The room control processors shall support Ethernet-controllable devices.
TR 13.176	The room control processors shall support automatic clock synchronization.
TR 13.177	The room control panels shall support control system synchronization.

TR 13.178	The room control panels shall support multi-level password protection.
TR 13.179	The room control panels shall support an easy to use browser based user interface.
TR 13.180	The room control system hardware shall be rack mountable.
TR 13.181	The room control systems shall integrate with other non-AV systems in the room. This includes and not limited to window coverings and lights in both the operations room and boardroom.
TR 13.182	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.183	The room control system shall be operable between 10 °C and +40 °C / 10% to 90%, non-condensing.
Operator Console	
Materials	
TR 13.184	Consoles are primarily a workspace that support operator workstations and monitors for monitoring various systems at the ACC, including the independent city systems and smart city platform. They maximize workspace for both the operators and communications staff, while meeting the ergonomic and occupational needs for staff working shift patterns with 24/7 coverage.
TR 13.185	All operator consoles shall be designed to meet the shape, dimensions, and orientation requirements within the Operations Room.
TR 13.186	The consoles shall satisfy the functional, aesthetic and ergonomic requirements of the working environment of the Operations Room staff.
TR 13.187	All console materials and components shall be of sufficient design, manufacturing, and operational quality to provide dependable and durable performance for constant use 24 hours a day, every day of the year.
TR 13.188	The consoles shall provide work surfaces with multiple vertical locations (stand / sit system) - standing height, work surface height, and below work surface height.
TR 13.189	The consoles shall be of a modular design, allowing for future equipment and room layout configurations.
TR 13.190	The consoles shall be fabricated to meet or exceed recognized industry quality standards (e.g., ANSI/BIFMA or equivalent).
TR 13.191	The consoles shall be designed to accommodate a variety of computer displays, communications and operator interface devices and include appropriate power and data cabling management for said devices.
TR 13.192	Each console shall be capable of accommodating, as a minimum: • Operator desk and chair • Three (3) wide-screen 610 mm (24 inch) LED monitors • One (1) standard keyboard • One (1) standard mouse • One (1) set of headset jacks mounted underneath desk • One (1) VOIP telephone • One (1) two-way radio (future) • Free space for paperwork • Desk slats for binder/manual storage; and • One (1) large file drawer for storage

TR 13.193	A selection of finishes shall be available for all console components. The console provider shall provide sample finishes to coordinate with the Operations Room environment, millwork, aesthetics, and the adjacent Cabin / Boardroom furniture finishes.
TR 13.194	All console components shall include trim pieces including fillers, connectors, full or partial end trims, top caps, etc. as required to create a professional appearance.
TR 13.195	All consoles and components shall not display manufacturer or vendor logo, name, or equivalent signage and nameplates.
Structure	
TR 13.196	Each console main structure shall be constructed of thick wall custom profile extruded aluminium alloy, or structural equivalent (e.g., 10 gauge steel).
TR 13.197	Structural assembly components (e.g., cabinet frames) shall be constructed of precision-tooled cold-rolled steel, or structural equivalent, and finished with durable electrostatic powder coat finish, or equivalent.
TR 13.198	Levelling glides shall provide a maximum height adjustment of up to 64 mm (2.5 inch) for each console and component.
TR 13.199	Structural assembly components shall be bolted as required to the raised floor tiles through the carpet tiles at locations a minimum of 305 mm (12 inch) from any floor access or other floor service location.
TR 13.200	Consoles shall provide work surface stability at all vertical positions including full height (stand) position, via suitable structural components such as a third leg.
Mounting System	
TR 13.201	Each console shall furnish a mounting system consisting of either a work surface mount (with articulated arm) or slat wall mount (with double pivoting articulating arm).
TR 13.202	Mounting systems shall be available from 174mm to 522mm in height utilizing a vertical stackable option in incremental heights above the console work surface.
TR 13.203	Stacking elements shall be load-bearing on all tiers and shall use like parts as base panels (i.e. skins, electrical, horizontal beams, etc.) to create a professional appearance.
TR 13.204	Mounting systems shall be capable of being equipped with a maximum of three (3) monitor arms at each console. Monitor arms shall be removable and interchangeable with other consoles. Monitor arms shall be easily moveable horizontally across the mounting system if slat wall mount is used.
TR 13.205	Each monitor arm shall be capable of supporting a variety of typical LED monitor sizes and types (including iPads and other types of tablets) weighing up to and including 23 kg (50 lbs).
TR 13.206	Each monitor arm shall have swivel, tilt, and height-adjustable capability with appropriate positive friction or mechanical locking mechanism to maintain the desired positions and orientations. Monitor arms should be single touch adjustable for ease of use.
Wiring and Cabling	
TR 13.207	Special components shall not be required to bring power, data, and communication wiring into consoles.

TR 13.208	The console placements in the Operations Room and dimensions shall be adjusted accordingly to integrate all cabling service entry accesses in the floor.
TR 13.209	Consoles shall not obstruct or interfere with any raised floor access location cabling services or functionality.
TR 13.210	All consoles shall provide suitable provisions to regain reasonable access to each raised floor access location to preserve the ability to install future power/cabling services into the console via cabling service entry accesses in the floor.
TR 13.211	Each console shall provide a built-in cable management system that accommodates two (2) wiring runs, one (1) for power and one (1) for data and communication (e.g., through hollow leg space or other hollow spaces in the structure).
TR 13.212	Cable management system shall provide continuous and appropriate components to protect all cables, including those connected with extension cords, during height adjustable work surface vertical height transitions.
TR 13.213	The cable management system shall provide appropriate access points and continuous cable management throughout the entire console, including but not limited to: • All floor access locations; and • Entire height adjustable work surfaces of each console, including returns
TR 13.214	The cable management system shall be integrated, routed, and accessible to enable easy addition/removal of cables/wires in the future and shall not be interfered when adding or removing stacking elements.
TR 13.215	The cable management system shall have the capability to accommodate vertical cable runs in all stationary components neatly and internally.
TR 13.216	The cable management system in all stationary structures, bases, frames and components shall be capable of maintaining a minimum 51 mm (2 inch) bend radius required for any future cable.
TR 13.217	Power strips shall be durable metal construction or equivalent.
TR 13.218	Power strips shall not incorporate any surge, overload, or power on/off switch.
TR 13.219	Each console shall provide one (1) fully integrated sixteen (16) receptacle power strip mounted horizontally throughout the entire height adjustable work surface frame, accessible from the work surface.
TR 13.220	Each console shall provide two (2) fully integrated four (4) receptacle power strips mounted vertically at each back corner.
TR 13.221	Each console shall be provided with two (2) computer extension cables that shall connect workstations in the Rack Room to I/O endpoints at the consoles in the Operations Room. Extension cables may consist of powered cable extender units. Extension cables shall be a suitable length, fully shielded, and interface with video, mouse, keyboard, speakers, and microphone computer interfaces.
TR 13.222	Each computer extension cable shall provide the following connectors at the workstation end in the Rack Room: • One (1) HD-15/HDMI male video • One (1) USB female keyboard and DVI/HDMI adaptor • One (1) USB female mouse and DVI/HDMI adaptor

	• Two (2) USB female (spares) • One (1) 3.5 mm male speaker; and • One (1) 3.5 mm male microphone
TR 13.223	Each computer extension cable shall provide the following connectors at the height adjustable work surface end: • One (1) HD-15/HDMI female video • One (1) USB female keyboard and DVI/HDMI adaptor • One (1) USB female mouse and DVI/HDMI adaptor • Two (2) USB female (spares) • One (1) 3.5 mm female speaker; and • One (1) 3.5 mm female microphone
TR 13.224	Wiring and cabling details provided in this set of specifications are indicative only. The console provider shall confirm the wiring and cabling details with the AITL or their designate during the detailed design of the consoles.
Work Surfaces and Counters	
TR 13.225	All work surfaces shall be: • 25 mm (1 inch) minimum density core particle board or MDF thickness • 20 kg (44 lbs) minimum density core particle board or MDF • Utilize 3-ply construction with solid grade high pressure composite laminate
TR 13.226	All work surfaces and counters shall be finished in solid grade high pressure composite laminate with minimum thickness of 1.2 mm (e.g., 12 mm acrylic solid surface).
TR 13.227	All work surfaces and counters shall be available in curvilinear shapes including corner, extended corners, peninsula, visitor, spanner, linking, transitional, wave, and bridge designs.
TR 13.228	All work surfaces design shall incorporate ergonomic standards including knee well space, view/reach distances, and keyboard height.
TR 13.229	All work surfaces and counters shall be capable of supporting a minimum static load of 75 kg per linear meter (50 lbs per linear foot) at any vertical position.
TR 13.230	All work surface nosing edges, excluding joints, shall have a waterfall-type edge and finger pull.
TR 13.231	The console provider shall provide work surface, nosing, and edge styles, finishes, and construction material choices available for the same fixed lump-sum operations consoles contract price.
TR 13.232	Plastic laminate finish of all work surfaces and counters shall adhere to the minimum criteria for the resistance of wear, boiling water, high temperature, cigarette burns, fading, dimensional stability, staining, and uniformity of appearance.
TR 13.233	All joints required on a console's height adjustable work surface shall be even in height along the entire length of the joint to form a continuous working area/counter appearance.
TR 13.234	Work surfaces and work surface accessories shall accommodate cable routing, access, management and storage. Easy access to cable routing shall be provided via a system such as hinged panels with brush strip.

Height-Adjustable Work Surfaces	
TR 13.235	Each console shall provide height-adjustable work surfaces, enabling Operations Room staff to work from various vertical positions while sitting or standing. Slat walls (if used) shall automatically raise and lower at the same rate and distance as the work surface is raised or lowered.
TR 13.236	Each console's entire work surface shall be fully height-adjustable.
TR 13.237	Each console height adjustment system shall smoothly and evenly lift and lower all work surfaces together and provide the capability to stop at any time to provide a stable and secure work surfaces at any position within the height range of travel.
TR 13.238	The height adjustment system velocity shall be constant and virtually the same rate when lifting and lowering work surfaces.
TR 13.239	Cable management system shall function without requirement for manual alteration, as the work surfaced is height-adjusted. Cables during lift and lowering operation shall be controlled and protected via a suitable mechanism such as a flexible cable chain or equivalent.
TR 13.240	Sufficient space shall be provided between moving and stationary components for safe movement, with no pinch points.
TR 13.241	Each console shall provide reasonable maintenance and service access to height adjustment system electrical and mechanical components.
Desk Binder/Manual Storage	
TR 13.242	Each console shall have one (1) binder/manual storage unit above desk top.
Free Work Space	
TR 13.243	Each console shall have sufficient free work space for paper work on the console desk top.
TR 13.244	Free work space shall be at least 0.61 linear metres (2'-0" linear feet) of the console desktop.
Keyboard Trays	
TR 13.245	Each console shall have an ergonomic keyboard tray drawer installed underneath the desk workspace.
TR 13.246	Ergonomic keyboard tray drawers shall glide on steel ball bearings and shall be mounted with durable metal hardware.
Large File Drawer	
TR 13.247	Each console shall have one (1) large file drawer unit with lockable casters for storage below the desk top, minimum 305 mm (12 inch) high.
TR 13.248	As a minimum, the following drawer fronts construction material shall be available: • 17 mm (11/16 inch) particle board core with high-pressure laminate facing and edges • Steel with powder coated finish; and • Wood veneer with solid wood facing and edges
TR 13.249	Drawer glide shall be a minimum two-part precision steel ball bearing suspension, with cushioned stops, both in and out.

TR 13.250	File drawer is to expose a minimum of 100% of its overall length when fully extended from the console.
TR 13.251	File drawer shall have drawer bumpers to cushion and quiet the drawer.
TR 13.252	Drawer dividers and one (1) pencil tray shall be included in the file drawer. The pencil tray should be about 102 mm (4 inch) wide and 25 mm (1 inch) deep, and the length of the pencil tray shall be equal to the width of the drawer. The pencil tray shall be secured in the drawer in such manner to prevent its sliding during the operation of the drawer.
TR 13.253	File drawer shall be provided with compressor/hanging rails for side-to-side filing.
TR 13.254	File drawer shall accommodate legal and letter paper filing.
Reliability	
TR 13.255	Consoles shall be designed for high durability and performance.
TR 13.256	Consoles shall be warranted for 24/7 use.
Operator Workstations	
TR 13.257	The workstations shall be rack mounted with only keyboard, video, mouse at the operator console. The MSI shall neatly install the workstations at the designated rack locations in the rack room.
TR 13.258	Please refer to the Workstation Specification as mentioned under IT Infrastructure specification Section 2.2.11.1 for other details on the workstations.
Other Workstations	
TR 13.259	The other workstation requirements shall be as per the traditional desktop computer workstations that will be installed at individual desks. Please refer to the Workstation Specification as mentioned under IT Infrastructure specification Section 2.2.11.1.
Task Lights	
TR 13.260	Task lights shall maintain the required lux level (400-500 lux).
TR 13.261	The task lights shall have a professional appearance and ergonomic design to complement the console and Operations Room and Cabin / Boardroom aesthetics.
TR 13.262	Task lights cords shall be non-handed.
TR 13.263	Task lights reflector shade shall be designed to provide a glare-free lighting on work surfaces.
TR 13.264	Task lights shall be provided with a weighted base providing a minimum 340° arm rotation.
TR 13.265	The task light on/off switch shall be located in the front of the light for easy accessibility.
TR 13.266	All task lights shall use LED or low voltage lamps. Each task light shall be provided with two (2) suitable lamps. One (1) shall be installed for immediate use and one (1) shall be delivered to the ACC as a spare.
Multi-Functional Printers including Scanner	
TR 13.267	Printers shall be of latest laser technology & for duplex printing (colour and black and white) for all paper size including but not limited to A4 and A3.

TR 13.268	It shall have Print Speed 30ppm or above.
TR 13.269	It shall have Resolution Min 600 x 600 dpi or better.
TR 13.270	It shall have Memory 1 GB or higher.
TR 13.271	It shall have Copy speed 12ppm or better.
TR 13.272	It shall have scanner of Flat Bed type with ADF.
TR 13.273	It shall have Interface USB 2.0, Ethernet Port.
TR 13.274	It shall have the duty cycle of monthly 5000 pages at minimum.
TR 13.275	Full toner Cartridge shall be supplied with the printer.
TR 13.276	It shall have input tray capacity of minimum 100 sheets.
TR 13.277	It shall have output tray capacity of minimum 100 sheets.
TR 13.278	Printer shall be accompanied with the necessary accessories such as connecting cables, driver media, etc.
Contact Centre Solution	
TR 13.279	The contact centre solution shall include VoIP based PBAX, IVRS, phones among other hardware and software. Using the contact centre solution, citizens can contact AITL through the emergency communications system or through the contact centre helpline number.
TR 13.280	The contact centre solution shall be able to route voice/ VOIP calls from centralized Interactive Voice Response System (IVRS) to respective call centre (s) along with interaction history of the calling party.
TR 13.281	The callers shall be able to access the various services through state-of-art centralized integrated Interactive Voice Response System (IVRS). The information is envisaged to be available to the customer through telephone (IVRS) and call centres operators.
TR 13.282	The IVRS shall establish two way communication on the same channel with customers through recorded synthesized voice in Hindi / English / Marathi or in combination of languages to give information, reply to queries and provide other. Number of concurrent users shall be approximately 15.
TR 13.283	IVRS shall be modular and scalable in nature for easy expansion without requiring any change in the software.
TR 13.284	It shall be possible to access IVRS through any of the access devices such as Landline telephone, Mobile phone (GSM as well as CDMA) etc.
TR 13.285	IVRS shall support various means of Alarm indications in case of system failures, e.g. Functional error, missing voice message prompt, etc., and shall generate error Logs.
TR 13.286	The system shall have the ability to define business rules based upon which the system shall quickly identify, classify and prioritize callers, and using sophisticated routing, to deliver interactions to the best qualified operator in the any of the connected local/remote call centre, regardless of interaction channel.
TR 13.287	The application shall provide (Computer-Telephony Integration) CTI services such as:

	• Automatic display (screen pop) of information concerning a user/customer on the call operator screen prior to taking the call based on ANI, DNIS or IVR data. • Synchronized transfer of the data and the call to the call centre operator. • Transfer of data corresponding to any query raised by any IP operator regarding a query raised by a customer whose call is being attended by the call IP operator. • Call routing facilities such as business rule based routing, skills-based routing etc.
TR 13.288	The application shall support integration to leading CTI middleware vendors.
TR 13.289	It shall provide pre-integration with industry standard IVR servers and enhance routing & screen-pop by passing forward the information.
TR 13.290	It shall provide facilities for outbound calling list management, and software based predictive or preview dialling for at least 5 outbound dialling ports as a minimum.
TR 13.291	The application shall allow service level plans to be varied by day, time of day, or a specific date.
TR 13.292	Call Centre Operator's Desktop: The operators desktop shall have an application which shall fulfil the following functionalities: • It shall provide consistent operator interface across multiple media types like fax, SMS, telephone, email, and web call back. • Operator shall have VoIP based telephones (with digital display pads) on the workstation with wireless headsets. • It shall provide the operators with a help-desk functionality to guide the operators to answer a specific query intelligently. • It shall also provide an easy access to operators to previous similar query which was answered successfully. • It shall also be possible to identify a request to be a similar request made earlier. • It shall be possible for operators to mark a query as complex/typical and put in to database for future reference by other operators. • It shall be possible for operators to escalate the query.
TR 13.293	IVRS shall be able to get information /text/data from databases, convert to voice, and speaks it back to the caller in relevant/desired language.
TR 13.294	IVRS shall maintain log of all services offered which can be used for audit and analysis purpose.
TR 13.295	System shall provide for 100% recording of calls using a call logger. The recording shall contain detailed call information and the solution must provide advanced searching capabilities.
TR 13.296	Call Centre representative must have view to unified screen giving both network & service view.
TR 13.297	There shall be enough provision for supervisory view supported by Supervisory terminals.

TR 13.298	System shall be able to integrate with e–mail / sms gateway so that appropriate messages can be sent to the relevant stakeholders after the interaction and any updates thereon.
TR 13.299	Shall intelligently and automatically responds to email inquiries or routes inquires with skills based routing discipline to operators.
TR 13.300	Shall have an Intelligent distribution of email to operators.
TR 13.301	System shall be able to route emails to the Call agent using single system, based on the availability and skills and shall be able to send auto-acknowledgement.
TR 13.302	System shall provide unified agent licenses to handle voice calls and emails.
TR 13.303	System shall support auto-forward capabilities to pre-defined cell phone numbers i.e. auto patching.
TR 13.304	System shall support single solution for inbound calls, outbound calls and emails handling and intelligently route the calls to available call agent.
EPABX System	
TR 13.305	It shall have provision for at least 100 IP Phone extensions for 45 Call Takers, 25 Dispatchers, 20 for CCD, 10 for Supervisors/Manager etc. (Total – 100). Expandable to 150 Extensions.
TR 13.306	It shall have 6 Party Internal/External Multi group Tele-conferencing facility to all the Call Takers, Dispatchers and Supervisors/ Managers etc.
TR 13.307	It shall support all the standard features like Call Transfer, Call Forward, Call pick-up, Call hold, Call Barge-in etc.
TR 13.308	At minimum, it shall have 1 Trunk Card of 8 lines with CLI to connect Land Line / GSM Phones.
TR 13.309	It shall have ISDN PRI Cards 4 Nos. at minimum that shall be expandable for 8 Nos.
TR 13.310	It shall have PCM-TDM, IP, Non-blocking as technology.
TR 13.311	It shall support all Telecom interfaces.
TR 13.312	It shall have ISDN interface for digital & Basic interface for Analog lines.
TR 13.313	It shall support analog and IP/ Soft phone.
TR 13.314	It shall have maximum loop resistance of 1400 ohms or higher including telephone for analog extensions.
TR 13.315	It shall have Integrated Voice messaging system with required channels for IVRS function.
TR 13.316	It shall have Voice messaging-Pre-defined text to voice conversion information.
TR 13.317	It shall have an estimated wait time in case if all operators are busy.
TR 13.318	It shall have voice mail instructions to caller in case all the operators are busy.
TR 13.319	It shall have maximum loop resistance of 1200 ohms at –48 Volts DC for analog trunk lines.
TR 13.320	It shall have 6 party In and Out Multi group conferencing facility to be provided to all the Call Takers, Supervisor and Manager etc. (To be configurable Dynamically).

TR 13.321	It shall have Digital Extension telephone instrument with programmable one touch keys, Graphical display, Keys with LED, 4 Programmable keys with dual function,10 fixed function keys.
TR 13.322	It shall provide industry tested, proved and market leading switches to ensure smooth installation and protecting businesses existing call centre hardware investment.
TR 13.323	It shall support SIP based communications.
CTI Server, Data Base Server, Digital Voice Logger Server	
TR 13.324	It shall have latest compatible chipset supporting above processor.
TR 13.325	It shall have 64 GB memory (8x8 GB) DDR3/DDR4 -1066MHz registered ECC DIMMs & expandable to upto 1.5TB.
TR 13.326	The Server shall support 48 DIMM Slots or higher.
TR 13.327	It shall have features of advanced ECC memory protection and memory mirroring.
TR 13.328	It shall have 4* 500 GB 15K SAS 6Gbps 2.5in Slim-HS HDD (Hot swappable) scalable up to 16 drives.
TR 13.329	It shall have integrated hardware RAID controller and shall support RAID 0, 1 and 5 and should be provided with RAID Controller with 512 MB NV Cache.
TR 13.330	It shall have DVD-RW as an optical drive.
TR 13.331	The graphics controller shall be of minimum 8Mb memory.
TR 13.332	It shall have minimum 2 * 1 GbE & 2* 10Gbe network ports.
TR 13.333	It shall have minimum 4 PCI-E slots.
TR 13.334	It shall have ability to remotely configure machines completely with advance settings utility.
TR 13.335	It shall have redundant hot swap power supplies.
TR 13.336	It shall have minimum 4 hot-swap redundant cooling fans. Fans should automatically adjust speeds depending on the temperature inside the server chassis.
TR 13.337	The server shall be able to alert impending failures on maximum number of components. The components covered under alerting mechanism shall at least include Processors, memory, hard disk drives.
TR 13.338	Server shall support high availability clustering.
TR 13.339	It shall have maximum form factor of 4 U.
TR 13.340	The server shall come with systems management licensed software from the OEM with Remote Power On & Power Off, Remote KVM and other features.
Digital Voice Logger Server	
TR 13.341	The Recording should be done in HDD and archiving in back up media.
TR 13.342	It shall have at least 100 ports and expandable to additional 50 ports in future. The Recording shall be done from Digital extension side and it shall be recorded in digital voice logger which is capable to record calls between extension lines also.
TR 13.343	The Recorded voice shall be indexed and linked with Incident Report Number with real time and date. The voice logger shall have the CTI capabilities that will

	automatically track the incoming call. The recording shall go on till the call is disconnected.
TR 13.344	It shall be possible to configure automatic voice recording on answering the call by the Operator.
TR 13.345	It shall be based on the above mentioned server configuration with additional 500 GB of Hard disk, maximum 5U space and suitable OS and Software/ Hardware.
TR 13.346	Voice Logger software compatible with the call Centre package.
TR 13.347	Software & hardware required to record the wireless communication.
Automatic Call Distribution (ACD) Requirements	
TR 13.348	The ACD solution shall be able to route the call to any remote call centre operator using IP phones.
TR 13.349	It shall have an ability to queue or hold the call for an operator if none is immediately available.
TR 13.350	It shall have an ability to keep the callers informed as to the status of the call and providing information to callers while they wait in queue.
TR 13.351	System shall be able to perform prioritized call routing.
TR 13.352	It shall be possible to define Operator Preference options using: • Longest total time in idle state since login • Longest time in idle state since last status change; and • Longest total time since last ACD call • Alarms for callers in queue & Call-back message support
Call Transaction Log	
TR 13.353	A call transaction log for both inbound and outbound calls shall be created automatically by the CTI server while a call is received by the ACD system.
TR 13.354	The call transaction log shall be saved on the hard-disk of the active CTI server automatically while the call is dropped (Customer or operator).
TR 13.355	The call transaction log shall contain the following minimum information: • Time of call received into ACD • Time of call answered by operators • Time of call disconnect • Duration of call in ACD • Call handling time by the operators • Both source and destination operator ID • In case of call from PSTN, Trunk ID shall also be included • ANI and DNIS; and • User data from IVRS or Intelligent work station
TR 13.356	The CTI server shall be able to synchronize itself to the ACD Clock.
Supervisor Module	
TR 13.357	Any supervisor shall be able to monitor or control any group in the call Centre.

TR 13.358	It shall show the live activity of each operator in details as well as in a summarized fashion including information like total number of calls received, calls answered, average response time etc.
TR 13.359	The Supervisor console shall also graphically display live status of the call session summary, number of call waiting in the queue, call traffic etc.
TR 13.360	Live status of the group shall be shown, including waiting calls and calls being answered currently.
TR 13.361	Access to the supervisor console shall be restricted; and
Audit Trail	
TR 13.362	It shall have a comprehensive audit trail detailing every user activity including system/security administrators with before and after image.
TR 13.363	Audit trails presented by the system shall be very detailed with all the related fields, such as User ID, time log, changes made before and after, Machines ID etc.
TR 13.364	It shall have the facility to generate security report(s) and audit the whole process from logs reports at any future date. The system shall have complete audit trail of any changes to the system e.g. alert generated, system configuration etc.
TR 13.365	The system shall not allow audit log to be deleted and any attempts to delete must be logged.
TR 13.366	The system shall have at a minimum following standard reports: • List of users, user privileges and status • User sign-off and sign-on • User violation – unsuccessful logon attempts • User additions, amendments and deletions with before & after image
Network Time Protocol (NTP) based Digital Clock	
TR 13.367	The digital clock shall be synced with the Network Time Protocol (NTP).
TR 13.368	The Network Time Server (NTS) shall be a high-bandwidth NTP time server.
TR 13.369	The NTS shall synchronize with a GPS satellite.
TR 13.370	The NTS shall support a 50 nanosecond time accuracy to UTC.
TR 13.371	The NTS shall have minimum of 3 independent 10/100 Base-T ports.
TR 13.372	The NTS shall comprise of high resolution display.
TR 13.373	The NTS shall compliance with IPv6 and IPv4.
TR 13.374	The NTS shall have a secure web-based management application that is intuitive for easy control and maintenance.
TR 13.375	The NTS shall support SSH, SSL, SCP, SNMP v3, custom MIB, HTTPS and Telnet protocol.
TR 13.376	The NTS shall be equipped with USB ports.
TR 13.377	The NTS shall have independent/in-built time references: GPS, IRIG B, 1PPS, 10 MHz.
TR 13.378	The NTS shall have versatile timing outputs; IRIG B, 1PPS, 10 MHz.
TR 13.379	The NTS shall be easy to configure.

TR 13.380	The NTS shall be able to synchronize a minimum of 500 clocks.
TR 13.381	The NTS shall include GPS antenna.
TR 13.382	The GPS antenna shall be roof-top mountable.
TR 13.383	The GPS antenna shall be rugged and all-weather.
TR 13.384	The GPS antenna shall have amplifier: LNA +40 dB gain and bandpass filter for out-of-band interference rejection.
TR 13.385	The GPS antenna shall come with industry standard cable with low-loss, and capable for lengths of up to 1000 feet without signal degradation.
TR 13.386	The NTP digital clock shall display digital characters in red colour.
TR 13.387	The NTP digital clock shall retains time and date during loss of power and/or reference using a battery backed real-time clock (RTC) chip and maintenance-free rechargeable battery.
TR 13.388	The NTP digital clock shall support configuration of time zone and daylight saving time parameters.
TR 13.389	The NTP digital clock shall include a software utility which provides easy configuration of clocks and generators attached to network.
TR 13.390	The digital clock shall have fully configurable network settings, including DHCP/BOOTP/STATIC IP.
TR 13.391	The digital clocks configuration shall be saved to non-volatile memory and survives power losses.
TR 13.392	The digital clock shall have password protection that prevents unauthorized clock configuration tampering.
TR 13.393	The digital clock shall have option to display time in 12- or 24-hr format – hh:mm:ss.
TR 13.394	The digital clock shall have option to display date in mm:dd:yy, dd:mm:yy or yy:mm:dd.
TR 13.395	The digital clock shall have adjustable brightness levels.
TR 13.396	The time and date shall be visible at 350 feet (100 meters).
TR 13.397	The digital clock shall be wall-mountable and comes with required mounting brackets.
TR 13.398	The digital clock case shall be in black colour.
TR 13.399	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.400	The digital clock shall support 10/100/1000 Ethernet network.
TR 13.401	The digital clock shall have an operational temperature between Ten degrees Celsius (10ºC) to forty degrees Celsius (40ºC).
Matrix Switcher	
TR 13.402	The Matrix Switcher shall have a modular chassis with minimum 8 slots for I/O board insertion.
TR 13.403	The Matrix Switcher shall have a minimum of 16x16 I/O configuration.
TR 13.404	The Matrix Switcher shall support a wide selection of input and output boards that provides a variety of signal types and formats including analog, digital and control.

TR 13.405	The Matrix Switcher must support full digital signal routing of up to 1080p.
TR 13.406	The Matrix Switcher shall support signal transmission through CATx cable from transmitters and receivers.
TR 13.407	The Matrix Switcher shall have seamless switching between sources.
TR 13.408	The Matrix Switcher shall support HDCP.
TR 13.409	The Matrix Switcher must be compatible with all new AV devices.
TR 13.410	The Matrix Switcher shall be capable of audio breakaway.
TR 13.411	The Matrix Switcher shall have a simple and easy to use configuration software.
TR 13.412	The Matrix Switcher shall be capable of providing power to connected transmitter and receiver devices.
TR 13.413	The Matrix Switcher shall be rack mountable.
TR 13.414	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.415	The Matrix Switcher shall be operable between 10°C and +40 °C / 10% to 90%, non-condensing.
Wireless Microphone Systems	
TR 13.416	The wireless microphone shall be synchronized via RF remote channel.
TR 13.417	The wireless microphone shall be able to pick up audio from anywhere in the room, while maintaining quality audibility.
TR 13.418	The wireless microphone shall have a 24 MHz bandwidth (13 MHz for the E band).
TR 13.419	The wireless microphone shall have greater than 103 dB(A) signal-to-noise ratio.
TR 13.420	The wireless microphone shall have a Total Harmonic Distortion less than 1%.
TR 13.421	The wireless microphone shall support pick-up pattern applicable to table setup.
TR 13.422	The wireless microphone shall have frequencies tunable in steps of 25kHz.
TR 13.423	The wireless microphone shall incorporate a clip-on microphone and body pack.
TR 13.424	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.425	The wireless microphone shall use Radio Frequency for communication.
TR 13.426	The wireless microphone be operational in temperature between ten degrees Celsius (10°C) to forty degrees Celsius (40°C).
Audio Processor	
TR 13.427	The audio processor shall have auto switching/mixing capability.
TR 13.428	The audio processor shall accept microphone and line level signals.
TR 13.429	The audio processor shall support external volume and mute control.
TR 13.430	The audio processor shall have balance and unbalance signals.
TR 13.431	The audio processor shall be able to rack mount, shelf mount on cabinet or under desk.
TR 13.432	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.

TR 13.433	The audio processor shall be operable between 10°C and +40 °C / 10% to 90%, non-condensing.
Audio Distribution Amplifier	
TR 13.434	The audio distribution amplifier shall have balanced or unbalanced stereo or mono on a captive screw connector, unbalanced stereo or mono on RCA connectors and a 3.5 mm stereo mini jack.
TR 13.435	The audio distribution amplifier shall have an automatic clip limiter.
TR 13.436	The audio distribution amplifier shall have front panel bass, treble, and input level controls.
TR 13.437	The audio distribution amplifier shall be able to rack mount, shelf mount on cabinet, or under a desk as per design.
TR 13.438	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.439	The audio distribution amplifier shall be operable between 10 and +40 °C / 10% to 90%, non-condensing.
Audio Extractor	
TR 13.440	The audio extractor shall be HDCP compliant.
TR 13.441	The audio extractor shall be capable of HDMI/DP audio de-embedding with analog stereo and digital S/PDIF audio outputs.
TR 13.442	The audio extractor shall be capable of de-embedding audio with/without HDMI/DP outputs connected.
TR 13.443	The audio extractor shall have simultaneous analog stereo and digital S/PDIF outputs.
TR 13.444	The audio extractor shall automatically equalize input cables.
TR 13.445	The amplifier shall be able to rack mount, shelf mount on cabinet, or under a desk.
TR 13.446	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.447	The audio extractor shall be operable between 10 and +40 °C / 10% to 90%, non-condensing.
Distribution Amplifier	
TR 13.448	The distribution amplifier shall have HDMI or DP connector inputs.
TR 13.449	The distribution amplifier shall have at least two HDMI & DP connector outputs.
TR 13.450	The distribution amplifier shall be HDCP Compliant.
TR 13.451	The distribution amplifier shall continuously verify HDCP compliance.
TR 13.452	The distribution amplifier shall support computer-video to 1920x1200, including HDTV 1080p @ 60Hz and 2k.
TR 13.453	The distribution amplifier shall support HDMI& DP specification features including data rates up to 6.75 Gbps, deep colour up to 12-bit, Lip Sync, and HD lossless audio formats.
TR 13.454	The distribution amplifier shall equalize input cables automatically.
TR 13.455	The distribution amplifier shall have built-in scaling capability to match monitor display resolutions.

TR 13.456	The amplifier shall be able to rack mount, shelf mount on cabinet, or under a desk.
TR 13.457	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.458	The distribution amplifier shall be operable between 10 and +40 °C / 10% to 90%, non-condensing.
AV Auto Switcher	
TR 13.459	The AV auto switcher shall have automatic switching capability between inputs.
TR 13.460	The AV auto switcher shall meet the minimum number of video and audio ports to support the design as a minimum. And additional 2 video and 2 audio ports for future connection.
TR 13.461	The AV auto switcher shall be capable of audio breakaway.
TR 13.462	The AV auto switcher shall have automatic scaling output and can support up to HDTV 1080p.
TR 13.463	The AV auto switcher shall have multiple digital and analog input.
TR 13.464	The AV auto switcher shall be HDCP compliant.
TR 13.465	The AV auto switcher shall be easily configurable with user friendly interface.
TR 13.466	The AV auto switcher shall be able to rack mount, shelf mount on cabinet or under desk.
TR 13.467	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.468	The AV auto switcher shall be operable between 10 and +40 °C / 10% to 90%, non-condensing.
USB KVM Extender	
TR 13.469	The extender shall extend USB, keyboard, audio, video and mouse signals through a single cable CATx cable.
TR 13.470	The extender shall provide control on both the local and remote location. Controls include and not limited to video, keyboard, mouse and USB.
TR 13.471	The extender shall extend signals to a minimum distance of 300m via CATx cable.
TR 13.472	The extender shall automatically synchronizes the time delay of RGB signals to compensate for distance and support Auto Signal Compensation (ASC).
TR 13.473	The extender shall support high resolution video up to 1920 x 1200Hz (150 m); 1280 x 1024 at 300 m.
TR 13.474	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
TR 13.475	The extender shall support auto-negotiable 10/100/1000 Ethernet network.
TR 13.476	The extender shall be operational in temperature between ten degrees Celsius (10°C) to forty degrees Celsius (40°C).
Communication Cabinets with Racks	
TR 13.477	Please refer to the Communications Cabinet with Racks specifications as mentioned under IT Infrastructure Section 2.2.11.2.
Smart City Platform	
TR 13.478	The platform shall serve as the integration point for all infrastructure domains within the city, operating with strong security and high reliability for 24 hours per day and 7 days a week.

TR 13.479	The platform shall be operational with low network latency at all times. It shall have an inbuilt historian and shall provide real-time information, along with historical information and analytics.
TR 13.480	Management dashboard that provides the real-time status shall be automatically updated when certain actions, incidents and resources have been assigned, pending, acknowledged, dispatched, implemented, and completed. The above attributes shall be colour coded.
TR 13.481	Smart city platform shall include the following core components as a minimum: • Business Rules and SOP definitions – it shall enable users to define the business rules around incidents handling and emergency response as per the agreed SOPs with the Client for a smart city. • Platform – The platform shall provide a common data integration layer which can collect and contextualize information from disparate data sources regardless of individual source specific protocol. The platform shall support templatization to allow 'build-once-deploy-everywhere" functionality. • Incidents lifecycle engine – It shall manage the life cycle of incidents and related entities via pre-defined workflows. The workflow could cut across multiple systems via the interfacing modules. Workflow for operational alerts and escalations should be triggered automatically without human intervention. • Task management – It shall manage planning, preparation of an incident including resource allocation, task management, etc. • Analytics and MIS – It shall provide users with business analytics, reporting and tools to organize, evaluate and efficiently perform day to day operations. • Reports and dashboards – It shall provide filterable reports and dashboards about critical information pertaining to incidents and KPIs collated in a single view which can be drilled down further for more detailed information. • Security and Roles – It shall manage roles definition for internal and external access. • Historian: ➢ Platform shall have in-built function to store all platform related data for a user defined period of time. ➢ The platform data store shall support high-speed data acquisition and efficient data compression. The data compression for the data storage functionality shall not use any algorithms that do not allow for the storage of the tag data at their scanned rate. The stored data records shall be able to recreate the process data without any losses. ➢ The platform shall provide a real-time relational database storage for long-term storage of process data. The data store shall enable the storage of real-time and historical data for each analog, discrete or string tag name. It shall also store summary, event, alarm and configuration data. ➢ The platform data store shall have store and forward capability. If the data store is offline or unreachable, the engine servicing active objects shall store data locally, and forward the buffered data to the data store with time stamps and quality information when the data store server is available.

	• Centralized data archiving for operational data – It shall provide facility for centralized storage of operational data (time series or transactional) with high granularity and data compression capabilities. • Mobility – It shall enable operators and the crew members to access the workflow task assigned to them and act using the native mobile application. They should be able to close the loop of workflow by acknowledging the real time status of action assigned to them.
TR 13.482	The platform shall have cross functional workflows with ability to communicate between people, devices and systems.
TR 13.483	The platform software provided shall consist of Human Machine Interface (HMI) system with support for supervisory and process control, real-time data acquisition, alarm and event management, historical data collection, report generation, local or remote telemetry communications to PLC's/RTUs and internet/intranet access.
TR 13.484	The platform shall allow the operators to develop customizable SOP templates based on actual requirements.
TR 13.485	The platform shall be able to issue, log, track, manage and report on all activities underway during these modes of operation: • anticipation of incident • incident or crisis • recovery; and • incident simulation
TR 13.486	The platform shall allow creation of hierarchy of incidents and be able to present the same in the form of a tree structure for analysis purposes.
TR 13.487	The dashboard content and layout shall be configurable and information displayed on these dashboards shall be filtered by the role of the person viewing dashboard.
TR 13.488	The platform shall provide complete view of facilities, sensors, and alarms in an easy-to-use and intuitive GIS-enabled graphical interface with a powerful workflow and business logic engine.
TR 13.489	The platform shall integrate with GIS and map information and be able to dynamically update information on the GIS maps to show status of resources.
TR 13.490	The platform shall have the ability to extract data in desired formats for publishing and interfacing purposes.
TR 13.491	The platform shall have mobility devices & applications for field staff to ensure fast restoration of services in case of alarms & issues. In case of non-attending of alarm, decision escalations will be done automatically. After closure of issue, the workflow shall be closed with feedback from those devices.
TR 13.492	The platform shall have tightly integrated System to have all relevant information of all assets in Smart City Area to give real time status of assets & update automatically in case of failure. Note that as part of this project, an asset management system is being provided via the ERP system. Some of these functionalities shall be met using the asset management system provided as part of the ERP system.
TR 13.493	All data on the platform shall provide ability to attach documents and other artifacts to incidents and other entities.

TR 13.494	The platform shall use a hybrid architecture consisting of cloud computing and local storage and processing. In general, active data and direct feeds shall be processed and stored in local servers; historical information shall be stored on the cloud.
TR 13.495	The platform server shall be backed up at least once a day.
TR 13.496	It shall be possible to combine the different views onto a single screen or a multi-monitor workstation.
TR 13.497	The platform shall provide possibility to connect to workstations in order to be displayed in one or more video wall with one or more module/application/solution being independently and/or simultaneously being displayed and functional. The platform shall be customizable, scalable, and flexible for integration of all City Systems.
TR 13.498	The platform shall maintain a comprehensive and easy to understand audit trail of read and write actions performed on the system.
TR 13.499	The system shall also provide an integrated user interface to other third party information systems part of other packages (if any).
TR 13.500	The smart city platform shall take feeds/inputs from various sensors, citizens, real-time systems, processed data and legacy data to enable proactive monitoring, analytical prediction and cross-system communications for making an intelligent city. In terms of analysis, using this platform, the city can achieve analytics, big data analytics, business intelligence and real-time event processing. Through this platform, various 'mined' information can be shared with city officials and citizens in form of reports, dashboards, standard APIs and open-data. The platform should also allow the manufacturers of the sensors to develop integrations themselves using SDKs without affecting the applications and existing integrations. It shall also leverage an in-built IoT layer which will enable realization of all desired functionalities of the RFQ cum RFP. This IoT layer shall integrate and enable cross system communications along with all analytics features desired as part of the RFQ cum RFP for various IoT devices being installed as part of the project at present and in future.
TR 13.501	The platform shall integrate devices using their respective APIs into this platform. It shall be able to integrate any type of sensor immaterial of the technology or vendor of the respective sensor and application.
Platform Software	
TR 13.502	Platform software shall be capable of processing all inputs from all City Systems, including active data and direct feeds, with low network latency.
TR 13.503	The platform software shall provide output to the DCMS in DCMS-compatible formats – eg., webpages and H.264.
TR 13.504	Tools for data collection and analysis, monitoring and control all services Tools shall include, but not limited to: • Applications on the platform to process inputs from select City Systems; and • Remote control software to directly monitor and control select City Systems at the facilities.
Platform Hardware	
TR 13.505	The platform hardware shall be housed within the ACC Rack Room.
TR 13.506	The platform hardware shall consist of multiple components including servers, storage, racks, networking systems, other IT equipment, policy-based security

	systems, along with supporting HVAC systems, mechanical systems, and electrical systems.
TR 13.507	City Systems using the local servers and storage shall have network connections to the platform hardware.
TR 13.508	The platform servers shall be designed such that no more than 50% of the server's hardware performance (RAM, processors, storage, etc.) is being used at any given time.
Video Display Wall	
TR 13.509	The dashboard shall be capable of simultaneously displaying one (1) to one hundred (100) independent sets of information on the video display wall. Specific outputs to be displayed shall be chosen by operators.
TR 13.510	The platform shall have the ability to automatically reconfigure the video display wall based on thresholds being met on user defined analytic parameters.
Operator's Workstation, Manager's Workstation and Boardroom Display	
TR 13.511	Platform visuals shall be displayable as an individual window, or as combination of several windows of information on the operators' workstation, manager's workstation, and boardroom display.
Electrical	
TR 13.512	The AC input power shall be 110-240 VAC +/- 10% at 50/60 Hz +/- 1Hz.
Communications	
TR 13.513	The platform hardware shall have Ethernet communications for device management. All the equipment shall support 10/10/1000 Ethernet network.
TR 13.514	The platform hardware shall support connections of upto 1000 Mbps bandwidth.
Environmental	
TR 13.515	The platform shall be operational in temperature between ten degrees Celsius (10°C) to thirty five degrees Celsius (35°C).
Local On-Site Servers	
TR 13.516	Please refer to the Servers specifications as mentioned under IT infrastructure Section 2.2.11.3.
Other Specification	
Lighting	
TR 13.517	All overhead lighting shall be LEDs both recessed direct and indirect lighting, including pot-lights.
TR 13.518	The overhead lighting treatment shall be incorporated into the other ceiling elements to create an aesthetic specialty ceiling design, in combination with the Rooms.
TR 13.519	Overhead lighting intensity shall be: • For Operations Room: atleast 400 lux • For Cabin/Boardroom: atleast 500 lux • For Rack Room: atleast 500 lux
TR 13.520	Dimming control shall be continuous (all lights dimmable) and zone-based (with a minimum of 4 lighting zones on separate circuits).

TR 13.521	Dimming control shall have various configurations preset for the ideal operations lighting environment, based on the perimeter glass wall natural lighting conditions (e.g., sunny, cloudy, partly cloudy, night, etc.).
TR 13.522	Appropriate wall boxes for corresponding dimmer size shall be provided. Dimmers shall not be ganged in one box.
TR 13.523	Manual switches shall be used for on / off lighting control and for overriding any preset lighting configurations.
TR 13.524	Cover plates for switches shall match the colour of switches, receptacles, and receptacle cover plates. Cover plates shall be of the same manufacturer as the devices.
TR 13.525	All lighting fixtures shall be of high-grade quality over and above the standard level of quality for office lighting.
TR 13.526	Lighting arrangement shall accommodate console locations.
TR 13.527	Lighting shall be configured in order to reduce glares and reflections on console monitors and on the video wall, as well as accommodate any other lighting needs the monitors and video wall may have.
Ceiling	
TR 13.528	The specialty ceiling treatment shall incorporate the following as a minimum: • Overhead lighting • Suspended audio system components (e.g., speakers) • Fire / CO alarms • Wet sprinklers; and • Sound absorption ceiling tiles
TR 13.529	In the Operations Room, the specialty ceiling treatment shall also accommodate a fill-in wall partition between the upper edge of the video display wall and the ceiling.
TR 13.530	In Rack Room, the ceiling shall be open (to the concrete slab) to allow access to cable and fibre infrastructure and HVAC system. The ceiling slab shall be reinforced to support the fully loaded weight of cable trays, fibre trays, and the overhead electrical (power) raceway. Each of these will be securely fastened to the ceiling slab with either uni-strut bars or hangers and threaded rods.
Floors	
TR 13.531	Flooring with proper acoustic treatment shall be used to reduce the impact sound by at least 14dB.
TR 13.532	A 12 in / 0.30 m raised floating floor shall be installed, bolted to the understructure (i.e., pedestals).
TR 13.533	The raised floating floor shall have the ability to be accessed from any location within the Operations Room and Cabin / Boardroom.
TR 13.534	The baseboard treatment shall extend to conceal the 12 in / 0.3 m raised floating floor.
TR 13.535	The raised floating floor shall be capable of supporting general loading of 600 – 1200 kg / m^3 (123 – 245 lb / ft^2).
TR 13.536	The raised floating floor shall be capable of supporting in excess of the concentrated static loading of the consoles, video wall and loaded equipment racks.

TR 13.537	The raised floating floor shall be grounded.
TR 13.538	The pedestal / supporting structure for the video wall shall be fastened to the concrete slab floor.
TR 13.539	Stub conduits shall be installed in the concrete slab floor (underneath the raised floating floor) of the Operations Room.
Glass Partition Walls	
TR 13.540	The Glass partition walls to be provided between the Board Room/Cabin and Operations Room shall be made up of 12mm toughened laminated glass with frame-less structure.
TR 13.541	The glass partition shall be supported by 600mm high Modular metal partition (having the same finish as that of wall cladding) from the floor.
TR 13.542	Proper structure shall be made to ensure the fixing of glass from slab above false ceiling and flooring.
TR 13.543	Safety film shall be applied on the glass to avoid shattering.
TR 13.544	Glass shall be fitted on anodized extrusion with tool less technology and shall have a provision for replacing glass with perforated sheet/acoustic tile by removing the glass.
Environmental Conditions to be Maintained inside ACC	
Temperature	
TR 13.545	The temperature level shall be set at 23°C +/- 1°C.
TR 13.546	The temperature shall be digitally controlled by the building automation system; however, the occupants shall have the ability to override the automated set room temperature with a manual control in the room.
Humidity	
TR 13.547	Relative humidity level shall be constant and set to 45% - 55%.
Ventilation	
TR 13.548	The base building specifications i.e AURIC Hall EPC contractor shall cover general pressure requirements.
TR 13.549	The normal pressure shall be maintained.
Acoustics	
TR 13.550	A high level of noise will be generated by ACC activities, therefore sound insulation and sound absorptive measures shall be installed in the Operations Room & Cabin / Boardroom (e.g., ceiling panels / tiles, wall panels).
TR 13.551	In order to mitigate acoustic issues, floor to slab construction is required for all walls and partitions.

3 Detailed Scope of Work

3.1 MSI Scope of Services - Overview

The Project requires turnkey services wherein the MSI shall broadly cover the following main scope of services:

- Design;
- Supply;
- Install;
- Test;
- Integrate;
- Commission; and
- Operations and maintenance.

The subsequent sections detail out the scope with respect to execution of this Project. The MSI shall note that the activities defined within scope of work mentioned are indicative and may not be exhaustive. MSI is expected to perform independent analysis of any additional work that may be required to be carried out to fulfil the requirements as mentioned in this bid document and factor the same in its response.

The following Exhibit 17 presents the detailed scope of services that have to be carried out as a part of the contract.

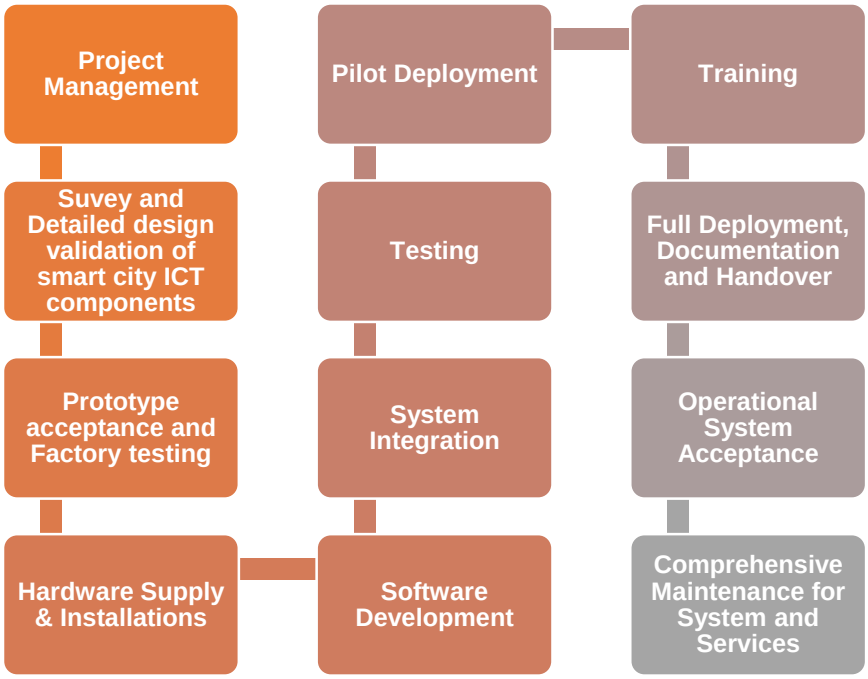


Exhibit 17: Detailed Scope of Work

3.1.1 Project Management

MSI shall be responsible for end to end project management for the implementation and maintenance of the smart city ICT components. MSI shall deploy a competent team of experts for project management which shall include a Project Manager along with a deputy.

The Project Manager shall be the single point of contact that shall assume overall responsibility of the Project and ensure end to end working of the Project. He shall function as the primary channel of communication for all Client requirements to the implementation team. In case of any absence of the project manager (sickness or vacation), the MSI shall ensure that an alternate project manager (as approved by the client or its representative) shall be provided during the absence period.

MSI shall be responsible for preparing a master schedule of work which shall highlight implementation plan for all the Project milestones. The schedule shall identify the manufacture, delivery, installation, integration of equipment (Software and Hardware), training programs, test procedures, delivery of documentation and the respective solutions. The schedule shall also show Client and any third party responsibilities along with the activities in the timeline. MSI shall conduct bi-weekly meetings between the Client (and/or its representative) and the 'key personnel' to discuss project progress and implementation in Delhi, Mumbai or Aurangabad. All key personnel associated with the project shall also be available for meetings whenever asked by the Client or its representative.

MSI shall also be responsible for effective risk and issue management and escalation procedures along with matrix as part of project management. MSI shall identify, analyse, and evaluate the project risks and shall develop cost effective strategies and action plan for mitigation of risks. As part of the Project MSI shall monitor, report and update risk management plans and shall be discussed during project meetings.

MSI shall prepare minutes of every meeting which takes place and submit to Client or its representative for tracking of the Project. MSI shall propose a suitable progress reporting mechanism for the project duration.

All the tools required by MSI for project management, configuration management, issue and risk management, escalation procedure and matrix document repository etc. shall be factored in the proposal submitted by MSI.

Based on progress reports, MSI shall also accordingly update the master schedule of work on a continuous basis during the period of the contract.

All deliverables shall be submitted in at least two (2) formats i.e. draft and final. The Client's representative will have at least 30 days to review and comment on every deliverable. The practice of submissions for all deliverables will be that three (3) hard copies and CDs of every deliverable shall be submitted. Two of these copies will be submitted to the ICT consultant and one will be submitted to the client. The submissions will include both hard and soft copies.

3.1.2 Survey and Detailed Design Validation of all Smart City ICT Component

MSI shall conduct end-to-end survey of the site area, additional requirement gathering and based on the observations, asses and validate the present conditions, implementation approach and methodology, project challenges and mitigations and other project critical information. During the survey stage itself, MSI shall mobilize its entire staff and fully acquaint them with the site conditions. It is MSI's responsibilities to periodically survey the site and be updated on the conditions during the course of the contract. During the design validation stage, MSI is also expected to:

- Workshops with different stakeholders for capturing business requirements, creating awareness of best practices, communicating the changes, building consensus on process design etc. These needs to be organized at different intervals and in different places throughout the duration of the projects as needed.
- Stake holder consultation other than workshops, with those stake holders who will be identified by AITL, for critical inputs, review, suggestions, process description etc.

- Review sessions with different stake holders for signing off the deliverables, walking through the deliverables for facilitating quick understanding.

The MSI shall also be responsible for the detailed design validation of the project. MSI shall discuss in detail and validate with the Client or its representatives the detailed design of the smart city ICT components and fine tune any requirements. It is the MSI's responsibility to satisfy the operational requirements of the Client and adopt industry best practices for implementation during the design stage itself. Based on the survey observation, analysis and discussion with the Client, the MSI shall submit a Detailed Design Report. The detailed design report shall include end-to-end design validation for the project including any project understanding, analysis, detailed design, integration plan, and for-construction drawings. Complete set of design and construction drawing including method of installation as applicable shall also be included in the Detailed Project Report. Construction details shall accurately reflect actual job conditions.

All technical data sheets of the products may be submitted ahead of time by the MSI. It is MSI's responsibility to get all technical data sheets approved by the Client or its representative to meet the overall project schedule.

Design and construction drawings shall include the following at a minimum:

- All system device locations as required for installation, operation and maintenance;
- Cable requirements, routing and location (as applicable);
- Typical mounting details;
- Single Line Diagrams (SLDs);
- Splicing diagrams;
- Wiring diagrams;
- 3D layouts and renderings for POP and AURIC Hall;
- Any other layouts;
- Any other requirement to meet the requirements of the RFP.

All drawings shall be updated/revised to "as-built" conditions when installation is complete.

Design submissions shall be based on project requirements and shall include as applicable, but not limited to, the following:

- Complete listing of specifications to be used along with detailed technical data sheet;
- Detailed engineering drawings;
- Shop drawings including product data sheets;
- Revisions to original design submissions.

No work requiring shop drawing submission shall commence until final review has been obtained by Client. However, review of the shop drawings by the Client shall not relive the MSI of his responsibility for detailed design validation inherent to shop drawings.

For the software components like ERP, E-Governance applications, MSI will create requirement analysis documents for various components of the solution. This includes System Requirements Specification (SRS) and Functional Requirements Specification (FRS) documentation. The MSI shall be responsible for documenting any existing/planned 'processes' of the Client as part of these deliverables.

As part of the Project, the ICT Consultant shall provide drawings to the MSI in raw format. These drawings include typical details, proposed equipment location, routing and typical

splicing. It will be MSI's responsibility to work on these drawings as a base, update them as per the latest site conditions, and convert these drawings to 'for construction' drawings.

This detailed design report shall be submitted into two (2) separate deliverables including one for phase 1 and one for all other phases of the project.

3.1.3 Prototype Acceptance and Factory Acceptance Testing

After the approvals of the technical data sheets by the Client or its representative, MSI shall submit the prototype of all the material presented in the Detailed Design Report to the Client or its representative for its review and approval. Note that it shall be MSI's responsibility to get the prototypes approved in due course of time without affecting the overall schedule of completion of works.

Material provided as part of the Project shall undergo Prototype Acceptance Test (PAT) and Factory Acceptance Test (FAT). Details regarding the PAT and FAT are presented in Testing Section of the Scope of Work. MSI shall also present to the Client and its representatives the test results for PAT and FAT in the form of Test Result Documentation presented in the Testing section. The Client and its representative at their own discretion shall visit any FAT site. MSI shall be responsible for organizing all logistics required for any such site visit.

For all the software components like ERP and e-Governance, MSI shall also propose prototype of solution components in this phase and get the required approvals.

3.1.4 Hardware Supply and Installation Stage

MSI shall be responsible for the supply and installation of all components as part of the Shendra smart city ICT components to meet the technical, functional, business and performance requirements of the RFQ cum RFP. No deviations from these requirements shall be acceptable by the Client. Any additional hardware or software component required to meet the technical and performance requirement of the project and not specified as part of this document but required to meet the overall requirements of the project shall be factored in as part of the Bid, and provided by the MSI. MSI shall deliver the project and install and handle the equipment in accordance with manufacturer's requirements. Installation process of the MSI shall be flexible and shall accommodate Client's requirements without affecting the schedule as specified in the RFQ cum RFP.

MSI shall be responsible to provide electrical meters for measuring electricity consumption of the Smart City ICT components at 5 different places. MSI shall be responsible for all supply, storage and handling of the material provided as part of the project. The OEM proposed for the IT infrastructure shall be in line with the national security policy (as applicable).

If there is removal/change of any existing material during installation process and belongs to the Client, the material shall be handed-over to the Client. MSI shall also be responsible for reinstating any site in the project limits at no additional cost to the client. It shall be the MSI's responsibility to supply and install all hardware in compliance with the requirements of the RFQ cum RFP. Since this is a turnkey contract, MSI shall be responsible for all implementation works on the project including any civil, structural, electrical, etc. works required to meet the requirements of the project. All power conversions necessary to operate the equipment shall be under the scope of MSI. The Client shall only provide raw power for all the equipment.

3.1.5 Software Development

MSI shall be responsible for development and deployment of all software required to meet the requirements of the project. Some of the software may be COTS or may require bespoke development. MSI shall be fully responsible for developing, implementing and integrating all software required for the project. All software development/implementation may be demonstrated to the client periodically in Mumbai as per the project requirements. All software

shall be developed based on the approved software and functional requirements specifications. The technology platform chosen for all software shall be based on industry standards based and shall be secure. Migration of data shall be the responsibility of the MSI. MSI is required to take the source data in the format which is available. Subsequently, MSI is required to take complete ownership of data migration and also develop a detailed plan for data migration.

The MSI shall ensure that full support from the OEM's is provided during the course of the contract. MSI shall be responsible to provide any upgrades, patches, fixes to the software during the course of the contract at no additional cost to the client.

3.1.6 System Integration

MSI shall be responsible for the integration of all hardware and software supplied as part of this Project as per the technical and performance requirements of the project. The system integration scope also includes integration of the Project components with the components provided by Others as per the details of the RFQ cum RFP.

It shall be the responsibility of MSI to take approval of the Client for the Integration of the overall system as per the RFQ cum RFP. Post systems integration, the Client shall review and approve the overall performance of the integrated system as per the requirements of the RFQ cum RFP. MSI shall be responsible for fixing any requirements that are not found in compliance with the original RFQ cum RFP and approved detailed design at no additional cost to the client.

3.1.7 Testing

All materials, equipment, systems, manufacturing or configuration processes, or other items to be provided under the Contract shall be inspected and tested in accordance with the requirements specified in this document and will be subject to Client or its representative's approval. The testing shall include any existing civil infrastructure equipment or materials to be taken over by the MSI. Approvals or passing of any inspection by the Client shall not, however, prejudice the right of the Client or its representative to reject the material if it does not comply with the specification or requirements of the RFQ cum RFP when erected or give complete satisfaction in service.

The MSI shall design and successfully complete tests to demonstrate that all equipment, materials and systems furnished and installed function in the manner intended and in full compliance with the requirements outlined in the RFQ cum RFP and the approved detailed design of the MSI.

All tests shall be subject to inspection or witnessing of tests by the Client or its representative. Inspection or witnessing of tests may be waived at the sole discretion of the Client or their representative, subject to the MSI furnishing the Client or their representative with properly completed test certificates in accordance with the requirements of the RFQ cum RFP. Failure of the Client or their representative to witness any test shall not relieve the MSI of the obligation to meet the requirements of the Contract.

MSI shall submit an Acceptance Test Procedures document (ATP), for Client's approval prior to undertaking any testing. The ATP shall clearly address:

- Type of testing and device to be tested;
- How each testable specification requirement will be demonstrated, including the test environment and set-up, specific functionality to be tested, method for performing the test and quality assurance procedures;
- The results that will constitute success for each test;

- Timing of test within the overall Contract schedule;
- The location for testing;
- Personnel required to conduct the test;
- Approximate time required to execute the test or set oftests;
- Responsibilities of both the MSI and Client's representatives during each test; and
- A cross-reference to which Contract requirements from the Compliance Matrix (to be developed by the MSI) are being addressed by each test procedure.

The ATP shall include an updated Compliance Matrix to include the test relevant stage at which each contract requirement will be demonstrated; and a cross-reference to the test procedure(s) that serve to address each contract requirement. The Compliance Matrix shall be used as a "punch list" to track which requirements have not yet been demonstrated at each stage of testing. A requirement classified as having been "demonstrated" during a certain ATP stage can be subsequently redefined as having been "not demonstrated" if compliance issues emerge prior to System Acceptance. ATP shall be submitted to Client at least three (3) weeks in advance of any intended testing.

All measuring instruments required to measure test parameters shall be calibrated by an approved testing authority. The equipment shall be inspected for standards of construction and electrical and mechanical safety.

Test results shall be recorded for all tests conducted under this Contract. The MSI shall make test results available to Client or their designate for review immediately after completion of the tests.

ATP for each test shall be collated, bound and delivered as part of the close-out documentation requirements specified herein.

ATP shall incorporate the following distinct stages for each deployed stage:

- **Prototype Acceptance Tests (PAT)**: Prototype Approval Test shall be conducted only on the customised equipment for their design and compliance to functional specifications. PAT shall be completed before conducting FAT and only after approval of PAT by Client's representative, the equipment shall go in production. PAT shall be witnessed by Client's representatives.
- **Factory Acceptance Tests (FAT)**: FAT shall be conducted before the equipment and software is shipped to Client for installation, and deficiencies shall be rectified before shipping to Client for installation. All devices furnished by the MSI shall be tested and subjected to a nominal 72-hours burin-in period at the factory. FAT shall be witnessed by Client's representatives at their discretion. In case of software components like ERP and E-Governance applications, unit testing will be carried out by the MSI team and test results will be submitted for verification.

  Factory acceptance tests shall be conducted on randomly selected final assemblies of all equipment to be supplied. In case any of the selected samples fail, the failed sampled is rejected and additional 20% samples shall be selected randomly and tested. In case any sample from the additional 20% also fails the entire batch may be rejected.
- **Pre-Installation Testing (PIT):** All equipment supplied under this Contract shall undergo pre-installation testing in accordance with the ATP. This shall include existing equipment, any spare parts, any new equipment provided by Client or their designate and new equipment provided by the MSI.

If the equipment is considered a standard production item, the MSI may, with the prior consent of the Client or their representative, supply a copy of the equipment manufacturer's quality control test results in place of a MSI performed test.

All PIT testing shall be carried out prior to installation of the equipment. After satisfactory completion of the MSI's PIT tests, the MSI shall supply all test measurements and results to the Client or their representative, together with a Test Certificate.

- **Installation Acceptance Tests (IAT)**: IAT shall be conducted after each installation of each equipment type, and deficiencies shall be rectified before the initiation of SAT. IAT may be witnessed by Client's representatives.
- **Proof of Performance Testing (POP):** The MSI shall implement a structured proof of performance testing, which will progressively place all components in service. Site tests shall be performed on individual components, subsystem sites, and the complete subsystems, as necessary to confirm that each element of the system functions satisfactorily and fulfils the requirements of this specification.

  Completion, submission, and approval of all relevant PIT and IAT tests and results must be completed prior to carrying out any POP tests.

  All subsystem equipment and components shall be tested by the MSI regardless of whether or not it is a standard item.

  After satisfactory completion of the MSI's POP tests, the MSI shall supply all test measurements and results to the Client or their representative, together with a Test Certificate.
- **System Integration Testing (SIT):** The MSI is responsible for the proper and harmonious operation of all subsystems installed under this Contract. Where connections of the new systems to existing subsystems or equipment supplied by others are required, the MSI is responsible for connection of equipment specified in the Contract and for initial system integration tests. Such a test will verify the full functionality of each subsystem as they are interconnected. This will require testing to be coordinated by the MSI with the Client or their designate. This work will be carried out under the direction of the Client or their designate.

  Completion, submission and approval of all relevant PAT, FAT, PIT IAT and POP tests and results must be complete prior to carrying out any SIT tests.

  The MSI shall:

  - Complete all equipment and subsystem tests required in the Contract;
  - Test each subsystem independently;
  - Add subsystems one at a time and monitor the overall performance;
  - Fail safe testing of all subsystems one at the time while monitoring overall systems performance.

  A SIT certificate will be issued when all system tests have been completed satisfactorily, and the MSI has supplied a full set of Test Certificates and a Test Certificate for the complete system, together with final copies of all Operating and Maintenance Documentation for the System.
- **Stress and Load Testing:** Comprehensive stress and load testing of AEE modules shall be conducted to demonstrate robustness and reliability of the system will be undertaken for approximately 30% of projected population.

- **Security Testing (including penetration and vulnerability test):** Security test shall be conducted to demonstrate security requirements at network layer and software applications. Components shall pass vulnerability and penetration testing for rollout of each phase. Components shall also pass web application security testing for portal, mobile app, and other systems. Security testing shall be carried out for exact same environment/architecture that shall be set up for go-live. Penetration test shall be carried out periodically and vulnerability analysis shall be carried half-yearly during maintenance phase. For all applications hosted on-cloud or hosted on premises, the security testing shall be a mandatory requirement.
- **Pilot Test:** Requirements for Pilot Test is explained in the Pilot Deployment Section of the Scope of Work.
- **System Acceptance Tests (SAT)**: SAT shall be conducted after the entire system has been installed, integrated and commissioned. Deficiencies, if any shall be rectified before the initiation of Burn-in Test. SAT shall be conducted on full system completion only to determine if the system business, functional and technical requirements as specified in the bidding documents are meet. SAT shall be witnessed by Client's representatives. Data migration, if any will be carried out by MST prior to commencement of this stage. SAT shall also include any performance and load testing for the software applications.
- **Burn-in Tests (BT)**: Following successful completion of the SIT and SAT, the approved System will be put into service and its performance monitored for a period of thirty (30) consecutive calendar days for the purpose of verifying system reliability in an operating environment. Any failures and defects occurring in this time will be documented. Any serious defects which affect the availability of the system will be a basis for restarting the test. Upon the satisfactory completion of this performance testing a Completion Certificate will be issued.

  The MSI shall not commence BT until SIT and SAT have been performed and successfully completed/approved and all documentation of the successful completion of PAT, FAT, PIT, IAT, POP, SIT and SIT, along with notification of the schedule date of the BT is provided to the Client or their representative in accordance with the Requirements. Commencement of BT will be conditional on the Client or their designate providing written notification of Client's readiness to proceed to BT.

  The MSI shall be suitably prepared for the BT prior to the start date. Repeated failure of the BT may result in the MSI having to reimburse the Client or their representative for costs incurred. No compensation to the MSI will be made for repeat testing.

  Where equipment supplied by the MSI fails during the burn-in period, the MSI shall restart the test at day zero (0) following appropriate corrective measures.

  If a utility failure is proved to be the cause of testing failure, then the MSI shall restart the fourteen (14) day burn-in test at the day the failure occurred. If a subsystem failure is proved to be the cause of testing failure, then the MSI shall start the test over at day 0 (zero).

  Where tests or burn-in indicate that an existing subsystem or component, not provided by the MSI, is defective, the MSI shall immediately report the deficiency to the Client or their representative. The Client or their representative may assign corrective repairs, retesting and repeat of BT to the MSI, in accordance with change provisions of the Agreement.

  The MSI shall provide the Client or their representative with a contact name and phone number(s) for a designated emergency contact person during BT. The emergency contact person shall be accessible twenty-four (24) hour a day, for each day of testing.

- **Operational Acceptance Test:** Shall be conducted after successful SAT and Burn-in tests. Continuous fault free running of the System shall be tested. Post the completion of Operational Acceptance Test, System shall be considered for Operational System Acceptance and Defect Liability Period (DLP) shall commence. Operational Acceptance Test shall include the following as a minimum:
  - Completion of all activities and fulfilment of all business, functional and technical requirements listed in RFQ cum RFP;
  - Scrutiny of all inspection reports, audit findings, Contracts, licensing agreements etc.;
  - Satisfactory completion of closing of accounts and generation of complete balance sheet for one financial quarter, with the ERP solution and approved by the head of finance and accounts of AITL.

Client may authorize the MSI to proceed to the next testing stage with certain deficiencies not yet resolved.

The MSI shall provide written notice to Client at least five days in advance of any testing, indicating the specific tests to be completed as well as the date, time and location. The MSI shall be required to reschedule testing if Client witnessing representatives cannot be present or if other circumstances prevent testing from taking place.

MSI shall provide written Test Results Documentation (TRD) within one week of completing each stage of testing. The TRD shall document the results of each ATP procedure and provide an updated Compliance Matrix that indicates which contract requirements have been demonstrated. The TRD must be approved before Client will grant System Acceptance. A sample format for the TRD is provided below:

<table>
<tr><td colspan="2">Item #:
Item Description:
Test:</td><td colspan="2">Tester:
Date:</td></tr>
<tr><td colspan="4">Test Set-up:</td></tr>
<tr><td>Clause</td><td>Test Procedure</td><td>Expected Results</td><td>Actual Results</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="4">Witnessed:
(This Does Not Constitute Approval)
Reviewed and Approved:</td></tr>
</table>

MSI shall be responsible to carry out all the testing as per the satisfaction of the Client and its representatives. It is the responsibility of the MSI for all documentation required for establishing approval and acceptance of installation and operation of the system components. All the costs those are associated with any testing are to be borne by the MSI including the costs of travel and accommodation of the Client or its representatives from their home locations in their cost bid. In the interest of the MSI maximum of three (3) people shall be nominated by the Client to attend any such testing wherever it is carried out.

In case of failure of any testing, the failure component shall be repaired and the test shall be rerun. If a component has been modified as a result of failure, that component shall be replaced in all like units and the test shall be rerun for each unit.

MSI shall provide the Client with a copy of the manufacturer's quality assurance procedures for information. Documentation certifying the showing that each item supplied has passed factory inspection shall also be submitted by the MSI.

3.1.8 Pilot Deployment

The MSI shall conduct Pilot deployment and testing for meeting Client's business requirements before rolling out the complete system. The pilot will be run for four weeks to study any issues arising out of the implementation. MSI shall also review health, usage and performance of the system till it is stabilized during pilot deployment. Based on Client's feedback for incorporating changes as required and appropriate, MSI shall train staff involved in the Pilot implementation.

The Pilot shall be demonstrated to the Client's representatives. If for any reason the pilot is found to be incomplete, these will be communicated to the MSI in writing on the lapses that need to be made good. A one-time extension will be provided to the MSI for making good on the lapses pointed out before offering the system to Client for review. Failure to successfully demonstrate the Pilot may lead to termination of the contract with no liability to Client.

3.1.9 Training

Post the system integration, MSI shall train Client and any representatives to operate the implemented systems and to conduct any routine diagnostics and routine maintenance work. Training shall be done during Pilot Deployment and before Final Deployment. The period of training shall be mutually agreed upon by Client and MSI.

The MSI shall provide training courses for at least:

- Decision Makers/ Management;
- Client's operations personnel;
- Users of Various Systems/Applications developed as part of the project.

The actual number of each of above categories of trainees will be provided during the course of the Contract.

MSI shall provide all training materials in both Microsoft Office and Adobe PDF formats, consisting of graphics, video and animations on Compact Disc (CD) and Digital Video Disc (DVD) with a permission to reproduce copies later on.

MSI shall also be responsible for full capacity building of AITL staff. Training and capacity building shall be provided for all individual modules along with their respective integrations. All training materials shall be developed by the MSI.

The Training Plan (TP), including the training schedule and course outlines, must be provided to Client for review at least three weeks in advance of the start of training. The TP must be approved by Client before the start of training.

MSI shall furnish all special tools, training videos, self-learning tools, equipment, training aids, and any other materials required to train course participants, for use during training courses. Training shall include, as a minimum, a four (4) hour session on system maintenance and configuration, and a four (4) hour session on system operation.

The instructors shall demonstrate a thorough knowledge of the material covered in the courses, familiarity with the training materials used in the courses, and the ability to effectively lead the staff in a classroom setting. If at any stage of training, the Client feels that on-field sessions are required, the same shall be conducted by the MSI. The language of training shall be in English/Hindi as indicated by the Client during this stage.

If any instructor is considered unsuitable by Client, either before or during the training, the MSI shall provide a suitable replacement within one week of receiving such notice from Client.

The MSI shall provide brief refresher versions of each training course to the original trainees and new inductees between three to six months after System Acceptance for each deployment stage at no additional cost.

MSI shall train 50 staff of the Client during the initial stage. Subsequently, MSI shall train around 25 staff every 3 to 6 months during the contract period.

MSI has to ensure that training sessions are effective and the attendees shall be able to carry on with their work efficiently. For this purpose, it is necessary that effectiveness of the training session is measured through a comprehensive online feedback mechanism.

3.1.10 Final Deployment and Documentation

After addressing the Client feedback and any deficiency observed during the Pilot deployment and upon completion of System Acceptance Tests (SAT) and data migration, final deployment of the project components shall be considered by the MSI. For achievement of final deployment, MSI shall also be responsible for development of a cutover strategy which shall include initial data take on, sequence of data take on, set up of support mechanisms to minimize business impact due to any cutover activities.

Post the final deployment, MSI shall handover detailed documentation that describes the site conditions, system design, configuration, training, as-built conditions, operation and maintenance. All documentation shall be in English, shall utilize metric measurements, and shall be submitted directly to Client in paper hardcopy and electronically in Word/AutoCAD/Excel/Project and Adobe Acrobat.

All installation drawings shall be prepared in AutoCAD, GIS and Adobe Acrobat and provided on CD-ROM as well as hard copies. The drawings shall contain sufficient detail including but not limited to equipment dimensions, interfaces, cable details, equipment mounting and fire protection.

Electrical and electronic drawings shall be supplied to show engineering changes made to any component or module any time during the contract period.

‘As-built’ Documents delivered by the MSI shall include:

- An inventory of all components supplied including model name, model number, serial number and installation location;
- An inventory of all spare parts supplied including brand, model number, and serial number and storage location;
- All reference and user manuals for system components, including those components supplied by third parties;
- All warranties documentation, including that for components supplied by third parties;
- As-builts in CAD and GIS;
- A diagram indicating the as-built inter-connections between components;
- Software documentation which also includes the version number of all software, including that supplied by third parties;
- Cable run lists and schedules;
- All network and equipment details such as IP addresses, user names, and passwords;
- Manufacturer’s test procedures and quality assurance procedures for information.
- Data communication protocols; and
- ‘As-Built’ drawings for all components installed.

MSI shall submit to the Client copies of comprehensive operating and maintenance manuals, and log sheets for all systems and hardware supplied as part of this bid document. These shall be supported with the manufacturer's operating and maintenance manuals. The manuals shall be complete, accurate, up-to-date, and shall contain only that information that pertains to the system installed. Maintenance documents shall include:

- Equipment installation and operating documentation, manuals, and software for all installed equipment;
- System Installation and setup guides, with data forms to plan and record options and configuration information;
- The schedule/procedures for preventative maintenance, inspection, fault diagnosis, component replacement and on-site warranty support administration on each system component;
- Hard copies of manufacturer's product specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM or non-volatile memory stick of the hard-copy submittal;
- Complete list of replaceable parts including names of vendors for parts not identified by universal part numbers (such as EIA codes);
- Manufacturer's product specification sheets, operating specifications, design guides, user's guides;
- Permits; and
- Contractor names and telephone number lists for all project trades.

MSI shall provide Systems Manuals (SM), documentation including:

- The configuration and topology of central systems hardware and software;
- Central systems software functions and operations;
- Scheduled maintenance required for the central systems; and
- Database structure and data dictionary.

MSI shall also provide following documents for any be-spoke software development:

- Business process guides;
- Program flow descriptions;
- Data model descriptions;
- Sample reports;
- Screen formats;
- Frequently Asked Questions (FAQ) guides;
- User Manuals and technical manuals;
- Any other documentation required for usage of implemented solution.

Documentation of processes shall be done using standard flow charting software. An intuitive online learning tool depicting standard operating procedures of system usage are required to be deployed. There shall be a provision of training system in the deployment architecture so as new employees can be inducted easily.

All pages of the documentation shall carry a title, version number, page number and issue date, and shall contain a complete subject index. MSI shall be responsible for fully coordinating

and cross referencing all interfaces and areas associated with interconnecting equipment and systems.

Documentation shall require re-issues if any change or modification is made to the equipment proposed to be supplied. MSI may re-issue individual sheets or portions of the documentation that are affected by the change or modification. Each re-issue or revision shall carry the same title as the original, with a change in version number and issue date.

Each volume shall have a binder (stiff cover and spine), and drawings shall be protected by clear plastic to withstand frequent handling. The binding arrangement shall permit the manual to be laid flat when opened.

The paper used shall be of good quality and adequate thickness for frequent handling.

3.1.11 Operational System Acceptance

At the completion of operational acceptance test, the system shall be considered for operational system acceptance. At the close of the work and before issue of final certificate of completion by the Client, the MSI shall furnish a written guarantee indemnifying Client against defective materials and workmanship for a period of one (1) year after completion which is referred to as Defect Liability Period. The MSI shall hold himself fully responsible for reinstallation or replace free of cost to Client during the Defect Liability period. MSI shall provide approved temporary replacement equipment and material such that the system remains fully functional as designed and commissioned during repair or replacement activities at no cost to the Client.

3.1.12 Comprehensive Maintenance for System and Services

MSI shall be responsible for comprehensive maintenance of both hardware and software, up-gradations in the system, expansion of the system, technical manpower, spares management and replenishment, performance monitoring and enhancements, preventive and corrective maintenance of the Shendra smart city ICT components deployed as part of this project and shall maintain service levels as defined in the RFQ cum RFP. All equipment and material supplied by the MSI shall be provided with standard warranty against defects of design and manufacturing and against faults and failures associated with workmanship of MSI and its sub-contractors commencing from operation acceptance of the system. All equipment found to be defective during comprehensive maintenance shall be repaired or replaced by the MSI at no cost to the Client.

MSI shall provide all the technical, managerial, and other staffing required to manage day-to-day maintenance of the Shendra smart city ICT components during the Contract period.

All spares required for the smooth operation of the Shendra smart city ICT components shall be maintained by the MSI for the entire duration of the contract to meet SLA requirements. The cost of the spares, repairs, and replacement shall all be deemed to be included in the price quoted by the MSI. MSI shall also institutionalize structures, processes and reports for management of SLA. Root cause analysis and long term problem solutions shall also be part of MSI scope.

MSI shall maintain all data regarding entitlement for any upgrade, enhancement, refreshes, replacement, bug fixing and maintenance for all project components during Warranty. MSI shall be responsible for updates/upgrades and implementation of new versions for software and operating systems when released by the respective OEM at no extra cost to the Client during entire duration of contract. Requisite adjustments / changes in the configuration for implementing different versions of system solution and/or its components shall also be done by MSI. The MSI shall also ensure application of patches to the licensed software covering the appropriate system component software, operating system, databases and other

applications. Software License management and control services shall also be conducted by the MSI during this phase. Any changes/upgrades to the software during comprehensive maintenance shall be subjected to comprehensive and integrated testing by MSI to ensure that changes implemented in system meets the specified requirements and doesn't impact any other function of the system. Issue log for errors and bugs identified in the solution and any change done in solution (vis-à-vis the FRS, BRS and SRS signed off) shall be periodically submitted to the Client. MSI shall also be responsible for operating AITL website, city portal, and city application including all support, content updates and upgrades throughout the duration of contract.

MSI shall ensure OEM support during Comprehensive Maintenance stage for system performance, performance tuning, upgrades etc. MSI shall provide all support for formulation of all policies and procedures related to System Administration, Data Base Management, applications, archives, network management & security, back up and data recovery and archive, data synchronization after crash. Assistance to Client shall be provided as needed in management of legacy data interfaced, print spools, batch jobs, printer configuration etc.

MSI shall prepare a detailed System administration manual, Data administration manual, operational manual, User manual which shall be used by Client's employees to operate Shendra smart city ICT components. This shall also include how the various parameters shall be monitored/ tuned in a live system. Preparation of requisite system configuration for disaster recovery management and fail over system plan shall also be under the supervision of MSI. The MSI shall also maintain the following minimum documents with respect to ICT components:

- High level design of system;
- Module level design of system;
- System Requirement Specifications (SRS);
- Any other explanatory notes about system;
- Traceability matrix;
- Compilation environment.

MSI shall also ensure updation of following documentation of software system:

- Documentation of source code;
- Documentation of functional specifications;
- Application documentation is updated to reflect on-going maintenance an enhancement including FRS and SRS, in accordance with the defined standards;
- User manuals and training manuals are updated to reflect on-going changes/enhancements;
- Adoption of standard practices in regards to version control and management.

The communication costs (Internet charges, telephone charges, 3G/GPRS connectivity charges) and any other incidental charges related to maintenance period shall be in the scope of the MSI and considered to be included in the proposal submitted by the MSI for the entire contract duration.

Any planned and emergency changes to any component during maintenance period shall be through a change management process. For any change, MSI shall ensure:

- Detailed impact analysis;
- Change plan with roll back plan;
- Appropriate communication on change required has taken place;

- Approvals on change;
- Schedules have been adjusted to minimum impact on production environment;
- All associated documentation are updated post stabilization of the change;
- Version control maintained for software.

Any software changes required due to problems/bugs in the developed software/application will not be considered under change control. The MSI will have to modify the software/application free of cost. This may lead to enhancements/customizations and the same needs to be implemented by the MSI at no extra cost.

If the Operating System or additional copies of Operating System are required to be installed / reinstalled / de-installed, the same should be done as part of the post implementation support.

Support Personnel Required

Well trained, efficient and effective support personnel (Engineers) shall be provided by the MSI during the maintenance phase of the project. Any fault originating for the Shendra smart city ICT components shall be addressed by the MSI support staff in the least time possible. The support staff shall work in a shift based system and provide full support coverage and maintain the system as per the SLA's defined. Following Support Personnel shall be depute by the MSI during the comprehensive maintenance phase:

- ERP Support Engineer;
- e-Governance Support Engineer;
- Fibre Optic Support Engineer;
- Integration Support Engineer;
- Two (2) ACC Support Engineer.

Above mentioned Engineers shall be well qualified and trained to support the Client's operational and technical staff in day-to-day operations of the Shendra smart city ICT components provided by the MSI. The staff assigned shall be well qualified to attend to the emergency situations and shall be able to communicate in an effective and efficient manner. Support staff shall be well trained on the smart city ICT components to understand and take necessary action in any kind of situation.

In addition to the training to the operations staff during acceptance stage, the MSI shall conduct half-yearly training refreshment sessions to train the new staff inducted by the Client and to enhance the knowledge of the Client's staff operating the Shendra smart city ICT components by adopting "train the trainer" approach.

3.2 System Specific Scope of Services

Other than the scope of services specified in the RFP, subsequent sections detail any system specific requirements for the smart city ICT components. Note that this should be read in-conjunction with other sections in the RFQ cum RFP including functional and technical specifications:

3.2.1 Fibre Optic Infrastructure

- MSI shall undertake a detailed and comprehensive network architecture design validation of smart ICT components covering all the locations in Shendra, IT and physical infrastructure in line with the overall objective and requirements of the project.

MSI shall identify the space required for setting up the network infrastructure at each of the location;

- MSI shall be required to undertake the GIS based survey to design the OFC route planning and network topology and share the same with the Client. MSI can make use of the publicly available data and tools such as Google Maps, ArcGIS, NIC developed maps etc. However, the ownership of the accuracy and validation of the data map information shall be with the MSI;
- The network architecture validation exercise shall involve:
  - Detailed Network architecture covering all locations;
  - Detailed Fibre layout;
  - Detailed Network solution and deployment architecture covering the central infrastructure at ACC, POP and Cloud.
  - Solution required for managing / monitoring the complete Network Backbone, Distribution and Access Layers.
  - Detailed information security architecture to ensure data privacy as well as security.
- MSI shall validate Network architecture that includes all of the above along with other design elements like data standards, technology standards, interoperability standards, security architecture and other such guidelines / standards. This shall be prepared in active consultation with Client or its representative;
- MSI shall validate the space requirements for all active electronics with the Client;
- MSI shall factor inclusion of various AITL and Govt. offices and their location, bandwidth requirements, security, LAN/WAN protocols, network topology for each of the Smart City ICT component during design validation;
- The Network Architecture once approved shall be base lined either in part or in whole and the Client shall institutionalize the processes for Architecture Change management to undertake any change in the respective location, as required during the contract phase;
- Designing IP Address Schema:
  - The MSI shall design suitable IP Schema for the entire Network Backbone including ACC, POP, smart city ICT components and interfaces to external systems/ network. The MSI shall ensure efficient traffic routing irrespective of link medium;
  - The MSI shall maintain the IP Schema with required modifications from time to time within the scope of the project.
- MSI shall coordinate and validate with the Client the detailed cable routing along with locations of joints, terminations etc.;
- EPC Contractor shall provide end-to-end concrete encased trench with dedicated tray for fibre for the backbone fibre optic infrastructure for all RoWs except lesser than 30m. MSI to leverage this concrete encased trench for implementing its fibre optic infrastructure;
- For lesser than 30m RoW, MSI to provide dedicated trench for fibre optic infrastructure. MSI to coordinate with the EPC Contractor for obtaining access for this trench. MSI to approve the procedure and methodology of trenching with Client or its representative

prior to any work on site. EPC Contractor shall provide hume pipes for any crossings that will be used by the MSI for installation of the fibre optic infrastructure;

- MSI to provide trench for connectivity to plots and devices from the backbone and distribution trench as per the requirements of this RFQ cum RFP. MSI shall coordinate with EPC Contractor for access to streetlight poles for infrastructure connectivity.
- MSI to coordinate with EPC Contractor for all civil requirements and ensure all design requirements are met on-site;
- MSI to assess and incorporate in the implementation the type of soil, long cuttings, new embankments, water logged areas, types of major bridges, major yards etc;
- MSI to work out the requirements of heavy tools and plants depending upon nature of the territory, availability of roads alongside etc;
- MSI to work out requirement of transport vehicles like jeeps, lorries, motor trolleys, etc. as needed for execution of the work;
- EPC Contractor to provide manholes and handholes at strategic locations for connectivity to field devices across backbone and distribution network. MSI to coordinate with EPC Contractor for the manhole and handhole locations, detailed design and access. MSI to provide handholes for within AITL plots and any additional required for field level connectivity;
- Before carrying out laying and installation of ducts and fibre, MSI shall prepare an installation report (approved by the Client or its representative) which shall constitute the following:
  - Closely examining the proposed cable route and prepared cable route plans;
  - Installation of POP buildings and preparation of site plans;
  - Installation and preparation of site plans for buildings required for the execution of the work, as offices at different stations, store godowns;
  - Siting of areas for loading/unloading of cable drums and siding facilities for the for the project;
  - Preparation of the material schedule required for different protective works;
  - Arranging isolated components circuits to be provided in the cable;
  - Investigation of special problems, if any, of the section and finding out proposed solution thereof.
- MSI is expected to put in practices for precaution against damage by Termites & Rodents;
- Cable laying is proposed either by traditional Cable pulling method or by Cable blowing method (preferably);
- After the cable is laid and splicing is complete, measurements in the below proforma shall have to be prepared and maintained:

Section		**Distance**	**Cable Length**	**Fibre No.**	**Loss in dB**		**Remarks**
From	To				1310 nm	1550 nm	

- MSI shall coordinate with the EPC Contractor for ICT interface for utilities including but not limited to water, power and street lighting infrastructure;

- MSI shall coordinate with TSPs, cellular and any other tenants for their fibre optic infrastructure requirements including space at the POPs and any other network requirements. The tenants will be responsible for providing their respective FOSCs and splicing (installation). MSI shall be responsible for supervising this splicing works and any integration;
- MSI shall only be responsible for splicing of backbone, distribution and access network for AITL plots and AITL field devices only;
- For non-AITL plots, MSI shall provide the access duct from the manhole until just outside the property line, where it will be stubbed out for access in the future. Using this duct, the plot developer shall be responsible to provide the dedicated fibre optic infrastructure inside the plot and install the required fibre optic cable with the FOSC and splicing. In this case, the MSI shall be responsible for full supervision of these works and assistance in integrating this infrastructure end-to-end. For all AITL plots, the MSI shall be responsible for end-to-end fibre optic infrastructure;
- All coordination with plot developers for splicing and integration with AITL fibre shall be under the scope of the MSI;
- MSI shall compute and implement all the storage infrastructure required as part of the fibre optic infrastructure. All networking and firewall requirements for the fibre optic infrastructure will also need to be undertaken by MSI;
- MSI shall be responsible for data encryption and data security;
- Provide details on connection type, speed and bandwidth required at the ACC and POP (as applicable) for connectivity to outside world;
- Assist consultant and Client in registering AITL as an IP-1 with DoT;
- Maintain the fibre asset management system during the course of the contract;
- Proper earthing, grounding and lighting suppression for all applicable equipment under the scope of MSI.

3.2.1.1 POP Rooms

- MSI shall be required to undertake the complete site preparation and design-build exercise for five (5) POP facilities as per the requirement in consultation with Client and its representative;
- The detailed design in all aspects for the design-build (including but not limited to civil, mechanical, structural, electrical, communications, fire, fit-outs, etc) of the POP facility and the plot shall be the responsibility of the MSI and be approved by the Client or its representative. The MSI shall have the required personnel on the team including architect, structural engineer, MEP, etc as needed for this design-build. At least two (2) options for the design-build shall be proposed for the POP facility;
- This scope includes finalization of locations of the POP, development of the building, development of the plot in compliance with the regulations including necessary infrastructure within the plot, fencing, coordination with the tenants, coordination for installation of cellular towers and any other infrastructure of the tenants, partitioning for dedicated space for every tenant, and construction of the POP facility;
- All tenants will get dedicated partitioned space for their equipment along with access to power and other basic infrastructure. MSI shall ensure that the passive infrastructure in terms of ducts, termination points, etc for routing within the POP is provided for all tenants. MSI shall coordinate with all tenants to ensure end-to-end installation of all the tenant provided equipment. All tenant space shall have dedicated access, be

secure and should be modular in construction so that the number of tenants can be increased or decreased in the future;

- MSI shall furnish the POP rooms as part of the civil work in all aspects. All material to be used shall be of fine quality ISI marked or equivalent. The furnishing includes but not limited to:
  - Trench works;
  - Masonry works;
  - Cutting and chipping of any existing area;
  - Glazing;
  - False ceilings;
  - False floorings;
  - Paint work;
  - Storage;
  - Layouts and partitioning;
  - Doors and Locks;
  - Fire detection;
  - Cement concrete works;
  - Insulation.
- MSI shall install electrical distribution system in the buildings. MSI shall be responsible for proper and uninterrupted equipment working and shall ensure this by having the telecom equipment and server room power distribution with redundancy:
  - Incoming electrical feeder supply;
  - UPS system with battery bank for all AITL loads;
  - Connection between UPS system and the AITL equipment shall be redundant. No single point of failure shall exist in the power connectivity between the AITL equipment and UPS.
- Since POP room is a critical area, precise air conditioning system shall be exclusively installed by MSI to maintain the required temperature for the AITL area only. All AC units shall be redundant such that failure of one does not impact the operating temperature required to be maintained in the AITL area;
- MSI shall install UPS system to provide redundant power supply to following needs:
  - All AITL equipment;
  - Access control;
  - Fire detection and Gas suppression system of POP facility as per the specifications;
- MSI shall do complete electrical cabling work for telecommunication equipment which shall include but not limited to:
  - Main electrical panel in room;
  - Power cabling;
  - UPS distribution board;

- UPS point wiring;
- Power cabling for utility points and utility components etc.;
- Online UPS;
- Separate earth pits for the component;
- MSI shall use fire retardant cables of rated capacity exceeding the power requirements of equipment to be used at maximum capacity;
- All material shall conform to ISI standards as per industry practice.

- MSI shall be responsible for the lighting works in the building. Following items need to be undertaken by MSI for lighting:
  - Supply of all equipment associated with implementation of lighting including fixtures, lamps, wiring etc.;
  - Wiring for lighting system in the building;
  - Installation of lighting fixtures;
  - Warranty for the lighting equipment;
  - Critical lights shall be connected to UPS for uninterrupted lighting;
  - Post the installation, MSI shall ensure that lux levels of the building are as per IES-HB-10-11.
- The facility shall be equipped with adequate and advanced Fire Detection and Suppression system. The system shall raise an alarm in the event of smoke detection. The system shall have proper signage, response indicators and hooters in case of an emergency. The system shall be based as per NFPA standards;
- The Access card based access control system shall be deployed by the MSI with the objective of allowing entry and exit to and from the premises to only authorized personnel with appropriate door locks and controller assembly;
- MSI shall install Building Management System (BMS) at POP room for integrated monitoring, control and automation of multiple building components;
- MSI shall also be responsible for installing a rodent repellent provision inside the POP facilities.

3.2.2 City-Wide Wi-Fi

- The MSI shall validate through a coverage modelling and/or detailed survey in Shendra area the number of hotspots required;
- The MSI shall have a Wi-Fi operator, Licensed ISP in India who shall be able to meet all requirements for operations of network as per RFQ cum RFP who will be responsible for operating this Wi-Fi network. The Wi-Fi network operator shall be a neutral operator i.e. a tenant based model where any licensed service provider may offer Wi-Fi services using this network;
- The MSI shall be responsible for monetization of City Wi-Fi services in compliance with the requirements of the RFQ cum RFP;
- The APs shall be installed at street light poles and kiosks. MSI shall coordinate closely with EPC Contractor responsible for providing these street light poles;

- Raw bandwidth required for the city Wi-Fi network shall be provided at no additional cost by the MSI;
- Testing of Wi-Fi network for penetration, security and coverage post deployment of the network;
- The MSI shall comply with all the standards and best practices. MSI shall also ensure that DoT and TRAI guidelines issued from time to time including but not limited to security, user registration, equipment EIRP, etc. At no point Client or its authorized entities shall be responsible for any non-compliance on account of non-adherence by the MSI;
- The MSI shall develop and implement a billing and accounting software for e-recharge, enabling Wi-Fi usage and accounting for the service revenue as per the requirements stated in this RFQ cum RFP;
- MSI shall also be responsible for:
  - Providing Technical manpower, for the contract period from the date of acceptance, to look after the day to day management of services related to Wi-Fi facility management. These services shall include:
    - Providing connectivity to user devices as per requirements of this RFQ cum RFP and in consultation with the Client or its representative;
    - Satisfactorily handling all the issues related to connectivity, performance and security.
  - Providing adequate security mechanisms in City Wi-Fi service equipment to prevent unauthorized access or interfaces to services, calls, protocols and data;
  - The MSI shall provide all the usage data/log/analysis for further usage like usage prediction, planning towards additional resource deployment.

3.2.3 AURIC e-Governance and ERP (AEE) Systems

- The MSI is required to assess the requirements of AITL as listed in the RFQ cum RFP;
- The MSI is also required to institutionalize the mechanisms and transfer the knowledge under the CoE (Center of Excellence) so that AITL will be able to manage the incremental improvements and future expansions of the AEE solution, on its own;
- It is expected that for the ERP system, the solution must support a total of at least 100 users independent of any individual module;
- Design/Develop/Configure/customize AEE Components as per the RFQ cum RFP;
- Update all content of the website, portal and mobile application during the course of the contract;
- AEE shall support integration with the Aadhar card and other government initiatives. It shall also support integration with both e-signature and digital signature;
- Supply all software licenses required for solution components including any database, middleware and any other software licenses including comprehensive software AMC for implementation and O & M period;
- Recommend system architecture for all the application in scope for both cloud and on-premises;
- Provide Disaster recovery, back-up solution, specify RTO (Recovery time objective), RPO Recovery point objective), Clustering, Single sign on, proposed application

uptime, proposed Application response time for various applications in scope, storage requirements over the implementation and O & M period;

- Complete installation of all software components, configuration of the same as per designed architecture is the responsibility of MSI during implementation and O & M period;
- Configure and adapt the solution to meet the best practices for smart cities and statutory requirements as applicable in India;
- Data extraction, preparation and migration of data to the productive systems;
- Cover various functional units of AITL, City Manager and Business Partners and carry out system configuration and implement access controls based on requirements;
- Training the users and facilitating the adoption of the AEE solution by the AITL users/employees which include City Manager and AITL Partner Employees;
- Providing application support for five years after completing the implementation of AEE. All upgrades and enhancements to the system will be in scope of services during entire contract period;
- AEE – Set up End User Training Environment with self-learning kits for new employees;
- MSI shall coordinate with healthcare and education institutes for integration of smart city card system.

AITL intends to expand the usage of the AEE platform to cover all the requirements of AITL, in stages, the MSI is expected to propose the AEE solution with the capabilities listed in the detailed functional and business requirements section.

3.2.3.1 AITL Corporate Website

Specific scope of work for AITL corporate website has been provided below:

- Design and Construction:
  - Work closely with the AITL at each stage of the design to identify user needs and corresponding user interface requirements, workflows, and functionalities;
  - Ensure integration of all elements including content, information format, compatibility with software platforms used by AITL and standards for content management;
  - Select a platform that allows easy integration of multimedia products and user-friendly administrator interface;
  - Select a platform that allows users to search content of the website easily and quickly without the need for extremely high speed devices (desktop, laptop and mobile) and high speed internet access;
  - Create wireframes, storyboards and prototypes to propose options for implementation. Provide three (3) template designs for review in order to select a concept. Concepts should reflect the AITL's corporate identity, nature and purpose;
  - Develop corresponding user interface components (web templates, style sheets, scripts, images, dashboards, social media interfaces) as needed;
  - Use simple, cost-effective techniques to test designs with representatives of target audience prior to launch of site;

- Submit the final concept to AITL for review prior to 'going live.';
- Secure the existing website prior to transitioning to the new platform;
- Keep a full backup of the website through the duration of the project;
- AITL will own and host the new site design and will be provided with a full backup copy of the site design and code at the closing of the project.

- Content Migration:
  - The complete migration of the new website to existing AITL URL;
  - Deployment of new content;
- Training:
  - Structured training plan specific to website support staff;
  - Training of appointed AITL staff to conduct regular uploads and postings of content to the new website. The site must include a technology solution that allows our staff to easily and cost effectively update content and modify site design after the initial launch;
  - Training of appointed AITL staff on how to conduct basic maintenance updates to the site architecture and design;
  - Multi-Tier level support for training of AITL support staff to troubleshoot and maintain the website:
    - Tier 0 (or self-help) - FAQs that allow for AITL website support staff to access and resolve information on their own;
    - Tier 1 - an online help which will aid in self-training of website support staff. This can include a knowledge base with solutions related to the subject matter. In addition, it should include links to related help support forums;
    - Tier 2 - In-depth technical training.
- Identification of Hardware and Software for Self-Hosting:
  - Identification of hardware and software requirements for AITL hosting of the website;
- Maintenance and Support Services;
- Provide a detailed description of the standard support and maintenance required;
- Provide an annual support contract which includes the software support required;
- Provide an annual budget for software updates (security updates within the selected software version) and on-going technical support of AITL administrators in their content management activities.

3.2.3.2 GIS Platform with Web GIS

- GIS Base map with land related data shall be provided to the MSI. MSI shall keep this data as base to integrate all other spatial & attribute data;
- MSI shall integrate all spatial & non-spatial data of this project into an Enterprise Geodatabase and develop a GIS portal with required GIS functions, Tools, Analysis & Dashboard to provide web access to all users of the project;
- MSI shall supply & deploy GIS Server software/engine in cloud platform provided by Client and publish maps to all users of project;

- MSI shall be responsible for appropriate geo referencing & geo tagging on the map covering all relevant assets like Wi-Fi Hotspots, bin locations, CCTV locations, street poles, etc. EPC Contractor to provide layers of all components being implemented to the MSI. MSI shall incorporate these layers in the overall GIS solution;
- MSI shall provide GIS engine that shall allow operators to get an overview of the entire system and access to all the system components dynamically. GIS engine shall enable dynamic view of the location and status of resources and objects/sensors;
- System shall enable authorized user to open a new incident and to associate the incident with its geographic location automatically, via GIS display;
- MSI shall carry out application development to functions & tools as per requirement;
- MSI shall provide following licenses in the name of the Client:
    - Two (2) number of ArcGIS Desktop 10.5 or latest for data digitisation and updation.
    - One (1) number ArcGIS online license for Publishing GIS services, Authoring maps and administering ArcGIS Online groups and organizing content.
- Data Design, Modelling and Services:
    - MSI shall finalize the data list with all its structure & metadata for approval;
    - MSI shall carry out data integration requirement study with stakeholders and submit SRS (System Requirement Study) and Architecture document for approval by considering following factors (not limited to):
        - Best GIS practices shall be followed in spatial positional accuracy, GIS layers overlay matching accuracy, data correctness and completeness;
        - All the data generated, stored, linked as a part of this project from various modules shall be available as necessary to integrate with GIS portal through web services or data sharing through live/realtime, offline, periodical, etc. as deemed to be appropriate;
        - Apart from other modules data, all other required data for GIS portal shall be carried out with suitable data design and data modelling;
        - All required Data Modelling, Design shall be carried out by MSI to get Design Document approved from AITL;
        - Scale of mapping shall be 1:1000 or better as per requirement;
        - Integration of Government-to-Customer (G2C), Government-to-Government (G2G) & Government-to-Business (G2B) data;
        - Integration, export & import of various formats of data such as KML, JSON, XLS, XML, etc.;
        - 3D Data of city.
    - MSI shall carry out collection of data from various agencies or Government departments. All required data (spatial and non-spatial) are to be arranged by MSI. AITL will help by issuing required authorization letters;
    - Data creation - Necessary Field Survey, collection from various sources, compilation, digitization, accurate geo-referencing of spatial & Image data, migration, data conversion, integration, Enterprise Geodatabase preparation & maintenance shall be carried out by MSI;
    - MSI shall be responsible for identifying Data Gaps & take necessary measures & tasks to complete the data;

- It is responsibility of MSI regarding required Data Quality, Correctness & completeness. MSI shall follow standard QA-QC practices in data management;
- Some of the Government department's original records/drawings/maps/files may not be shared outside their office premises because of classified information, security & safety concerns. In such cases, the MSI shall compile/extract those source information at respective departments premises/onsite with necessary operational setup at their own expenses;
- After successful Go-live and implementation, the Maintenance & Operation of GIS shall be carried out during MSI's contract period by taking care of Data Management, 24/7 availability of Database, periodical data updation, editing & performance management.

- **GIS Engine Deployment and Application - Design & Development:**
  - MSI shall deploy/install GIS Engine (GIS Server Software) on Client provided cloud facility. It should have advanced GIS tools/ functionalities, capabilities and allow development of powerful GIS applications for GIS based information sharing, planning and Decision Support along with integration with Enterprise system;
  - It should be central component of the GIS platform, providing the means to easily create, organize, secure, and manage geographic assets. As a centralized portal, it shall provide a single gateway interface and capabilities for all map based web services, data management, visualization and analysis;
  - This Application should enable users to view multiple data layers on a map and perform various advanced functioning like map navigation, search, query, data analysis, geo processing, printing. It should support high scalability, security, availability, OGC Services of Open & Inter Operable standards and should be Industry standard Technology;
  - Deployment of GIS Server Engine (Software) with Performance settings, Server settings, Hardware & Software performance settings, Security settings, Administrative roles/privileges settings, Role based functionality access for 3 to 4 levels, RWD (Responsive Web Design) settings, etc;
  - The client side user interface & map display Performance shall ensure real-time response (within 2 sec) at any given point of time & ensure uninterrupted performance;
    - The web user interface for the GIS map shall allow basic functionalities including (but not limited to) zoom factor/scale based feature loading, variable symbology, linetype scaling, cartography standards, etc.;
    - The system must have secured access;
    - Efficient search tools & print tools;
    - Efficient query tools – Spatial Query & non-spatial query;
    - 3D view options of buildings & terrain;
    - Role based access allowing various functionalities at different roles.
  - Detailed system requirement study, architecture & design shall be carried out with project stake holders and get approvals from client by considering following factors (not limited to):
    - Enterprise level Architecture, Design & Development;

- Service Oriented Architecture, Scalability, Interoperable standards and Agile development;
- User Experience with portal;
- Web Design and Content Management: Innovative or latest proven trends of Graphics design, Web pages, UI buttons & Tools development;
- Real time performance of portal at user end;
- User friendly & Interactive interface: Innovative UI Techniques, Easy & minimum clicks based operation by users, Scale, zoom factor based Map features display, Best practices of map features display, advanced techniques of features & symbols display management;
- Map cartography - International standard shall be followed in terms labelling, color, linetype, Aesthetics, Symbology, Feature overlap management, etc.;
- Development of Functions, Tools, Analysis, Dashboard;
- Development of customized advanced analysis, query, search and report generation functions as per requirement by Enterprise level integration with various systems. Implement customized spatial analysis, weightage based thematic analysis, Spread analysis, Neighborhood analysis, required real-time geoprocessing, Thematic mapping functions, etc. followed by generation of user friendly reports;
- Web Services: Development and Enablement of Web Services for integration with external systems and access by external systems;
- Development of Mobility Solutions, Mobile Apps, Web Apps and Location Analytics;
- One-stop-shop or single point of interface for users of project with regard to access of all project implementations & features;
- Integration & Development with Crowd sourcing, Social Media, Mobile & other Internet trends;
- Development of any sub systems and portals for ease of use;
- Integration of G2C, G2G & G2B functions;
- Integration, Export & Import of various formats of data such as KML, JSON, XLS, XML, CSV, GPS data, etc with external systems;
- All Security aspects are considered for development;
- All required web interface Modules and Sub-modules shall be planned & designed as per requirement.

- Web Development shall be done with best practice programming language and web development;
- Integration with external system such as Maharashtra Remote Application Centre, Maharashtra Disaster Management System, etc., if required;
- Integration with Open Data System;
- 3D visualization and carrying out Landuse analysis;
- Manage complete operations and maintenance of the developed application and ensure that the developed application is bug / error free, running smoothly and simultaneously incorporate necessary changes in the application functionality;

3.2.3.3 Security and System Access

Single Sign On (SSO) capability is required using Microsoft/Linux/Open Source based users' account directory to control all the accesses to the resources. Access to all the system shall be through a Portal with Single sign on facility. Once a user is signed in all the available system features as per authorization matrix will be available to users without requiring to sign in another system. For meeting this requirement state of the art single sign on solution which is tightly integrated with Portal shall be recommended.

AITL requires the AEE system to be integrated with active directory to grant all rights with a single login in for each user.

Credential Management:

The application will allow the assignments of rights and responsibilities to each user through a unique user ID. User IDs are assigned to standard profiles. These profiles will describe the areas and types of transactions and types of transactions accepted for matching users. The application will allow and manage separate authorizations based on actions to be taken.

Managing user profiles:

Users will be divided into user groups with specific clearances. The application will thus help manage specific user profiles which may be defined during the period of project and/ or productive use of AEE. Some sample profiles are defined as below:

- System Administrator (opening / closing the application, authorization management);
- Function Administrator (management standards and parameters) ;
- Agent entry;
- Agent validation;
- Role Based Authorizations and Segregation of duties.

System specific control shall be provided based on user ID:

- Division / Department level;
- Module Level;
- Functional or menu level (e.g., data entry, data inquiry, budgeting);
- Screen level;
- Field level on a screen;
- Transactions by function (e.g., add, change or delete);
- Transaction level (e.g., normal credit/debit, reversing entry, prior period adjustment).

For security purposes, following system audit reports shall also be provided by the system:

- Transactions by user ID;
- Transactions by date and time;
- Changes to Master files;
- Prohibits users from accessing specific account codes or account segments;
- Ability to provide log file of changes made to specific fields of records;
- Generates security exception report that lists the users who have accessed the system and highlights attempts to gain unauthorized access.

The proposed AEE solution (for each component) is required to meet the AITL needs for defining role based authorization and segregation of duties by out of the box (programming not required) features for controlling individual user access at the following levels:

Organization or sub organization level:

Master Data Level: depending on the role the user would be allowed to access and/or operate only on a limited set of master data. Following is a non-exhaustive list of examples to illustrate the requirement. AITL reserve the right to add, subtract or modify the list as per its business needs:

- An Entrepreneur or plot lease holder, who has acquired an Industrial plot can only view details concerning his/her plot of land;
- An AITL employee (or partner employee) is only allowed to issue POs for certain type of materials no other material types;
- An AITL employee can undertake sale of only commercial property and not industrial or residential plots;
- An AITL employee can make payments but not approve the vendor invoices.

Transaction Level: flexibility to limit the role of each user for each transaction to one or more of the following:

- If transaction permission is granted, then role is limited to document creation or modification only;
- If transaction permission is granted, then role is limited to viewing documents only.

3.2.3.4 Reporting

The AEE components shall have a standard reporting module that offers a library of “statement”, “report” and “predefined dashboards” which can be easily modified as per AITL needs. The MSI will be required to make these modifications as a part of scope for the project.

It is also expected that the AEE components will allow the design of new reporting templates (creation of new fields, calculations, sorting, totals, sub totals, combination of existing reports etc.). Moreover, the users should be able to export/import data for/from external applications not limited to for example excel/ MS-access, for specific reports.

The MSI will also be required to ensure that it is possible to create or insert graphics into the generated documents or reports or dashboards. Nevertheless, “developing customer documents” must be within the reach of the users.

Print outs will be available on paper (A4 and A3) and in an electronic file format, as text files in column, Microsoft Word, Microsoft Excel or Adobe PDF document. In addition to the Microsoft suite of products, compatibility should also be ensured with the corresponding open source equivalent suite of office products.

Generating recurring reports should be automated.

3.2.3.5 Archiving

Shelf life of online data shall be 7 years, in addition to the current year. Beyond this period, the data will be extracted and stored outside of the AEE components. The application should therefore allow for extraction of archives for at least 10 years. If necessary, this data will be still being accessible and available via simple query tools requiring no technical knowledge. MSI is required to propose an industry standard tool for data archiving all the data including ERP, Portal, E-Governance services, and Document Management system.

User Device Operating System Requirements:

Desktops/laptops: operating on Windows, Linux or any other open source OS.

Palmtops/Hand held Devices/Mobile Devices: iOS/Windows/Android environments.

3.2.3.6 Interfaces

Integration services shall include:

- Define integration scope between the ERP solution and all other applications in use;
- Set-up data movement for various systems under integration framework;
- Create enterprise integration framework for various integration touchpoints. Approach for integration shall be SOA based and must be facilitated by industry best practices;
- Validation of data movement between source and target system.

MSI is required to propose a composite solution for integration which is SOA and BPM enabled. BPM will be configured to meet the requirements of workflow processes across systems. Main integration between systems will be web services based and industry standard solution is required to be proposed by the system integrator.

The below tables provides indicative list of system touchpoints required. Each of the touchpoints may have requirement of more than one integration.

S No	From	To	Description
1	ERP	Bank	Outgoing Payments
2	ERP	Payment channels	Outgoing Payments
3	ERP	Credit Card	Outgoing Payments
4	Bank	ERP	Incoming Payments, Bank Reconciliation
5	Payment channels	ERP	Incoming Payments
6	Credit Card	ERP	Incoming Payments
6	ERP	LMS	
7	ERP	GIS	Equipment, Locations, Assets
8	LMS	ERP	Property Id's would be first created on LMS
9	GIS	ERP	Equipment, Locations, Assets
10	GIS	LMS	Plot coordinates, Locations
11	LMS	GIS	Property
12	ERP	DMS	Document linkage at various processes
13	DMS	ERP	Document linkage at various processes
14	DMS	Portal	
15	DMS	LMS	Building Plans, etc.
16	LMS	DMS	
17	ERP	Portal/Mobile	
18	ERP	E Mail	User Authentication and mail services

S No	From	To	Description
			Integration with notification services
19	Portal	Mobile	
20	Portal	E Mail	User Authentication and mail services

Some of the processes that will be required for integration are listed below. However this is an indicative list and exact requirements will be defined during requirements session of various phases.

Processes

S No	Process	Descriptions	Interfaces
1	Town Planning and Plotting	• Town Planning and Plotting of Land parcels which will be created in LMS • The land parcels/plots would be allotted property id's in LMS which would be replicated in the ERP	• LMS – ERP(property id's)
2	Investor Registration	Investor logs on to the portal and registers the details stored as customer record in the LMS. Customer Id is created	• Portal – LMS – ERP
3	Plot Inquiry	• Investor will approach via the Portal, and access the LMS: • Portal – LMS : for viewing the plots and township • LMS – GIS: for populating the GIS with the plots • Portal – GIS : web GIS view would give the Entrepreneur a view of the township and its plots, what is available and what can be purchased, the price details would be fetched from LMS	• Portal – LMS • LMS- GIS • Portal - GIS
4	Plot Reservation	After Inquiry the Entrepreneur will: • Select Plot and reserves it. A sales order would be created in the ERP in favour of the Investor • Finalize the instalments • Pay Initial Deposit as advance along with sales order	• Portal – LMS • Portal – Email for confirmation to the Investor • Portal - ERP (customer record X-fer) • Portal – RTGS/Netbanking/Credit Card/Pay Wallets / Debit Card • Payment Gateway -ERP

S No	Process	Descriptions	Interfaces
5	Plot Billing	Raise an invoice with for payment of first invoice	• ERP – LMS (update payment status) • ERP – E Mail for intimation to Investor
6	Plot Payment Receipt		• Payment Gateway to ERP • ERP to LMS • ERP-Email (Payment Confirmation) • Portal - LMS (updated status)
7	New Connection	Initial touch point is the portal either directly by the resident, by a call to the Customer Interaction Center	• Portal –ERP (Notification creation) • ERP-Portal (Operator is intimated about work order for new connection)
8	New Connection Installation	Operator Work Man down loads a list of jobs allocated. Identifies the property details from the GIS Map and performs the tasks assigned for the day. For each task completed the workman enters the order confirmation on his mobile device	• Mobile – ERP (list of tasks) • Mobile-Web GIS (property location and details of electrical mains or water mains from which connection is to be given) • Mobile-ERP (job confirmation as well as input for materials consumed) • Mobile –ERP (service entry sheet) • ERP-E mail (caller for job completion)
9	Operator Payments Processing	Operator submits invoice for jobs performed via portal	• Portal to ERP • ERP – Payment Gateway
10	Waste Collection	RFID – process	• RFID – Middleware-ERP
11	Digital Locker Operation	Investors upload their documents through Portal and they are stored as per system configuration in DMS These documents links are made available to various systems requiring them like connection applications etc.	• Portal – Document Management System
12	Purchase Requirement Approval	Approval of PR on mobile	• ERP- Mobile-ERP
13	Leave Approval	Leave approval on mobile	• ERP-Mobile-ERP

S No	Process	Descriptions	Interfaces
14	Payment Approval	Approval of payments on Mobile	• ERP-Mobile-ERP
15	Building Plan Submissions	Building plan submission on Portal linking with LMS	• Portal – LMS • LMS-DMS • Portal –DMS
16	Project Report Submission	Project report linkage with ERP and LMS	• Portal – LMS • LMS-DMS • Portal –DMS • DMS-ERP
17	SCADA	SCADA alarms into ERP as work order and alert on mobile	• SCADA-ERP • ERP-EMAIL(inform operator) • ERP-Mobile

3.2.4 CCTV Surveillance System

- MSI shall install CCTV Cameras at all strategic locations including roads, intersections, public spaces/buildings, and other critical/sensitive facilities like AURIC Hall Building, AURIC Control Centre (ACC) Building and POP Rooms;
- MSI shall be responsible for integrating the City Surveillance System with the City Infrastructure;
- Indicative locations of CCTV cameras will be provided to the successful bidder. However, MSI shall conduct a conduct a survey and prepare a detailed report which shall validate and provide finalized locations, positions, mounting arrangements and height, orientation/field of view of the CCTV cameras;
- MSI shall be responsible for making proper adjustments to have the best possible image/video captured. MSI to also ensure cameras are protected from on-field challenges of weather, physical damage and theft;
- MSI shall be responsible for integrating each CCTV with the central application server by providing the unique ID, IP addresses, etc;
- MSI shall be responsible for data encryption and data security of the videos recorded;
- MSI shall coordinate with the EPC Contractor for installation of CCTVs on streetlights.

3.2.5 Multi-Services Digital Kiosks and Emergency Communications

- MSI shall be responsible for creating the required software platform to support the functionalities of the Multi-Services Digital Kiosk;
- MSI shall be responsible for integrating the VoIP features at the ACC for transferring the call to the respective departments;
- MSI shall be responsible for integrating the each kiosk with the central application server by providing the unique ID, IP addresses, etc.;
- MSI shall be responsible for upgrading the OS, firmware and other related platform of the Kiosk periodically;

- MSI shall be responsible for replenishment of consumables including paper for printing receipts and tickets;
- MSI shall be responsible for carrying out the turnkey works for implementing the kiosks;
- MSI shall coordinate with the EPC Contractor and other plot developers for installation and Right of Way (RoW).

3.2.6 ICT Interface for Smart Solid Waste Management System

- MSI shall be responsible for integrating the other sub-systems with the Solid Waste Management System. This includes coordination and integration with the solid waste management operations agency who shall be responsible for providing waste bins, and waste collection trucks.

3.2.7 Environmental Sensor

- MSI shall implement a Digital Display Screen (DDS) at AURIC Hall building to display environmental parameters to the public. MSI shall be responsible for all civil, electrical and communication works to implement DDS. MSI shall coordinate with AURIC Hall Building Contractor for implementing the same.

3.2.8 AVL System

- MSI shall be responsible for end-to-end coordination and integration with the respective fleet owners.

3.2.9 Other In-Facility System

3.2.9.1 Building Management System (BMS)

- MSI shall implement BMS at POP rooms. MSI shall develop the I/O summary and exhaustive integration capabilities of the BMS;
- MSI shall be responsible for all civil, electrical and communication works required for implementing BMS at POP rooms.

3.2.9.2 Access Control System

- MSI shall implement access control system at POP rooms and ACC facility;
- MSI shall coordinate with AURIC Hall Building Contractor for implementing Access Control System at ACC;
- MSI shall be responsible for all civil, electrical and communication works required for implementing Access Control at POP rooms and ACC.

3.2.10 Solar Panels with Batteries

- MSI shall install Solar Panel and Batteries at the street light poles where CCTV and Wi-Fi Access Points are to be installed. Also, shall be responsible for installation of solar panels with batteries at kiosks. All voltage conversions from solar to power the respective devices shall be the responsibility of the MSI;
- MSI shall coordinate with EPC Contractor and AITL to implement Solar Panel at the street light poles. The solar solution shall be capable of retrofitting on streetlight poles.

3.2.11 ICT interface for Water, Power and Streetlight Infrastructure

- EPC Contractor shall provide SCADA based water, power and streetlighting infrastructure, integrated at the respective reservoirs and substations. Preliminary information on this infrastructure is as follows:
  - Each plot shall have a dedicated water and power meter (both AMR based) respectively;
  - There will be multiple RMUs that will be provided by the EPC Contractor. Depending on the plot size, there shall either be one RMU per plot or multiple plots being fed by one RMU;
  - A total of four reservoirs will be implemented as part of the project; two (2) for fresh water and two (2) for recycled;
  - The streetlights shall be SCADA based at the panel level;
  - All water, power, streetlight, wastewater infrastructure shall be SCADA enabled.
- Coordinate with EPC Contractor to successfully integrate this infrastructure at the ACC. It is expected that not all functionality of this infrastructure will be duplicated at the ACC but only critical parameters shall be enabled at the ACC. This shall be finalized by the MSI in consultation with the Client, the EPC Contractor and the ICT consultant;
- EPC Contractor shall provide water and power meters with in-built M2M communications module. MSI shall work with the EPC Contractor to finalize the communications requirements of these meters and integrate them with the overall system;
- Integrate the operations and maintenance of this infrastructure with the AEE.

3.2.12 Hosting (On-Premises and Cloud)

- For hosting of all applications, an overall hybrid architecture of on-site infrastructure and infrastructure provided by the cloud service provider shall be considered.
- All servers provided by the MSI shall be in clustered configuration and shall be highly available. The server infrastructure provided by AITL through the cloud service provider shall be of high availability (typically 99.95%). MSI shall ensure that all applications are designed to support the high availability requirement of the infrastructure.
- All application level redundancy, scalability, reliability, etc requirements shall be under the scope of the MSI.
- As part of the Bid, Bidders shall define the expected storage, server requirements for all stages of the contract for the applications that will be hosted on-cloud.
- Hosting environment shall be in compliance with the Cloud Security Alliance (CSA) Cyber Security Guidelines for Smart City Technology Adoption.
- During the design and implementation stage of the project, the MSI shall provide a cloud architect as part of the team.
- MSI shall recommend system architecture for all the applications for both on-premises and cloud hosting.
- MSI shall provide Disaster recovery, back-up solution, specify/confirm RTO (Recovery time objective), RPO (Recovery point objective), Clustering/high-availability, Single

sign on, proposed application uptime, proposed Application response time for all applications, and their respective storage requirements over the implementation and O & M period.

- MSI shall only be responsible for the application level performance and uptime and not that of the availability of the hardware infrastructure being provided by the cloud service provider. However, the MSI shall be fully responsible to work hand-in-hand with the cloud service provider and ensure that an overall highly available solution is provided for the project.
- All applications deployed on cloud shall support required cloud architecture and shall be auto-scalable.
- MSI shall only get Infrastructure as a Service from AITL's cloud service provider. All installation/operations, management and operations of the MSI provided services and applications shall be performed by MSI. The Cloud Service Provider shall not provide managed services for installation but will only provide infrastructure that can be accessed and managed by the MSI. The MSI shall be responsible to ensure the optimized functioning of the infrastructure at any given time during the course of the Contract. MSI shall provide managed services for operations and maintenance of the cloud infrastructure for all applications;
- MSI shall be responsible for complete support and maintenance during phase-wise commissioning as well.
- Timelines for cloud is around 2-3 months from Bid submission date but can't be guaranteed at this stage. MSI shall ensure any temporary arrangement until cloud is available shall be provided as part of the overall solution.

3.2.13 Integration with e-LMS

AITL is implementing an electronic Land Management System (e-LMS) that will allow its potential clients to apply for land using a state-of-the-art online system. This system will enable key AITL officials to review and process the land applications online. The system supports end-to-end functionality of land management including:

- Getting registered on the land portal;
- Applying for land;
- Online application review including permitting with online approvals;
- Automated notifications on application progress; and
- Online payment for registration etc.

The e-LMS is divided into four (4) broad phases – phase 1 where the applicant registration and profile building is undertaken with the applicant submitting his application for land; phase 2 where AITL officials review the application against predefined criteria and shortlist potential applicants for land allotment after which the shortlisted applicants are called for a meeting. Post this meeting, if land is allotted to an applicant, lease agreement is generated automatically; Phase 3 where the applicant applies for necessary permits including water, power, etc and AITL reviews, processes and approves these permits; and Phase 4 where the architect and applicant apply for building plan related approvals and AITL reviews, processes and approves the same. Ultimately, through the e-LMS, a unique plot ID shall be generated for the applicant which will then be integrated with the ERP system. This e-LMS shall be integrated with GIS and web GIS being developed as part of this Project.

As part of the Project, MSI shall seamlessly integrate e-LMS with the designed ERP system, e-Governance modules and ACC. Integration of ERP system, e-Governance modules and ACC shall be done through web services.

MSI shall coordinate with e-LMS System Integrator for seamless integration of e-LMS with ERP system, e-Governance modules and ACC.

3.2.14 AURIC Control Centre (ACC)

- The detailed design in all aspects for the design-build (including but not limited to civil, mechanical, structural, electrical, communications, fire, fit-outs, furniture, etc.) of the ACC shall be the responsibility of the MSI and be approved by the Client or its representative. The MSI shall have the required personnel on the team including architect, structural engineer, MEP, etc as needed for this design-build. At least two (2) options for the design-build shall be proposed for the ACC;
- ACC area shall consist of ACC operations room including operator consoles with video wall, a cabin/boardroom for management and decision making, and a rack room for equipment. Implementation of ACC operations room, boardroom and rack room shall be done by MSI;
- As ACC shall be implemented at AURIC Hall Building, MSI shall coordinate with the AURIC Hall Building Contractor assigned for development of AURIC Hall for the spatial and basic infrastructure requirements. MSI may refer to the AURIC Hall tender available at the client website to understand and account for the scope of work of the AURIC Hall Building Contractor;
- AURIC Hall building Contractor shall provide an outer shell for the ACC including walls of the ACC room. This also includes an electrical and communication feed connection to the ACC room. It will be MSI's scope to provide all infrastructure and fit-out within the ACC room as per the requirements of this RFQ cum RFP;
- MSI shall coordinate with AURIC Hall architect for any requirements associated with layout of the ACC;
- MSI shall take consultation and approval of Client or its representative, for the interior layout and material to be procured for ACC;
- MSI shall furnish the ACC as part of the civil work in all aspects. All material to be used shall be of fine quality ISI marked or equivalent. The furnishing includes but not limited to:
    - Trench works;
    - Masonry works;
    - Cutting and chipping of any existing area;
    - Glazing;
    - False ceilings;
    - False floorings;
    - Paint work;
    - Storage;
    - Layouts and partitioning;
    - Doors and Locks;

- Fire proofing of all surfaces;
- Cement concrete works;
- Insulation.

- MSI shall install electrical distribution system inside the ACC. MSI shall be responsible for proper and uninterrupted equipment working and shall ensure this by having the IT equipment and server room power distribution with redundancy:
  - Incoming HT/LT feeder supply;
  - UPS system with battery bank for all AITL loads.
  - Connection between UPS system and the IT equipment shall be redundant. No single point of failure shall exist in the power connectivity between the IT equipment and UPS.
- Since ACC is a critical area, precise air conditioning system shall be exclusively installed by MSI to maintain the required temperature. The A/C shall be capable of providing sensible cooling capacities at ambient temperature and humidity with adequate air flow. The task of MSI shall include but not limited to:
  - Connecting the indoor unit with main electrical point;
  - Connecting indoor and outdoor units mechanically (with insulated copper piping);
  - Connecting indoor and outdoor unit to power;
  - The air conditioning shall be linked to a secondary power supply as redundant source to prevent them from shutting down in case of power outage.
- MSI shall do complete electrical cabling work for IT equipment which shall include but not limited to:
  - Main electrical panel in room;
  - Power cabling;
  - UPS distribution board;
  - UPS point wiring;
  - Power cabling for utility points and utility components etc.;
  - Online UPS;
  - Separate earth pits for the component;
  - MSI shall use fire retardant cables of rated capacity exceeding the power requirements of equipment to be used at maximum capacity;
  - All material shall conform to ISI standards as per industry practice.
- MSI shall be responsible for the lighting works in the facility. Following items need to be undertaken by MSI for lighting:
  - Supply of all equipment associated with implementation of lighting including fixtures, lamps, wiring etc.;
  - Wiring for lighting system in the building;
  - Installation of lighting fixtures;
  - Warranty for the lighting equipment;
  - Critical lights shall be connected to UPS for uninterrupted lighting;

  - Post the installation, MSI shall ensure that lux levels of the building are as per IES-HB-10-11 and requirements of this RFQ cum RFP.

- The ACC shall be equipped with adequate and advanced Fire Detection and Suppression system. The system shall raise an alarm in the event of smoke detection. The system shall have proper signage, response indicators and hooters in case of an emergency. The system shall be based as per NFPA standards;
- The Access card based access control system shall be deployed by the MSI with the objective of allowing entry and exit to and from the premises to only authorized personnel with appropriate door locks and controller assembly;
- MSI shall also install CCTV surveillance system inside ACC for video surveillance of the facility. The MSI shall also provide the ACC operations room to be Wi-Fi enabled;
- MSI shall also be responsible for installing a rodent repellent provision inside the ACC facility;
- MSI shall be responsible for compliance with all local standards and certifications, including building, electrical and occupational requirements;
- MSI shall integrate ACC with various other City systems and infrastructures. MSI shall coordinate with all the stakeholders of these city systems for integration purposes;
- MSI shall be responsible for setting up the required software platform and interfacing ACC with other city components;
- Define SOPs with the Client or its representative for the operations to ensure that ACC systems are configured to support the operational procedures;
- Creation of KPIs and dashboards as per the requirement of the Client;
- Mobile version for the smart city platform for the Client;
- Build and certify ACC as per ISO 27001:2011 and ISO 11064 standards;
- If required, the MSI shall also be responsible for setting up a temporary command and control centre at the POP facility using the same ICT infrastructure (reduced quantities) that is planned for the ACC. Any installation and dismantling required for this shall be under the scope of the MSI. This will be only for temporary basis.

4 Roles and Responsibilities

4.1 Master System Integrator (MSI)

MSI shall be responsible for providing a complete system that incorporates all specification requirements, including but not limited to:

- Provide all components as per the Project requirements;
- Deployment of a competent team of experts for each system solution with relevant prior experience and depth of knowledge in each functional area. Team of experts shall be able to supervise end to end business processes for all project components;
- Scheduling the activities and accordingly deploying the resources in a pragmatic manner in order to complete the implementation of the smart city ICT components within the required scope, quality and time constraints;
- Project Team and Management: Since the continuity of the key members of the project team is essential, MSI to follow diligent process for ensuring continuity of key personnel assigned for implementation of the project. For project team, MSI shall carry out following responsibilities:
  - At the project initiation, the MSI will share the profiles of the “Key Personnel” with Client and these key profiles shall meet the minimum eligibility criteria highlighted in the RFQ cum RFP as well as the proposal submitted by the MSI;
  - Regular meetings between key personnel and the Client or its representative to discuss project implementation and progress;
- Deployment of a project structure for effective governance, monitoring, review and risk mitigation;
- Provision of all Testing services, up to and including the System Acceptance Test;
- Provision of all Installation and Configuration services defined as part of bid document;
- Provision of detailed Documentation for the MSI’s solution;
- Provision of all Training and associated documentation for Client’s personnel;
- MSI shall provide Project Quality services as following:
  - Adoption of standard methodology encompassing project documentation at various phases, following robust review mechanisms and ensuring quality at all the stages of the project;
  - The MSI is expected to deploy all the quality assurance mechanisms as per international quality standards for this project;
  - ICT systems shall be deployed in such a manner that they are scalable and upgradations of hardware and software are possible with minimal efforts. MSI shall include product upgrade as part of scope during installation;
  - Detailed quality assurance plan for all the phases of the project shall be provided by the MSI.
- MSI shall be responsible for the following feedback, monitoring and adoption mechanism:
  - Stakeholder Mapping : The MSI will put together a structure and mechanism for ensuring that all the relevant stakeholders are consulted, feedback adopted and key differences identified, so as to facilitate standardization as well as user adoption;

- MSI shall indicate the deliverables which shall go for internal review and accordingly the level of expertise that will be deployed for the reviews and the deliverables which will follow quality assurance plans;
- If any of the deliverables are not accepted by the Client, it shall have the right to seek deployment of experts from MSI to review the deliverables. Client shall also hire third party experts to review the deliverables, if required;
- Mechanism to adopt feedback/audit findings: There are three types of feedback for the deliverables – from the users/stake holders, from the internal experts of the MSI and the third party experts hired by AITL. The following is expected from the MSI on these feedbacks/audit findings:
    - All the feedback shall be discussed with Client and based on the guidance of Client, the feedback shall be incorporated into the project;
    - Since the feedbacks/audit findings for any rework is by nature correcting the inadequacy of quality of the work produced in the first place, Client will not accept any change notice requests for these reworks;
    - MSI shall build in adequate mechanisms to control the risks of time over runs possibly due to effort required to rework bad quality deliverables;
    - MSI shall indicate in the beginning of each phase how it plans to take feedback and the mechanisms to incorporate the feedbacks into the project plan and deliverables;
    - MSI shall report to Client how the feedbacks have been incorporated into the project deliverables and take a sign off from the designated authority of Client.

- Warranty for all equipment and software, up to and following System Acceptance, and provision of a System Warranty following System Acceptance;
- All Spare Parts for the MSI Solution to meet the SLA requirements;
- Technical Support services following System Acceptance;
- MSI to coordinate with Client to complete the civil and electrical work as required;
- MSI to coordinate with all necessary stakeholders involved in the project for successful and smooth implementation;
- MSI shall work closely with EPC Contractor and AURIC Hall Building Contractor to meet the requirements of the Project;
- MSI shall provide all the integration support and develop necessary API, Program and necessary development to integrate with city operations with the ACC, ERP systems and e-Governance applications;
- MSI shall be responsible for demonstrating software development/implementation to the client periodically in Mumbai as per the project requirements;
- Training for relevant personnel;
- Secure storage of all equipment on-site;
- Opening and maintain of project office in Aurangabad throughout the course of the Contract. Maintaining any on-site office during construction (temporary) shall also be the responsibility of the MSI;
- MSI shall depute an on-site project coordinator in Mumbai during the entire implementation period;

- Maintenance support for system and field equipment;
- Client may at any anytime during the contract period choose to undertake an independent third party audit of the implemented system including both application and infrastructure audit. The MSI shall support this audit.

4.2 Client

Through its authorized personnel and representatives AITL shall:

- Provide basic infrastructure (power, space, access) required at each facility for installation of System equipment and for Training;
- Client shall provide plot area for the POP room;
- Shall approve any provision of raw electricity up to mains power distribution panel at ACC, POP rooms, other sites;
- Client shall pay the electricity bill for the smart city ICT components under the scope of this contract;
- Assign a Project Manager with the authority to make decisions (and/or designate representatives with such authority) on behalf of Client;
- Participate in all scheduled project activities, attend scheduled meetings and promptly respond to new meeting requests, requests for information, technical support or other necessary communication activities;
- Provide staff, and facilities for all Training held in accordance with the Training Plan;
- Participate and approve the results of all tests, in accordance with the Test Plan;
- Provide payment gateway for all financial transactions;
- Provide internet connectivity at ACC and between Shendra and Cloud Service Provider facility;
- Provide SMS gateway for SMS;
- Provide Infrastructure-as-a-Service through Cloud Service Provider;
- Provide base shape files for GIS works to be undertaken by the MSI;
- Any coordination or permits required for performing works in the project area;
- Client shall assist the MSI in:
  - Obtaining necessary permits or permissions for any activities requiring outside authorization;
  - Coordinating logistical arrangements to receive project related equipment at project facilities;
  - Providing access to field implementation locations as required;
  - Timely acquisition of required technical data from EPC Contractor or other parties;
  - Obtaining any new, changed, or updated operational information necessary for the MSI to configure and initialize the system; and
  - Scheduling and coordination for staff participating in training sessions as per the agreed training schedule.

5 Implementation Schedule (Activities, Milestones and Deliverables)

MSI shall deliver all project activities/milestones/deliverables to the Client as per the timelines stated in this section. MSI shall submit at least two (2) versions of each deliverable as per following:

- Draft Version;
- Final Version.

Client or its authorized representative shall take thirty (30) days to review and provide comments on all respective deliverables. MSI shall ensure that all comments provided by the Client or its authorized representative shall be incorporated in the final version of all deliverables.

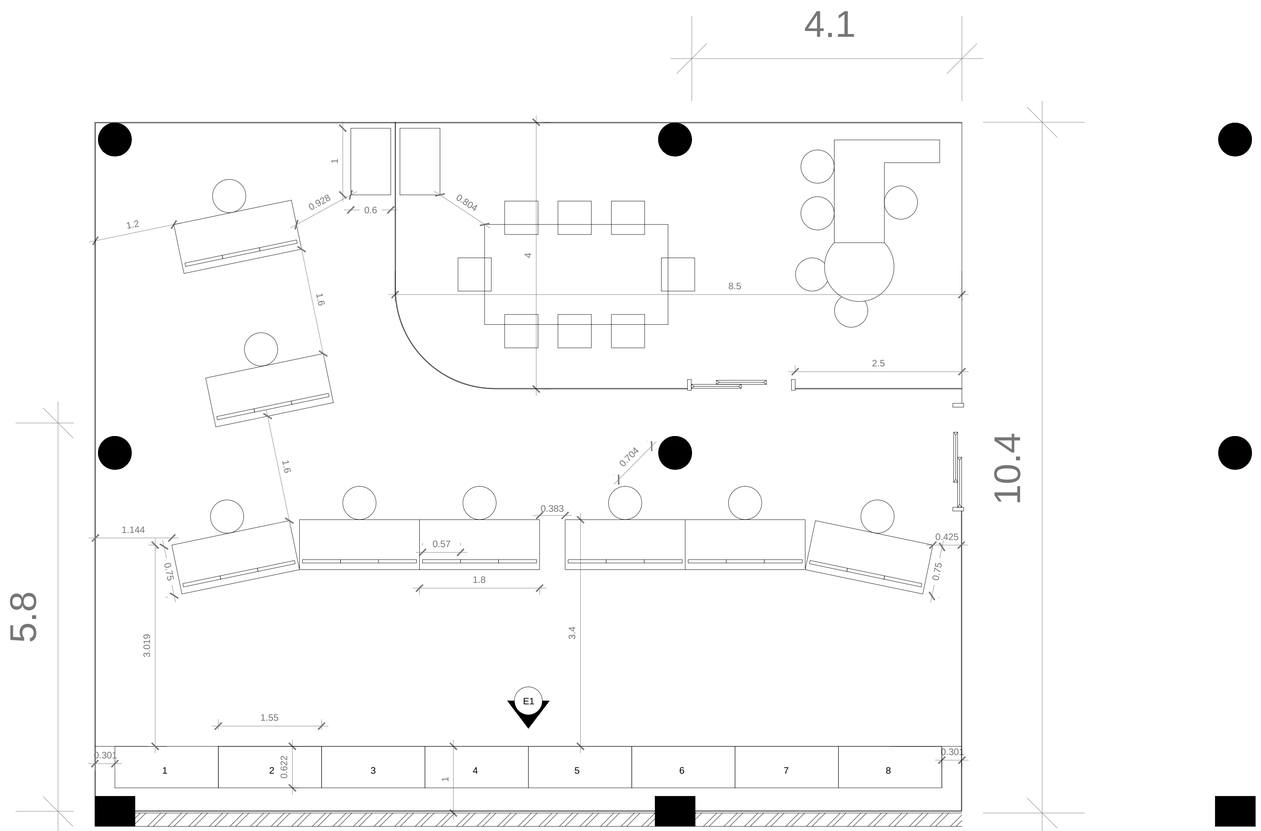
All deliverables indicated in the tables below are indicative only and shall be read in conjunction with the Detailed Scope of Work section and Volume II (Standard Form of Contract) of the RFQ cum RFP for detailed requirements. Client or its authorized representative reserves the right to ask for additional information, documents and deliverables throughout the Project.

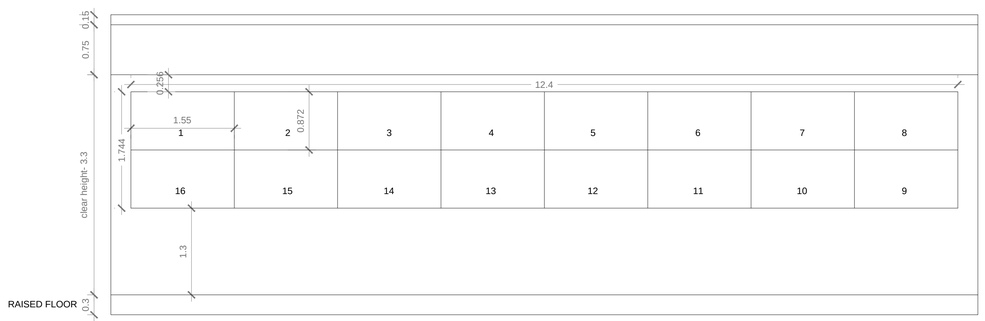
Activities/Milestones/Deliverables	**Expected Date of Delivery/Completion from Contract Signing (D)**
Shop Drawings	D + 15 Days
Inception Report	D + 1 Month
Detailed Project Report for Phase 1	D + 1 Month
Testing, Commissioning and Integration Plans for Phase 1	D + 2 Months
Detailed Project Report for all other Phases	D + 3 Months
All Design Drawings	
Testing for Phase 1	
Operational Acceptance + Go-Live of Phase 1	D + 4 Months
Testing, Commissioning and Integration Plans for Phase 2a	
Testing of Phase 2a	D + 6 Months
Detailed Plan of Operations for ACC including SOPs, roles and responsibilities, etc.	D + 7 Months
Operational Acceptance + Go-Live of Phase 2a	D + 8 Months
Testing, Commissioning and Integration Plans for Phase 2b	
Testing of Phase 2b	D + 10 Months
Operational Acceptance + Go-Live of Phase 2b	D + 11 Months
Testing, Commissioning and Integration Plans for Phase 3a	D + 12 Months

Activities/Milestones/Deliverables	**Expected Date of Delivery/Completion from Contract Signing (D)**
Testing of Phase 3a	D + 14 Months
Operational Acceptance + Go-Live of Phase 3a	D + 16 Months
Testing, Commissioning and Integration Plans for Phase 3b	D + 17 Months
Testing of Phase 3b	D + 18 Months
Operational Acceptance + Go-Live of Phase 3b	D + 19 Months
End to End Implementation and Go-Live of the Project	D + 19 Months
Completion of one-month 'Burn-In' Period + Handover of All Systems	D + 20 Months
Operational Acceptance of the Project	D + 20 Months
All 'As-Builts', Training Manuals, Maintenance Manuals. User manual etc.	D + 22 Months
Completion of Defect Liability Period and commencement of AMC Phase	D + 34 Months
Completion of AMC Phase	D + 80 Months

The timelines given in the table above are for draft version for all applicable documentation.

Appendix A:
Typical Drawings





ELEVATION E1
(VIDEO WALL)

REVISION	DD-MMM-YYYY	DESCRIPTION	DESIGN	DRAWN	CHECKED
V1.0	31-JAN-2017	ISSUED FOR RFQ CUM RFP	IN	AB	IN

SEAL 1

SCALE
N.T.S.

CLIENT
AURANGABAD INDUSTRIAL TOWNSHIP LTD. (AITL)

CONTRACTOR

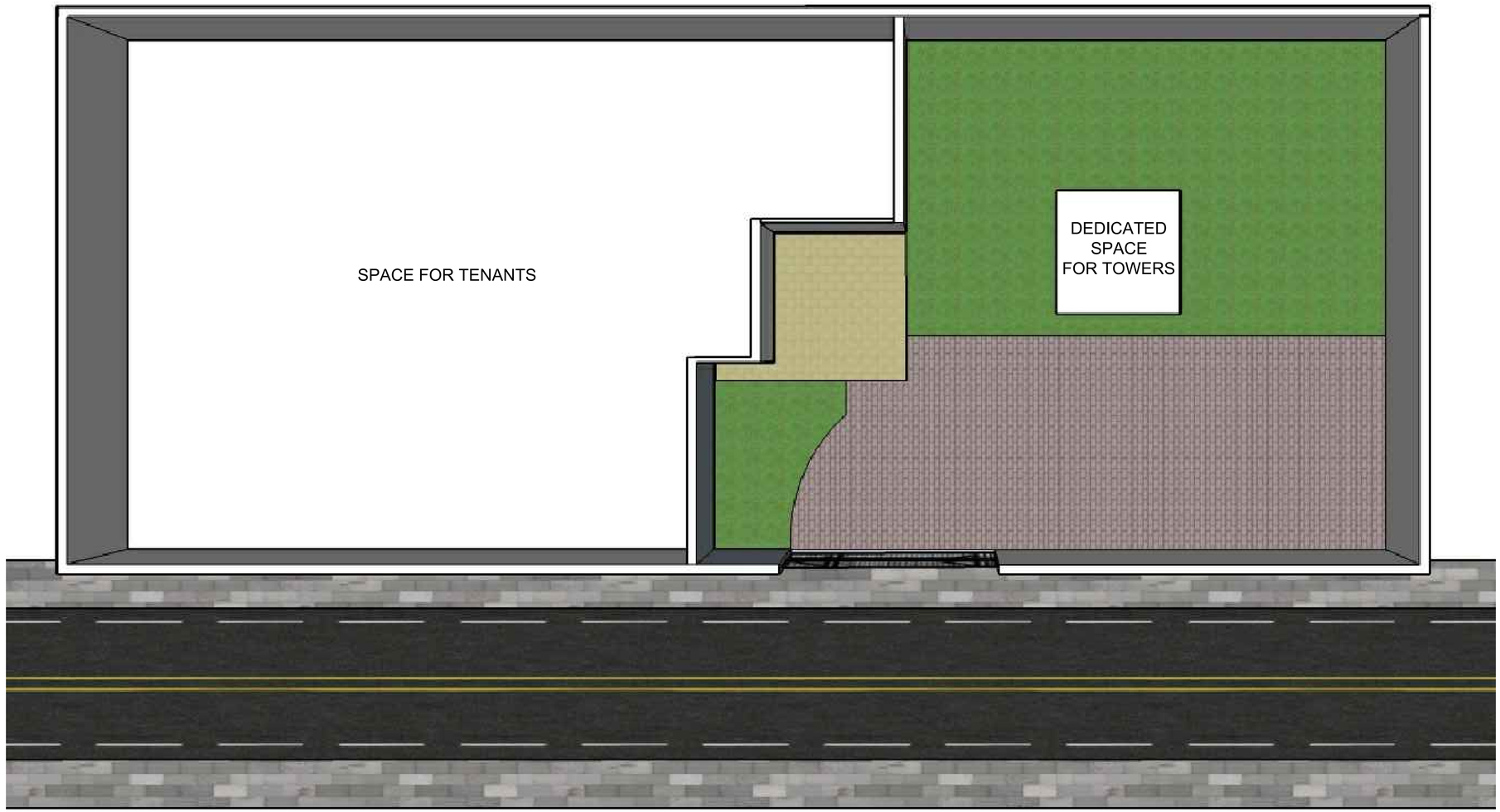
ENGINEER
IBI GROUP

AURANGABAD INDUSTRIAL TOWNSHIP LTD. (AITL)
TYPICAL LAYOUT DRAWINGS
AURIC CONTROL CENTRE (ACC)

PROJECT NUMBER
39549

DRAWING NUMBER
TP-SH-001

J:\39549 Shendra ICT\5.0 Design (Work) Phase\2.2 Data Centres\20160512_control centre_02_V0.1_10.05.2016.dwg



BUILDING SIZE = APPROXIMATELY 2000 Sq.Ft.

REVISION	DD-MMM-YYYY	DESCRIPTION	DESIGN	DRAWN	CHECKED
V1.0	31-JAN-2017	ISSUED FOR RFQ CUM RFP	KN	AB	SB

SEAL 1

SCALE

N.T.S.

CLIENT
AURANGABAD INDUSTRIAL TOWNSHIP LTD. (AITL)

CONTRACTOR

ENGINEER
IBI GROUP

AURANGABAD INDUSTRIAL TOWNSHIP LTD. (AITL)
TYPICAL LAYOUT DRAWINGS
POINT OF PRESENCE (POP)

PROJECT NUMBER
39549

DRAWING NUMBER
TP-SH-002

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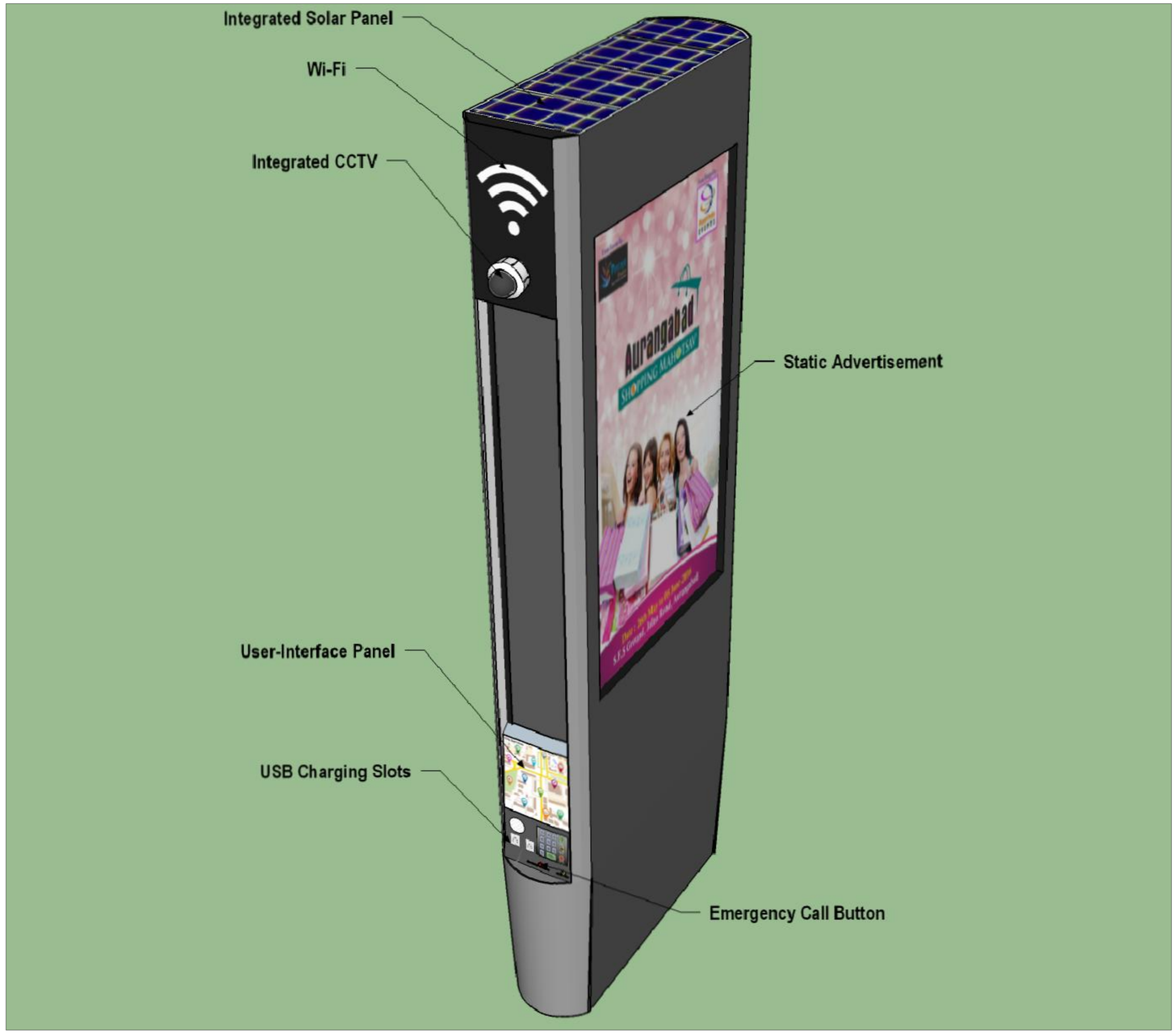

REVISION	DD-MMM-YYYY	DESCRIPTION	DESIGN	DRAWN	CHECKED
V1.0	31-JAN-2017	ISSUED FOR RFQ CUM RFP	KN	AB	SB

SEAL 1

SCALE

N.T.S.

CLIENT
AURANGABAD INDUSTRIAL TOWNSHIP LTD. (AITL)

CONTRACTOR

ENGINEER
IBI GROUP

AURANGABAD INDUSTRIAL TOWNSHIP LTD. (AITL)
TYPICAL LAYOUT DRAWINGS
MULTI-SERVICES DIGITIAL KIOSK

PROJECT NUMBER
39549

DRAWING NUMBER
TP-SH-003

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Appendix B:
Standards (for Reference only)

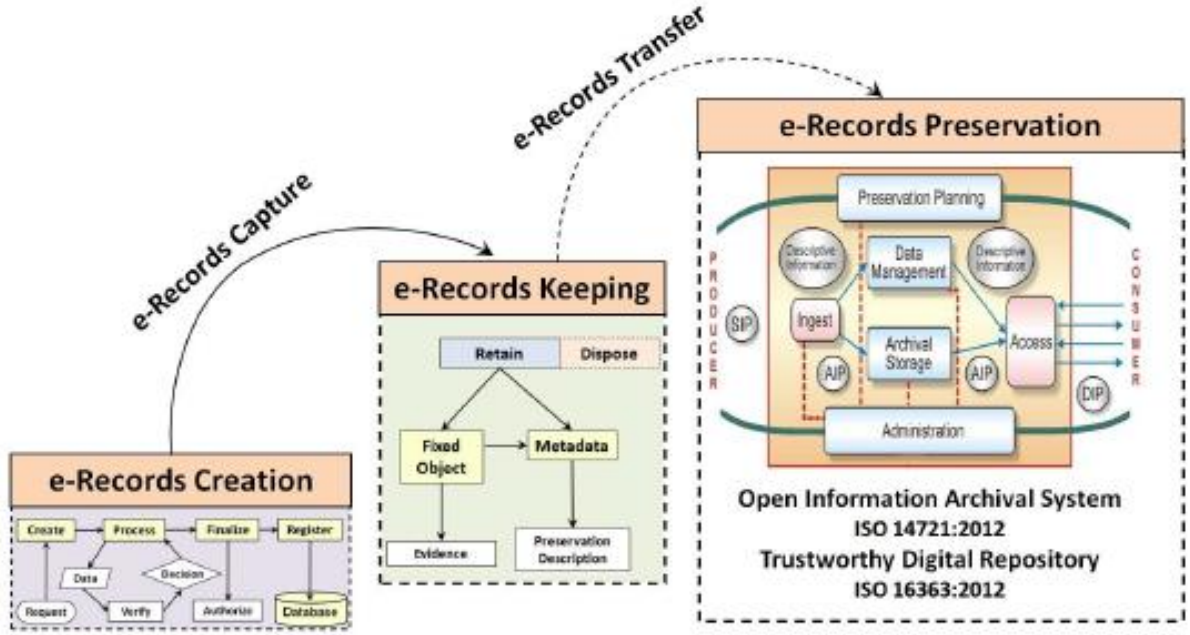
1. Digital Preservation Standards

The **e-Governance Standard for Preservation Information Documentation (eGOV-PID) of Electronic Records (eGOV-PID)** provides a standardized metadata dictionary and schema for describing the "preservation metadata" of an electronic record. This standard proposes to capture most of the preservation information (metadata) automatically after the final e-record is created by the e-Government system. Such preservation information documentation is necessary only for those e-records that need to be retained for long durations (e.g. 10 years, 25 years, 50 years and beyond) and the e-records that need to be preserved permanently.

The implementation of this standard helps in producing the valid input i.e. Submission Information Package (SIP) for archival and preservation purpose as per the requirements specified in the ISO 14721 Open Archival Information Systems (OAIS) Reference Model.

The eGOV-PID allows to capture the preservation metadata in terms of cataloguing information, enclosure information, provenance information, fixity information, representation information, digital signature information and access rights information.

The core concepts of 'preservability' are based on the requirements specified in IT ACT, ISO/TR 15489-1 and 2 Information Documentation - Records Management and ISO 14721 Open Archival Information Systems (OAIS) Reference Model. It introduces 5 distinct steps of e-record management i.e. e-record creation, e-record capturing, e-record keeping, e-record transfer to designated trusted digital repository and e-record preservation which need to be adopted in all e-Governance projects.



Standard	Description
ISO 15836:2009	Information and documentation - The Dublin Core metadata elements
ISO/TR 15489-1 and 2	Information and Documentation - Records Management: 2001
ISO 14721:2012	Open Archival Information Systems (OAIS) Reference Model
ISO/DIS 16363: 2012	Audit & Certification of Trustworthy Digital Repositories

Standard	Description
METS, Library of Congress, 2010	Metadata Encoding and Transmission Standard (METS) -
InterPARES 2	International Research on Permanent Authentic Records - A Framework of Principles for the Development of Policies, Strategies and Standards for the Long-term Preservation of Digital Records, 2008
ISO 19005-1:2005 Use of PDF 1.4 (PDF/A-1b) with Level B	Capture of e-records in PDF for Archival (PDFA) format - PDF/A-1a is based on the PDF Reference Version 1.4 from Adobe Systems Inc. (implemented in Adobe Acrobat 5 and latest versions) and is defined by ISO 19005-1:2005. Conformance is recommended for archival of reformatted digital documents due to following reasons: • PDF/A-1b preserves the visual appearance of the document • Digitized documents in image format can be composited as PDF/A-1b **PDF/A for e-governance applications** • Apache FOP 1.1 library can be used in the application logic for dynamically publishing the e-records in PDF/A format. **PDF/A for document creation** • Libre Office 4.0 supports the exporting of a document in PDF/A format. • MS Office 2007 onwards the support for “save as” PDF/A is available. • Adobe Acrobat Professional can be used for converting the PDF documents to PDF/A format.
ISO 19005-2:2011 Use of ISO 32000-1 (PDF/A-2)	Recommended for preservation of documents requiring the advanced features supported in it. PDF/A-2a is based on ISO 32000-1 – PDF 1.7 and is defined by ISO 19005-2:2011. Its features are as under: • Support for JPEG2000 image compression • Support for transparency effects and layers • Embedding of OpenType fonts • Provisions for digital signatures in accordance with the PDF Advanced Electronic Signatures – PAdES standard • Possibility to embed PDF/A files in PDF/A-2 for archiving of sets of documents as individual documents in a single file PDF/A-2 does not replace the PDF/A-1 standard but it co-exists alongside with an extended set of features. PDF/A-1a and PDF/A-1b compliance are minimum essential for e-government records as recommended in the IFEG technical standard of DeitY.
JPEG2000 (ISO/IEC 15444-1:2004) and PNG (ISO/IEC	Image file formats - which support lossless compression are recommended as raster image file formats for e-governance applications as specified in Technical Standards for Interoperability Framework for e-

Standard	Description
15948:2004)	Governance (IFEG) in India, published in 2012 by e-Gov Standards Division, DeitY.
ISO/IEC 27002: 2005	Code of practices for information security management for ensuring the security of the e-records archived on digital storage.

2. Localization and Language Technology Standard

- **Character Encoding Standard for Indian Languages**

Standardization is one of the baselines to be followed in localization. Standardization means to follow certain universally accepted standards, so that the developers could interact through the application. Standardization becomes applicable in almost everything specific to the language – for instance, a standard glossary of terms for translation, a standard keyboard layout for input system, a standard collation sequence order for sorting, a standard font etc.

Character Encoding standard for all constitutionally recognized Indian Languages should be such that it facilitates global data interchange.

ISCII is the National Standard and Unicode is the global character encoding standard.

Unicode shall be the storage-encoding standard for all constitutionally recognized Indian Languages including English and other global languages as follows:

Specification Area	Standard Name	Owner	Nature of the Standard	Nature of Recommend Actions
Character Encoding for Indian Languages	Unicode 5.1.0 and its future upgradation as reported by Unicode Consortium from time to time.	Unicode Consortium , Inc.	Matured	Mandatory

- **Font Standard for Indian Languages**

A single International Standard to comply with UNICODE data storage. This ensures data portability across various applications and platforms.

ISO/IEC 14496-OFF (Open Font Format) is based on a single International Standard and complies with UNICODE for data storage. This ensures data portability across various applications and platforms. Open type font is a smart font which has built- in script composition logic.

ISO/IEC 14496-OFF (Open Font Format) for font standard would be the standard for Indian Languages in e-Governance Applications. **ISO/IEC 14496-OFF (Open Font Format) for font standard is mandatory for all 22 constitutionally recognized languages.**

ISO/IEC 14496-OFF (Open Font Format)

OFF fonts allow the handling of large glyph sets using Unicode encoding. Such encoding allows broad international support for typographic glyph variants.

OFF fonts may contain digital signatures, which enable operating systems and browsing applications to identify the source and integrity of font files, (including the embedded font files obtained in web documents), before using them. Also, font developers can encode embedding restrictions in OFF fonts which cannot be altered in a font signed by the developer.

3. Metadata and Data Standards

Standardization of data elements is the prerequisite for systematic development of e-Governance applications.

Data and Metadata Standards provide a way for information resources in electronic form to communicate their existence and their nature to other electronic applications (e.g. via HTML or XML) or search tools and to permit exchange of information between applications.

The present document “Data and Metadata Standards- Demographic” focuses on Person Identification and Land Region codifications. It includes the following:

- **Mechanism for allocation of reference no**. to the identified Generic data elements, and their grouping.
- **Generic data elements specifications like:**
  - Generic data elements, common across all Domain applications
  - Generic data elements for Person identification
  - Generic data elements for Land Region Codification
  - Data elements to describe Address of a Premises, where a Person resides
- **Specifications of Code Directories like:**
  - Ownership with rights to update
  - Identification of attributes of the Code directories
  - Standardization of values in the Code directories
- **Metadata of Generic Data Elements:**
  - Identification of Metadata Qualifiers
  - Metadata of the data elements
- **Illustration of data elements to describe:**
  - Person identification
  - Address of a premises

This Standard would be applicable to all e-Governance applications in India as per the Government’s Policy on Open Standards (refer http://egovstandards.gov.in/policy/policy-onopen-standards-for-e-governance/)

Reference Standards:

- ISO Standard 1000:1992 for SI Units
- MNIC Coding for Person Identification
- ISO 693-3 for International language codes
- RGI’s coding schemes for Languages
- Top level document provided by Working Group on Metadata and Data Standards
- EGIF (e- Government Interoperability Framework) Standard of U.K.
- uidai.gov.in/UID_PDF/Working_Papers/A_UID_Numbering_Scheme.pdf
- http:// www.dolr.nic.in for conversion table of units as used by Department of Land

- Records
- GoI Policy on open standards version 1.0 released in November, 2010
- UID DDSVP Committee report, Version 1.0, Dec 09, 2009
- ANSI92 Standard

4. Mobile Governance

Framework for Mobile Governance (m-Governance)

Mobile Governance (m-Governance) is a strategy and its implementation to leverage available wireless and new media technology platforms, mobile phone devices and applications for delivery of public information and services to citizens and businesses.

The following are the main measures laid down:

- Web sites of all Government Departments and Agencies shall be made mobile compliant, using the "**One Web"** approach.
- **Open standards** shall be adopted for mobile applications for ensuring the interoperability of applications across various operating systems and devices as per the Government Policy on Open Standards for e-Governance.
- **Uniform/ single pre-designated numbers** (long and short codes) shall be used for mobile-based services to ensure convenience.

5. Guidelines for Indian Government Websites

It is suggested that the Indian Government websites adhere to certain common minimum standards, as prerequisites for a Government website to fulfil its primary objective of being a citizen centric source of information & service delivery.

These Guidelines have been framed with an objective to make the Indian Government Websites conform to the essential pre-requisites of UUU trilogy i.e. Usable, User-Centric and Universally Accessible. They also form the basis for obtaining Website Quality Certification from STQC (Standardization Testing Quality Certification) an organization of Department of Information Technology, Government of India.

These Guidelines are based on International Standards including ISO 23026, W3C's Web Content Accessibility Guidelines, Disability Act of India as well as Information Technology Act of India.

- **Indian Government Entity**

  All websites and Portals belonging to the Indian Government Domain at any hierarchical level (Apex Offices, Constitutional Bodies, Ministries, Departments, Organizations, States/UTs, District Administrations, and Village Panchayats et al) must prominently display a strong Indian Identity and ownership of Indian Government.

  The above objective can be achieved through the following:

  - The National Emblem of India MUST be displayed on the Homepage of the websites of Central Government Ministries/Departments. The usage of National Emblem on an Indian Government website must comply with the directives as per the 'State Emblem of India (Prohibition of improper use) Act, 2005'.

    Further, the State Governments should also display the State Emblem (or the National Emblem in case the State has adopted the National Emblem as its official State Emblem) as per the Code provided in the above Act. The Public Sector organisations and autonomous bodies should display their official logo on the Homepage of the website to re-enforce their identity.

  - The Homepage and all important entry pages of the website MUST display the ownership information, either in the header or footer.

  - The lineage of the Department should also be indicated at the bottom of the Homepage and all important entry pages of the website. For instance, at the bottom of the Homepage, the footer may state the lineage information, in the following manner:

    - This Website belongs to Department of Heavy Industries, Ministry of Heavy Industries and Public Enterprises, Government of India' (for a Central Government Department).
    - This Website belongs to Department of Industries, State Government of Maharashtra, India' (for a State Government Department).
    - This is the official Website of Gas Authority of India Limited (GAIL), a Public Sector Undertaking of the Government of India under the Ministry of Petroleum and Natural Gas (for a Public Sector Undertaking).
    - This is the official Website of the District Administration of Thanjavur, State Government of Tamil Nadu (India)' (for a District of India).

  - All subsequent pages of the website should also display the ownership information in a summarized form. Further, the search engines often index individual pages of a

website and therefore, it is important that each webpage belonging to a site displays the relevant ownership information.

- In case of those websites which belong to Inter-Departmental initiatives involving multiple Government Departments which are difficult to list on the Homepage, the Government ownership should still be reflected clearly at the bottom of the page with detailed information provided in the 'About the Portal/Website' section.
- The page title of the Homepage (the title which appears on the top bar of the browser) MUST be complete with the name of the country included, for instance, instead of the title being just Ministry of Health and Family Welfare, it should state, Government of India, Ministry of Health & Family Welfare.

  Alternatively, in case of a State Government Department, it should state 'Department of Health, Government of Karnataka, India '. This will not only facilitate an easy and unambiguous identification of the website but would also help in a more relevant and visible presence in the searchengine results. Further, it is important since the screen readers used by the visually impaired users first read the title of the page and in case the title is not explanatory enough, it may confuse or mislead them.

- **Government Domains**

  The URL or the Web Address of any Government website is also a strong indicator of its authenticity and status as being official. In today's era with a large proliferation of websites, which resemble Government websites and fraudulently claim to provide reliable Government information and services, the role of a designated Government domain name assumes a lot of significance.

  Hence, in compliance to the Government's Domain Name Policy, all Government websites MUST use 'gov.in' or 'nic.in' domain exclusively allotted and restricted to Government websites. The military institutions and organisations in India may also use 'mil.in' domain in place of or in addition to the gov.in /.nic.in domain. The above naming policy applies to all Government websites irrespective of where they are hosted.

  Those Departments and Government entities that are using and have been publicising a domain name other than the above should take appropriate early action to register official government domain names and use the existing ones as 'alias' for a period of six months. An intermediary page with a clear message notifying the visitors about the change in the URL and then auto redirecting them to the new URL after a time gap of 10 seconds should be used.

  The Domain Name Conventions, as specified in the '.IN Registration' policy should be followed while registering a 'gov.in' Domain Name.

  National Informatics Centre (NIC) is the exclusive Registrar for GOV.IN domain names. The use of GOV.IN Domain is restricted to the constituents of Indian Government at various levels right from Central, State/UT, District & Sub-District, block, village etc.

  For detailed information and step-by-step procedure on how to register a .GOV IN Domain, one may visit http://registry.gov.in .

- **Link with National Portal**

  - **india.gov.in:** The National Portal of India is a single window source for access to all information and services being provided by the various constituents of the Indian Government to its citizens and other stakeholders.

There are exclusive sections on Citizens, Business, Overseas, Government, Know India, Sectors etc. catering to the information needs. Sections targeting special interest groups such as Government Employees, Students, Senior Citizens, Kids etc. are also present.

- **Since the National Portal is the official single entry Portal of the Indian Government, all Indian Government websites MUST provide a prominent link to the National Portal from the Homepage and other important pages of citizens' interest.**
- **The pages belonging to the National Portal MUST load into a newly opened browser window of the user.** This will also help visitors find information or service they could not get on that particular website. It is quite common that citizens are not aware which information or service is provided by which Department.

As per linking Policy of the National Portal, no prior permission is required to link 'india.gov.in' from any Indian Government website. However, the Department providing a link to the National Portal is required to inform the National Portal Secretariat about the various sections of the National Portal that they have linked to, so that they can be informed of any changes, updations / additions therein. Also, it is not permitted that the National Portal Pages be loaded into frames on any site. These must be loaded into a new browser window.

Special Banners in different sizes and colour schemes for providing a link to the National Portal have been given at http://india.gov.in/linktous.php

Instructions on how to provide a link have also been given. The Government websites / portals may choose any banner from the ones provided, depending upon their site design and place the same on their Homepage.

- **Content Copyright**

Copyright is a form of protection provided under law to the owners of "original works of authorship" in any form or media. It is implied that the original information put up on the website by a Government Department is by default a copyright of the owner Department and may be copied, reproduced, republished, uploaded, posted, transmitted, or distributed only if the copyright policy of the concerned Department allows so.

Hence, the information, material and documents made available on an Indian Government website MUST be backed up with proper copyright policy explaining the terms and conditions of their usage and reference by others. The copyright policy of a Department could be liberal, moderate or conservative depending upon their preferences based on the kind of information available on their website. However, since it is a duty of a Government Department to provide all the information in the public domain freely to the citizens, the Departments should aim to have a liberal copyright policy.

The Departments should also be sensitive towards publishing any information having a third party copyright. The Government Departments MUST follow proper procedures to obtain the permission, prior to publishing such information on their websites.

If any published Government Document/Report is being reproduced on any website, whether as excerpts or in full, the source of the same i.e. Full Title of the Report/Document along with the name of the concerned Department and year of publication MUST be provided.

- **Content Hyper linking**

  Since Government websites often receive queries and requests from owners of other websites who might want to provide a hyper link to their web pages, every Indian Government website MUST have a comprehensive and clear-cut hyper linking policy defined and spelt out for those who wish to hyper link content from any of its sections. The basic hyper linking practices and rules should ideally be common across the websites of a State/Ministry.

  The hyperlinking policy enumerating the detailed criteria and guidelines with respect to hyperlinks with other sites may be made available under the common heading of **'Hyperlinking Policy'** and displayed at a common point on the Homepage of all sites under the ownership a State/Ministry.

  - To create a visual distinction for links that lead off site, Cascading Style Sheets (CSS) controls or XSL or some such similar mechanism should be used. In case the link takes the user to another website of the same Department/Ministry/ State, a seamless transition should be used through appropriate CSS controls.
  - Third party content should only be linked when consideration about the copyright, terms of use, permissions, content authenticity and other legal and ethical aspects of the concerned content have been taken into account.
  - The overall quality of a website's content is also dependent, among other things on the authenticity and relevance of the 'linked' information it provides.
  - Further, it MUST be ensured that 'broken links' or those leading to 'Page Not Found' errors are checked on a regular basis and are rectified or removed from the site immediately upon discovery.

- **Privacy Policy**

  Government websites should follow an extremely cautious approach when it comes to collecting personal details/information about the visitors to the sites. It should be an endeavor to solicit only that information which is absolutely necessary.

  In case a Department solicits or collects personal information from visitors through their websites, it MUST incorporate a prominently displayed Privacy Statement clearly stating the purpose for which information is being collected, whether the information shall be disclosed to anyone for any purpose and to whom.

  Further, the privacy statement should also clarify whether any cookies shall be transferred onto the visitor's system during the process and what shall be the purpose of the same.

  Whenever a Department's website allows e-commerce and collects high risk personal information from its visitors such as credit card or bank details, it MUST be done through sufficiently secure means to avoid any inconvenience. SSL (Secure Socket Layer), Digital Certificates are some of the instruments, which could be used to achieve this.

6. Open APIs

Policy on Open Application Programming Interfaces (APIs)

Interoperability among various e-Governance systems is an important prerequisite for upgrading the quality and effectiveness of service delivery. For promoting Open Standards for software interoperability across various Government departments and agencies, GoI has already notified the “Policy on Open Standards for e-Governance” and “Technical Standards on Interoperability Framework for e-Governance”.

Open API is the API that has been exposed to enable other systems to interact with that system. Open API may be either integrated with the host application or may be an additional piece of software that exposes any proprietary API with an Open API equivalent. The Open API, whenever possible, may be free of charge and without restrictions for reuse & modifications.

The objectives of the policy are to:

- Ensure that APIs are published by all Government organisations for all e-Governance applications and systems.
- Enable quick and transparent integration with other e-Governance applications and systems.
- Enable safe and reliable sharing of information and data across various e-Governance applications and systems.
- Promote and expedite innovation through the availability of data from e-Governance applications and systems to the public.
- Provide guidance to Government organizations in developing, publishing and implementation using these Open APIs.

Government of India shall adopt Open APIs to enable quick and transparent integration with other e-Governance applications and systems implemented by various Government organizations, thereby providing access to data & services and promoting citizen participation for the benefit of the community.

The Open APIs shall have the following characteristics for publishing and consumption:

- The relevant information being provided by all Government organizations through their respective e-Governance applications shall be open and machine readable.
- All the relevant information and data of a Government organization shall be made available by Open APIs, as per the classification given in the National Data Sharing and Accessibility Policy (NDSAP-2012), so that the public can access information and data.
- All Open APIs built and data provided, shall adhere to National Cyber Security Policy.
- The Government organizations shall make sure that the Open APIs are stable and scalable.
- All the relevant information, data and functionalities within an e-Governance application or system of a Government organization shall be made available to other e-Governance applications and systems through Open APIs which should be platform and language independent.
- A Government organization consuming the data and information from other e-Governance applications and systems using Open APIs shall undertake information

handling, authentication and authorization through a process as defined by the API publishing Organization.

- Each published API of a Government organization shall be provided free of charge whenever possible to other Government organizations and public.
- Each published API shall be properly documented with sample code and sufficient information for developers to make use of the API.
- The life-cycle of the Open API shall be made available by the API publishing Government organization. The API shall be backward compatible with at least two earlier versions.
- All Open API systems built and data provided shall adhere to GoI security policies and guidelines.
- Government organizations may use an authentication mechanism to enable service interoperability and single sign-on.

The policy shall be applicable to all Government organizations under the Central Government and those State Governments that choose to adopt this policy for the following categories of e-Governance systems:

- All new e-Governance applications and systems being considered for implementation.
- New versions of the legacy and existing systems.

7. Internet of Things

- **Sensor & Actuators**
  - **IEEE 1451**

    IEEE 1451 is a set of smart transducer interface standards developed by the Institute of Electrical and Electronics Engineers (IEEE) Instrumentation and Measurement Society's Sensor Technology Technical Committee describing a set of open, common, network-independent communication interfaces for connecting transducers (sensors or actuators) to microprocessors, instrumentation systems, and control/field networks.
  - **Identification Technology**

    ISO/IEC JTC 1/SC31 Automatic identification and data capture techniques

    It develops and facilitates standards within the field of automatic identification technologies. These technologies include 1D and 2D barcodes, active and passive RFID for item identification and OCR.
  - **Domain Specific Compliance:**

    Sensors/IoT Devices/Actuators should follow the compliance to respective domain specific standards, like healthcare devices HL7, OBD-II, Electric Vehicle Charging etc.

- **Communication Technology**
  - **Thread:**

    Networking protocol called Thread that aims to create a standard for communication between connected household devices.
  - **AllJoyn:**

    Open source AllJoyn protocol was initially developed by Qualcomm provides tools for the entire process of connecting and maintaining devices on a Wi-Fi network.
  - **IEEE 802.15.4:**

    It offers physical and media access control layers for low-cost, low-speed, low-power Wireless Personal Area Networks (WPANs).

    IEEE 802.15.4e-2012, IEEE 802.15.4-2011, IEEE 802.15.4-2003, IEEE 802.15.4-2006
  - **IETF IPv6 over Low power WPAN (6LoWPAN):**

    It defines encapsulation and header compression mechanisms that allow IPv6 packets to be sent to and received over IEEE 802.15.4 based networks.

    6LoWPAN Frame Format

    Fragmentation and Reassembly

    Header Compression

    Support for security mechanisms
  - **IETF "Routing Over Low power and Lossy (ROLL):**

    IPv6 Routing Protocol for Low power and Lossy Networks (LLNs) (RPL)

    RPL Topology Formation (Destination Oriented Directed Acyclic Graphs - DODAGs)

    RPL Control Messages

- **IETF Constrained Application Protocol (CoAP):**

  It offers simplicity and low overhead to enable the interaction and management of embedded devices.

- **Use Case/ Application Specific:**
  - **Industrial IoT (IIoT):** Object Modeling Group (OMG) has been active in IIoT standardization efforts. OMG IIoT standards and activities include (but are not limited to):
    - Data Distribution Service (DDS)
    - Dependability Assurance Framework For Safety-Sensitive Consumer Devices
    - Threat Modeling
    - Structured Assurance Case Metamodel
    - Unified Component Model for Distributed, Real-Time and Embedded Systems
    - Automated Quality Characteristic Measures
    - Interaction Flow Modeling Language™ (IFML™)

    (Source: http://www.omg.org/hot-topics/iot-standards.htm)
  - **eHealth:** IEEE has many standards in the eHealth technology area, from body area networks to 3D modeling of medical data and personal health device communications. IEEE 11073 standards are designed to help healthcare product vendors and integrators create devices and systems for disease management.
  - **eLearning:** The IEEE Learning Technology Standards Committee (LTSC) is chartered by the IEEE Computer Society Standards Activity Board to develop globally recognized technical standards, recommended practices, and guides for learning technology.

- **Consortia**
  - **Open Interconnect Consortium:**

    OIC (Atmel, Dell, Broadcom, Samsung, and Wind River as members) is an open environment to support the billions of connected devices coming online.
  - **Industrial Internet Consortium:**

    It was founded by Intel, Cisco, AT&T, GE & IBM with the goal of developing standards specifically for industrial use of the Internet of Things.

- **Architecture Technology**
  - **IEEE P2413: Standard for an Architectural Framework for the Internet of Things**

    The architectural framework for IoT provides a reference model that defines relationships among various IoT verticals (e.g., transportation, healthcare, etc.) and common architecture elements.

    The standard also provides a reference architecture that builds upon the reference model. The reference architecture covers the definition of basic architectural building blocks and their ability to be integrated into multi-tiered systems.

- **Further Readings for Standards**
  - **ITU Standardization Roadmap**

    This document was released on 6 May 2016. It contains a collection of Standards/ITU-

T Recommendations that fit into the scope of Joint Coordination Activity for IoT and Smart Cities. It includes Standards/ITU-T Recommendations related to Internet of Things (IoT), smart cities and communities (SC&C), network aspects of identification systems, including RFID (NID) and ubiquitous sensor networks (USN). Refer References for the link.

- **IERC Position Paper on IoT Standardization:**

  It presents an inventory of existing standards and provides an overview of past and current activity in relation to standardization in the area of Internet of Things, and assembles a series of examples of standardization activities in this area.

Appendix C:
Geotechnical Report

26th Feb
2016
GT-1097
DT 45242

GEOTECHNICAL REPORT

PROPOSED DEVELOPMENT OF SHENDRA-BIDLKIN INDUSTRIAL AREA, AURANGABAD, MAHARASHTRA

For,

SHAPOORJI PALLONJI AND COMPANY PRIVATE LIMITED, MUMBAI

DUROCRETE
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DUROCRETE
Test with the Best

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1. INTRODUCTION

1.1. PURPOSE

Shapoorji Pallonji and Company Private Ltd, Mumbai has awarded soil investigation work to Durocrete Engineering Services Private Limited, Pune to assess the subsoil strata to safe bearing capacity of soil. The proposed project is "Design and Built the Infrastructure Works for Roads, Drains, Culvert, Minor Bridges, Water Supply, Sewerage, Power Systems for Phase-I in Shendra-Bidkin Industrial Area, Aurangabad, Maharashtra".

1.2. PROJECT DESCRIPTION

As informed by the client it is proposed to construct following

BH No.	Location/Proposed Structure
BH 01	Potable Under Ground Water Tank
BH 02	Minor Bridge No.1
BH 03	Minor Bridge No.2
BH 04	Minor Bridge No.4
BH 05	Electric Substation
BH 06	Recycle Under Ground Water Tank
BH 07	Recycle Over Head Water Tank
BH 08	Electric Substation- 1
BH 09	Culvert
BH 10	Electric Substation-3
BH 11	Potable Over Head Water Tank
BH 12	Minor Bridge No.5
BH 13	Minor Bridge No.6
BH 14	Minor Bridge No.7
BH 15	Electric Substation- 4
BH 16	Electric Substation- 5
BH 17	Minor Bridge No.4
BH 18	Electric Substation- 2
BH 19	Lift Station-1
BH 20	Lift Station-2

1.3. SCOPE OF SERVICES

The scope of work include following items.

i) Drilling twenty boreholes

ii) Conducting SPT test in borehole wherever applicable/ possible

iii) Performing necessary & relevant laboratory tests

iv) Preparing soil investigation report

2. FIELD INVESTIGATION PROCEDURE

To advance borehole rotary drilling rig is used. Borehole in soil was advanced with 100mm diameter size of casing, while NX size (54.7mm) core barrel was used to drill in rock. Water was circulated to cool the drilling bit. Representative soil sample were obtained from the split spoon sampler used for the standard penetration test (SPT). SPT's were conducted as per IS 2131-1981. SPT sampler was drive into soil under the energy of a 63.5kg weight falling through 760mm. The number of blows required to drive the sampler 300mm is known as the standard penetration blow count (N value) which provide an indication of the condition or consistency of the soil. Water level was recorded after 24 hours of completion of drilling.

a) Drilling hard strata /Rock: The hard stratum is confirmed by either the refusal from SPT or due to resistance during the drilling operation. Once the hard stratum is met with, further drilling is carried out by Nx core drilling with (Single core barrel is used for drilling) TC/Diamond bits. The work is done generally as per IS 6926-1973(In hard & sound rock, the single tube core barrel may be used for drilling). Each run of the core drilling is properly recorded. At the end of each run the drill rod string with core barrel is extracted and core is recovered. The cores are carefully transferred to the core boxes and preserved. The core recovery percentage is recorded and also the core pieces transferred to the core box are numbered and labeled properly. Rock Quality Designation (RQD) is also recorded. Some of the cores are sent to the laboratory for conducting tests.

Rock Core Recovery (C.R. % = (Cumulative Length of Cores/Length of run) x 100) and Rock Quality Designation (RQD) is (RQD = (Total Length of core pieces of 100.0mm & above in Length / Length of run)x 100) .

In present investigation silty sand/clay with gravel was encountered from existing ground surface below this highly to completely disintegrate/ weathered rock was encountered. SPT test was conducted at every 1.5m depth & in disintegrated rock refusal was recorded. On completion of drilling run, soil & rock samples were numbered & tagged. Representative samples were taken for lab testing.

Field work was performed during December 2015 - January 2016. Following table mention total numbers & depth of boreholes and other details.

Bore hole no	Depth of borehole (m)	Northing	Easting	Ground Elevation
BH-1	10.0	2192930.5837	562622.2360	608.00
BH-2	10.0	2192501.0000	562602.0000	596.00
BH-3	10.0	2192251.9989	562673.9974	593.00
BH-4	10.0	2191801.9989	562830.9974	586.00
BH-5	10.0	2191367.0421	563527.5748	583.00
BH-6	8.0	2191198.5748	563678.9344	575.00
BH-7	10.0	2192013.9989	563804.9974	589.50
BH-8	10.0	2191912.6134	564264.5784	588.50
BH-9	10.0	2191892.9989	566103.9974	579.000
BH-10	10.0	2193226.9989	566466.9974	595.50
BH-11	10.0	2192860.0019	562632.9954	604.00
BH 12	10.0	2191853.2233	562762.6302	588.00
BH 13	10.0	2191072.9072	563571.8447	573.00
BH 14	10.0	2191275.3031	563903.7820	575.00
BH 15	10.0	2190686.6154	562593.9421	581.50
BH 16	9.0	2192315.2138	562820.6123	595.00
BH 17	10.0	2191198.1050	563295.6778	578.00
BH 18	10.0	2192026.3596	564894.0531	592.00
BH 19	10.0	2191494.8496	565448.7108	582.00
BH 20	10.0	2191613.6576	566158.1054	577.00

2.1. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of subsurface conditions for this project are given in borehole logs & are discussed below based on drilling and sampling in twenty boreholes. Generalized sub-soil profile for the area investigated can be classified as follows:-

- Layer I: Silty sand with gravel /Silty clay
- Layer II: Completely fractured weathered basalt
- Layer III: Highly to moderately fractured weathered amygdaloidal/ compact basalt
- Layer IV: Fractured amygdaloidal/ compact basalt.

Following table provides thickness in mtrs and RQD (Rock Quality Designation in %) & SPT N value range for the layers mentioned above. It shall be noted that the stratum encountered at site may not be in the same order as listed above.

Bore hole no	Layer I	Layer II	Layer III		Layer IV	
	Thick	Thick	Thick	RQD	Thick	RQD
BH-1	2.0	2.5	3.0	0-18	2.5	36-82
BH-2	2.1	-	-	-	7.9	11-46
BH-3	3.6	0.9	5.5	26-46	-	-
BH-4	1.6	4.4	4.0	15-23	-	-
BH-5	1.6	1.4	1.5	7	5.5	34-58
BH-6	-	1.5	-	-	6.5	9-43
BH-7	1.5	3.0	1.5	10	4.0	49-84
BH-8	1.5	3.0	-	-	5.5	32-76
BH-9	1.5	1.5	4.5	0-10	2.5	36-65
BH-10	2.1	0.9	3.0	0-7	4.0	35-77
BH-11	1.5	-	-	-	8.5	27-84
BH 12	-	-	1.5	-	3.5	37-62
BH 13	2.1	2.4	3.0	10-14	2.5	58-65
BH 14	1.5	-	-	-	8.5	079
BH 15	2.0	-	1.0	0	7.0	31-92
BH 16	1.5	-	3.0	0-15	4.5	25-50
BH 17	-	-	1.5	20	8.5	22-79
BH 18	-	-	1.5	0	8.5	13-69
BH 19	2.1	-	-	-	7.9	0-72
BH 20	3.4	1.6	2.0	0-10	3.0	10-61

2.2. WATER LEVEL

Water level/loss was observed in the boreholes after 24 hrs of drilling completed as tabulated below. The depth of water table was not met up to 10m.

Bore hole no	Water level (m)
BH-1	Water loss at 5m depth
BH-2	3.0

BH-3	4.0
BH-4	4.0
BH-5	Water loss at 5m depth
BH-6	Water loss at 5.5m depth
BH-7	Water loss at 6.5m depth
BH-8	Water loss at 6m depth
BH-9	Water loss at 4.5m depth
BH-10	Water loss at 5.5m depth
BH-11	Water loss at 5m depth
BH 12	Water loss
BH 13	3.0
BH 14	Water loss
BH 15	Water loss
BH 16	Water loss
BH 17	Water loss
BH 18	Water loss
BH 19	Water loss
BH 20	Water loss

2.3. LABORATORY TESTING

Laboratory tests were performed on selected samples to evaluate relevant engineering soil properties. Laboratory tests include moisture content, sieve analysis, Atterberg's limits, and differential free swell. Lab test are done as per relevant IS Code (See reference) Test results are summarized in Appendix 3.

3. DISCUSSIONS

Based on field data & laboratory test foundation design parameters are evaluated. All foundation design recommendation presented in this report is based on the assumptions that an adequate level of construction monitoring during foundation will be provided.

3.1. FOUNDATION

Based on the results of the borehole drilling, the residual soil profile over the majority of the land appears to be silty sand/clay with gravel followed by completely to highly weathered rock.

The proposed structure is minor bridges, two storey buildings, underground water tanks etc. It is our opinion that stratification above rock may not be able to support heavy column loads without excessive settlement.

Open foundations placed on rock shall be adopted

Safe baring capacity for foundations placed on rock is determined as per procedure given in IS12070 "Code of practice for Design and Construction of Shallow Foundations on Rock. The procedure is based on RMR (Rock Mass Rating) concept. RMR is calculated as per the method given in IS 13365 (Part 1) "Quantitative Classification System of Rock Mass". Determination of RMR takes into consideration following properties of rock stratum.

- Strength of Intact rock material
- Rock Quality Designation
- Spacing of Discontinuities
- Condition of Discontinuities
- Ground water condition
- Orientation of Discontinuities
- Joint Orientation

The allowable settlement limits for building and bridges foundation will vary as per IS 1904 and IRC 78:2014 Section VII respectively. However, it may be noted that the referred IS code does not specify any limitations as far as width and shape of foundations placed on rock. Also the code does not recommend factor of safety.

It is mentioned in IS 12070 that if net allowable bearing capacity is determined based on RMR "all bearing capacities arrived based on RMR will produce maximum 12 mm settlement".

Calculations might indicate that higher bearing capacity is possible lower value is recommended since poor recovery is reported below depth.

3.2. CONCLUSIONS & RECOMMENDATIONS:

Conclusions and Recommendations are based on following accepted norms.

- Foundations should not fail in shear.
- Anticipated settlements should be less than allowable value.

  Following table lists net safe bearing capacity to be adopted for pad foundation placed at different depths below the ground level.
- Please refer IRC 78 section 705.2.2 for rock socketing in soft rock & hard rock.
- For Sealing of open rock joints in excavations with cement grout prior to laying of PCC for foundation & treatment of foundation for jointed rockmass ; It is recommended that joints shall be cleaned out to a depth of four to five times their width & filled with cement grout, a mixture of one part of cement and one part of sand with enough water to permit pouring of grout into the joint. Large spaces, wider at top are commonly filled with dental concrete.
- For excavatability for depth of excavation greater than 1m in rockmass- It is recommended to excavate with breaker / controlled blasting operation if required on such a hard rock.
- The thickness of soil layer is small it is advisable to place foundation on rock

  Following table mention structure & type of foundation

  1. Potable & Recycle Under Ground Water Tank-Raft Foundation
  2. Minor Bridges & Culvert -Raft Foundation
  3. Electric Substation- Raft & Isolated Foundation
  4. Portable & Recycle Over Head Water Tank- Raft & Isolated Foundation
  5. Lift Station - Raft Foundation
  6. Buildings- Isolated footing

Borehole no	Type of structure	Ground elevation	Depth of foundation	Bottom elevation of foundation	Net Safe bearing capacity (T/m^2)
BH-1	Potable Under Ground Water Tank	608.00	1.5m	606.50	35
			2.0m	606.00	35
			3.0m	605.00	40
			4.0m	604.00	45
			5.0m	603.00	50
			6.0m	602.00	150

BH-2	Minor Bridge No.1	596.00	1.5m	594.50	35
			2.1m	592.90	145
			3.0m	593.00	155
			4.0m	592.00	165
			5.0m	591.00	175
			6.0m	590.00	195
BH-3	Minor Bridge No.2	593.00	1.5m	592.50	30
			2.0m	592.00	35
			3.0m	591.00	35
			4.0m	590.00	40
			5.0m	589.00	80
			6.0m	588.00	85
BH-4	Minor Bridge No.4	586.00	1.5m	584.50	35
			2.0m	584.00	30
			3.0m	583.00	30
			4.0m	582.00	35
			5.0m	581.00	40
			6.0m	580.00	120
BH-5	Electric Substation	583.00	1.5m	581.5	35
			2.0m	581.00	40
			3.0m	580.00	150
			4.0m	579.00	160
			5.0m	578.00	175
			6.0m	577.00	185
BH-6	Recycle Under Ground Water Tank	575.00	1.5m	573.50	115
			2.0m	573.00	140
			3.0m	572.00	155
			4.0m	571.00	165
			5.0m	570.00	175
			6.0m	569.00	180
BH-7	Recycle Over Head Water Tank	589.50	1.5m	589.00	35
			2.0m	587.50	40
			3.0m	586.50	40
			4.0m	585.50	145
			5.0m	584.50	155
			6.0m	583.50	175

BH-8	Electric Substation- 1	588.50	1.5m	2586.50	35
			2.0m	586.00	35
			3.0m	585.00	35
			4.0m	584.00	40
			5.0m	583.00	170
			6.0m	582.00	180
BH-9	Culvert	579.000	1.5m	577.50	35
			2.0m	577.00	35
			3.0m**	576.00	110
			4.0m	575.00	110
			5.0m	574.00	110
			6.0m	573.00	145
BH-10	Electric Substation-3	595.50	1.5m	594.00	15
			2.0m	593.50	35
			3.0m	592.50	45
			4.0m	591.50	115
			5.0m	590.50	135
			6.0m	589.50	155
BH-11	Potable Over Head Water Tank	604.00	1.5m	602.50	190
			2.0m	602.00	190
			3.0m	601.00	215
			4.0m	600.00	225
			5.0m	599.00	235
			6.0m	598.00	245
BH 12	Minor Bridge No.5	588.00	1.5m	586.50	215
			2.0m	586.00	220
			3.0m	585.00	225
BH 13	Minor Bridge No.6	573.00	1.5m	572.50	35
			2.1m	570.90	35
			3.0m	570.00	40
			4.0m	569.00	50
			5.0m	568.00	160
			6.0m	567.00	170
BH 14	Minor Bridge No.7	575.00	1.5m	573.50	100
			2.0m	573.00	120
			3.0m	572.00	120

			4.0m	571.00	120
			5.0m	570.00	120
			6.0m	559.00	170
BH 15	Electric Substation- 4	581.50	1.5m	580.00	25
			2.0m	579.50	45
			3.0m	578.50	215
			4.0m	577.50	225
			5.0m	576.50	235
			6.0m	575.50	245
BH 16	Electric Substation- 5	595.00	1.5m	593.50	45
			2.5m	592.50	155
			3.0m	592.00	175
			4.0m	591.00	180
			5.0m	590.00	200
			6.0m	589.00	210
BH 17	Minor Bridge No.4	578.00	1.0m	577.00	150
			1.5m	576.50	155
			2.0m	576.00	160
			3.0m	575.00	180
			4.0m	574.00	200
			5.0m	573.00	210
			6.0m	572.00	225
BH 18	Electric Substation- 2	592.00	1. 5m	590.50	150
			2.0m	590.00	165
			3.0m	589.00	175
			4.0m	588.00	195
			5.0m	586.00	210
			6.0m	585.00	220
BH 19	Lift Station-1	582.00	1.5m	580.50	30
			2.0m	580.00	45
			3.0m	579.00	50
			4.0m	578.00	50
			5.0m	577.00	145
			6.0m	576.00	150
			8.0m	574.00	175
BH 20	Lift Station-2	577.00	1.5m	575.50	15

			2.0m	575.00	30
			3.0m	574.00	35
			4.0m	573.00	40
			5.0m	572.00	45
			6.0m	571.00	105
			8.0m	569.00	110

Wherever RQD reduces with depth and equals zero low value of bearing capacity is recommended even though calculations might give higher value. In the zone with low or zero RQD modulus of elasticity will be lower than the zone with RQD more than zero percent. This will result in higher value of settlement. To account for such phenomenon low value is recommended so as ensure that settlements are within acceptable limits.

Whenever foundations are placed on rock, it is essential to ensure that there are no loose pockets on rock surface. In case of loose pockets or over excavation, it shall be filled by plain cement concrete.

All foundations shall rest on one type of stratum to avoid differential settlement.

Suitable dewatering system may be required so that foundation concrete can be placed in dry condition.

Suitable slope protection needs to be considered for deep excavation for foundations.

Note-Given SBC values are based on typical empirical calculation of Safe Bearing Capacity Foundations placed on rock (Page no-14)

3.3. MODULUS OF SUB GRADE REACTION:

This is determined from plate load tests. In the absence of these tests normally accepted correlation is as given in Bowles.

Modulus of sub-grade reaction Ks = 40 xF x qa KN/m3 (Bowles)

F = Factor of safety

qa = Allowable bearing capacity KN/m2.

Notes:

The data, conclusions & recommendations which are presented in this report are based on the subsoil condition revealed at the location of boreholes and laboratory tests performed on recovered samples. The number of boreholes may not be sufficient to determine all the factors that may affect construction method & costs. If during construction of foundations it is observed that sub soil conditions vary from those revealed during investigation it is essential that Durocrete Engineering Services Private limited, Pune shall be contacted so that on confirmation supplementary report shall be issued.

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Vishwas Kulkarni
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Typical calculation of Safe Bearing Capacity
Foundations placed on rock

Sample calculations based on UCS data

Borehole: BH-2

Depth of sample: 2.1m

Reference to IS 12070 section 6.2

Gross safe bearing pressure =Nj*qc

Nj=Empirical coefficient

qc=Average uniaxial compressive strength=160Kg/cm2(average of crushing strength of rock samples 4no are in kg/cm2 (15.420,214.39,308.94,148.31,115.23)

Nj=0.1 (conservative value)(Ref.IS 12070-Table no.4)

Water table correction=1 (as saturated crushing strength data is used)

Slope correction =1

Gross safe bearing pressure =160*0.1*1*1=16Kg/cm2 or 160T/m2

Net safe bearing pressure for foundation placed at 1m depth =160-2.1*1.8=156T/m2

Recommended value =145T/m2

IS 13365 considers five parameters for determining RMR

BH-01 (Depth of foundation 6m)

Parameter	Value	Rating
Strength of intact rock	5.8-13.6	1
Rock quality Designation %	18-82	8
Spacing of discontinuities	Moderate to wide	11
Conditions of discontinuities	-	23
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		43

According to IS 12070 (table 3) classification of rock is III.

BH-02 (Depth of foundation 3.1m)

Parameter	Value	Rating
Strength of intact rock	14.8-30.9	2
Rock quality Designation %	28-46	8
Spacing of discontinuities	Moderate	10
Conditions of discontinuities	-	22
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		42

According to IS 12070 (table 3) classification of rock is III.

BH-03 (Depth of foundation 5.1m)

Parameter	Value	Rating
Strength of intact rock	7.5	1
Rock quality Designation %	0-46	7
Spacing of discontinuities	Very close to moderate	7
Conditions of discontinuities	-	17
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		32

According to IS 12070 (table 3) classification of rock is IV.

BH-04 (Depth of foundation 6.6m)

Parameter	Value	Rating
Strength of intact rock	52.6	4
Rock quality Designation %	15-23	3
Spacing of discontinuities	Moderate	10
Conditions of discontinuities	-	21
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		38

According to IS 12070 (table 3) classification of rock is IV.

BH-05 (Depth of foundation 3m)

Parameter	Value	Rating
Strength of intact rock	21.9-26.5	2
Rock quality Designation %	7-58	8
Spacing of discontinuities	Moderate to wide	10
Conditions of discontinuities	-	23
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		43

According to IS 12070 (table 3) classification of rock is III.

BH-06 (Depth of foundation 2m)

Parameter	Value	Rating
Strength of intact rock	2.8-50.8	2
Rock quality Designation %	9-43	8
Spacing of discontinuities	Moderate	10
Conditions of discontinuities	-	21
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		41

According to IS 12070 (table 3) classification of rock is III.

BH-07 (Depth of foundation 4m)

Parameter	Value	Rating
Strength of intact rock	6.5-21.9	1
Rock quality Designation %	10-84	8
Spacing of discontinuities	Moderate to wide	10
Conditions of discontinuities	-	23
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		42

According to IS 12070 (table 3) classification of rock is III.

BH-08 (Depth of foundation 1.5m)

Parameter	Value	Rating
Strength of intact rock	0-30.3	0
Rock quality Designation %	0-76	5
Spacing of discontinuities	Very close to wide	6
Conditions of discontinuities	-	8
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		19

According to IS 12070 (table 3) classification of rock is V.

BH-09 (Depth of foundation 3m)

Parameter	Value	Rating
Strength of intact rock	17.8-67.1	2
Rock quality Designation %	7-65	3
Spacing of discontinuities	Moderate to wide	11
Conditions of discontinuities	-	23
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		39

According to IS 12070 (table 3) classification of rock is IV.

BH-10 (Depth of foundation 2.1m)

Parameter	Value	Rating
Strength of intact rock	0-11.3	1
Rock quality Designation %	0-77	5
Spacing of discontinuities	Very close to wide	6
Conditions of discontinuities	-	8
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		20

According to IS 12070 (table 3) classification of rock is IV.

BH-11 (Depth of foundation 1.5m)

Parameter	Value	Rating
Strength of intact rock	6.4-14.8	1
Rock quality Designation %	27-84	13
Spacing of discontinuities	Moderate to wide	11
Conditions of discontinuities	-	24
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		49

According to IS 12070 (table 3) classification of rock is III.

BH-12 (Depth of foundation 1.5m)

Parameter	Value	Rating
Strength of intact rock	40.5-43.5	4
Rock quality Designation %	37-62	13
Spacing of discontinuities	Moderate to wide	11
Conditions of discontinuities	-	24
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		52

According to IS 12070 (table 3) classification of rock is III.

BH-13 (Depth of foundation 5.1m)

Parameter	Value	Rating
Strength of intact rock	18.3-38.2	4
Rock quality Designation %	10-65	8
Spacing of discontinuities	Moderate to wide	11
Conditions of discontinuities	-	23
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		46

According to IS 12070 (table 3) classification of rock is III.

BH-14 (Depth of foundation 2.1m)

Parameter	Value	Rating
Strength of intact rock	10.8-58.5	3
Rock quality Designation %	0-79	7
Spacing of discontinuities	Close to wide	9
Conditions of discontinuities	-	21
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		40

According to IS 12070 (table 3) classification of rock is IV.

BH-15 (Depth of foundation 3m)

Parameter	Value	Rating
Strength of intact rock	0-27.6	1
Rock quality Designation %	31-92	13
Spacing of discontinuities	Moderate to wide	13
Conditions of discontinuities	-	25
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		52

According to IS 12070 (table 3) classification of rock is III.

BH-16 (Depth of foundation 2.5m)

Parameter	Value	Rating
Strength of intact rock	34-55.6	4
Rock quality Designation %	15-50	8
Spacing of discontinuities	Moderate	10
Conditions of discontinuities	-	23
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		45

According to IS 12070 (table 3) classification of rock is III.

BH-17 (Depth of foundation 1m)

Parameter	Value	Rating
Strength of intact rock	13.9-22.4	2
Rock quality Designation %	20-79	8
Spacing of discontinuities	Moderate to wide	11
Conditions of discontinuities	-	23
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		44

According to IS 12070 (table 3) classification of rock is III.

BH-18 (Depth of foundation m)

Parameter	Value	Rating
Strength of intact rock	19.1-30.7	2
Rock quality Designation %	13-69	8
Spacing of discontinuities	Moderate to wide	11
Conditions of discontinuities	-	23
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		44

According to IS 12070 (table 3) classification of rock is III.

BH-19 (Depth of foundation 8m)

Parameter	Value	Rating
Strength of intact rock	28.1-30.7	4
Rock quality Designation %	35-72	8
Spacing of discontinuities	Moderate to wide	11
Conditions of discontinuities	-	23
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		46

According to IS 12070 (table 3) classification of rock is III.

BH-20 (Depth of foundation 8m)

Parameter	Value	Rating
Strength of intact rock	4.9	1
Rock quality Designation %	10-27	3
Spacing of discontinuities	Moderate	10
Conditions of discontinuities	-	22
Ground water condition	Wet	7
Adjustment for joint orientation	Fair	-7
Total		36

According to IS 12070 (table 3) classification of rock is IV.

REFERENCES

IS code used for testing samples recovered from boreholes

1. *IS -1498* *Classification & identification of soils for general engineering purposes*
2. *IS - 2720* *(& its Parts) Physical test of soil / chemical test*
3. *IS - 2131* *Method for standard penetration test of soil*
4. *IS - 9143* *Unconfined Compression test on rock*
5. *IS - 8764* *Point load test on rock*
6. *IS – 1124* *Water absorption test on rock , Specific gravity / porosity on rock*

IS code method used for design / SBC calculations

7. *IS – 12070* *Design & construction of shallow foundation on rock*
8. *IS – 13365* *(Part -1) Quantitative classification system of rock mass - Guidelines : Part 1 RMR for predicting of engineering properties*
9. *IS – 6403* *Determination of bearing capacity of shallow foundations*
10. *IS – 8009* *Design & construction of shallow foundation on rock*

11. *FOUNDATION DESIGN MANUAL – Narayan V. Nayak*

12. *FOUDNATION ANALYSIS & DESIGN – Joseph E. Bowles*

GT- 1097

BOREHOLE LOG SUMMARY

DUROCRETE Engineering Services Pvt. Ltd. 19/1, Hingane Khurd, Vitthalwadi, Pune	***Project No:*** GT 1097	***Borehole No:*** BH-01
	Project: Potable underground Water Tank	
	Client: Shapoorji Pollonji And Company Pvt.Ltd.	
	Location: Shendra-Bidkin Industrial Area,Aurangabad	***Ground RL:*** 608 m
	Date: 25.12.2015 to 25.12.2015	***Depth of borehole:*** 10.00 m
	Water Level: Water loss at 5.00 meter	***Coordinates:*** X-562622.236 Y-2192930.583

SUBSURFACE PROFILE				SAMPLE							
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	Remark
0.00	0.000		Ground Surface			0.00					
1.00			Silty Sand Gravels		DS	1.00					
	1.500										
2.00	2.000		Sand & Gravels		SPT-1	2.00	50				
			Highly Weathered Rock Recovered as small pieces boulders		DR			Nil	Nil		
3.00						3.00					
4.00					DR	4.00		Nil	Nil		
	4.500										
5.00			Reddish Slighlty weathered Amygdaloidal Basalt	1-9	DR	5.00		18	Nil		
6.00						6.00					
7.00				10-21	DR	7.00		50	18		
8.00				22-29	DR	8.00		50	36		
	9.000										
9.00			Grayish Freash Amygdaloidal Basalt	30-32	DR	9.00		82	82		
	10.000										
10.00			End of Borehole			10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam
Prepared By : Mr. Ashok
Drill Method: Rotary
Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock
UDS: Undisturbed Soil Sample
DS: Disturbed Sample
SPT: Standard Penetration Test
R: Refusal in SPT Test

RQD: Rock Quality Designation
DR: Drill Run Rock
S: Soil, F: Filling
CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097

Project: Minor Bridge No.1

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Borehole No: BH-02

Location: Shendra-Bidkin Industrial Area,Aurangabad

Ground RL: 596 m

Date: 26.12.2015 to 26.12.2015

Depth of borehole: 10.00 m

Water Level: 3.00 m

Coordinates: X-562602.00, Y-2192501.00

SUBSURFACE PROFILE				SAMPLE							Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	
0.00	0.000		Ground Surface			0.00					
1.00			Silty Sand Gravels		DS	1.00					
	1.500										
2.00	2.100		Silty Sand		SPT-1	2.00	65				
3.00			Reddish Slighlty weathereed Amygdaloidal Basalt	1-5	DR	3.00		43	11		
4.00				6-9	DR	4.00		37	37		
5.00				10-13	DR	5.00		46	46		
6.00						6.00					
7.00				14-16	DR	7.00		40	36		
8.00				17-18	DR	8.00		32	33		
9.00	9.000					9.00					
			Highly Fractured Grayish Fresh Compact Basalt	19-23	DR			46	28		
10.00	10.000		End of Borehole			10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097 — ***Borehole No: BH-03***

Project: Minor Bridge No.2

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Location: Shendra-Bidkin Industrial Area,Aurangabad — ***Ground RL:*** 593m

Date: 28.12.2015 to 28.12.2015 — ***Depth of borehole:*** 10.00 m

Water Level: 4.00 m — ***Coordinates:*** X-562673.99, Y-2192251.99

SUBSURFACE PROFILE				SAMPLE							Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	
0.00	0.000		Ground Surface			0.00					
1.00			Silty Sand Gravels		DS	1.00					
	1.500										
2.00			Sand & Gravels		SPT-1	2.00	50				
3.00						3.00					
	3.600				SPT-2		65				
4.00			Highly Weathered & Fractured Rock Recovered as Small pieces boulders		DR	4.00		Nil	Nil		
	4.500										
5.00			Reddish slighlty weathered Amygdaloidal Basalt	1-5	DR	5.00		41	38		
	6.000										
6.00			Highly Fractured Grayish fresh Amygdaloidal Basalt			6.00					
7.00				6-9	DR	7.00		52	46		
8.00				10	DR	8.00		2	Nil		
9.00				11-16	DR	9.00		32	26		
	10.000										
10.00			End of Borehole			10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097

Project: Minor Bridge No.4

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Borehole No: BH-04

Location: Shendra-Bidkin Industrial Area,Aurangabad

Ground RL: 586m

Date: 01.01.2016 to 01.01.2016

Depth of borehole: 10.00 m

Water Level: 4.00 m

Coordinates: X-562830.99, Y-2191801.99

SUBSURFACE PROFILE				SAMPLE							Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	
0.00	0.000		Ground Surface								
			Gravels		DS						
1.00						1.00					
	1.590										
2.00			Highly Weathered & Fractured Rock Recovered as Small pieces boulders		DR	2.00		Nil	Nil		
3.00						3.00					
					DR			Nil	Nil		
4.00						4.00					
5.00				1-3	DR	5.00		4	Nil		
	6.000										
6.00			Highly Fractured Grayish fresh Amygdaloidal Basalt			6.00					
7.00				4-9	DR	7.00		37	15		
8.00				10-13	DR	8.00		33	23		
9.00						9.00					
				14-24	DR			69	20		
10.00	10.000		End of Borehole			10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097 ***Borehole No: BH-05***

Project: Electric Substation

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Location: Shendra-Bidkin Industrial Area,Aurangabad ***Ground RL:*** 583m

Date: 02.01.2016 to 02.01.2016 ***Depth of borehole:*** 10.00 m

Water Level: Water loss at 5.00 m ***Coordinates:*** X-563527.57, Y-2191367.042

SUBSURFACE PROFILE				SAMPLE							Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	
0.00	0.000		Ground Surface								
1.00			Silty Sands		DS						
	1.630										
2.00			Highly Weathered & Fractured Rock Recovered as Small pieces boulders		DR			Nil	Nil		
	3.000										
3.00			Reddish slightly weathered Amygdaloidal Basalt	1-5	DR			23	7		
4.00											
5.00				6-8	DR			35	35		
6.00											
7.00				9-11	DR			40	31		
8.00				12-16	DR			58	58		
	9.000										
9.00			Highly Fractured Grayish fresh Amygdaloidal Basalt	17-23	DR			63	34		
	10.000										
10.00			End of Borehole								
11.00											
12.00											
13.00											
14.00											
15.00											

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097

Project: Recycle Underground Water Tank

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Borehole No: BH-06

Location: Shendra-Bidkin Industrial Area,Aurangabad

Ground RL: 575m

Date: 17.01.2016 to 17.01.2016

Depth of borehole: 8.00 m

Water Level: Water loss at 5.50 m

Coordinates: X-5633678.93, Y-2191198.574

SUBSURFACE PROFILE				SAMPLE							Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	
0.00	0.000		Ground Surface			0.00					
1.00			Highly Weathered & Fractured Rock Recovered as Small pieces boulders		DR	1.00					
	1.500										
2.00			Grayish to Reddish slighlty weathered Amygdaloidal Basalt	1-8	DR	2.00		41	9		
3.00						3.00					
4.00				9-16	DR	4.00		65	43		
5.00				17-31	DR	5.00		56	15		
6.00				32-39	DR	6.00		63	41		
	7.000										
7.00			Grayish fresh Compact Basalt	40-45	DR	7.00		60	39		
	8.000										
8.00			End of Borehole			8.00					
9.00						9.00					
10.00						10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097 — ***Borehole No: BH-07***

Project: Recycle Over Head Water Tank

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Location: Shendra-Bidkin Industrial Area,Aurangabad — ***Ground RL:*** 589.5

Date: 04.01.2016 to 04.01.2016 — ***Depth of borehole:*** 10.00 m

Water Level: Water loss at 6.50 m — ***Coordinates:*** X-563804.997, Y-2192013.998

SUBSURFACE PROFILE				SAMPLE							
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	Remark
0.00	0.000		Ground Surface								
1.00			Silty Sands & Gravels		DS						
	1.500		Sand & Gravels								
2.00			Highly Weathered & Fractured Rock Recovered as Small pieces boulders		DR			Nil	Nil		
3.00	3.000		Reddish moderately to slighlty weathered Amygdaloidal Basalt	1-3	DR			5	Nil		
4.00											
5.00				4-10	DR			32	10		
6.00											
7.00				11-12	DR			49	49		
8.00				13-16	DR			59	59		
9.00				17-18	DR			84	84		
10.00	10.000		End of Borehole								
11.00											
12.00											
13.00											
14.00											
15.00											

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097 — ***Borehole No: BH-08***

Project: Electric Sibstation-1

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Location: Shendra-Bidkin Industrial Area,Aurangabad — ***Ground RL:*** 588.5 m

Date: 05.01.2016 to 05.01.2016 — ***Depth of borehole:*** 10.00 m

Water Level: Water loss at 6.00 m — ***Coordinates:*** X-564264.578, Y-2191912.613

SUBSURFACE PROFILE				SAMPLE							Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	
0.00	0.000		Ground Surface			0.00					
			Silty Sands & Gravels		DS						
1.00	1.500					1.00	R				
			Sand & Gravels								
2.00			Highly Weathered & Fractured Rock Recovered as Small pieces boulders		DR	2.00		Nil	Nil		
3.00					DR	3.00		Nil	Nil		
4.00	4.500					4.00					
5.00			Reddish slightly weathered Amygdaloidal Basalt	1-5	DR	5.00		41	32		
6.00				6-9	DR	6.00		45	45		
7.00						7.00					
8.00				10-13	DR	8.00		49	49		
9.00	9.000					9.00					
			Grayish fresh Amygdaloidal Basalt	14-17	DR			76	76		
10.00	10.000		End of Borehole			10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097 ***Borehole No: BH-09***

Project: Culvert

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Location: Shendra-Bidkin Industrial Area,Aurangabad ***Ground RL:*** 579 m

Date: 06.01.2016 to 06.01.2016 ***Depth of borehole:*** 10.00 m

Water Level: Water loss at 4.50 m ***Coordinates:*** X-566103.997 Y-2191892.998

SUBSURFACE PROFILE				SAMPLE							Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	
0.00	0.000		Ground Surface								
			Silty Sands & Gravels		DS						
1.00	1.500		Sand & Gravels								
2.00			Highly Weathered & Fractured Rock Recovered as Small pieces boulders		DR			Nil	Nil		
3.00	3.000		Reddish moderately to slightly weathered Amygdaloidal Basalt	1-2	DR			16	10		
4.00											
5.00				3-11	DR			32	Nil		
6.00											
7.00				12-18	DR			29	7		
8.00				19-2	DR			36	36		
9.00				21-23	DR			65	65		
10.00	10.000		End of Borehole								
11.00											
12.00											
13.00											
14.00											
15.00											

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097

Project: Electric Substation-3

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Borehole No: BH-10

Location: Shendra-Bidkin Industrial Area,Aurangabad

Ground RL: 595.5 m

Date: 08.01.2016 to 08.01.2016

Depth of borehole: 10.00 m

Water Level: Water loss at 5.50 m

Coordinates: X-566466.997 Y-2193226.998

SUBSURFACE PROFILE				SAMPLE						Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)
0.00	0.000		Ground Surface			0.00				
1.00			Sands & Gravels		DS	1.00				
	1.500									
2.00	2.100		Sand		SPT-1	2.00	26			
3.00	3.000		Highly Weathered & Fractured Rock Recovered as Small pieces boulders		DR	3.00		Nil	Nil	
4.00			Grayish fresh Amygdaloidal Basalt	1-6	DR	4.00		20	Nil	
5.00				7-18	DR	5.00		39	7	
6.00						6.00				
7.00				19-27	DR	7.00		55	35	
8.00				28-32	DR	8.00		76	76	
9.00				33-34	DR	9.00		77	77	
10.00	10.000		End of Borehole			10.00				
11.00						11.00				
12.00						12.00				
13.00						13.00				
14.00						14.00				
15.00						15.00				

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097

Project: pOTABLE oVER HEAD wATER tANK

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Borehole No: BH-11

Location: Shendra-Bidkin Industrial Area,Aurangabad

Ground RL: 604 m

Date: 1701.2016 to 17.01.2016

Depth of borehole: 10.00 m

Water Level: Water loss at 5.00 m

Coordinates: X-562632.995 Y-2192860.001

SUBSURFACE PROFILE				SAMPLE							
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	Remark
0.00	0.000		Ground Surface								
1.00			Highly Weathered & Fractured Rock Recovered as Small pieces boulders	1	DR	1.00		1	Nil		
	1.500		Sand								
2.00			Reddish slightly weathered Amygdaloidal Basalt	2-9	DR	2.00		44	27		
3.00											
4.00				10-13	DR	4.00		50	50		
5.00				14-17	DR	5.00		69	64		
6.00						6.00					
7.00				18-20	DR	7.00		72	72		
8.00				21-22	DR	8.00		84	84		
9.00				23-26	DR	9.00		76	76		
10.00	10.000		End of Borehole			10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097

Project: Minor Bridge No. 5

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Borehole No: BH-12

Location: Shendra-Bidkin Industrial Area,Aurangabad

Ground RL: 588 m

Date:

Depth of borehole: 5.00 m

Water Level: Water loss

Coordinates: X-562762.6302,Y-2191853.2233

SUBSURFACE PROFILE				SAMPLE							
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	Remark
0.00	0.000		Ground Surface			0.00					
1.00	1.500		Moderately Weathered to highly fractured basalt recovered as small pieces	1-3	DR	1.00		6	Nil		
2.00			Grayish Fractured fresh Compact basalt	4-12	DR	2.00		53	37		
3.00				13-21	DR	3.00		61	58		
4.00				22-31	DR	4.00		97	62		
5.00	5.000		End of Borehole			5.00					
6.00						6.00					
7.00						7.00					
8.00						8.00					
9.00						9.00					
10.00						10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097
Project: Minor Bridge No. 6
Client: Shapoorji Pollonji And Company Pvt.Ltd.
Location: Shendra-Bidkin Industrial Area,Aurangabad
Date: 14.01.2016
Water Level: 3.00 m

Borehole No: BH-13
Ground RL: 573 m
Depth of borehole: 10.00 m
Coordinates: X-563571.8447,Y-2191072.9072

SUBSURFACE PROFILE				SAMPLE							Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	
0.00	0.000		Ground Surface			0.00					
1.00			Sandy Silt		DS	1.00					
	1.500										
2.00	2.100		Silty Clay with Sand		SPT-1	2.00	57				
3.00			Highly Weathered & Fractured Rock Recovered as Small pieces boulders		DR	3.00		Nil	Nil		
4.00				1-3	DR	4.00		5	Nil		
	4.500										
5.00			Reddish moderately weathered Amygdaloidal Basalt	4-5	DR	5.00		15	10		
6.00						6.00					
7.00				6-10	DR	7.00		27	14		
8.00				11-15	DR	8.00		58	58		
9.00				16-19	DR	9.00		65	65		
10.00	10.000		End of Borehole			10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam
Prepared By : Mr. Ashok
Drill Method: Rotary
Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock
UDS: Undisturbed Soil Sample
DS: Disturbed Sample
SPT: Standard Penetration Test
R: Refusal in SPT Test

RQD: Rock Quality Designation
DR: Drill Run Rock
S: Soil, F: Filling
CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097 ***Borehole No: BH-14***

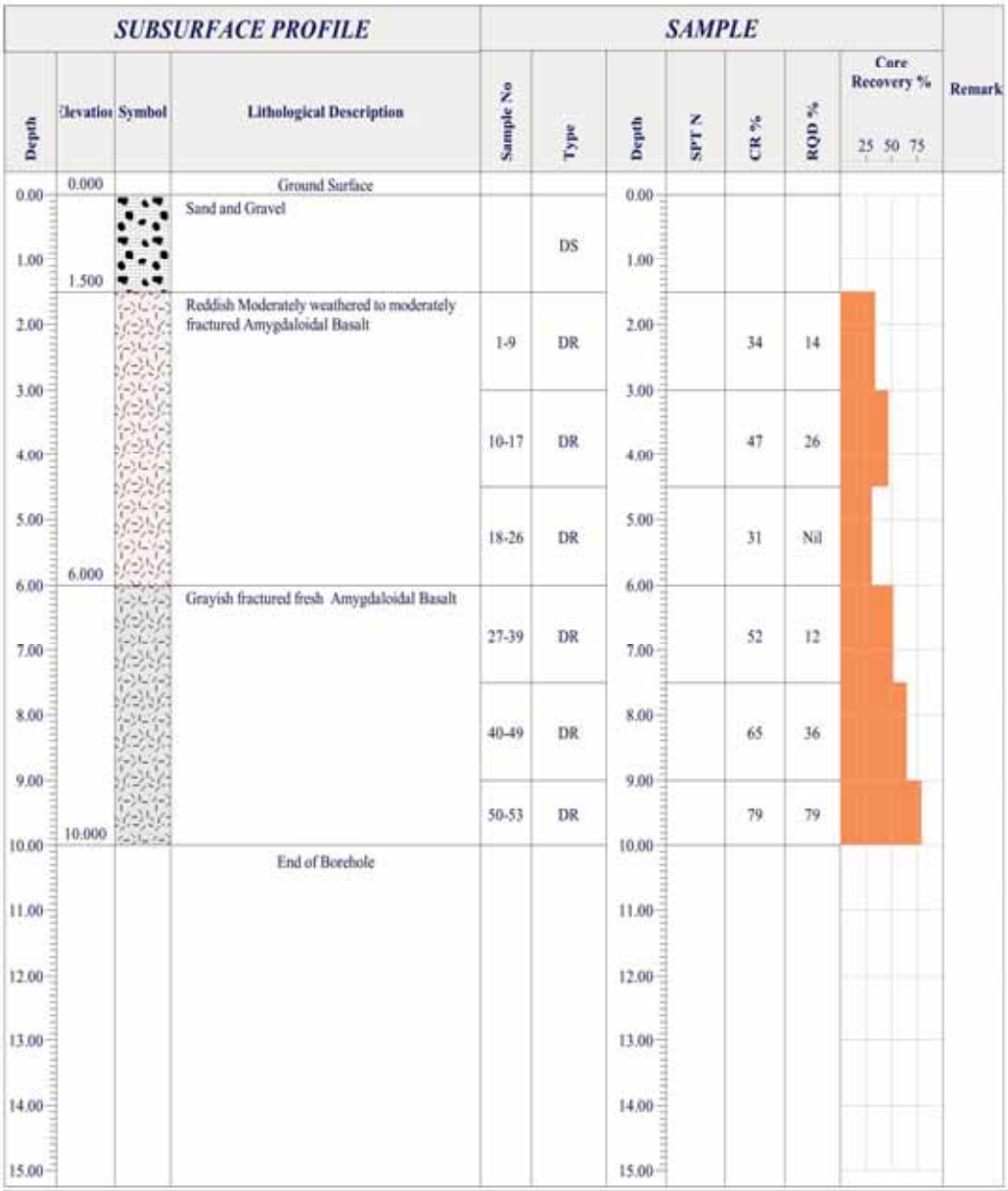
Project: Minor Bridge No. 7

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Location: Shendra-Bidkin Industrial Area,Aurangabad ***Ground RL:*** 575 m

Date: ***Depth of borehole:*** 10.00 m

Water Level: Waterloss ***Coordinates:*** X-563903.7820,Y-2191275.3031



Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097 ***Borehole No: BH-15***

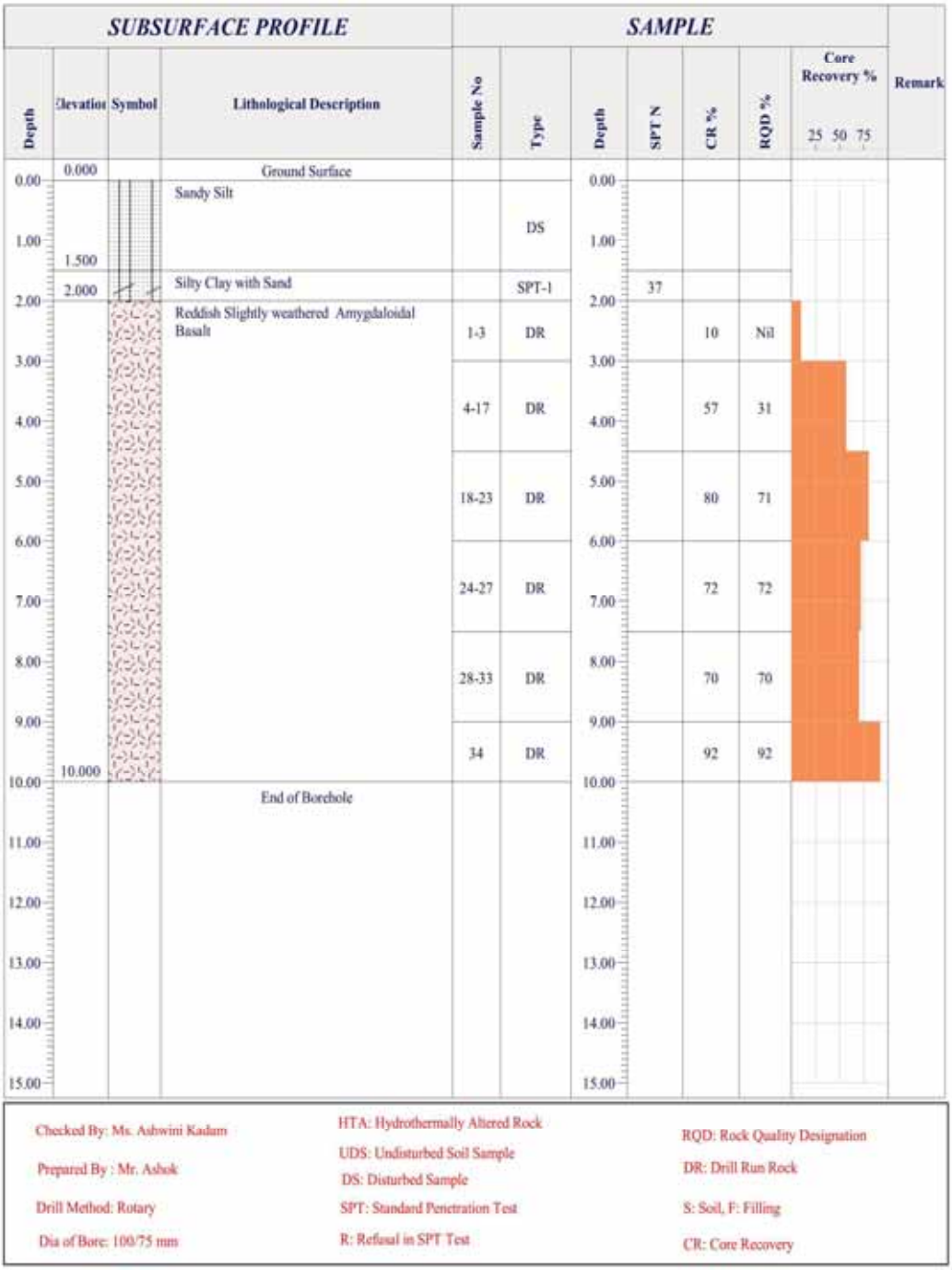
Project: Electric Substation-4

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Location: Shendra-Bidkin Industrial Area,Aurangabad ***Ground RL:*** 581.50 m

Date: ***Depth of borehole:*** 10.00 m

Water Level: Waterloss ***Coordinates:*** X-562593.9421,Y-2190686.6154



Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

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DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097

Project: Electric Substation-5

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Location: Shendra-Bidkin Industrial Area,Aurangabad

Date:

Water Level: Waterloss

Borehole No: BH-16

Ground RL: 595 m

Depth of borehole: 9.00 m

Coordinates: X-562820.6123,Y-2192315.2138

SUBSURFACE PROFILE				SAMPLE						Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)
0.00	0.000		Ground Surface			0.00				
			Sandy Silt		DS					
1.00	1.500					1.00				
2.00			Moderately Fractured to moderately weathered Redish Amygdaloidal Basalt	1-13	DR	2.00		37	Nil	
3.00						3.00				
4.00				14-25	DR	4.00		43	15	
5.00				26-35	DR	5.00		56	25	
6.00						6.00				
7.00				36-43	DR	7.00		67	40	
8.00				44-52	DR	8.00		62	50	
9.00	9.000		End of Borehole			9.00				
10.00						10.00				
11.00						11.00				
12.00						12.00				
13.00						13.00				
14.00						14.00				
15.00						15.00				

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

GT- 1097

DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097

Project: Minor Bridge no. 4

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Borehole No: BH-17

Location: Shendra-Bidkin Industrial Area,Aurangabad

Ground RL: 578 m

Date:

Depth of borehole: 10.00 m

Water Level: Waterloss

Coordinates: X-563295.6778,Y-2191198.1050

SUBSURFACE PROFILE				SAMPLE							
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	Remark
0.00	0.000		Ground Surface								
0.00			Reddish Farctured slightly weathered Amygdaloidal Basalt	1-7	DR	0.00		29	20		
1.00						1.00					
2.00				8-15	DR	2.00		45	22		
3.00						3.00					
4.00				16-19	DR	4.00		47	44		
5.00				20-30	DR	5.00		72	44		
6.00						6.00					
7.00	7.500			31-36	DR	7.00		62	57		
8.00			Grayish fresh Amygdaloidal BAsalt	37-45	DR	8.00		57	37		
9.00				46-52	DR	9.00		97	79		
10.00	10.000		End of Borehole			10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

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CR: Core Recovery

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DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097 ***Borehole No: BH-18***

Project: Electric Substation-2

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Location: Shendra-Bidkin Industrial Area,Aurangabad ***Ground RL:*** 592 m

Date: ***Depth of borehole:*** 10.00 m

Water Level: Waterloss ***Coordinates:*** X-564894.0531,Y-2192026.3596

SUBSURFACE PROFILE				SAMPLE							
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	Remark
0.00	0.000		Ground Surface								
0.00			Reddish moderately to slightly weathered Amygdaloidal Basalt	1-4	DR	0.00 – 1.00		12	Nil		
1.00 – 2.00				5-8	DR	1.00 – 2.00		27	13		
2.00 – 3.00				9-14	DR	2.00 – 3.00		45	39		
3.00 – 4.00				15-18	DR	3.00 – 4.00		37	32		
4.00 – 5.00				19-25	DR	4.00 – 5.00		60	50		
5.00 – 6.00				26-38	DR	5.00 – 6.00		72	52		
6.00 – 7.00				39-45	DR	6.00 – 7.00		84	69		
7.00 – 8.00						7.00 – 8.00					
8.00 – 9.00						8.00 – 9.00					
9.00 – 10.00	10.000		End of Borehole			9.00 – 10.00					
10.00 – 15.00						10.00 – 15.00					

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

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DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097 ***Borehole No: BH-19***

Project: Lift Station-1

Client: Shapoorji Pollonji And Company Pvt.Ltd.

Location: Shendra-Bidkin Industrial Area,Aurangabad ***Ground RL:*** 582 m

Date: ***Depth of borehole:*** 10.00 m

Water Level: Waterloss ***Coordinates:*** X-565448.7108,Y-2191494.8496

SUBSURFACE PROFILE				SAMPLE							Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % 25 50 75	
0.00	0.000		Ground Surface			0.00					
1.00			Silty Clay with Sand		DS	1.00					
2.00	2.100				SPT-1	2.00	42				
3.00			Reddish moderately to slightly weathered Amygdaloidal Basalt	1-5	DR	3.00		52	33		
4.00				6-15	DR	4.00		45	Nil		
5.00				16-25	DR	5.00		44	21		
6.00				26-30	DR	6.00		48	48		
7.00				31-34	DR	7.00		45	35		
8.00				35-38	DR	8.00		72	72		
9.00						9.00					
10.00	10.000		End of Borehole			10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam

Prepared By : Mr. Ashok

Drill Method: Rotary

Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock

UDS: Undisturbed Soil Sample

DS: Disturbed Sample

SPT: Standard Penetration Test

R: Refusal in SPT Test

RQD: Rock Quality Designation

DR: Drill Run Rock

S: Soil, F: Filling

CR: Core Recovery

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DUROCRETE Engineering Services Pvt. Ltd.

19/1, Hingane Khurd, Vitthalwadi, Pune

Project No: GT 1097
Project: Lift Station-2
Client: Shapoorji Pollonji And Company Pvt.Ltd.
Location: Shendra-Bidkin Industrial Area,Aurangabad
Date:
Water Level: Waterloss

Borehole No: BH-20
Ground RL: 577 m
Depth of borehole: 10.00 m
Coordinates: X-566158.1054,Y-2191613.6576

SUBSURFACE PROFILE				SAMPLE							Remark
Depth	Elevation	Symbol	Lithological Description	Sample No	Type	Depth	SPT N	CR %	RQD %	Core Recovery % (25 50 75)	
0.00	0.000		Ground Surface			0.00					
1.00			Silty Clay with Sand		DS	1.00					
2.00	2.100				SPT-1	2.00	22				
3.00			Sand and Gravels			3.00					
	3.400				SPT-2		R				
4.00			Highly weathered rock recovered as small pieces		DR	4.00		Nil	Nil		
5.00	5.000		Reddish slightly weathered Amygdaloidal Basalt	1-12	DR	5.00		47	Nil		
6.00				13-21	DR	6.00		53	10		
7.00				22-23	DR	7.00		61	61		
8.00	8.000		Grayish Fresh Amygdaloidal Basalt	24-34	DR	8.00		74	10		
9.00				35-41	DR	9.00		60	27		
10.00	10.000		End of Borehole			10.00					
11.00						11.00					
12.00						12.00					
13.00						13.00					
14.00						14.00					
15.00						15.00					

Checked By: Ms. Ashwini Kadam
Prepared By : Mr. Ashok
Drill Method: Rotary
Dia of Bore: 100/75 mm

HTA: Hydrothermally Altered Rock
UDS: Undisturbed Soil Sample
DS: Disturbed Sample
SPT: Standard Penetration Test
R: Refusal in SPT Test

RQD: Rock Quality Designation
DR: Drill Run Rock
S: Soil, F: Filling
CR: Core Recovery

Appendix 3

Calculation of Point Load index test on rock samples

The uniaxial compressive strength of rock maybe predicted following correction Qc=22 Is (50)

qc- uniaxial compressive strength on (kg/cm2)

Is=corrected point load strength

LAB TEST SUMMARY

ROCK TEST SUMMARY

BH NO.	Depth (m)	PC. NO.	Avg. dia of core	Avg. height of core	Density	Specific Gravity	Water Absorption	Porosity	Unconfined Comp. Strength	Remark
			(mm)	(mm)	(gm/cc)		%	%	Mpa	
BH 01	4.5-6.0	1	54.32	57.52	2.21	2.09	7.70	16.10	0.00	Point
	6.0-7.5	18	54.25	76.99	2.51	2.22	8.02	17.81	11.68	Point
	7.5-9.0	27	55.00	106.89	2.34	2.11	7.92	16.70	13.34	
	9.0-10.0	30	54.53	109.97	2.32	2.06	8.73	18.01	5.70	
BH 02	2.1-3.0	5	55.86	69.04	2.30	2.11	6.79	14.32	1.49	Point
	3.0-4.5	8	55.47	105.69	2.43	2.42	4.12	9.97	21.02	
	4.5-6.0	12	54.01	104.08	2.53	2.20	4.94	10.86	30.30	
	7.5-9.0	17	55.20	103.97	2.35	2.20	5.40	11.87	14.54	
	9.0-10.0	23	55.47	76.78	2.81	2.70	0.93	2.52	11.30	Point
BH 03	4.5-6.0	2	55.36	106.40	2.43	2.35	4.67	10.98	17.33	
	6.0-7.5	9	55.51	106.69	2.25	2.04	8.34	17.05	7.40	
	9.0-10.0	16	56.37	62.68	2.86	2.70	0.81	2.19	74.93	Point
BH 04	6.0-7.5	9	54.42	78.66	2.66	2.52	2.57	6.48	19.38	Point
	7.5-9.0	13	58.57	107.04	2.78	2.70	0.81	2.17	51.60	
	9.0-10.0	23	54.45	60.92	2.83	2.73	0.25	0.68	54.22	Point
BH 05	3.0-4.5	5	55.50	95.45	2.37	2.18	3.60	7.85	24.23	
	4.5-6.0	8	55.85	107.17	2.34	2.14	6.04	12.93	24.99	
	6.0-7.5	11	55.79	107.95	2.30	2.24	2.92	6.52	21.52	
	7.5-9.0	15	56.01	106.70	2.61	2.48	2.69	6.69	26.02	

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	9.0-10.0	22	55.82	86.42	2.80	2.67	1.51	4.02	37.31	Point
BH 06	1.5-3.0	7	56.76	104.26	2.38	2.26	3.91	8.85	22.93	
	3.0-4.5	16	57.27	107.78	2.34	2.32	2.27	5.27	24.81	
	4.5-6.0	21	53.97	102.50	2.26	2.17	5.91	12.80	5.73	
	6.0-7.0	39	57.83	106.03	2.79	2.79	0.52	1.45	49.88	
	7.0-8.0	45	57.60	89.86	2.89	2.85	0.09	0.25	210.02	Point
BH 07	4.5-6.0	9	55.79	106.67	2.14	2.03	6.52	13.21	6.46	
	6.0-7.5	12	52.70	105.72	2.15	2.02	7.45	15.07	10.04	
	7.5-9.0	16	49.42	108.83	2.20	2.07	6.35	13.14	10.22	
	9.0-10.0	18	47.51	106.83	2.64	2.38	5.05	12.04	21.49	
BH 08	4.5-6.0	4	55.99	110.04	2.55	2.50	3.38	8.43	12.51	
	6.0-7.5	8	56.04	109.61	2.37	2.21	5.61	12.40	24.57	
	7.5-9.0	12	55.50	107.35	2.49	2.33	5.18	12.07	29.73	
	9.0-10.0	17	56.10	106.97	2.45	2.32	5.45	12.62	13.96	
BH 09	4.5-6.0	6	52.62	64.01	2.19	2.23	3.54	7.88	61.15	Point
	6.0-7.5	19	56.49	107.56	2.41	2.39	3.18	7.60	65.85	
	9.0-10.0	21	50.84	104.06	2.46	2.29	5.77	13.25	17.54	
BH 10	3.0-4.5	6	53.36	76.72	2.38	2.14	9.69	20.76	0.00	Point
	4.5-6.0	17	53.18	48.20	--	--	--	--	#VALUE!	Disint
	6.0-7.5	26	53.71	108.69	2.46	2.29	4.92	11.30	11.17	
	7.5-9.0	30	54.55	107.95	2.59	2.51	3.38	8.50	7.10	
	9.0-10.0	33	54.62	109.45	2.40	2.24	6.06	13.55	6.62	
BH-11	1.6-3.0	9	56.58	101.94	2.31	2.28	5.30	12.06	6.32	
	3.0-4.5	13	55.84	110.79	2.30	2.19	6.21	13.57	9.35	
	6.0-7.5	18	55.78	111.61	2.28	2.13	6.94	14.80	10.93	
	7.5-9.0	21	54.89	105.99	2.36	2.23	4.57	10.19	14.54	
	9.0-10.0	24	54.93	105.10	2.21	2.11	6.41	13.52	10.85	

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BH-12	1.5-3.0	12	54.81	100.71	2.88	2.89	0.29	0.85	42.73	
	3.0-4.0	19	55.32	88.13	2.89	2.81	0.16	0.46	86.99	Point
	4.0-5.0	23	55.10	108.77	2.91	2.96	0.21	0.63	39.72	
BH-13	4.5-6.0	4	56.05	107.90	2.81	2.77	0.67	1.86	18.00	
	6.0-7.5	8	56.73	106.37	2.74	2.72	0.71	1.93	28.01	
	7.5-9.0	13	56.47	107.94	2.43	2.35	2.33	5.49	29.15	
	9.0-10.0	16	56.17	105.39	2.38	2.29	2.57	5.90	37.46	
BH-14	1.5-3.0	3	53.48	74.32	2.27	2.22	5.16	11.47	35.81	Point
	3.0-4.5	14	53.87	110.11	2.44	2.37	3.06	7.26	20.71	
	4.5-6.0	23	54.20	72.81	2.33	2.34	2.90	6.78	23.40	Point
	6.0-7.5	29	54.27	108.86	2.41	2.34	3.40	7.96	10.68	
	7.5-9.0	49	54.83	102.74	2.92	2.92	0.06	0.17	21.39	Fractured
	9.0-10.0	53	54.57	107.81	2.88	2.87	0.06	0.16	57.39	
BH-15	3.0-4.5	16	54.59	97.95	--	--	--	--	--	Disint
	4.5-6.0	22	54.96	97.87	2.27	2.17	4.94	10.72	19.06	
	6.0-7.5	27	55.02	106.94	2.36	2.26	4.03	9.11	16.74	
	7.5-9.0	31	54.80	106.86	2.36	2.67	2.13	5.67	21.71	
	9.0-10.0	34	54.69	107.17	2.35	2.31	3.80	8.77	27.16	
BH-16	1.5-3.0	7	56.36	45.37	2.25	2.23	3.16	7.05	18.39	Point
	3.0-4.5	21	57.21	86.36	2.73	2.68	1.03	2.77	39.56	Point
	4.5-6.0	28	54.61	79.18	2.76	2.76	0.95	2.61	92.54	Point
	6.0-7.5	41	56.86	112.80	2.17	2.39	2.24	5.34	33.40	
	7.5-9.0	51	56.68	108.47	2.46	2.38	1.91	4.54	54.58	
BH-17	0.0-1.5	7	52.48	78.54	2.60	2.24	6.14	13.79	32.74	Point
	3.0-4.5	18	54.64	107.20	2.30	2.22	4.30	9.56	13.65	
	4.5-6.0	21	54.80	110.55	2.34	2.28	4.32	9.85	15.35	
	6.0-7.5	34	54.75	113.25	2.47	2.38	4.12	9.80	22.01	

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	7.5-9.0	40	54.72	52.12	2.69	2.66	1.48	3.93	3.84	Point
	9.0-10.0	50	54.65	109.13	2.41	2.28	3.22	7.33	11.09	
BH-18	0.0-1.5	4	55.56	42.17	2.45	2.24	2.54	5.71	41.33	Point
	1.5-3.0	8	56.17	104.18	2.48	2.44	1.47	3.60	29.71	
	3.0-4.5	13	56.07	96.16	2.48	2.46	2.40	5.90	24.79	
	4.5-6.0	18	55.84	108.62	2.41	2.26	4.84	10.95	24.71	
	6.0-7.5	20	55.94	105.91	2.42	2.38	3.01	7.15	30.15	
	7.5-9.0	33	56.19	100.22	2.39	2.29	2.91	6.68	25.89	
	9.0-10.0	40	56.52	107.72	2.43	2.32	2.76	6.39	18.78	
BH-19	2.1-3.0	5	56.14	110.47	2.49	2.38	2.84	6.74	10.51	
	3.0-4.5	9	54.11	51.92	2.43	2.29	2.62	6.01	31.28	Point
	4.5-6.0	25	54.59	106.76	2.41	2.22	2.70	5.98	61.92	
	6.0-7.5	26	54.00	101.95	2.36	2.29	2.49	5.71	31.36	
	7.5-9.0	32	56.05	109.47	2.41	2.36	2.32	5.48	27.60	
	9.0-10.0	34	55.98	96.91	2.31	2.29	2.84	6.50	30.19	
BH-20	5.0-6.0	8	53.42	37.39	2.18	2.10	7.79	16.38	7.97	Point
	6.0-7.0	17	53.25	70.97	2.15	2.04	5.71	11.66	4.00	Point
	7.0-8.0	23	54.33	103.53	2.39	2.30	3.35	7.71	16.57	
	8.0-9.0	20	53.06	57.46	2.65	2.60	2.38	6.17	20.13	Point
	9.0-10.0	41	54.04	102.95	2.41	2.28	6.12	13.96	4.84	

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SOIL TEST SUMMARY

BH no	Sample type	Depth of sample	Differential Free Swell	Mechanical Sieve Analysis			Atterberg's limit			IS Classification
				Gravel	Sand	Silt & Clay	Liquid Limit	Plastic Limit	Plasticity Index	
			%	%	%	%	%	%	%	
BH 01	DS	0.0-1.5	-	30.87	32.63	36.50	-	-	-	SM
	SPT-1	1.5-2.0	-	26.61	58.27	15.12	-	-	-	SM
BH 02	DS	0.0-1.5	-	38.63	37.4	23.97	-	-	-	SM
	SPT-1	1.5-2.1	-	15.82	47.06	37.12	49	32	17	CI
BH 03	DS	0.0-1.5	-	17.17	41.76	41.07	-	-	-	SM
	SPT-1	1.5-2.1	-	79.78	18.68	1.54	-	-	-	GM
	SPT-2	3.0-3.6	-	65.8	29.2	5	-	-	-	GM
BH 04	DS	0.0-1.5	-	93.17	3.73	3.1	-	-	-	GM
	SPT-1	1.5-1.59	-	14.49	49.09	36.45	-	-	-	SM
BH 05	DS	0.0-1.5	-	16.91	36.79	46.3	-	-	-	SM
	SPT-1	1.5-1.63	-	9.8	35.57	54.63	-	-	-	SM
BH 06	DS	0.0-1.5	-	2.33	41.82	55.85	-	-	-	SM
	SPT-1	1.5-1.55	-	52.44	43.06	4.5	-	-	-	SM
BH 07	DS	0.0-1.5	-	25.27	30	44.73	-	-	-	SM
	SPT-1	1.5-1.6	-	49.27	47.06	3.67	-	-	-	GM
BH 08	DS	0.0-1.5	-	11.33	43.48	45.19	-	-	-	SM
	SPT-1	1.5-1.58	-	14.77	72.57	12.72	-	-	-	SM
BH 10	DS	0.0-1.5	-	20.13	72.13	7.74	-	-	-	SM
	SPT-1	1.5-2.1	-	0	82.94	17.06	-	-	-	SM
BH 11	SPT-1	1.5-1.6	-	7.2	58.54	34.26	-	-	-	SM
	DS	0.0-1.0	-	30.66	66.46	2.88	-	-	-	SM
BH 13	SPT-1	1.5-2.1	36.36	2.06	62.36	35.58	79	32	47	MH or OH

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	DS	0.0-1.0	-	9.22	62.03	28.75	-	-	-	SM
BH 14	DS	0.0-1.0	-	47.01	47.87	5.12	-	-	-	SW
BH 15	DS	0.0-1.0	-	9.38	66.17	24.45	-	-	-	SM
	SPT-1	1.5-2.0	25.00	0	25.92	74.08	55	34	21	CH or OH
BH 19	DS	0.0-1.0	-	4.76	32.48	62.76	-	-	-	CH or OH
	SPT-1	1.5-2.1	36.36	22.34	25.94	51.72	55	32	23	CH or OH
BH 20	SPT-1	1.5-2.1	60.00	2.56	29.54	67.9	47	30	17	CI
	SPT-2	3.0-3.4	-	10.88	87.47	1.645	-	-	-	SM

SITE PHOTOGRAPHS

SAMPLES FROM BOREHOLES

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