REQUEST FOR PROPOSAL FOR SELECTION OF IMPLEMENTATION AGENCY FOR INTELLIGENT TRANSIT MANAGEMENT SYSTEM (ITMS) IN VADODARA CITY

Volume II: Scope of Work and Specifications

Tender Number: VSCDL/908/2017-18

Issued by

The CEO

Vadodara Smart City Development Limited (VSCDL)

Vadodara

Table of Contents

1. *Disclaimer*

The information contained in this Request for Proposal document ("**RFP**") whether subsequently provided to the bidders, ("**Bidder/s**") verbally or in documentary form by Vadodara Smart City Development Limited (henceforth, referred to as "VSCDL" in this document) or any of its employees or advisors, is provided to Bidders on the terms and conditions set out in this Tender document and any other terms and conditions subject to which such information is provided.

This RFP is not an agreement and is not an offer or invitation to any party. The purpose of this RFP is to provide the Bidders or any other person with information to assist the formulation of their financial offers ("**Bid**"). This RFP includes statements, which reflect various assumptions and assessments arrived at by VSCDL in relation to this scope. This Tender document does not purport to contain all the information each Bidder may require. This Tender document may not be appropriate for all persons, and it is not possible for the Chief Executive Officer, VSCDL and their employees or advisors to consider the objectives, technical expertise and particular needs of each Bidder. The assumptions, assessments, statements and information contained in the Bid documents, may not be complete, accurate, adequate or correct. Each Bidder must therefore conduct its own analysis of the information contained in this RFP and to seek its own professional advice from appropriate sources.

Information provided in this Tender document to the Bidder is on a wide range of matters, some of which may depend upon interpretation of law. The information given is not intended to be an exhaustive account of statutory requirements and should not be regarded as a complete or authoritative statement of law. VSCDL accepts no responsibility for the accuracy or otherwise for any interpretation of opinion on law expressed herein.

VSCDL and their employees and advisors make no representation or warranty and shall incur no liability to any person, including the Bidder under law, statute, rules or regulations or tort, the principles of restitution or unjust enrichment or otherwise for any loss, cost, expense or damage which may arise from or be incurred or suffered on account of anything contained in this RFP or otherwise, including the accuracy, reliability or completeness of the RFP, and any assessment, assumption, statement or information contained therein or deemed to form part of this RFP or arising in any way in this Selection Process.

VSCDL also accepts no liability of any nature whether resulting from negligence or otherwise howsoever caused arising from reliance of any Bidder upon the statements contained in this RFP. VSCDL may in its absolute discretion, but without being under any obligation to do so, can amend or supplement the information in this RFP.

The issue of this Tender document does not imply that VSCDL is bound to select a Bidder or to appoint the Selected Bidder (as defined hereinafter), for implementation and VSCDL reserves the right to reject all or any of the Bidders or Bids without assigning any reason whatsoever. The Bidder shall bear all its costs associated with or relating to the preparation and submission of its Bid including but not limited to preparation, copying, postage, delivery fees, expenses

associated with any demonstrations or presentations which may be required by VSCDL   or any other costs incurred in connection with or relating to its Bid. All such costs and expenses will remain with the Bidder and VSCDL shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by a Bidder in preparation for submission of the Bid, regardless of the conduct or outcome of the Selection process

.

2. Glossary

Term	Meaning
ANPR	Automatic Number Plate Recognition
AP	Access Point
API	Application Program Interface
ATCS	Adaptive Traffic Control System
AVLS	Automated Vehicle Locator System
BCV	Bus Card Validator
BDC	Bus Driver Console
BEC	Bid Evaluation Committee
BI	Business Intelligence
BOM	Bill of Material
BP	Building Plan
BSF	Bid Security Form
BTMS	Bus Terminal Management System
CAD	Computer Aided Dispatch
CC	Capital Cost (CC1-Capital Cost 1, CC2 - Capital Cost 2)
CCC	Command and Control Centre
BCC	Bus Control Center (Centrally operated)
CCHS	Central Clearing House System
CCPS	Common City Payments System
CCTV	Closed Circuit Television
CEO	Chief Executive Officer
CMMI	Capability Maturity Model Integration
CRPA	Control Room Process &Analyst
CSP	Cloud Service Provider
DC	Data Centre
DD	Demand Draft
DMS	Depot Management System
DR	Disaster Recovery
ECB	Emergency Call Box
EMD	Earnest Money Deposit
EMS	Enterprise Management System
ERP	Enterprise Resource Planning
ETL	Extract, Transform and Load
FRS	Functional Requirements Specifications
FTTH	Fiber to the Home
GIS	Geographical Information System
GoG	Government of Gujarat
GoI	Government of India
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communications
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HOD	Head of Department
HTT	Handheld Ticketing Terminal
HTTPS	Hypertext Transfer Protocol Secure
HTU	Handheld Ticketing Unit

ICT	Information and Communication Technology
IMS	Incident Management System
INR	Indian Rupee
iPole	Intelligent Pole
ISO	International Organization for Standardization
IT	Information Technology
ITIL	Information Technology Infrastructure Library
ITMS	Integrated Transit Management System
KVM	Keyboard Video Mouse
LED	Light Emitting Diode
LoI	Letter of Intent
MAF	Manufacturer's Authorization Form
MFP	Multi-Functional Printer
MTBF	Mean Time Before Failure
MTTR	Mean Time to Replace
NDCS	Hardware, Network & Data Centre Staff Member
NMS	Network Management System
NOC	Network Operation Center
NPV	Net Present Value
NVR	Network Video Recorder
O&M	Operation & Maintenance
OEM	Original Equipment Manufacture
OFC	Optical Fiber Cable
PBG	Performance Bank Guarantee
PM	Project Manager
PMC	Project Management Consultant
PoA	Power of Attorney
PoC	Proof of Concept
POP	Point of Presence
POS	Point of Sale System
PQ	Pre-Qualification
PSU	Public Sector Undertaking
PV	Present Value
PVC	Polyvinyl chloride
QA	Quality Assurance
QC	Quality Control
QoS	Quality of Service
RDBMS	Relational Database Management System
RFP	Request for Proposal
RV	Revenue (RV1-Revenue from 1, RV2-Revenue from 2)
SAN	Storage Area Network
SC	Smart Card
SCV	Station Card Validator
SI	System Integrator
SLA	Service Level Agreement
SOR	Schedule Of Rates
SP	Service Provider
SPV	Special Purpose Vehicle
SRS	Software Requirement Specifications
STSM	Senior Technical Staff Member
STT	Station Ticket Terminal

TAT	Turn-Around-Time
TDS	Tax Deducted at Source
TPA	Third Party Auditor
TQ	Technical Qualification
TVM	Ticket Vending Machine
UMTS	Universal Mobile Telecommunications System
VAT	Value Added Tax
VM	Virtual Machine
VMC	Vadodara Municipal Corporation
VPN	Virtual Private Network
VSCDL	Vadodara Smart City Development Limited
VSDS	Vehicle Scheduling and Dispatch System

3. Introduction

The purpose of this document is to provide guidelines for development, implementation, operation and maintenance of integrated transit management system (ITMS) for Vadodara Smart City Development Ltd to be implemented within Vadodara City. The document underlines all functional, technology and end use requirements related to requirements of VSCDL to achieve integrated, highly automated and stable environment for integrated transportation operations management environment within city of Vadodara.

3.1. Project Objectives

Intelligent Transit Management System (ITMS) is the IT Solution that helps

- To enable gathering of transit data or intelligence
- Provides timely feedback to traffic managers and commuters
- Provides tools for real time monitoring of Fleet of Public Transport Buses
- Enhances commuter satisfaction, reliability and punctuality of bus operations

VSCDL aims to enhance operational capability, citizen's satisfaction, reliability and on-time availability of its services offered through various departments like public transportation to start with (and then extending it to other department like, solid waste, engineering services and emergency/fire services etc in future). VSCDL is soliciting proposals through this RFP from qualified services providers to implement an integrated operations management city platform which will render its services to different departments in a collaborative manner and augment VSCDL initiative of delivering quality services which meet citizen's expectations. The services thereby are aimed at enhancing the efficiency of VSCDL's operational capability and better management of fleet of vehicles which in-turn will instill confidence within citizens of Vadodara city. SMC, through this RFP is desirous of implementing the "Intelligent Transit Management System" (hereinafter referred to as the "ITMS" OR "The Project"). Through this project, VSCDL will monitor the movement and manage the fleet of vehicles owned and operated for the Bus Operator, as well as own vehicles, collect data related to their geographical position, vehicle movement patterns and to provide relevant information to citizens / VSCDL/VMC management to better manage services.

3.2. Solution Overview

3.2.1. Integrated ITMS Solution Overview

The system being proposed to be implemented will act as a city foundation framework for integrating objectives of diverse set of stakeholders with Vadodara city. VMC/VSCL provides several other services other than transportation to its citizens like emergency services, engineering services etc. and hence all such services mentioned within the scope of this RFP shall utilize common ITS infrastructure like tracking and GIS systems to deliver its desirable end objectives.

Component	Use and Advantages
Automatic vehicle Locating system (AVLS)	AVLS Software shall help in better Fleet management through fleet planning, tracking and performance monitoring. GPS units are provided by bus operator

Passenger Information System	It shall provide real-time information about schedule of Buses to Citizen. PIS Display in buses already provided by Bus Operator)
Vehicle Scheduling & Dispatch System	Fleet optimisation through Schedule allocation, Route allocation, crew allocation and rostering etc.
Incident Management System	It shall help in improving the response time to any undesirable incidents and hence improves safety to drivers and commuters
CCTV based Security and Surveillance System	Enhances Security of assets and commuters through real time Surveillance
Business Intelligence Software System	BI tools builds reports from operation data to have better insight into performance parameters and enable authority to take decisions for better operational efficiency
Transport Portal and Mobile App	For Transit Information, for Bus Schedule, ETA , Ticketing (QR Code) etc.
Integration with CCC	Integration of ITMS Solution with the CCC Solution (IBM IOC Software) for two-way information exchange between the solution.

The following table describes overall scope requirement in summary form:

Project Area	Equipment/Software
In Buses	Bus Driver Console and OBU GPS Unit for City Bus/Other Vehicles Mobile NVR for buses Fixed Minidome camera for buses and Bus Stops
At Bus Stops	3G/4G Router with built-in Switch at bus Stops PTZ Camera for Bus Terminal Bus Stop PIS Display Unit (2 Rows) Voltage Stabilizer Junction Box at Bus Stop/Field
At Bus Control Room / Bus Terminal	Bus Terminal Ultra Stretch Display Bus Terminal LED PIS Multi-line Display LED TV (Professional Displays) for Video Wall Desktop PC Video Feed Receiving Station Video Management System Rack Server for Bus Control Room UPS LAN and Structured Cabling
For DC (at CCC Building)	Internal Firewall Blade Servers Blade Chassis DC Switch / TOR Switch SAN Storage Server/Networking Rack KVM Module

	Structured Cabling Components
DR Site (Optional)	DR Equipment DR Connectivity
Software Solutions	Integrated Operations Management Platform Automated Vehicle Locating System Passenger Information System Vehicle Scheduling and Dispatch System Depot Management System Incident Management System Business Intelligent Platform
For Public/Citizen/Commuters	Transit Website Mobile Application

The Functional Schematic/Architecture of the ITMS solution is described below:
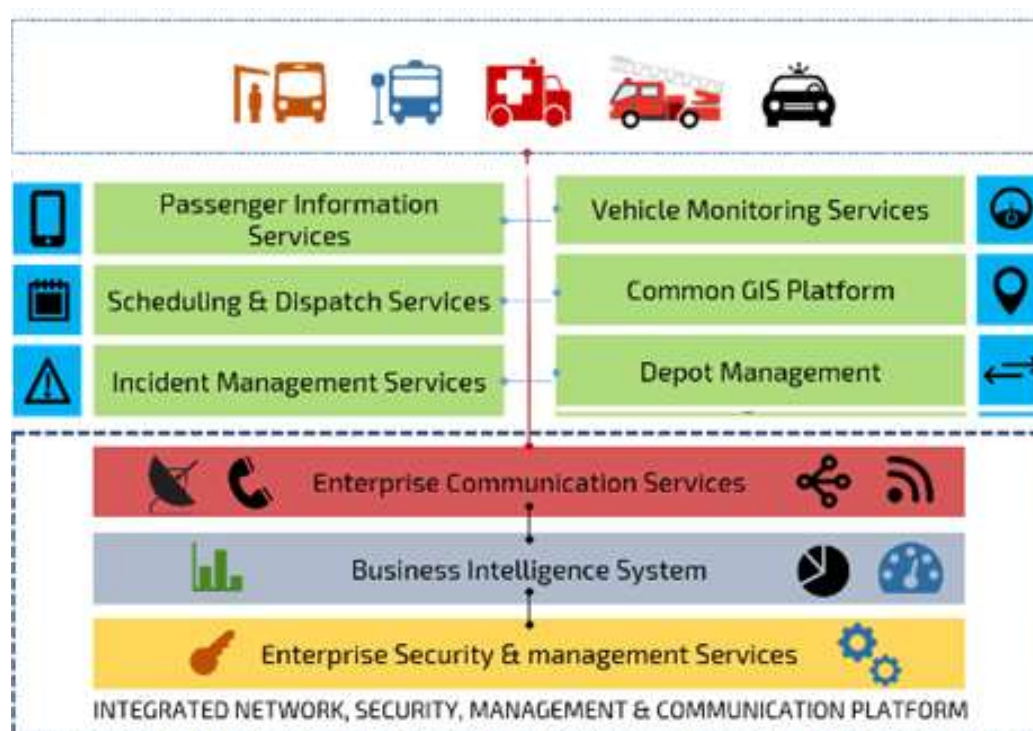
Figure 1: Integrated Vadodara City ITMS Architecture (Indicative)**

3.2.2. Bus Stop ITS Overview

The city bus stops (A list is given in this volume) are open kerb side shelters and are utilized by VSCDL for passenger boarding / alighting services. The station shall provide a LED based PIS display to deliver estimated arrival time of city buses at individual stations. The devices shall be connected to central control center via wireless interface like GSM / GPRS / 3G for data exchange purposes. The device shall operate in autonomous mode and can be managed centrally by central control center. The device shall also be connected to uninterrupted power supply for information continuity.
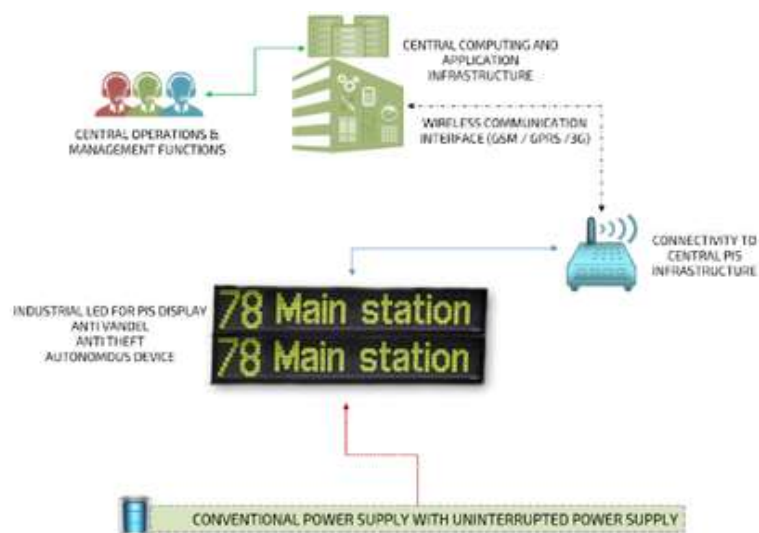
Figure 2: City Bus station ITS Equipment's, Interfaces and Communication

3.2.3.   City Bus ITS Infrastructure Overview

The bus ITS system is an integrated system installed on the bus to deliver primarily services pertaining to location tracking, operating parameters like speed, direction etc. The system will also provide passenger information system using visual and voice aids to enable passengers with diverse needs to know about the route and station information. The system shall be connected to central control center via wireless communication system provided using GSM /GPRS / 3G system.

The essential components are:

- Controller for GPS/GSM (Already installed in buses by the Bus Operator)
- Bus Driver Console
- LED based PIS displays (Already installed in buses by the Bus Operator)
- CCTV Camera and Mobile NVR
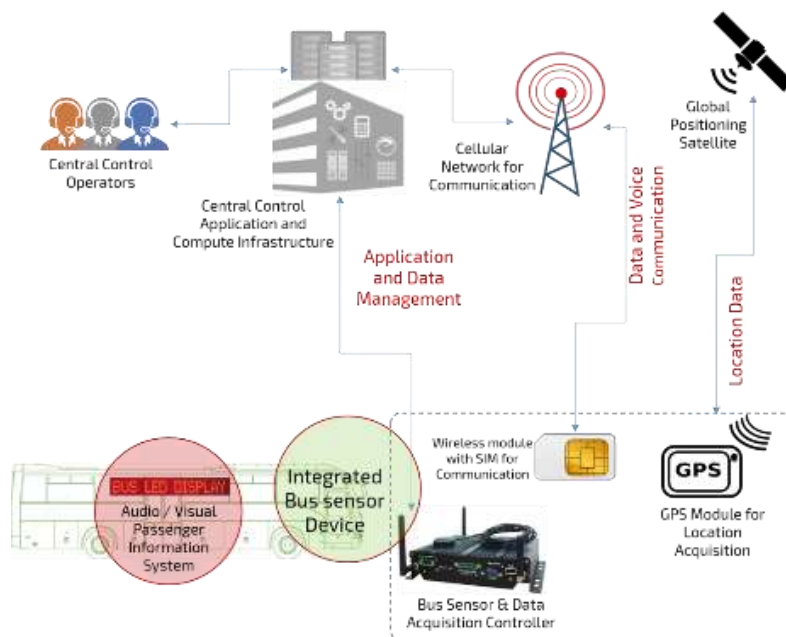
Figure 3: Bus ITS Equipment's, Interfaces and Communication

The system shall provide two-way communication with the drivers, so as to ensure services are delivered and adhered to, based on the expected operations levels.

3.2.4.   ITMS Communication System Overview

The communication system for ITMS project needs to be able to connect multiple types of assets, mobile and fixed. The communication system thus required for the purpose of connecting field devices to the central computing infrastructure shall depend on the type of asset. For mobile assets ITMS shall utilize wireless connectivity like GSM/GPRS/3G to establish connectivity with CCC/DC/DR and fixed assets like Bus Control Station, bus terminals, depots etc. shall be connected over fixed lines as these assets will need to manage a large volume of data. The data communication needs to be secured so that the sanctity and sanity of data is maintained at all times.
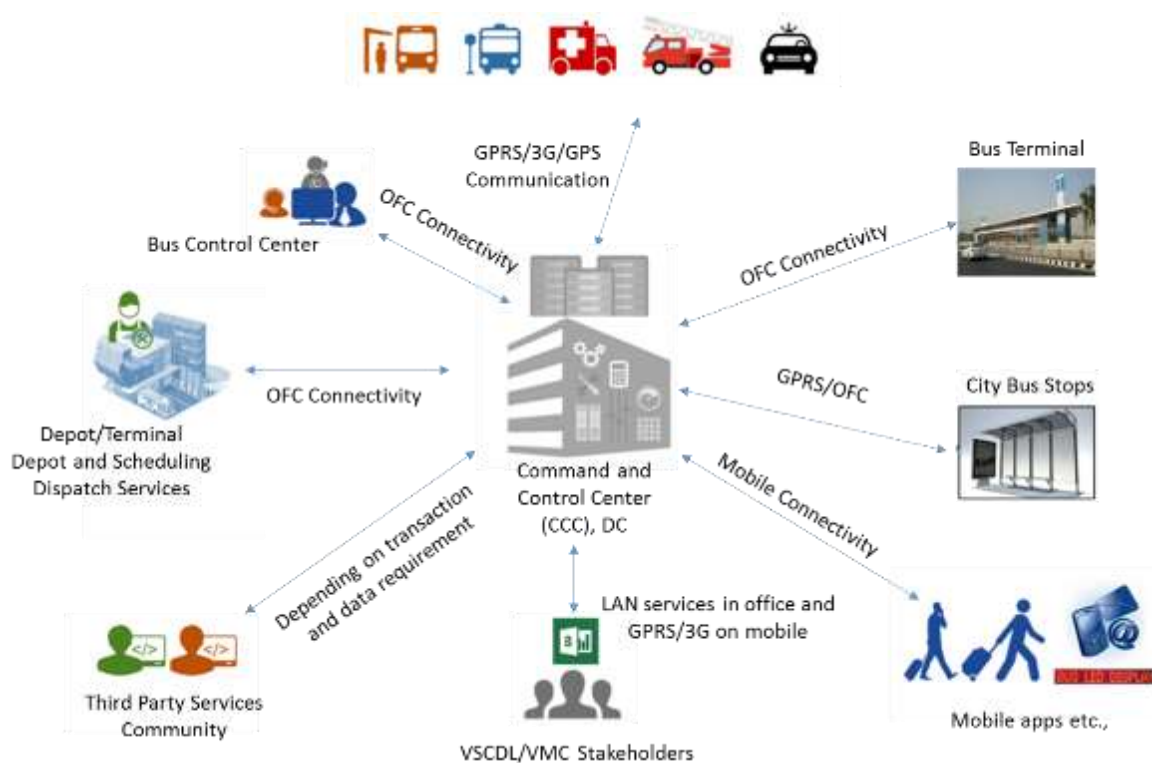
Figure 4: *Communication Interfaces for ITMS ecosystem for VSCDL*

4. *Scope of Services for the Project*

Overall scope is described in this section, which needs to be complied by the System Integrator. The detailed scope of work and considerations are defined in Annexure V,that also needs to be adhered to and complied.

4.1. Components & Services Overview

The SI should ensure the successful implementation of the proposed "ITMS Solution" and provide capacity building support to city authorities & bus operator personnel as per the scope of services described below. Any functionality not expressly stated in this document but required to meet the needs of the VSCDL to ensure successful operations of the system shall essentially be under the scope of the SI and for that no extra charges shall be admissible. SI shall implement and deliver the systems and components as described in RFP documents

The SI's scope of work shall include but will not be limited to the following broad areas. Details of each of these broad areas have also been outlined in annexure V.

1. **Assessment, Scoping and Feasibility Study:** Conduct a detailed assessment, scoping study and develop a comprehensive project plan, including:
   a. Assess existing systems, street infrastructure and connectivity within the city for the scope items mentioned in section 4.1
   b. Conduct feasibility study for finalization of detailed technical architecture, gap analysis and project plan
   c. Conduct site surveys to identify need for site preparation activities
   d. Obtain site Clearance obligations & other relevant permissions

2. **Design, Supply, Installation and Commissioning Central and Field Equipment** which includes, but not limited to the following components:
   - Bus Driver Console
   - Bus Stop PIS Display Unit
   - Bus Stop Vertical Display
   - Control Centre Hardware (Servers, Equipment, LAN, WAN etc.)
   - Bus Stop UPS
   - Depot Hardware
   - CCTV Setup with DVR in Bus
   - Camera on Bus Stops
   - Router/Switch at Bus Stops
   - Junction Box at Bus Stop
   - Other equipment as specified in BoQ

3. **Forward and backward integration** (in terms of functions - components, applications, devices, geographical coverage and volume) with CCC Solution. Such forward or backward integration could take place at any of the layers defined in the over architecture viz. sensor and actuator layer, network layer, data centre layer, application layer, integration layer, service delivery layer, command centre layer, visualization layer and security layer.

4. **Design, Supply, Installation and Commissioning of Network Connectivity for ITMS Solution** which includes
   a. Bus Station Connectivity via GPRS (SIM card based) and Wired Connectivity
   b. Bus Control Room Connectivity
   c. DC and DR Connectivity (Connecting ITMS hardware within existing DC and DR)

5. **Provisioning Hardware and Software Infrastructure** which includes design, supply, installation, and commissioning of IT Infrastructure at all project locations. This consist of:
   a. Basic Site preparation services (as required)
   b. IT Infrastructure including server, storage, other required hardware, application portfolio, licenses
   c. Control Room infrastructure including operator Desktops, IP phones, as per project requirements.
   d. Application integration services with other VSCDL applications

6. **Capacity Building** for VSCDL which includes preparation of operational manuals, training documents and capacity building support, including:
   a. Training of the city authorities and bus operator personnel on operationalization of the ITMS system, at the start of the project, on yearly basis, at urgent instances (such as change of bus operator agency, staff attrition etc).
   b. Support during execution of acceptance testing
   c. Preparation and implementation of the information security policy, including policies on backup and redundancy plan
   d. Preparation of revised KPIs for performance monitoring of various urban utilities monitored through the system envisaged to be implemented
   e. Developing standard operating procedures for operations management and other services to be rendered by ITMS
   f. Preparation of system documents, user manuals, performance manuals, etc.

7. **Warranty and Annual Maintenance** which includes periodic maintenance services for the software, hardware and other IT infrastructure installed as part of project for a period of 5 years i.e. 3 year default onsite comprehensive warranty with support on hardware/parts/equipment and onsite comprehensive support (AMC) for 4th and 5th year, and conducting periodic audits of the project from a third party, if required or instructed by VSCDL .

4.2. Geographical Scope of services
The following is a summary of the geographical extent of the project.

#	System Description	Number of Locations
1.	City Buses	150
2.	Bus Stops	125
3.	Bus Control Room City Centre, Opp Railway Station (This needs to be moved in side Jan Mahal when it is	1

	ready)	
4.	CCC at Badamadi Baug Integration with CCC Solution	1
5.	DC for ITMS	1
6.	DR for ITMS (on Cloud)	1

The proposed list of locations to be covered under this project are provided as **Annexure I.**

4.3. Feasibility study for technical architecture and project plan

After signing of contract, the Systems Integrator needs to deploy local team (based out of Vadodara) proposed for the project and ensure that a Project Inception Report is submitted to VSCDL which should cover following aspects:

1. Names of the Project Team members, their roles and responsibilities
2. Approach and methodology to be adopted to implement the Project (which should be in line with what has been proposed during bidding stage, but may have value additions / learning in the interest of the project).
3. Responsibility matrix for all stakeholders
4. Risks the SI anticipates and the plans they have towards their mitigation
5. Detailed project plan specifying dependencies between various project activities / sub-activities and their timelines
6. Installation locations geo mapped preferably on google earth to visually identify the geographical area

The SI as part of the feasibility study shall also conduct a comprehensive As-Is study of the existing infrastructure of traffic junctions/intersections (identified for this project) during various time periods of day including peak and non-peak hours to establish the key performance indicators(KPI) for the project. The KPIs of the study shall be included in the feasibility report. The following minimum parameters should be captured during the comprehensive study

1. Volumes of vehicles moving in the road network within the area identified for ITMS implementation
2. Vehicle type distribution
3. Directional distribution
4. Traffic Situation, Lane Marking, One way Traffic etc.
5. Physical and visual characteristics of the area
6. Travel times, delays between different points of the network
7. Additional dependencies with respect to the available infrastructure and geometry at the junctions
8. Any other relevant data which the SI anticipates will assist in establishing the benchmarks for the project

The feasibility report shall also include the expected measurable improvements against each KPI as detailed out in the above 'As-Is' study after implementation of ATCS. The benchmarking data should also be developed to track current situation and desired state.

The System Integrator shall study the existing business processes, functionalities, existing CCTV and traffic Signalling systems and applications including MIS reporting requirements.

Additionally, the System Integrator should provide as part of feasibility report the detailed To-Be designs (Junction layout plans) specifying the following:

1. High Level Design (including but not limited to) Application architecture, Logical and physical database design, Data dictionary and data definitions, ER diagrams and other data modelling documents and Physical infrastructure design for devices on the field

2. Application component design including component deployment views, control flows, etc.

3. Low Level Design (including but not limited to) Application flows and logic including pseudo code, GUI design (screen design, navigation, etc.), Database architecture, including defining data structure, data dictionary as per standards laid-down by Government of India/ Government of Chhattisgarh

4. Location of all field systems and components proposed at the junctions, (KML /KMZ file plotted on GIS platform like google earth etc.)

5. Height and foundation of Cameras, Traffic Signals and Standard Poles for Pedestrian signals, Height and foundation of Poles, cantilevers, gantry and other mounting structures for other field devices

6. Location of Junction Box

7. Location of Network Provider' (CCC)s Point of Presence (PoP) – if used

8. Design of Cables, Ducts routing, digging and trenching

9. Electrical power provisioning

The SI shall also identify the customizations/ workaround that would be required for successful implementation and operation of the project. The feasibility report should take into consideration following guiding principles:

1. Scalability - Important technical components of the architecture must support scalability to provide continuous growth to meet the growing demand of the Vadodara city. The system should also support vertical and horizontal scalability so that depending on changing requirements from time to time, the system may be scaled upwards. There must not be any system imposed restrictions on the upward scalability in number of field devices. Main technological components requiring scalability are storage, bandwidth, computing performance (IT Infrastructure), software / application performance. In quantitative terms, there may not be major change in number of Command Centres.

2. Availability - Components of the architecture must provide redundancy and ensure that are no single point of failures in the key project components. Considering the high sensitivity of the system, design should be in such a way as to be resilient to technological sabotage. To take care of remote failure, the systems need to be configured to mask and recover with minimum outage. The SI shall make the provision for high availability for all the services of the system.

3. Security - The architecture must adopt an end-to-end security model that protects data and the infrastructure from malicious attacks, theft, natural disasters etc. SI

must make provisions for security of field equipment as well as protection of the software system from hackers and other threats. Using Firewalls and Intrusion detection systems such attacks and theft should be controlled and well supported (and implemented) with the security policy. The virus and worms attacks should be well defended with gateway level Anti-virus system, along with workstation level anti-virus mechanism. Furthermore, all the system logs should be properly stored & archived for future analysis and forensics whenever desired. VSCDL may carry out the Security Audit of the entire system post acceptance / operationalization through a Third Party Auditor (TPA). The following guidelines need to be observed for security:

a. Build a complete audit trail of all activities and operations using log reports, so that errors in system – intentional or otherwise – can be traced and corrected.
b. Access controls must be provided to ensure that the system is not tampered or modified by the system operators.
c. Implement data security to allow for changes in technology and business needs.
d. The security of the field devices must be ensured with system architecture designed in a way to secure the field devices in terms of physical damage & unauthorized access.

4. Manageability - Ease of configuration, ongoing health monitoring, and failure detection are vital to the goals of scalability, availability, and security and must be able to match the scalability of the system

5. Interoperability - The system should have capability to take inputs from other third party systems as per situational requirements

6. Open Standards - System should use open standards and protocols to the extent possible without compromising on the security

7. Convergence - VSCDL has already initiated many projects which have state of the art infrastructure at field locations deployed under them. The ITMS Infrastructure should be made scalable for future convergence needs. Under the smart city program, VSCDL has created a state of the art CCC infrastructure and services for the citizens of Vadodara, hence it is imperative that all infrastructure created under the project shall be capable to converge/integrate with CCC project components.

Sub-contracting / Outsourcing shall be allowed only for the work which is allowed as mentioned in the clause with prior written approval of VSCDL. However, even if the work is sub-contracted / outsourced, the sole responsibility of the work shall lie with the SI. The SI shall be held responsible for any delay/error/non-compliance etc. of its sub-contracted vendor. The details of the sub-contracting agreements (if any) between both the parties would be required to be submitted to VSCDL. Sub-contracting / outsourcing would be allowed only for work such as:

1. Passive Networking & Civil Work during implementation,
2. FMS staff for non- IT support during post-implementation
3. Services of professional architect for design of traffic command / viewing centres

4.4. Scope of Services for ITMS Project

The scope of work & services covers the design, procurement, supply, installation, construction, testing and commissioning of a city wide Intelligent Transit Management System in the *Vadodara city for Building a Smart City*, along with the associated active, passive components, civil, mechanical and power. The SI should ensure the successful implementation of the proposed System and provide capacity building support to city authorities and Bus Operator Personnel as per the scope of services described below. Any functionality not expressly stated in this document but required to meet the needs of the VSCDL to ensure successful operations of the system shall essentially be under the scope of the SI and for that no extra charges shall be admissible.

SI Shall have to Conduct a detailed assessment, scoping study (Feasibility Study) and develop a comprehensive project plan, including detailed technical architecture and gap analysis.

Following services and applications needs to be incorporated under project SOW:
- GPS Equipment and PIS Displays in existing Buses
- All other PIS Displays, Networking Equipment, Display Equipment, Computing Equipment on field, as part of this project and additional similar installations
- Connectivity for All project locations.

The scope of work for THE PROJECT shall cover the following activities but not limited to:

4.4.1.   ITMS Field Equipment
This component of the project would involves the following:

- Bus Driver Console
- Bus Stop PIS Display Unit
- Bus Stop Verticle Display
- Control Centre Hardware (Servers, Equipments, LAN, WAN etc.)
- Bus Stop UPS
- Depot Hardware
- CCTV Setup with DVR in Bus
- Camera on Bus Stops
- Switch on Bus Stops
- Router at Bus Stops
- UPS at Bus Stop
- Junction Box at Bus Stop

4.4.2.   Central Infrastructure
Central IT infrastructure will be required to centrally monitor, control and manage the ITMS System from Bus Control Room. This comprises establishment of Operations Centre within Bus Control Room and development and deployment of Operations Support System and Business Support Systems. The required solutions shall be hosted in Smart DC in CCC Building and with disaster recovery site (DR) of CCC on cloud.

4.4.2.1.   Data Centre / Disaster Recovery

Data Centre (DC) will host the IT infrastructure required for running the backbone and core applications related to ITMS. The IT infrastructure and core application will be hosted in Data Centre within CCC Building.

The Data Recovery Centre (DR) of ITMS needs to be setup at the DR Service provider of CCC Project (which is M/s ESDS). This DR site has to prevent service disruption by ensuring the high availability and redundant storage. Infrastructure available at secondary site for business continuity in case of full failure of primary site due to disaster or disaster like situation shall be for all the applications of ITMS. There shall be fool proof arrangement for complete replication of data on secondary site in the form of back up, storage and replication so that there is minimum loss of data.

4.4.2.2. Central NOC at Tech Support Room of CCC

Network Operations Centre (NOC) of the ITMS, shall be operated from CCC, would be the central location from which network administrators manage, control and monitor the network. NOC would have the capability of analysing problems, performing troubleshooting, communicating with site technicians and tracking problems until they are resolved. NOC shall also have the capability able to monitor the DC from the central location. The NOC of System Integrator may be utilized to administrators manage, control and monitor the network. System integrator should ensure sufficient qualified man power for NOC operations. NOC should be managed 24x7x365 and accordingly manpower should be planned by the SI.

In order to achieve increased reliability and improved performance by seamless monitoring and management of the network, the common Network Management System (NMS) shall be utilised. The NOC operators would be able to access the network for effective monitoring and management.

4.4.2.3. Operation & Maintenance (O&M)

SI is responsible of O&M for the period of 5 years. O&M would entail undertaking all activities to ensure uptime of the network as per agreed SLAs defined in Volume I. This shall also apply to the entire supporting infrastructure network, DC, DR, etc. The O&M shall also entail ensuring timely upgrade of infrastructure (Active + Passive) to meet the changing demand scenarios.

Active Component: Electronic refreshment shall be considered for active component after 5 years. Active component shall be covered under 3 years of warranty & 2 years of Comprehensive AMC.

Passive Component: All the passive component shall be covered under 3 year of warranty & 2 years of Comprehensive AMC.

4.4.3. Integrations
- The solution implemented will be scalable for all future integrations and demands that may arise in the future and will enable VSCDL to provide seamless connectivity for all future projects

- It is required to have protocol level compatibility between devices/electronics installed at bus stops/stations/terminals in order to have one unified seamless network available across the city

- City services such as surveillance, parking sensors, environmental sensors variable sign boards, public address system, self-service kiosks, and FTTH (in future if required) which will utilize this network will be integrated with the city wide OFC

4.4.4. General

- Supply of Field Equipment and Accessories as per the quantities defined in the BOQ.
- Preferably all installation works needs to be done on the Footpaths. This will ensure minimal damages to Tar Roads
- During the course of installation, if any utility services or roads or other VMC assets or third party assets etc. are damaged, then the successful bidder has to repair and reinstate the same at his own cost. The SI will be completely responsible for damages if any to other utility or VMC/VSCDL/MGVCL, during the work and shall resolve all disputes including reimbursement of the damages.
- Contractor will be responsible to undertake and complete the works related to **supply installation and commissioning of services as indicated in the bid.**
- The works are to be completed on turnkey basis and the supplied equipment's and Network are required to be maintained for 5 years on comprehensive warranty basis from the date of **Final Approval and Testing** and need to sign SLA. The Bidder shall be responsible for implementation of the work as defined.
- During the installation activities, records must be kept of all items installed. Including reference to cable pathways used, final location, identity of cables and equipment. The presentation of all of these records will provide the "As-Installed" basis for all future reference to the installation.
- All installed Equipment, cables, termination boxes, distribution panels and wall outlets shall be marked and numbered in accordance with Indian and International Standards as applicable.
- The documentation required at the completion of the installation phases shall contain all of the following information, together with any other information the installer has acquired during the installation.
- "As-Installed" documentation, showing total Equipment cabling and connections installed must be submitted.

4.4.5. Project Methodology

- **Turnkey Project Basis**: - The Contractor shall act as single Contractor to organize and manage the entire project – including supply, installation and commissioning of all required items etc. The Contractor shall be in a position to test, demonstrate and certify the basic requirements in accordance with the contract.
- **Technical arrangements**: - The Contractor shall provide details of site and infrastructure requirements (Power, Earthing etc.) in a layout plan after making a site survey. The Contractor shall execute Works/Project and Cabling as per the layout plan which will be approved by Authority post Under Ground utilities Survey and Submission by the Contractor for all routes
- **Warranty and Post-Warranty Support**: - The Contractor shall be responsible for the warranty support and also for the post warranty support as mentioned in this RFP.
- All goods or materials shall be supplied strictly in accordance with the specifications, Drawings, datasheets, other attachments and conditions stated in the RFP / Agreement / SLA. All materials supplied by the Contractor shall be guaranteed to be of

the best quality of their respective kinds and shall be free from faulty design, workmanship and materials.

- **Documents**: - The Contractor shall provide two set of documents and manuals (hard copy, soft copy with each item of the unit supplied.)
- **Certification: -** The Contractor shall test and certify the availability and reliability of FIBRE Cabling/Accessories of the location and give the connectivity matrix between various locations and get it certified by the Authority.
- **Reporting:** - Detailed report is required to be submitted for the work under progress and for functional performance of the connectivity, throughput. The same have to be certified by representative of Authority and or Authority appointed TPA.

Authority and or Authority appointed TPA *reserves the right to redefine the requirement of service within the scope of items specified in the bid as required from time to time.*

4.4.6.   Earthing

For the earthing of all the proposed products/circuits, the installer has to closely follow the related recommendations of the supplier, in accordance with local regulations. The earthling procedure that has to be followed shall be put at the disposal by the supplier under an official document

4.4.7.   Management of the project

4.4.8.   Project Management

- For the complete duration of the project the vendor will appoint a Project Manager, who will work on his behalf. He will be the single point of contact to ensure a smooth co-ordination with the VMC/VSCDL
- The vendor will appoint a Site Manager, who will be permanently present on site on behalf of the vendor. The Site Manager will report to the Project Manager, in order to ensure that the correct information is communicated from the commencement of the project until the hand-over of the network to the client

4.4.9.   Design of the Project

- The vendor will first make a site survey. This will allow him to propose a complete turnkey solution without any additional costs for unforeseen labour. If possible, the installer will try to use the existing infrastructure as much as possible. If cable supports or cable trays are lacking, then the vendor will have to evaluate the necessary quantities and price and take up a detailed description in his offer.
- To ensure the transparency of the installation and the maintenance of the structured cabling, the vendor has to develop a numbering and labelling scheme in agreement with the owner or his representative in order to identify all the components without ambiguity. After the temporary reception of the project, all the cabinets' layouts and the drawings of the building will be completed referring to this numbering scheme.

4.4.10.   Acceptance Testing

The VSCDL shall review and finalize the detailed acceptance test plan proposed by the SI. The VSCDL would also conduct audit of the process, plan and results of the Acceptance Test carried out by the SI for both IT & non-IT components. The VSCDL would issue certification of completion for which VSCDL shall verify availability of all the defined services as per the contract signed between the SI and VSCDL. The SI shall be required to demonstrate all the services, features, functionalities as mentioned in the agreement.

All acceptance testing, project review and monitoring shall be enabled through a Project Management Unit (PMU) nominated by VSCDL prior to certification by VSCDL.

Commissioning shall involve the completion of the site preparation, supply and installation of the required components and making the Project available to the VSCDL for carrying out live Operations and getting the acceptance of the same from the VSCDL. Testing and Commissioning shall be carried out before the commencement of Operations.

4.4.11. Partial Acceptance Testing

Partial Acceptance Test shall involve scrutiny of documents for various IT / Non-IT components to verify if the specifications conform to the technical and functional requirements mentioned in the Tender and subsequent corrigendum. VSCDL   reserves right to conduct physical inspection of the equipment delivered to ensure that they arrive at the sites in good condition and are free from physical damage and incomplete shipments and shall return the products to the supplier at the supplier's expenses if required quality is not maintained. Physical inspection of hardware will also include physical checking and counting of the delivered equipment in presence of the Successful SI. This equipment will only be acceptable as correct when each received item corresponds with the checklist that will be prepared by the Successful SI prior to shipment. Any shortfalls in terms of number of items received may render the delivered equipment incomplete.

4.4.12.   Final Acceptance Testing

The final acceptance shall cover 100% of the Project Infrastructure being laid as part of ITMS Project, after successful testing by the VSCDL or its PMU; a Final Acceptance Test Certificate (FAT) shall be issued by the VSCDL to the SI.

Prerequisite for Carrying out FAT activity:

1. Detailed test plan shall be developed by the SI and approved by VSCDL. This shall be submitted by SI before FAT activity to be carried out.

2. All documentation related to the Project and relevant acceptance test document (including IT Components, Non IT Components etc.) should be completed & submitted before the final acceptance test to the VSCDL

3. The training requirements as mentioned should be completed before the final acceptance test.

4. For both IT & Non-IT equipment's / software manuals / brochures / Data Sheets / CD / DVD / media for all the supplied components.

The FAT shall include the following:

1. All hardware and software items must be installed at respective sites as per the specification.

2. Availability of all the defined services shall be verified.

3. The SI shall be required to demonstrate all the features / facilities / functionalities as mentioned in the RFP.

4. The SI shall arrange the test equipment required for performance verification, and will also provide documented test results.

5. The SI shall be responsible for the security audit of the establishes OFC Network of this project, to be carried out by a certified third party as agreed by VSCDL.

Any delay by the SI in the Final Acceptance Testing shall render him liable to the imposition of appropriate Penalties. However, delays identified beyond the control of SI shall be considered appropriately and as per mutual agreement between VSCDL and SI.

4.4.13.   System Documents and User Manuals

The SI shall provide documentation, which follows the ITIL (Information Technology Infrastructure Library) standards or IEEE/ISO Acceptable Documentation Standards. This documentation should be submitted as the project undergoes various stages of implementation and provide all traceability documentation on changes done on the IT components during the course of the implementation of the solution. Indicative list of documents include:

*   Project Commencement: Project Plan   should provide micro level activities with milestones & deadlines.

*   Delivery of Material: Original Manuals from OEMs.

*   Training: Training Material will be provided which will include the presentations used for trainings and also the required relevant documents for the topics being covered.

*   Process Documentation: The SI shall be responsible for preparing process documentation related to the operation and maintenance of each and every component of the OFC Network being laid as part of this project. The prepared process document shall be formally signed off by VSCDL before completion of final acceptance test.

    a) The SI shall document all the installation and commissioning procedures and provide the same to the VSCDL within one week of the commissioning of the Project

b) The SI shall submit a complete set of Single Line diagram, a complete cabling system layout (as installed), including cable routing, telecommunication closets and telecommunication outlet/ connector designations. The layout shall detail locations of all components and indicate all wiring pathways.

c) Manuals for configuring of switches, routers, etc. shall be provided by the selected SI.

The SI shall be responsible for documenting configuration of all devices and keeping back up of all configuration files, so as to enable quick recovery in case of failure of devices.

4.4.14. Implementation and Roll out Plan

The Implementation Schedule is defined in Phases, through a number of Request Orders against the bid. They are specified in Volume I of the RFP. However, the bidder may also suggest more efficient and speedy implementation and roll out plan, which may or may not be accepted by VSCDL.

4.4.15. Other

- SI to ensure that for operation and maintenance team has the uniform with the identity card, safety shoes, helmet, Neon Jackets etc.

- SI will have to carry his own vehicle for carry out implementation and maintenance work (including transportation of items required for Project) during the Contract Period. All the expenses pertaining to vehicle such as driver's expense, fuel, lubricants, maintenance, etc., will have to be borne by the SI.

4.5. Site Clearance obligations & other relevant permissions

4.5.1. Survey and Commencement of Works

Prior to starting the site clearance, the SI shall carry out survey of field locations as specified in **this volume**, for bus stations/bus stops, etc. The VSCDL shall be fully informed of the results of the survey and the amount and extent of the available facilities (space, electrical power etc.) and site clearance shall then be agreed with the VSCDL.

4.5.2. Existing Bus Station

There is PIS Display in some of the bus stops. Electrical Power is also available at certain bus stops (to power Backlit advertisement Boards put up by the authorised Agency of VMC). The infrastructure of existing bus stops will be retrofitted with the new systems which are proposed and required under the scope of the ITMS Solution. If any component is not usable in the new system (such as PIS Display), they needs to be dismantled in safe manner and replaced with new systems. The dismantled infrastructure shall be delivered at the VSCDL designated location without damage at no extra cost.

4.5.3. Electrical works and power supply

At many bus stops, the electrical power may be available. The SI shall apply for and install a sub-meter in their name from this connection. The SI shall directly interact with electricity boards for provision of mains power supply at all desired field locations of the project. The SI shall be responsible to submit the electricity bill including connection charge, new meter charge, recurring charges etc. to the electricity board directly. SI shall have to submit the challan of bill submission to VSCDL. VSCDL /VMC will reimburse the amount submitted to the SI after verification in next billing cycle.

4.5.4. Lightning-proof measures

The SI shall comply with lightning-protection and anti –interference measures for system structure, equipment type selection, equipment earthing, power, signal cables laying. The SI shall describe the planned lightning-protection and anti –interference measures in the feasibility report. Corresponding lightning arrester shall be erected for the entrance cables of power line, video line, data transmission cables. All crates shall have firm, durable shell. Shell shall have dustproof, antifouling, waterproof function & should capable to bear certain mechanical external force. Signal separation of low and high frequency; equipment's protective field shall be connected with its own public equal power bodies; small size/equipment signal lightning arrester shall be erected before the earthling. The Internal Surge Protection Device for Data Line Protection shall be selected as per zone of protection described in IEC 62305, 61643-11/12/21, 60364-4/5. Data line protection shall be used for security system, server data path and other communication equipment. Data line protection shall be installed as per zone defined in IEC 62305.Type 1 device shall be installed between zone 0B and zone 1. Type 2 devices shall be installed before the equipment in zone 2 and 3.

4.5.5. Earthing System

All electrical components are to be earthen by connecting two earth tapes from the frame of the component ring and will be connected via several earth electrodes. The cable arm will be earthen through the cable glands. The entire applicable IT infrastructure i.e. signal junction or command centre shall have adequate earthing. Further, earthling should be done as per Local state national standard in relevance with IS standard.

1. Earthing should be done for the entire power system and provisioning should be there to earth UPS systems, Power distribution units, AC units, etc. so as to avoid a ground differential. VSCDL shall provide the necessary space required to prepare the earthing pits.

2. All metallic objects on the premises that are likely to be energized by electric currents should be effectively grounded.

3. There should be enough space between data and power cabling and there should not be any cross wiring of the two, in order to avoid any interference, or corruption of data.

4. The earth connections shall be properly made.

5.   A complete copper mesh earthing grid needs to be installed for the server farm area, every rack need to be connected to this earthing grid. A separate earthing pit needs to be in place for this copper mesh.

6.   Provide separate Earthing pits for Servers, & UPS as per the standards.

4.5.6. Junction Box, Poles etc.

1.   The System Integrator shall provide the Junction Boxes, poles etc to mount the field equipment at all field locations, as per the specifications given in the RFP.

2.   The Junction Box needs to be appropriately sized in-order to accommodate the systems envisaged at the field locations.

4.5.7. Cabling Infrastructure

1.   The System Integrator shall provide standardized cabling for all devices and subsystems in the field and at central locations.

2.   SI shall ensure the installation of all necessary cables and connectors between the field sensors /devices assembly, outstation junction box, for pole mounted field sensors /devices the cables shall be routed down the inside of the pole and through underground duct to the outstation cabinet.

3.   All cables shall be clearly labelled with indelible indications that can clearly be identified by maintenance personnel. The proposed cables shall meet the valid directives and standards.

4.   Cabling must be carried out per relevant BIS standards. All cabling shall be documented in a cable plan by the SI.

4.6. Design, Supply, Installation & Commissioning of the Field Equipment

The Scope includes Supply, Installation, commissioning and Customization (as required) of various field equipment, and other IT infrastructure required for successful operation of the ITMS project.

Based on the approved feasibility report, the SI will undertake the system configuration and customization in line with the changed, improved or specific requirements of VSCDL including:

1.   The implementation methodology and approach must be based on the global best practices in-order to meet the defined Service Levels during the operation.

2.   Best efforts have been made to define major functionalities for each sub- system of ITMS Project. However, System Integrator should not limit its offerings to the functionalities proposed in this RFP and is suggested to propose any functionality over and above what has already been given in this tender.

3.   The SI shall design the field level equipment architecture to ensure maximum optimization of network equipment, poles, cantilever, mounting infrastructures, power supply equipment including, electric meters and junction box.

4.   Finally approved/accepted solution for each component of ITMS systems shall be accompanied with "System Configuration" document and the same should be referenced for installation of ITMS systems at Junctions that are identified within the scope of this project.

5.   The system integrator shall be required to submit a detailed installation report post installation of all the equipment at approved locations. The report shall be utilized during the acceptance testing period of the project to verify the actual quantity of the equipment supplied and commissioned under the project.

6.   The SI shall be responsible for obtaining all permits and approvals necessary to install the ITMS systems components as per the approved design.

The sub-components included as part of the project for which field equipment needs to be deployed and integrated are given in the subsequent sections.

4.7. Design, Augmentation, Supply, Installation and Commissioning of Network & Backbone Connectivity for all field devices

1.   Network Connectivity (including Internet Connectivity) is an important components of the project and needs very careful attention in assessment, planning and implementation. It is important not only to ensure that the required connectivity is provisioned within the required timelines but also ensure that it is reliable, secure and supports the required SLA parameters of Latency, Jitter, Packet Loss and Performance.

2.   The SI shall design the overall network for the project, in order to meet the requirements as defined and within the service level agreement.

3.   For more details on technical and functional specifications of City Wide OFC Network that is being created as part of CCC Project, the SI should refer to CCC RFP which was floated in 2017.

4.   Eventually, all bus stops/bus terminals shall be connected to the city wide OFC connectivity that is being rolled out as part of CCC Project. Till such time, bus stops shall be connected via GPRS Network (SIM card based) using 4G Mobile Service Provider.

5.   The SI should provide a detailed network architecture of the overall system, incorporating findings of site survey exercise. The network so envisaged should be able to provide real time data streams to the Data Centre. All the components of the technical network architecture should be of industry best standard and assist SI in ensuring that all the connectivity SLAs are adhered to during the operational phase.

6. The SI is also responsible for providing network services for integration for below connectivity requirements:

   a. Internet Connectivity at Data Centre (at CCC)

   b. Internet Connectivity at DR Site

7. The network connectivity between Data Centre and Water SCADA Field Devices is being be provided by the supplier of the Water SCADA Project.

8. Surveillance system with City Backbone Network.

9. The SI shall prepare the overall network connectivity plan for this project. The plan shall comprise of deployment of network equipment at the junctions to be connected over network, any clearances required from other government departments for setting up of the entire network. The network architecture proposed should be scalable and in adherence to network security standards. It is necessary that all OFC cabling and proposed last mile connectivity should be underground. Last Mile to be defined as "the access link from the service provider's PoP – (as per Telco Standards) to the field device".

10. SIs are also required to do the estimation of bandwidth requirements considering following benchmark parameters (these considerations are for network sizing perspective and not for hardware/storage sizing):

#	ITMS Project component	Consideration
1	Surveillance (CCTV) Cameras	• Minimum 2 Mbps per Fixed Camera • Minimum 2.5 Mbps per PTZ Camera
2	PIS Display at bus stops/bus station	• Minimum 512 KB for each location
3	PIS Display at bus terminal	• Minimum 1 MB for each location
3	LED TV Display	• Minimum 2 MB for each location
4	Bus Control Room	• Minimum 20 Mbps
5	DC (at CCC building)	• Minimum 50 Mbps
6	DR (on Cloud Service Provider site)	• Minimum 50 Mbps

11. The actual bandwidth requirement to cater the above mentioned bandwidth parameters and to meet SLAs would be calculated by the SI and the same shall be clearly proposed in the technical proposal with detail calculations. VSCDL also requires the SI to meet the parameters of video feed quality, security & performance and thus SIs should factor the same while designing the solution. VSCDL reserves its right to ask the Systems Integrator to increase the bandwidth if the provided bandwidth is not sufficient to give the functionality of the system mentioned in the RFP and adhere to the SLAs.

12.   In case the Telecommunication guidelines of Government of India require the purchaser to place Purchase Order to the Service Provider for bandwidth, VSCDL shall do so. However, Systems Integrator shall sign a contract with Telecom Service Provider(s) and ensure the performance. VSCDL shall make payments to the Systems Integrator.

13.   The system integrator shall be required to submit a detailed installation report post installation of all the equipment at approved locations. The report shall be utilized during the acceptance testing period of the project to verify the actual quantity of the equipment supplied and commissioned under the project.

4.8. Design, Supply, Installation and Commissioning of IT Infrastructure at Bus Control Centre and Smart DC

1.   It is proposed that the SI shall provide the IT hardware infrastructure at the Smart DC (also called DC) for successful operations of the systems. The DC where this equipment shall be hosted is on second floor of the CCC. SI has to ensure that redundancy is provided for all the key components to ensure that there is **no single point of failure** in ITMS Central IT Infrastructure, that would affect the performance of the overall system. It will be SI's responsibility to:
   a.   Supply, Install and Commission of IT Infrastructure including power and LAN cabling within existing DC.
   b.   Supply Viewing LED Video Wall, Desktops, network switch, and required accessories at Central Bus Control Room.

2.   The following systems shall also be available for monitoring at the all viewing centres:
   a.   Video feeds from field CCTV cameras (existing cameras as well as new cameras)
   b.   Live report on the status of Junctions and traffic signals
   c.   Live feeds and two-way operations of all other field devices being provisioned under this project

3.   Server/Networking racks as per specifications should be provided and commissioned.

4.   The SI shall provide system integration services to customize and integrate the applications procured through the project. All the applications proposed by the SI should have open APIs and should be able to integrate and share the data with other third party systems already available or coming up in the near future

5.   As part of preparing the final bill of material for the central facilities, the successful SI will be required to list all passive & active components required.

6.   The bill of material proposed by the successful SI will be approved by VSCDL for its supply and installation. Indicative IT Infrastructure to be commissioned as part of the project at Data Centre are as under:
   a.   Servers (inclusive of OS)
   b.   Application & System Software
   c.   RDBMS (if required)
   d.   EMS software
   e.   Storage Solution including storage management
   f.   Switches
   g.   KVM Switch
   h.   Internal Firewall
   i.   Rack in DC
   j.   All required Passive / Structured cabling Components
   k.   Electrical Cabling for all IT and supplied components
   l.   Any other Server required to the cater to the scope of work mentioned in RFP

7. The above are only indicative requirements of IT & Non-IT Infrastructure requirements at Smart DC. The exact quantity and requirement shall be proposed as part of the technical proposal of the SI.

8. The SI shall provide solution for DR hosting (at Third party cloud CSP site) & their operational plan for this project. Disaster recovery site component is OPTIONAL purchase requirement in the tender. However, it is mandatory to be quoted. VSCDL will decide about the DR requirement at any time during the project period within two years from go live. Hence the prices for DR related items and components must be valid for first two years of O&M period.

9. If VSCDL choses to go for DR site, then the DR plan shall comprise of deployment of all the DR equipment required under the project. The implementation roll-out plan for hosting of the DR shall be approved by VSCDL. The detailed plan shall be also comprise of the scalability, expandability and security of the DR infrastructure under this project.
    a. Passive Networking Components (Structured cabling)
    b. Electrical Cabling for IT Equipment

4.9. DR Site on third party (Cloud) site

1. The DR Site component is mandatory to be quoted, by VSCDL may or may not order it at the start of the project. It may go for DR site subsequently, within 2 years from GO-LIVE of this project. Hence the prices for DR components should be valid for 2 years.

2. DR site for this project needs to be hosted at ESDS (Current DR site of CCC Project)

3. The following services shall be provisioned at the DR Site
    a. Virtualised environment (VM Machines)
    b. Storage
    c. Networking
    d. Security
    e. Internet Bandwidth
    f. Hosting Space
    g. Power & Cooling
    h. Secured Data Centre Environment

4. The design rule of *No-Single-Point-of-Failure* shall not apply to DR components.

5. The SI shall borne the charges for hosting data centre services at the DR Site.

6. The SI need to do the sizing of VM Environment and other Infrastructure resources required at facilities based on its capacity planning and sizing for the entire duration of the contract.

7. DR should be 100% capacity in terms of compute power of the ITMS compute power. RPO and RTO shall be designed and configured as per following requirements:

Sr No	Project Infrastructure	Compute	RPO	RTO
1	ITMS Project Central IT Infrastructure being commissioned through this project		4 Hours	1 hour

8. All the requisite consumables like tapes, hard disks, etc. for backup shall be provided by the SI as per the project requirements. All the tapes, hard disks, etc. once deployed for the project will become property of VSCDL including corrupted/damaged devices.

4.10. Preparation and implementation of the Information security policy, including policies on backup

The SI shall adopt the information security policy formed as part of CCC Project, for ITMS project. The SI can suggest enhancements in the policy to cater to business and IT needs of this project. The same would be reviewed and then finalized by VSCDL & its authorized committees. The Security policy needs to be submitted by the System Integrator within 1st quarter of the successful Final Acceptance Tests.

4.11. Responsibility Matrix

#	Key Activities	Successful Bidder	VMC	VSCDL	Electricity Providers	Other Utilities	Other Departments (Including Police)	Prj Mgmt Consultant	Existing ICT Vendors at VMC
1	Project Kick Off	R/A	C	C	I	I	I	C	I
2	Deployment of manpower	R/A	C	C	I	I	I	C	I
3	Assess the requirement of IT Infrastructure and Non IT Infrastructure	R/A	C	C	C	C	C	C	C
4	Assessment of Business processes	R/A	C	C	I	I	C	C	I
5	Assessment of requirement of Software requirements	R/A	C	C	I	I	C	C	I
6	Assess the Integration requirement	R/A	C	C	C	I	C	C	C
7	Assess the connectivity requirement all locations (including Building)	R/A	C	C	I	I	C	C	I
8	Assessment the Network laying requirement	R/A	C	C	I	I	C	C	I
9	Assessment of training requirement	R/A	C	C	I	I	C	C	I

10	Formulation of Solution Architecture	R/A	C	C	I	I	C	C	I
11	Creation of Detail Drawing	R/A	C	C	I	I	C	C	I
12	Detailed Design of Smart City Solutions	R/A	C	C	I	I	C	C	I
13	Development of test cases (Unit, System Integration and User Acceptance)	R/A	C	C	I	I	C	C	I
14	Preparation of final bill of quantity and material	R/A	C	C	C	I	C	C	I
15	SoP preparation	R/A	C	C	C	C	C	C	I
16	Helpdesk setup	R/A	C	C	I	I	I	C	I
17	Physical Infrastructure setup	R/A	C	C	I	I	I	C	I
18	Procurement of Equipment , Edge devices, Software Licenses etc.	R/A	C	C	I	I	I	C	I
19	IT and Non IT Infrastructure Installation	R/A	C	C	I	I	I	C	I
20	Development, Testing and Production environment setup	R/A	C	C	I	I	I	C	I
21	Software Application customization (if any)	R/A	C	C	I	I	I	C	I
22	Development of Bespoke Solution (if any)	R/A	C	C	I	I	I	C	I
23	Data Migration	R/A	C	C	I	I	I	C	I
24	Integration with Third party	R/A	C	C	I	I	I	C	I

	services/application (if any)								
25	Unit and User Acceptance Testing	R/A	C	C	I	I	I	C	I
26	Implementation of Solutions	R/A	C	C	I	I	I	C	I
27	Preparation of User Manuals , training curriculum and training materials	R/A	C	C	I	I	I	C	I
28	Role based training(s) on the Command Center Software	R/A	C	C	I	I	I	C	I
29	SoP implementation	R/A	C	C	C	C	C	C	I
30	Integration of solutions with Command and Control Centre	R/A	C	C	C	C	C	C	I
31	Integration with Vadodara Eye, GIS, ERP, Water SCADA Projects	R/A	C	C	C	C	C	C	I
32	Go Live	R/A	C	C	I	I	I	C	I
33	Operation and Maintenance of IT, Non IT infrastructure and Applications	R/A	C	C	I	I	I	C	I
34	SLA and Performance Monitoring	R/A	C	C	I	I	I	C	I
35	Logging, tracking and resolution of issues.	R/A	C	C	I	I	I	C	I
36	Application enhancement	R/A	C	C	I	I	I	C	I
37	Patch & Version Updates	R/A	C	C	I	I	I	C	I
38	Helpdesk services	R/A	C	C	I	I	I	C	I

Note: All decisions will be taken by VSCDL which need to be abided by all the stakeholders in the above matrix.

4.12. Project Deliverables

#	Key Activities	Deliverables
1	Project Kick Off	1. Project Plan
2	Deployment of manpower	2. Risk Management and Mitigation Plan
3	Assess the requirement of IT Infrastructure and Non IT Infrastructure	1. Functional Requirement Specification document
4	Assessment of Business processes	2. System Requirement Specification document
5	Assessment of requirement of Software requirements	3. Requirements Traceability Matrix
6	Assess the Integration requirement	4. Site Survey Report 5. Engineering Drawings for Command Centre
7	Assess the connectivity requirement all locations (including Building)	6. Layout drawings for Smart Components to deployed on street
8	Assessment of network laying requirement	
9	Assessment of training requirement	
10	Formulation of Solution Architecture	1. Final Bill of Quantity 2. HLD documents
11	Creation of Detail Drawing	3. LLD documents
12	Detailed Design of Smart City Solutions	4. Application architecture documents. 5. Technical Architecture documents.
13	Development of test cases (Unit, System Integration and User Acceptance)	6. Network Architecture documents. 7. ER diagrams and other data modelling documents.
14	Preparation of final bill of quantity and material	8. Logical and physical database design. 9. Data dictionary and data definitions.
15	SoP preparation for command centre based on extensive consultation with all stakeholders	10. GUI design (screen design, navigation, etc.). 11. Test Plans 12. SoPs for the command centre 13. Change management Plan
16	Helpdesk setup	1. IT and Non IT'S Infrastructure Installation Report
17	Physical Infrastructure setup	
18	Procurement of Equipment , edge devices, COTS software (if any), Licenses	2. Completion of UAT and closure of observations report

19	IT and Non IT Infrastructure Installation	3. Training Completion report
20	Development, Testing and Production environment setup	4. Application deployment and configuration report
21	Software Application customization (if any)	5. Software License documents
22	Development of Bespoke Solution (if any)	6. Hardware warranty documents
23	Data Migration	
24	Integration with Third party services/application (if any)	
25	Unit and User Acceptance Testing	
26	Implementation of Solutions	
27	Preparation of User Manuals , training curriculum and training materials	
28	Role based training(s) on the Smart City Solutions	
29	SoP implementation	1. Integration Testing Report
30	Integration with GIS	
31	Integration of solutions with Command and Control Centre	
32	Go Live	1. Go-Live Report
33	Operation and Maintenance of IT, Non IT infrastructure and Applications	1. Detailed plan for monitoring of SLAs and performance of the overall system
34	SLA and Performance Monitoring	2. Fortnightly Progress Report
35	Logging, tracking and resolution of issues.	3. Monthly SLA Monitoring Report and Exception Report
36	Application enhancement	4. Quarterly security Report
37	Patch & Version Updates	5. Issues logging and resolution report
38	Helpdesk services	6. Operations manual for all components

4.13. Project Timelines

Please refer Volume I for project timelines , request order schedule and deliverables milestones.

5. Annexure I- List of Locations

This annexure gives the locations which are to be covered as part of Scope of Work for this project:

5.1. City Buses

City Buses		
#	Location	Qty
1	City buses operating in the city by current Bus Operator (Currently M/s Vinayak)	150

5.2. Bus Control Room

Bus Control Centre	
#	Location
1	Current City Bus Station Office (Temporary). Opp Railway Station, Vadodara This will move into Jan Mahal, when Jan Mahal is ready.

5.3. CCC (For Integration)

Smart DC		
#	Location	Qty
1	CCC Building, Second Floor, Badamadi Baug, Vadodara	1

5.4. DC for ITMS

Smart DC		
#	Location	Qty
1	DC Facility at CCC, Second Floor, Badamadi Baug, Vadodara	1

5.5. DR for ITMS

DR		
#	Location	Qty
1	DR Site of CCC Project (ESDS Facility)	1

5.6. Bus Stops

Note: Below is initial list of Bus Stops. Additional 21 bus stops (up to 125) will be identified during System Study phase,

અ	બસ સ્ટોપનુ નામ	Bus Stop Name	કયા કયા રૂટ	Routes
1	કમાટીબાગ સયાજીગંજ	Kamatibaug Sayajiganj	ઓલ રુટસ	ઓલ રુટસ
2	લહેરીપુરા	Laheripura	૧,૨,૩,૪,૫,૭,૯,૮,૨૦,૧ ૧ડી,૧૦ડી,૧૩,૧૬,૧૭એ, ૧૭,૧૪	1, 2, 3, 4, 5, 7, 9, 8, 20, 11D, 10D, 13, 16, 17A, 17, 14

4	વી.આપ.પી.રોડ બ્રાઇટ સ્કુલ	V.I.P. Road Bright School	૩ ડી,૪ડી,૯ડી	3D, 4D, 9D
7	કારેલીબાગ પાણી ટાંકી	Karelibaug water tank	૫,૬	5, 6
8	મુકતાનંદ	Muktanand	૫,૬	5, 6
9	ફતેગંજ પોસ્ટ ઓફિસ	Fatehganj Post Office	૧૮,૧૮એ,૧૯એ	18, 18A, 19A
10	ફતેગંજ ઇ.એમ.ઇ. સ્કુલ	Fatehganj EME School	૩ ડી,૪ડી,૯ડી	3D, 4D, 9D
11	ફતેગંજ ઇ.એમ.ઇ.સર્કલ	Fatehganj EME Circle	૩ ડી,૪ડી,૯ડી	3D, 4D, 9D
12	કલ્યાણ હોટલ ફતેગંજ	Kalyan Hotel Fatehganj	૩ ડી,૪ડી,૯ડી	3D, 4D, 9D
14	આર.સી.દત્ત રોડ , સર્કીટ હાઉસ	RC Dutt Road, Circuit House	૨૨એ,૨૩,૨૩એ,૨૪,૨૪એ,૨૫,,૨૬એ,૨૭,૨૭એ, ૨૭બી,૨૮,૨૯,૨૯એ,૩૦, ૩૧	22A, 23, 23A, 24, 24A, 25, 26A, 27, 27A, 27B, 28, 29, 29A, 30, 31
15	રેસકોર્સ સર્કલ	Race Course Circle	૨૨એ,૨૩એ,૨૪,૨૪એ,૨૫,,૨૬એ,૨૭,૨૭એ, ૨૭બી,૨૮,૨૯,૨૯એ,૩૦, ૩૧	22A, 23A, 24, 24A, 25, 26A, 27, 27A, 27B, 28, 29, 29A, 30, 31
16	રેસકોર્ષ એસ.ટી.ઓફિસ	Race Course ST Office	૨૨,૨૪,૨૫,૨૪એ,૨૭,૨૭એ,૨૭બી,૨૮,૨૯,૩૦,૩૧	22, 24, 25, 24A, 27, 27A, 27B, 28, 29, 30, 31
17	ગેડા સર્કલ	Genda Circle	૨૫,૨૫એ,૩૧	25, 25A, 31
18	ઓ.પી.રોડ વિધ્યુત નગર	OP Road, Vidyut Nagar	૨૩એ,૨૬,૨૬એ,૨૨	23A, 26, 26A, 22
20	કોઠી કલેકટર ઓફિસ	Kothi Collector Office	૧,૨,૩,૪,૫,૭,૯,૯એ,૨૦, ૧૧,૧૦ડી,૧૧ડી,૧૩,૧૪ એ,૧૫એ,૧૫ડી,૧૬,૧૭, ૧૭એ,૨૦	1, 2, 3, 4, 5, 7, 9, 9A, 20, 11, 10D, 11D, 13, 14A, 15A, 15D, 16, 17, 17A, 20
22	બરોડા ડેરી સર્કલ	Baroda Dairy Circle	૧૧,૧૧એ,૧૧બી,૧૧ડી,૧૪એ,૧૭,૧૭એ	11, 11A, 11B, 11D, 14A, 17, 17A

24	ઓ.પી.રોડ એબીએસ ટાવર	OP Road ABS Tower	૨૨,૨૬,૨૬એ	22, 26, 26A
26	આર.સી.દત્ત રોડ , સર્કીટ હાઉસ	RC Dutt Road, Circuit House	૨૧,૨૨,૨૨એ,૨૩,૨૩એ, ૨૩બી,૨૪,૨૪એ,૨૫,૨૬, ૨૬એ,૨૭,૨૭એ,૨૭ડી,૨ ૮,૨૯,૨૯એ 30,૩૧	21, 22, 22A, 23, 23A, 23B, 24, 24A, 25, 26, 26A, 27, 27A, 27D, 28, 29, 29A 30, 31
27	રેસકોર્સ સર્કલ	Race Course Circle	૨૧,૨૨,૨૨એ,૨૩,૨૩એ, ૨૩બી,૨૪,૨૪એ,૨૫,૨૬, ૨૬એ,૨૭,૨૭એ,૨૭ડી,૨ ૮,૨૯,૨૯એ 30,૩૧	21, 22, 22A, 23, 23A, 23B, 24, 24A, 25, 26, 26A, 27, 27A, 27D, 28, 29, 29A 30, 31
28	હરણી રોડ એરપોર્ટ સર્કલ	Harni Road Airport Circle	૩ડી,૪ડી,૯ડી,૧૫,૧૫એ,૧ ૫ડી	3D, 4D, 9D, 15, 15A, 15D
29	વી.આઇ.પી.રોડ માણેકપાર્ક	V.I.P. Road Manek Park	૩ડી,૪ડી,૯ડી,૧૫,૧૫એ,૧ ૫ડી	3D, 4D, 9D, 15, 15A, 15D
30	વી.આઇ.પી.રોડ એલ.એન્ડ ટી સર્કલ	V.I.P. Road L & T Circle	૩ડી,૪ડી,૯ડી	3D, 4D, 9D
32	સારાભાઇ રોડ ગેડા સર્કલ	Sarabhai Road Genda Circle	૨૫,૨૫એ,૩૧	25, 25A, 31
33	યોગ નિકેતન, વડ સર્કલ	Yoga Niketan, High Circle	૧૫એ	15A
34	કિર્તીસ્થંભ	Kirti Stambh	૧૦ડી,૧૧ડી,૮,૧૩,	10D, 11D, 8, 13,
36	બદામડીબાગ	Badamdi Baug	૧૦,૧૧,૧૧એ,૧૧બી,૧૨, ૧૪,	10, 11, 11A, 11B, 12, 14,
37	ખંડેરાવ માર્કેટ	Khanderao Market	૮,૧૦ડી,૧૧ડી,૧૩,	8, 10D, 11D, 13,
39	પ્રેમદાસ જલારામ હોસ્પિટલ	Premdas Jalaram Hospital	૫,૬	5, 6
41	સંગમ ચાર રસ્તા	Sangam Char Roads	૫,૬,૧૫,૧૫એ,૧૫ડી,	5, 6, 15, 15A, 15D,
42	પાણીગેટ પોલીસ સ્ટેશન	Panigate Police Station	૩,૪,૫,૮,૯,૯એ.,	3, 4, 5, 8, 9, 9A,
43	કુબેરેશ્વર મહાદેવ	Kubereshwar Mahadev	૧૧એ,૧૨,૧૩,૧૪,	11A, 12, 13, 14,
44	ગાંધીપાર્ક	Gandhi park		
45	શ્રેયસ સ્કુલ	Shreyas School	૧૨,૧૩,૧૪	12, 13, 14

46	ટી.બી.હોસ્પીટલ	TB Hospital	૨૭,૨૭એ,૨૭બી	27, 27A, 27B
47	પ્રતાપનગર	Pratapnagar	૨૦,૨૦એ	20, 20A
49	રાણેશ્વર મંદિર	Raneshwar Temple	૨૩,૨૩એ	23, 23A
50	એસ.એસ.જી.હોસ્પી.ગેટ	SSG Hospital Gate	૧,૨,૩,૪,૫,૭બી,૯,૯એ,૧૦ડી,૧૧ડી,૧૩,૧૪એ,૧૫,૧૫એ,૧૬,૧૭,૧૭એ,૨૦,૨૦એ	1, 2, 3, 4, 5, 7B, 9, 9A, 10D, 11D, 13, 14A, 15, 15A, 16, 17, 17A, 20, 20A
52	એસ.એસ.જી.હોસ્પીટલ, પંચમુખી હનુમાન મંદિર	SSG Hospital, Panchmukhi Hanuman Temple	૨૬એ, ૨૭,૨૭એ,૨૭બી,૨૮,૨૯,૨૯એ,૩૦,૩૧	26A, 27, 27A, 27B, 28, 29, 29A, 30, 31
53	બ્રાઇટ સ્કુલ સી.બીએસસી, એરપોર્ટ રોડ,	Bright School CBSE, Airport Road	૩ડી,૪ડી,૯ડી	3D, 4D, 9D
54	શરદનગર	Sharad Nagar	૧૧,૧૧બી,૧૧ડી	11, 11B, 11D
55	આઇ.ટી.આઇ., તરસાલી	ITI, Tarsali	૧૧,૧૧બી,૧૧ડી	11, 11B, 11D
56	રોઝરી સર્કલ	Rosary Circle	૩ડી,૪ડી,૯ડી	3D, 4D, 9D
57	ચંદ્રગૃપ્ત કોમ્પ્લેક્ષ, હરણી રોડ	Chandragupta Complex, Harni Road	૧૫એ,૧૫ડી	15A, 15D
59	સમા તળાવ	Sama Talav	૧૮,૧૮એ	18, 18A
60	છાણી ઓકટ્રોય નાકા	Chhani Jakatnaka	૧૯,૧૯એ,૧૯બી,૧૯સી	19, 19A, 19B, 19C
61	ડીલક્ષ ચાર રસ્તા સ્ટેશન તરફ	Delux char rasta, station road	૧૮,૧૮એ,૧૯એ	18, 18A, 19A
62	સ્વાતિ ટર્મીનલ	Swati Terminal	૧૮	18
63	દીવાળીપુરા જંકશન	Diwalipura junction	૨૩,	23,
64	વૃંદાવન ક્રોસ રોડ	Vrundavan cross road	૩,૯ડી	3, 9D
65	પ્રતાપનગર બ્રીજ	Pratap Nagar Bridge	૧૪એ,૧૭,૧૭એ,૨૦,	14A, 17, 17A, 20,
66	કોઠી ખાદી ભવન	Khadi Gram Udyog Bhavan, Kothi	૧,૨,૩,૪,૫,૭બી,૯,૯એ,૧૧ડી,૧૩,૧૪,૨૦,૧૫એ,૧૫ડી,૧૬,૧૭,૧૭એ	1, 2, 3, 4, 5, 7B, 9, 9A, 11D, 13, 14, 20, 15A, 15D, 16, 17, 17A

68	આકાશવાણી મકરપુરા	Akashwani, Makarpura	૧૨,૧૩,૧૪,૧૪એ	12, 13, 14, 14A
69	નોવીનો મકરપુરા	Novino, Makarpura	૧૨,૧૩,૧૪,૧૪એ	12, 13, 14, 14A
70	કલ્યાણ સોસા.અકોટા રોડ	Kalyan Society, Akota Road	૨૨એ	22A
71	મકરપુરા, ને.હા.૮	Makarpura, NH.8	૧૨,૧૩,૧૪,૧૪એ,	12, 13, 14, 14A,
72	ટાવર રાવપુરા	Tower Raopura	૧,૨,૩,૪,૫,૭બી,૯,૯એ,૧૦ડી,૧૧ડી,૧૩,૧૪એ,૧૫એ,૧૫ડી,૧૬,૧૭,૧૭એ,૨૦,૨૦એ	1, 2, 3, 4, 5, 7B, 9, 9A, 10D, 11D, 13, 14A, 15A, 15D, 16, 17, 17A, 20, 20A
73	સીધ્ધીવિનાયક મંદિર દાંડીયા બજાર	Siddhivinayak Mandir Dandia Bazar	૭એ,	7A,
74	લાલકોર્ટ	Lal Court	૧,૨,૩,૪,૫,૭બી,૯,૯એ,૧૦ડી,૧૧ડી,૧૩,૧૪એ,૧૫એ,૧૫ડી,૧૬,૧૭,૧૭એ,૨૦,૨૦એ	1, 2, 3, 4, 5, 7B, 9, 9A, 10D, 11D, 13, 14A, 15A, 15D, 16, 17, 17A, 20, 20A
75	પેટ્રોફીલ્સ નગર	Petrofolis Nagar	૨૫,૨૫એ	25, 25A
76	પંચવટી ગોરવા	Panchavati Gorwa	૨૫,૨૫એ, ૩૧	25, 25A, 31
77	પવિત્ર ટાઉનશીપ	Pavitra Township	૧૪,૧૪એ	14, 14A
78	હરીનગર, ગોત્રી	Harinagar, Gotri Road	૨૭,૨૭એ,૨૭બી,	27, 27A, 27B,
79	આર.સી.દત્ત રોડ, બી.ઓ.બી.	RC Dutt Road, Bank Of Baroda	૨૧,૨૨,૨૩એ,૨૪,૨૪એ,૨૫,૨૬એ,૨૭,૨૭એ,૨૭બી,૨૮,૨૯,૨૯એ,૩૦,૩૧	21, 22, 23A, 24, 24A, 25, 26A, 27, 27A, 27B, 28, 29, 29A, 30, 31
80	ગોરવા નાકા	Gurwa Naka	૨૫,૨૫એ,૩૧	25, 25A, 31
81	કમાટીબાગ	Kamati Baug	૩ડી,૪ડી ,૯ડી,૧૮,૧૮એ,૧૯એ,	3D, 4D , 9D, 18, 18A, 19A,
82	લેપ્રસી હોસ્પી . આજવા રોડ,	Leprosy Hospital, Ajwa Road	૪,૪ડી	4, 4D
83	ઝવેરનગર	Jewar Nagar	૩, ૩ડી	3, 3D
85	અક્ષરચોક	Akshar Chowk	૨૨,૨૨એ	22, 22A

86	મહાવીર ચાર રસ્તા	Mahavir Char Rasta	પ	5
87	મહાવીર ચાર રસ્તા	Mahavir Char Rasta	૬	6
88	જ્યોતિ સર્કલ	Jyoti Circle	૨૫એ	25A
90	વડીવાડી ફાયર સ્ટેશન	Vadivadi Fire Station	૨૫,૩૧	25, 31
92	માંડવી દરવાજા	Mandvi Darvaja	૧,૨,૩,૫,૭,૭એ,૭બી,૮,૯,૯એ,૧૪એ,૧૫એ,૧૫ડી,૧૬,૧૭,૧૭એ,૨૦	1, 2, 3, 5, 7, 7A, 7B, 8, 9, 9A, 14A, 15A, 15D, 16, 17, 17A, 20
93	માંડવી દરવાજા	Mandvi Darvaja	૧,૨,૩,૬,૭,૭એ,૭બી,૮,૯,૯એ,૧૪એ,૧૫એ,૧૫ડી,૧૬,૧૭,૧૭એ,૨૦	1, 2, 3, 6, 7, 7A, 7B, 8, 9, 9A, 14A, 15A, 15D, 16, 17, 17A, 20
94	તુલસીધામ ચાર રસ્તા	Tulsidham Char Rasta	૧૨,૧૩,૧૪,૧૧એ	12, 13, 14, 11A
96	નટુભાઇ સર્કલ	Natubhai Circle	૨૭,૨૭એ,૨૭બી	27, 27A, 27B
98	એલેમ્બીક ગ્રાઉન્ડ	Alembic Ground	૨૫,૨૫એ,૩૧	25, 25A, 31
100	વિદ્યુતનગર	Vidyut Nagar	૨૨,૨૬,૨૬એ	22, 26, 26A
101	એરપોર્ટ સર્કલ	Airport Circle	૩ડી,૪ડી,૯ડી,૧૫,૧૫એ,૧૫ડી	3D, 4D, 9D, 15, 15A, 15D
102	અમીતનગર મહાકાળી મંદિર	Amitnagar Mahakali Mandir	૩ડી,૪ડી,૯ડી	3D, 4D, 9D
103	શ્રેયસ સ્કુલ	Shreyas School	૧૧,૧૧એ,	11, 11A,
104	ટ્યૂબ કંપની	Tube Company	૨૨,૨૬એ	22, 26A

6.   *Annexure II- Functional requirements*

This section describes functional specification and end user requirements for different components within scope of this RFP. The functional specifications shall be the base requirement understanding given to bidders, however VSCDL expects the service provider to on-board best practices and enable a highly integrated and automated operations environment.

The functional specifications section provides specification for major components for ITMS:

- Automated Vehicle Location System
- Passenger Information System
- Vehicle Scheduling & Dispatch System
- Depot Management System
- Incident Management
- Business Intelligence
- Enterprise Management System

6.1. Integrated Operations Management Platform

1) VSCDL through this project implementation intends to develop a city wide transit operations management platform which will be utilized by diverse set of users like transport, emergency service and engineering services to enhance service capabilities in terms of asset location identification, service management and emergency management. The common system shall deliver workflow and rules management capability so that individual departments can manage their operations, compliant to their functional requirements. This involves leveraging on the information provided by various departments and providing a comprehensive response mechanism for the day-to-day challenges across the city. This solution shall be a fully integrated, web-based solution that provides seamless incident – response management, collaboration and geo-spatial display.

2) The service provider shall be required to implement ITS infrastructure in a way that shall have provisioning capability to on-board functionality based on the user requirements in a progressive manner by a template based approach. The integration shall be facilitated by publishing open interface protocols so that diverse set of hardware technologies can be integrated into the system. The service provider shall also be required to publish API's for the use of integrating informal / private transit systems like taxis, autos etc. for service and fare integration purposes.

3) The system shall provide capability to individual users based on workflow, rules and authorization to carry out business functions designated for the user types.

4) The central operation management platform shall create unique operational capability for individual stakeholders to meet their operational requirement and hence augment their operational capability to better respond to the service requests.

6.2. Automated Vehicle Location System

The Automated Vehicle Locator System (AVLS) shall primarily use GPS based location tracking devices mounted on the vehicle as primary source of data for tracking purposes. The location and associated data acquired from the vehicle units shall act as input source for

tracking and operations process management required by user executing their specific functions. The AVLS system shall enable VSCDL operations team to monitor vehicle movement in real-time and synthesize the AVL field data to deliver the same on the public information system devices installed on Bus stations, Terminals, Buses, VSCDL customer portal, mobile information delivery system in case of public transit application. The AVL data from vehicles other than the transit vehicles shall be delivered to individual process owners within VSCDL for further use and processing based on the requirements identified for individual departments.

The AVLS shall be source for enabling public information system service which acts as a source of information to be made available across various types of end point devices like mobile, fixed displays, web etc. in form of text &voice.

The AVLS for City Buses shall essentially comprise of following components:

- Bus Mounted GPS based controller with two way communication interface.
- On-board Passenger Information System
- Off-board Passenger Information System
- GIS Based Fleet Monitoring and Control System

The AVLS for emergency vehicles like ambulance, security and fire shall comprise of(Future Requirement):

Vehicle Mounted GPS based driver console

GIS Based Fleet Monitoring and Control System

The central AVLS system should offer functionality to manage diversity of end use requirement as may be required by individual departments for operational use purposes. This should be facilitated by use of common GIS platform and allowing customization of views with respect to asset identification, tracking and process management.

The AVLS system will essentially offer workflows, rules and SOP's being mapped based on the process type and user authorization to carry out functional processes as may be required for specific operations. It may be noted that each department may have specific routing and tracking requirements which may be very specific in case of emergency vehicles and other type of services. The system should offer dispatch and scheduling capability to manage vehicles with reference to end use requirement.

The service provider shall be required to provide facility to ensure that end use requirement of different departments and vehicles is met and functional and technical processes are provided to meet the operational requirements.

Emergency service vehicles will need to be provided with dispatch and schedule services along with navigational maps to ensure such vehicles reach point of interest in stipulated period of time, similarly other vehicles should be tracked and relevant SOP's to be built for operations management purposes to ensure end use requirement is met.

The system will also be compliant to GTFS / inter-operable data formats to enable external technology ecosystem provider to build complimentary applications to further boost consumer oriented delivery and service environment.

6.3. Passenger Information System
The passenger information system is a very important exponent of intelligent and integrated ITS system and renders a very important consumer facing service. Accurate and timely transit

information delivery enables consumer trust on public transport service and also aids modal shift in long term, as the reliability and availability becomes evident to the users.

The passenger information system is an integrated service which utilizes tracking data from vehicles which is centrally processed for the purpose of arrival and departure time estimation. Central PIS system shall deliver ETA/ETD information on schedule or request basis depending on the type of end point application or device. The central PIS delivers ETA / ETD to fixed display devices installed on bus stations at a set frequency or on bus movement basis. The PIS information on buses is driven by local geo location aided controller which has capability to deliver information in visual and audio formats, this controller can also be interrupted by BCC to display or play specific messages dynamically. The transit information to commuters will also be delivered via other electronic means like website, mobile app, SMS or IVRS. This multi-channel commuter interface enables quick access to transport system and ensure citizens see the city transit system as safe and reliable alternative for their travel purposes.

The system shall consist of following units to offer users access to real-time information regarding operations of bus transit service and extend ease of information access related to travel needs:

- Display Screen on Bus Stations

- Display Screen on Bus

- Voice announcement system on Bus

- VSCDL Transit web portal for Bus Schedule &ETA, SMS, Mobile App and IVRS.

The PIS display systems at bus stations shall display real-time information of the route and estimated time of arrival using communication system installed within the station (Wired / Wireless) with the central AVLS / PIS Application. The system will have capabilities to clearly indicate the direction and route no of the bus on the display to assist passengers.

The bus display units on the front wind shield and the back window shall display bus route information and the internal display shall display real-time information of the stations bus in terms of route information, next stop etc. via text and voice interface. The voice information system shall also derive information of the next station based on the location information derived from the GPS unit and shall have capabilities of playing pre-recorded voice information in the bus. This system shall also be used to deliver consumer centric outreach information as may be required by the transit agency from time-to-time.

The VSCDL web portal shall enable passengers to get information about the bus schedules on various routes operated by VSCDL and shall also have facility to deliver ETA based on the real-time data from central PIS system. PIS shall also be made available to users via mobile apps, SMS and IVRS.

A call centre shall be maintained by the service provider on behalf of VSCDL for passengers to call into for information on bus routes and schedules as well as for any issues related to transit service. Call centre shall be able to log in complaints through call centre executive or IVR.

6.4. Vehicle Scheduling and Dispatch System

Scheduling/dispatch software shall be used to aid designing and modifying transit routes. It shall also be used to route, schedule, and dispatch vehicles in demand response operations. The application shall combine GIS and AVL to coordinate different transit functions.

Combined technologies such as, computer-aided dispatching and AVL shall increase the efficiency of transit operations, enhance safety, improve service. For example, systems integrating automated scheduling and dispatching and AVL enable a dispatcher to know the exact location and status of each bus under control. This real-time information allows the dispatcher to address any problems with service or to respond to any emergency. In addition, automated dispatching software and AVL allows the coordination of services among many separate transportation agencies.

Vehicle scheduling and dispatching system should be capable of dynamic planning and Capable of optimizing 1000s of vehicle movements, the system should be capable of automatic dispatch distribution and transport operations, dynamically rescheduling vehicle and driver assignments based on real-time events.

Vehicle scheduling and dispatch system shall be capable of providing schedule adherence reporting, route condition monitoring, emergency / incident interfaces and dynamic scheduling apart for standard functions that would be required to deliver computer aided scheduling and dispatch services from designated operations locations within VSCDL operations framework.

This system is expected to lend its functionality not only to transit vehicles but also to other municipal vehicles functioning under engineering and emergency services.

Detailed Specifications provided in sections below.

6.5. Depot Management System

Integrated Depot Management System

This module enables to automate depot Operations, which include workshop management, fuel management, traffic management, vehicle management, and so on. The module shall also cover administrative activities and stores requirement.

Stores & Inventory System

This module shall enable automation of stores and inventory for various items at each depot, workshop, and division and so on. The module also covers purchase and procurement processes right from sampling to evaluation of products to tendering to purchases to consumption. It also enables to exchange the information across the depots, divisions and workshops for products availability and requisitions.

Personal Information System

This module covers the various processes related to Payroll and HR activities of Personnel working at Central Units, Divisions, Depots and Workshops. It offers centralized system for better control as well as employee satisfaction.

Functional units of IT system and interrelation

The IT system for VSCDL operations shall be designed to meet specific needs of following operational entities to achieve the above system needs:

- Central Control Centre
    i)   Central Computing Infrastructure
    ii) Central Vehicle Monitoring System

- Bus Terminals/Depot (In future)
- Bus Stops
- Buses

Detailed Specifications provided in sections below.

6.6. Functional Solution Landscape

The functional solution architecture is envisaged to be based on integrated approach wherein all the solution sub-components like AVLS, PIS, Scheduling, Dispatch etc. are loosely coupled to offer a modular design philosophy. The requirement for loosely coupled environment while the system works in an integrated manner is to ensure future innovation and scalability. The sub systems implemented as part of integrated project will integrate with each other through a well-defined and documented data and process exchange protocols which will be part of the overall deliverable to ensure VSCDL has ability to onboard new initiatives with ease. Since the project is being envisaged as a city wide open platform, the solution provider will have to ensure that the overall architecture maintains ability to interface or add / remove sub system components without going through a major change management process.

The project being a field where major innovations are expected in coming times from the standpoint of hardware, software, interfaces and algorithms, it is thus imperative that VSCDL's ITMS design and implementation is of the nature which could embrace such eco-systems changes with ease and in a well-defined manner. Sustainability and longevity of such solutions being of prime importance, the service provider shall be required to deliver designs and architecture which aligns with the expectation of VSCDL and also industry open standards.

VSCDL expects service provider to deploy maximum possible COTS products in terms of software, hardware and communication, so that technology being provided can be sourced easily, brings in economics and also migration is less cumbersome and aligns with industry's technology upgradation curve.

The technology components proposed for the purpose of implementing the project should be generally available in country and through multiple product providers, this would create a competitive environment also allow onboarding of technology at significantly lower prices and generally ensure availability of such products at all times.

7.   *Annexure III - Technical Requirements for ITMS*

The technical requirement and specifications section provides detailed specifications for software, hardware, communication and interfaces required to achieve the objectives of the project.

7.1. GPS Based Automated Vehicle Location System
7.1.1.   Bus Vehicle tracking device

GPS and GPRS based Vehicle tracking unit

The Bus Driver Console shall be installed on the VSCDL City buses. The service provider is required to interface with the on-board devices to take necessary data required for control & operations purposes.

The Driver Console Unit with wireless communication module (based on GPRS/3G/Wifi) shall be used to provide vehicle tracking accurately and reliably. The back end system shall be able to produce MIS reports of the vehicle schedule adherence report and operated kilometers by each bus, by route and by fleet of each Service provider. VSCDL may require additional information to be extracted from the vehicle tracking information logged at the control center.

The unit would additionally have an interface module in front of the bus driver for two way communication, messages to be sent by driver and messages to be sent to the driver from the control center.

The Bus Driver Console unit has to be mounted on board the bus and the assembly has to be designed in a way that integrates with the dashboard of the bus. The bidder has to provide a design which should be theft proof and cannot be in normal circumstances removed from the bus unless standard technique specified by the bidder is applied.

The bus driver console will act as the sole management console for devices onboard like PIS equipment etc.. The BDC shall operate PIS manually in-case of GPS outage.

Features of BDC UNIT:

For detailed specification refer technical specifications section in this document.

The Unit should primarily be able to help central monitoring system to generate minimum of following data points as minimum and at the time of finalization of requirements a comprehensive requirement shall be furnished to the service provider:
- Start Stop
- Begin – End Shift
- Fleet Summary
- Detailed Activity
- Speed
- Fleet Status
- Alerts
- Battery Report
- Unit ON/OFF Report
- Ignition ON/OFF

VSCDL can request for other reports / data / information as deemed necessary for management purposes.

The unit will also be able to deliver real-time information to drivers with respect to route information, messages from control centre and any other intervention that may be required to ensure operational sanctity. The units supplied should have facility to for drivers to login/log-off facility and data should be linked with the AVLS server for authentication and tracking purposes.

7.1.2.   AVLS Software:

The software shall be web based and utilizes high resolution digital map to show real-time position of the vehicles. The software shall provide map based tracking and transit route line based tracking of vehicles by the control centre operators. The software is expected to have enterprise capabilities which enables multiple user type to be enabled to carry out various functions like, Alarm Management, Vehicle Schedule Tracking, Speed Management, Stoppage management, Route replays, bus tracking dashboard etc. as a standard functionality. The software shall enable control centre management staff quick decision making capability, which shall be achieved by providing graphical tools for visualization. The software shall enable VSCDL to drill and analyze information and online data in a multi-dimensional manner. Comprehensive analysis and reporting capabilities are expected to be part of the application delivery which matches the world standard capabilities of AVLS systems.

The software should have capability to have a multi-screen based tracking system, so as to enable tracking staff to quickly analyze activities and have a better insight into operational data of all activities within the system.

The operations Management system installed and managed through integrated AVLS platform shall have functionalities (not limited to) *(This is a partial list, SP will provide a full capable AVLS system based on best practices)*:

7.1.3.   AVLS Controller Software Functionalities
- Ability to distribute control of services among controllers
- Real Time Communication with the Fleet
- Supervision and Monitoring Of Fleet Positions in Real-Time
- Ability to Track Bus Service based on different operational state parameters
- Time Monitoring Analysis
- On-Line Assignment of Service Time
- Management of Information Displays at Stops
- Regulating Service by Time and Frequency
- Ability to See Trips by different colours
- Colour Legend of Vehicles
- Status Tracking of Messages Sent to BDC
- Status Tracking of Messages Sent to Internal Screens
- Controller System Messages
- Controller's Authentication
- Vehicles, Virtual Vehicles, Stops and Lines on Map
- Vehicles, Virtual Vehicles, Stops and Lines on Straight-Line Diagram
- Information on Vehicle on mouse overs
- Information on PIS and Stops on Mouse Over
- Vehicle Menu
- Information on Drivers
- Detailed Control information of Vehicle
- Selection of Stop on Route
- Ability to Define Types of Stops

- Detailed Stop Control
- Detailed Stop Control
- Current Trip Views on Map, Lines etc.
- Multi-Map Views
- Ability for Zone Creation
- Ability to Draw Detours on Map in Send it to Vehicles in Real-Time
- Management of Detours, Geo-fencing violation etc.
- General Control of Lines
- Control of Routes
- Technical Alarms Management and Disposal
- Bus Alerts management and Disposal
- Messages to Console, Manually, Auto Mode, Event Activated
- Automatic Messages with Acknowledgment
- Messages to PIS Screens
- Answering Messages from the Vehicle
- Panic Button Messages Management
- Information Panel Messages
- Line Legend
- Lines with Activated Legend
- Bus Service Graph
- Trip Graph
- Information Signs – Checking On the Lines
- Information Signs – Checking On Predefined Messages
- Information Signs – Checking On On-Line Messages
- Information Displays – Lines
- Information Displays – Predefined Messages
- Information Signs – On-Line Messages
- Information Signs – Simulator
- Statistics of Lines, Drivers, Routes etc.
- Traffic Density using Colour Codes on Lines, Maps

7.1.4. GPS Device Configuration & Management

- Configuration of driver's interface (console) messages
- Configuration of predefined messages
- Configuration of zone messages
- Filtering lines for warning the controller
- Calendar configuration
- Configuration of voice types and frequency
- Map data configuration
- Incident types
- Controller Authentication
- Configuration of Vehicle Control Panel Messages
- Configuration of Predefined Messages
- Creation of Predefined Messages
- Zone Indication Message to Buses
- I/O Zone Warning Messages
- Line Filter for which Warnings are sent to the Controller
- Day Type Configuration, New Day

- Day Type Configuration, Alter
- Day Type Configuration, Search
- Day Type Configuration, Seasons
- Day Type Configuration, Results
- Voice Time Configuration
- Configuration of Reaction Times
- Map Data

7.1.5. PIS Display Configuration and Management

- Configuration Tools
- Creation of Information Displays
- Line Configuration.
- Predefined Messages
- Associating Predefined Messages with Displays

7.1.6. Maintenance Requirements

- Device settings shall be updated including software/firmware updates through transmission via the secured communication network set up by the service provider. For reasons of security, device settings shall not be modifiable by field staff of the service provider/others.

- Any device settings modifications including software/firmware updates as well as business rules such as fare settings, discounts etc. shall be done with prior authorization by VSCDL. A digital log of all changes of settings on each and every device shall be maintained and delivered to VSCDL.

- Any faulty equipment shall be replaced with a tested unit from the spares maintained by service provider.

- Repair and testing of equipment shall be done at the Service provider's maintenance centre and not at site.

- Only a maintenance engineer with maintenance access card shall be able to access maintenance mode of the device which shall allow the maintenance engineer to diagnose the faults and update the device settings directly, if required.

- A repaired unit shall be tested for full functionality as at the time of initial deployment and certified before it is reinstalled at any site.

7.2. Passenger Information System

Passenger Information System hardware shall consist of LED based display system for bus Stops, Bus Terminals and Buses. Following are the technical specifications for the display units. The passenger information system shall comprise of following components:

- Display Screen on Bus Stations
- Display Screen on Bus (Already installed in the buses by Bus Operator)
- Voice announcement system on Bus
- Web Portal for Bus route Schedule &ETA
- Mobile Schedule Access System

7.2.1. PIS at Bus Stops and terminals

LED based display screens that provide sufficient visibility in broad daylight condition shall be installed at bus Stops. There shall be two displays per bus stops. They shall display route and estimated arrival time (ETA) including digital advertisements and other digital content as may be approved by VSCDL. They may also be used to display public service information.

The display shall receive encoded information of route and ETA from the AVTS control centre through the common wired/wireless communication link set up at each bus station as part of the ITMS system. The displays must have the ability to decode the information received from CCS and display appropriate message on the screen.

LED Board at Bus Stations shall have the following functional specifications:

- Display of PIS in a display unit at bus station shall be configurable based on bus station and platform. Single unit should display services of more than one platform.

- Information Display units will be supplied and mounted appropriately, configured and commissioned by the vendor.

- PIS information shall be displayed in Gujarati, Hindi and English alternatively (single or multiple language shall be configurable).

- At all these bus stations, display units will receive/display transmitted contents from the central system through a gateway or mention other suitable means in the technical architecture.

- Display systems needs to support full colour display for streaming advertisements, Digital display of text, images and video on LED screens.

- Displayed messages must be readable in high bright, day light.

- Display system in addition to the display of information for PIS shall be capable of displaying advertisements and multimedia content at the bus stops and may need to alternate between Passenger information and Advertisements.

- The frequency and period of information display on PIS display shall be configurable from central location for advertisements and other transit information.

- Display shall provide for modular configurable layout enabling parallel display of content on different areas of the screen – Real time Transit information (Routes, ETA, Type of service, Fare, Time/Date, Public announcements, Safety information, Commercial advertising, a ticker tape at the bottom for text announcements/advertisements, other local Tourist information).

- All displays for PIS will have a configurable refresh rate with minimum of 10 seconds.

7.2.2. Display System Technical Requirement (PIS):

- Display units shall be mounted on a rugged enclosure to withstand harsh environmental conditions with reasonable physical security.

- Display will be located at a convenient height to have a clear view of the message of next arrival bus.

- Fitment provision will have to be provided in the Bus stations. The power supply shall be made available by VSCDL.

Display Hardware Specification

- One Integrated tamper proof casing for complete PIS Unit addressing physical security considerations.

- Provide any hardware like PC, networking, etc. required to run the PIS and advertisements on LED Display Units.

- Ensure smooth transition from main power supply to UPS in case of power outage.

- Aesthetic requirements such as fonts, colours, rows per page, display time to be remotely configurable and displayed based on business requirement.

7.2.3. PIS on bus

Passenger information system on bus shall function as an independent system and shall not be directly dependent on the CCS. They shall receive display information and voice announcement commands from the onboard GPS vehicle control module based on stored memory on the bus.

Specifications of PIS units to be installed on bus:

Refer Annexure 1: MOUD Urban Bus Specification II.

Voice Announcement system on Bus
The Voice PIS must play clearly audible pre-recorded voice announcements informing passengers of next bus station on route. The voice PIS shall interface with the on-bus GPS module to gather location information and making the appropriate next station announcement.

Voice Announcement system on Bus
The Voice PIS must play clearly audible pre-recorded voice announcements informing passengers of next bus station on route. The voice PIS shall interface with the on-bus GPS module to gather location information and making the appropriate next station announcement.

7.2.4. Web Portal for Bus Schedule & ETA

VSCDL's transit web portal shall have capabilities to passengers to download route information, route schedule and real-time ETA from the web portal. This information must be accessible using GPRS Data enabled mobile phones also. The portal shall have facilities for pass application, City bus Tour (*Vadodara Darshan*) tickets and other bus related facilities. Etc.

The service provider shall also be required to develop mobile App for iOS, Android, Windows mobile devices to enable commuter to use the same for the purpose of travel information relating to service which may include, route planning, ETA, Offers, Fare and route tables etc.

The portal will act as a single source of information with regards to transportation system in Vadodara city and hence shall have all possible interfaces like logging complaints, viewing transport information, real-time updates, organizational structure, citizen blogs etc.

The portal shall have sections which shall provide information related to travel advisories, camera still feeds and PIS locations mapped on GIS map with real-time data.

The service provider shall be required to develop integrate this Travel portal website with Vadodara Smart City Website. The Travel Mobile App needs to be integrated with OneVadodara Mobile App.

7.3. Scheduling, Planning & Dispatch Management

System should have capability and be used at public transport operator with bus operations at least 300 buses.

The system should have ability to optimize the complete service delivery by developing the route network and publish final timetables & rosters, generate informative statistical summaries and MIS from the system, handle multiple vehicle type like AC buses, ordinary buses, long route buses etc.

Proposed Solution should have following integrated functionalities/tools from same OEM and should offer complete integration capability with other operations management system like AVLS, etc. and AFCS in the future.

- o Network Plan & Timetables
- o Trips & Vehicle Planning
- o Crew Schedules
- o Roster and Dispatch (Operations)
- o Crew Kiosks
- o Performance monitoring
- o Workshop & Fleet Management System
- o Fuel Management
- o Tyre Management
- o Procurement & Inventory Management
- o Capability to scan and upload documents like License, purchase order copy, etc. into corresponding sub systems and use this information for compliance purposes.

The proposed system shall provide feature for creating vehicles in one depot and process for transferring vehicles to other depots including features to capture trip/schedule wise revenue kilometer. The system shall also have following feature:

- Capability to capture dead kilometers in the solution.
- Define and create Charter trips into the system
- The charter trips should be reflected into the operation module for rostering and dispatch functions.
- Capture requirements from customer for chartered trips into the system.

- Make changes in routes and bus stop locations due to traffic management (traffic police) changes (one way streets, construction, etc.)
- Create users in the system
- Assign roles, access and user permission in the system
- Support user defined event definition for sending alerts and message
- Send alerts and email based on certain conditions/events/transaction.
- All modules/sub modules of Depot management should be seamlessly integrated
- Support in deriving efficient vehicle assignment by route minimal repositioning/dead runs
- Should have integrated Optimization Tool for vehicle and crew based on various constraints and preferences
- Generate "what-if" scenarios.
- Support drag and drop for network planner; undo and redo; search.
- labor award conditions and preferences
- Provides the costs associated with each service option
- Produce printouts of crew schedules, duty rosters, route timetables, bus stop timetables etc.
- Generate On-demand statistical reports and summaries
- Ability to generate Reports such as
  - Statistics Report - Headway, Running times for each trips.
  - Running Boards - Time table of each RUN
  - Arrive Depart Graph
  - Timetable reports - to be displayed at bus stops
- Import master data such as nodes details with its respective GIS data to the Map, Vehicle data etc.
- Additional reports as per request
- Provide facility to export data/reports to in pdf, excel /.csv /XML or HTML formats

- Perform trip time deviation analysis to find where the critical trips.
- Support for constraint analysis to find where the critical constraints are
- Save documents like birth certificates, education certificates, license, offer/ appointment order, etc.
- Solution should support following MIS Reporting
  - Crew allocation
  - Schedule allocation
  - Crew utilization report
  - Fleet departure at depot
  - Fleet dead KM per route/ fleet wise
  - Revenue kilometer
  - Schedule or trip cancellation
  - Crew license renewal history
  - Over time details per staff wise
  - Fuel stock per month/ week/ per day
  - Fuel consumption every day
  - Fleet wise fuel consumption
  - Vehicle service alerts

7.3.1. Network Plan & Timetable

Proposed solution should be capable to interface with GIS Maps.

- Calculate distances between associated points defined as stop / terminus / depot on the GIS Maps.
- Network planner or map interface that allows the user to define stops, terminus and depots on the map
- Ability to link various nodes (stops, terminus etc.) with paths to create a graphical route network that is easy to understand.
- Create, edit and modify depots, stops and terminus in system
- Create routes and timetables for both inbound and outbound directions.
- Track and minimize dead runs
- Add/view Average Speed / Distance
- Add/modify/delete/undelete/view Vehicle Type.
- Create timetable, adding and modification of trips, assigning the vehicles to the trips thus creating a vehicle schedule.
- Construct crew schedules by integrating with the vehicle schedule.
- Create vehicle schedules with split into a set of shifts, allowing the split to occur only at the relief points, a place where a crew may handover the bus to another crew.
- Create a new route
- Edit an existing Route
- Add turn restrictions
- Remove Turn restrictions
- Enable / disable turn restriction
- Set to One-way
- Set to Two – way
- Set to Blocked Road
- Define Road Class - Main roads, highway, narrow road, freeway, toll road etc…
- Authorized user should be able to create Road speeds for various road types
- Authorized user should be able to add nodes / points. With identified with unique Id. as Bus stops, Bus terminus, Time points, Meal place, Depot, Relief points etc.
- Only Authorized User should be able to delete nodes / points.
- For each of the nodes / points added, user should be able to add name for public timetable.
- Add Longitude and Latitude coordinates for nodes / Points.
- Indicate type of shelter for a bus stop
- Capable to define vehicle types which can stop at this location, if it is a bus stop
- Ability to create and add multiple type of buses - single decker, double decker, mini bus, multi axle bus etc.
- Create a Path - user should be able to
- Define route/path with unique path ID / name for it
- Edit an existing path by choosing the path id / name
- Create Route/Path with repositioning/z-path, start point and end point with or without GIS MAP
- Adjust the route/path to consider the roads and shortest distance the bus has to perform the journey
- Copy and duplicate an existing path
- Add, remove or modify nodes on the path
- Create a multiple path with a combination of one or more paths
- Define inbound and outbound routes

- Ability to automatically create a reverse/return path with the same attributes and details as in the original path
- choose a Vehicle type or types for a particular path
- Allow an authorised user to delete a path or a multiple path
- Identify and edit Travel distance, Travel time based on GIS information and Average speed defined by user for the entire path / route or specific nodes/stops.
- Define and edit the speed for the entire path / route or specific nodes/stops
- Create on the MAP dead run path from a specific depot to any bus stop of a path
- Auto create dead run path from any of the depots to any bus stop of a path and what if analysis
- Define and Edit the speed, Travel time, Travel distance for the entire dead run path
- Allow user to combine a path and the dead run path to be part of an inbound/outbound route path
- Handle multiple depots and optimize schedule across depots
- Optimize fleet results against depot and vehicle constraints
- Ability to edit Running Times in
  - in table view
  - using graph
- The Fleet/vehicle module should support
  - Multiple day types – like Week Day, SAT, SUN, Holidays etc.
  - Timetable - inbound and outbound paths
  - Add trips - inbound and outbound paths
- Ability to View trips by
  - Tabular Format
  - Graphical/Zig-zag view
  - Horizontal view
- Ability to define multiple day types for the entire calendar year or a specified period for weekdays, Public Holidays, School vacation, Saturdays, Sundays and any other combination of days (like 2nd Saturday) etc.
- Ability to define and link route/path to a specific day type time table - weekdays, Saturday, Sunday, Holiday etc.
- Map should feature's such as PAN, Zoom-in, Zoom-out etc.
- User should be able to print the below reports
  - Graphical report for a Path / Route
  - List of Nodes / points with the relevant details
  - Graphical report for a path / route with different travel times for different time periods in a day
  - Public Time Tables

7.3.2. Trips & Vehicle Scheduling

- Solution should have ability/edit specify inbound and/or outbound timetable for a specified day type.
- Allow user to define the path type for the time table - circular, loop, Radial etc.
- Add, edit and copy/duplicate timetables
- Only authorized users should be able add, edit or delete timetables
- Link/add trips to the selected timetable.
- Add trips automatically to the time table based on start time, end time, number of trips or headway

- Modify any / all trip running time, running distance, add new time points, truncate any of the trips and save the changes
- Allow user to join / unjoin the trips based on ending or starting within a time gap
- Join/unjoin trips in manual, assisted and auto mode.
- Allow user to split the trips in a time table
- Support multiple methods of viewing the trips, paths and nodes / bus stops and to switch instantaneously between the views.
- Add, edit, delete and copy/duplicate a Bus schedule for a day(s) in which buses have to operate trips as per the selected inbound and outbound timetable (s) and include a user defined name to it
- Allow an authorized user to add, edit, delete and copy/duplicate a bus schedule.
- Ability to link all the inbound and outbound trips in manual, assisted and auto mode.
- Ability to indicate the number of buses required to Operate all of the trips upon complete linking of all the trips.
- Ability to provide appropriate error messages in case layover times and Dead run timings do not match in the time tables.
- Solution should have ability to Minimize shifts
- Ability to Minimize mixed shifts
- Ability to Minimize costs
- Ability to minimize Total spread of hours of running
- Ability to Minimize number of continuous driving segments
- Solution should have ability to Avoid idle time of bus during AM peak, PM peak
- Ability to Minimize dead running KMS
- Solution should have ability to Minimize layover time at Depots, meal points/Relief points
- Ability to suggest minimum vehicle required for the schedule.
- Ability to Maximise or minimise the bus running hours
- Ability to display exceptions such as trip without any bus
- Ability to split, Join, Merge and Renumber RUNs
- Ability to duplicate RUNs
- Ability to colour code trips
- Ability to link /unlink buses to trips
- Ability to perform parallel scheduling of services such as trunk and feeder system, the schedule of the trunk bus and the feeder bus must be synchronized to the extent possible, to minimize the transfer waiting time for passengers. The system should allow for such synchronization and calculate automatically the trips of schedules of a route/multiple routes
- Ability to identify relief points where crew can interchange and have meals.
- Ability to pick and drop crew at relief points/depots as per the schedule.
- Solution should handle the schedule for these pick and drops using either fleet of vehicle dedicated for crews or public transport.

Ability to provide multiple MIS and reports from the System, such as:

- o For Time table
- o by Path
- o by Route
- o by start time
- o by end time
- o by trip number

- o by day(s) of the week
- o by distance
- o by speed
- o Bus Arrival and departure summary from a depot
- o Bus RUN summary report with or without time points / bus stops for day(s) of the week with statistics data on Running KMS and time, Dead Running, Idle time, recovery / layover time,
- o Number of buses operating in traffic from a depot spread over 24 hours

7.3.3. Crew Schedules

Solution should be capable of meeting the existing Rules of crew duties.

- Create crew schedules considering different shifts parameters such as shift spreads, meal time etc.
- Create crew scheduling as per the Motor Vehicle Act.
- Define relief points.
- Define shift start and end points
- Define relief points and duties with travel to these points by walk, bus, Metro or by staff bus.
- Ability to consider the different modes of transport and the time taken by each mode while creating crew schedules
- Ability to consider the travel time to relief points with multiple mode of travel In case relief points and shift start location is different locations.
- Ability to minimize the duty spread
- Ability to Minimize travel time from relief points to depot / meal locations
- Ability to minimize breaks between 2 blocks of service
- Ability to Schedule duties such that the last portion of duty shall close at a particular depot
- Ability to ensure minimum hours are worked before a meal break or an extra break
- Ability to ensure minimum hours are worked before an extra break
- Solution should be capable of creating crew schedules for Bus schedules which operate from a specific depot / group of depots or from all the Depots
- Capability to create crew schedule including/excluding certain Route Numbers

- Capability to create crew schedule considering a specific meal break location for a particular Route Number / selected route numbers
- Ability to view, edit or allocate crew to a schedule
- Ability to re-adjust Constraints / preferences rules for a depot or the entire depot and re-run the Crew schedules
- Solution should be accessible by all Depot authorized users to download the Crew schedules created by the system

Solution shall enable the user to define rules, including:

- o Relief points (driver changeover points)
- o Vehicle depots
- o Meal places (may be a vehicle depot)
- o Modes of travel (e.g. walk, staff car, etc.) to and from relief points and depots
- o Shift types that can operate a service, e.g. straight, broken or part-time
- o Rules for legal schedules

- o Ability for optimizer to number driver shifts in a user defined numbering pattern

7.3.4. Reports from the System

- Detailed Crew report for each duty / crew day(s) of the week clearly indicating sign On, Sign Off, Trip details that are to be performed, meal break location, etc.
- Consolidated Crew report for all duties in a depot for day(s) of the week clearly indicating Sign On, Sign Off, On vehicle, OFF vehicle, Steering time and hours of duty for driver and conductors
- Statistics reports of crew and depot.
- Horizontal Blocks to provide duty wise details of each crew along with the Route number on which they will perform duty

7.3.5. Rostering

The Bidder shall provide a Crew Rostering Software, already used by Public Transport Operators.

- The Software shall have provision for creating the Roster as per Rules, Acts and statutory requirements.
- Crew Rostering module shall be able to create group of users based on set of defined parameters.
- The proposed rostering module shall plan and generate the rostering automatically for next one month to one year.
- It shall allow admin or authorized user to create and view the planning for a week/month before it applies to real production.
- Solution should have provisions to easily make changes to the planned roster
- Solution should have provision to create rosters for user definable day types such as Public Holidays, weekends etc.
- Solution should have capability to automatically rotate crew as per the user definable parameters
- Ability to create groups and types of crew.
- Ability to assign crew work/duties based on user defined groups
- System should have provision to include non-driving work in the roster
- Solution should have provision to utilise drivers from other Depots
- The proposed rostering application shall display or provide rostering using graphical representation for the selected period
- The Rostering module shall interface with scheduling module to assign crews automatically to the schedule.
- In case schedule is cancelled then rostering shall update crew's operation hours, ideal hours, etc., for day to improve the operation.
- Rostering shall have technique to minimize and help purchaser in identify the non-performing/underperforming crew.
- Scheduling module shall support purchaser to assign the vehicle to particular schedule and number of trips. Forms and acts applicable to purchaser shall be incorporated into the scheduling & rostering module.
- All schedule shall be identified by schedule number and/or start and destination name.
- Schedule master shall have minimum start place, end place, starting and end time of each trip, rest time in between the trips, distance between the start and end place, distance between stops, overnight stay, crew name, fleet registration number, etc.

- Scheduling module shall allow admin or authorized user to update, modify or cancel the schedule.
- It shall also allow user to cancel particular trip that means partial schedule cancellation.
- The proposed application shall allow users to modify/update the schedule quickly
- Various MIS reports to support shall be provided. The reports include, but are not limited to:
  - Distance Reports
  - Depot Reports
  - Station Reports
  - Route Reports
  - Form-4 Reports
  - Anomalies Reports
  - Dead Kilometre Reports
  - Comparative Reports

7.3.6. Dispatch/Daily Operations

- Ability to plan dispatch of depot vehicle using a depot Plan
- System should have functionality and provisions to establish Crew Biometric and smart card based Kiosk, this should be fully integrated with Rostering and Dispatch
- Proposed solution should manage multiple Depots from the one screen
- Data from multiple should be available one screen for operations manager/starter to make decisions.
- The Dispatch module should be fully integrated and have availability of vehicles in real time from workshop.
- The solution should have ability to display the current and future duties to be performed by the staff.
- Solution should have provision to easily swap work between crew.
- Solution should have provision to Easily sway work between vehicles
- Solution should have provision to handle on-road vehicle changes due to accidents, breakdowns etc.
- The solution should have provisions to capture driver licenses and other statutory documents
- System should alert various stake holders including driver in case the document has expired and need to be renewed
- Solution should have provisions to manage crew contact details
- Ability to volunteer for additional work by crew from the crew kiosks
- Solution should have detailed shift information available to operations manager/ starter
- Solution should have ability to change how many hours are required by crew to perform a duties and highlight the overtime in case it is required
- Solution should highlight the workshop plan and vehicles required for workshop maintenance for the period
- Solution should have capability to send the SMS messaging to crew, either in bulk or individually
- Ability to send SMS alerts if crew late for work
- Ability to send SMS alert to crew if work has changed
- System should flag and give Late crew popup alerts

- Ability to sort vehicle / drivers as required
- Solution should have ability to incorporates Charter work
- Ability to apply skill restrictions at a Shift or vehicle level
- Gate processes for Vehicle In/Out from the Depots shall be captured in the system.
- Depot manager shall be provided real-time information and reports on staff presence from the system using the Proximity reader data.

7.3.7. Performance Monitor

- Ability to capture KPI events as they occur
- Ability to define and manage company workflows
- Ability to capture crew performance
- Ability to capture depot performance
- Ability to capture incidents and trigger the training requirements for the crew
- Ability to define level of detail from minor to complex as per company or regulatory requirements
- Seamless creation of records for Operations, Workshop and Management

7.3.8. Charter module

- Solution should cater for the entire process – Quote > Booking > Allocation > Invoicing
- Solution should maintain customer records and historic data
- Ability to handle multiple costing options – Charter Group, Coach Rates, Charter types
- Ability to do multi day bookings
- Solution should maintain and handle destinations details / Node information recording
- Solution should have Web based customer enquires
- Ability to record and report on Charter source
- Ability to perform recurring and repeating Charter requirements
- Ability to specify vehicle types and options associated with them
- While creating the charter requirement user should have Vehicle availability view

- Ability to access charter calendar that accommodates advance searching and caters for the entire booking process.
- Ability to directly email correspondence to clients – Quotes, Confirmations etc.

7.3.9. Operational

Solution should have booked charters integrated into dispatch

- Ability to create multiple options for allocation that follow the same allocation rules and methods
- solution should have integrated charters into dispatch along with workflow
- Solution should have Gantt charter for a visual aid to your work day
- Ability to easily configure shift sheets to allow charters to be slotted into existing route or shift work where applicable
- Solution should be able to provide driver instruction report.
- Solution should support vehicle change overs and Breakdowns

- Solution should be able to perform Splitting / Breaking Trips

7.3.10. Fuel Management

- Opening of fuel stock shall be captured in the system.
- Fuel consumption shall be captured for each bus and notified by bus, bus type, depot, division, etc.
- solution should have capability to integrate with fuelmachine
- Ability to interfaces with wide range of fuel bowser systems/external fuel suppliers
- Ability to manually add a fuel sheet for each depot
- Ability to add vehicle for fuel not from that depot
- Ability to enter fuel quantity and current odometer- solution should populate km's travelled from last odometer reading
- Ability to enter oil, coolant, other materials quantities

7.3.11. Workshop Management

- Ability to create the bus as a maintainable asset in the system
- Asset will have unit make, model, part number and location of asset for both movable and immovable.
- Solution should support creation of components for the bus
- solution should support identification of components by serial and should have serial tracking
- Solution should have functionality for body repairs
- Ability to have alerts for Fitness Certificate Renewal
- ability to perform reconditioning of assemblies and engines
- solution should be able to track the spares required for maintenance and integrated with inventory system
- solution should maintain the tyre tracking and tyre re-treading
- solution should also have functionality to perform Repair and reconditioning of Plant, Machinery, Equipment, etc.
- Ability to dispose of Scrap Vehicles
- The application shall support and capture Vehicle IN /Out with detail.
- The application shall capture tyre re-treading cycle with history of kilometre run.
- Application shall provide list of checks that should be done before the fitness certificate.
- Vehicle breakdown and accident details shall be captured in the application
- Provision shall be available to capture vehicle maintenance on the application
- Workshop specific scheduled maintenance alerts shall be sent to concerned staff or department.
- The application shall provide query by fleet to view and update the fleet status. The application shall have features to capture daily progress of particular vehicle department-wise to track progress by type of workshop activity (accident, engine rebuild, fitness certificate, etc.)
- Application shall have features to capture and report vehicle-wise insurance claims, road permit, etc.
- Application shall capture scrap vehicles information along with history.
- Solution should manage all vehicles and workshop equipment
- Ability to capture all relevant Vehicle information
- Solution should support and maintenance Schedule

- Solution should have functionality for defect rectification
- Solution should have functionality for running a maintenance Campaign, such change of certain component on all vehicles
- Ability to capture Permits and registration information
- Solution should creation of Fuel sheets and odometers
- Solution should support rebuilds
- Ability to amortization of consumable items against services performed
- Solution should support maintenance of vehicles and Plant
- Solution should be able to define and record the attributes for vehicle, components item within the fleet.
- Solution should be able to define and record the Manufacturer and Model for vehicle, components item within the fleet.
- Solution should be able to define and record the Purchase and In Service dates for vehicle, components item within the fleet.
- Solution should be able to define and record the Components (e.g. Engine) for vehicle, components item within the fleet.
- Solution should be able to define and record the Permits (i.e. Licences) for vehicle, components item within the fleet.
- Solution should be able to define and record the Last Service details for vehicle, components item within the fleet.
- Solution should be able to define and record the Service History for vehicle, components item within the fleet.
- Solution should be able to define and record the Odometer History for vehicle, components item within the fleet.
- Solution should be able to define and record the Fuel compliance for vehicle, components item within the fleet.
- Solution should be able to define and record the Warranties for vehicle, components item within the fleet.
- Solution should be able to define and record the Dimensions for vehicle, components item within the fleet.
- Solution should be able to define and record the Weight for vehicle, components item within the fleet.
- Solution should be able to define and record the Passenger capacity for vehicle.
- Solution should be able to define and record the warranty/expected life period
- Ability management of Scheduled Servicing
- Ability to maintenance schedule based on hours, days, anniversary date, KMS travelled or a combination of these
- ability to perform major and minor service
- Ability to Add labour to maintenance schedule
- Ability to Add inventory items to maintenance schedule
- Ability to Add a checklist of actions to maintenance schedule
- Ability for workshop manager / team to view all defects at all depots
- Ability for workshop manager / team to view all scheduled services at all depots
- Ability for workshop manager / team to Book a job in at any depot
- Ability for workshop manager / team to allocate / change a mechanic against a job
- Ability for workshop manager / team to move jobs to another day
- Ability for workshop manager / team to create a book back (i.e. tyre change in the morning, create a book back to bring the vehicle back in for a wheel nut retention)

- Ability to add/update labour on a Work Order
- Ability to add/update inventory on a Work Order
- Ability to post the Work Order (this process updates vehicle, inventory and other records)
- Ability to enter and track workshop labour costs
- Ability to enter and track Spare parts costs
- Ability to enter and track Consumables
- Ability to enter and track Fuel
- Ability to define multiple cost categories
- The following MIS reports form the tentative list. Additional reports may be added during design discussions and pilot implementation.
  - Breakdown
  - Accident
  - Vehicle In/Out
  - Pending Maintenance
  - KMPL for each Fleet
  - Vehicle FC, Road permit history
  - Complete history of each vehicle maintenance by month and year

7.3.12. Stores and Inventory

The proposed Stores and Inventory application shall have features to generate purchase orders, maintenance contractor details, previous quotes, etc.

- Inventory shall be maintained in a single software for different operators and transit systems. Asset management system to maintain all the physical items belongs to this project.
- Application shall have receipt of incoming goods/ GRN.
- The application shall support barcode reader to read the item information, warranty, etc. and register into application.
- Barcode reader to read the goods while procuring and it shall register into the system for inventory.
- Barcode reader to check the goods warranty, batch, year of manufacture, etc. by reading the bar code label on the goods.
- The application shall have provision to track goods transferred to other depots.
- Each item shall set with threshold level for stock. When the stock is going below threshold then system shall send alerts to concerned person(s) or department.
- The system shall have warranty information for each item.
- There shall be a provision to note the physical stock location number on the application to identify the stock easily.
- All the items entered into system with date of manufacture, date of warranty expiry, batch, date of purchase, etc.
- Query screen to check warranty information of particular item shall be available.
- Asset scrap detail shall be entered in the system
- Ability to enter and track items in stock
- Ability to enter and track an item as consumable
- Ability to enter and track issue equipment to staff
- Ability to enter and track scan items to a Work Order
- Ability to manage rebuild stock
- Ability to create and run stocktakes

- Ability to easily determine minimum quantity and reorder levels, and automatically generate purchase orders for those items
- Ability to transfer stock to/from other warehouses
- Ability to set items to 'Phase Out' or 'Obsolete'
- Stock management shall be able to capture new and used items.
- Ability to enter and track Warehouse info
- Ability to enter and track Open PO's/Receiving's
- Ability to track Item history
- Ability to enter and track item as used on Vehicle- linked to service/repair history showing what vehicles have been fitted with that part
- Ability to enter and track Suppliers
- Ability to enter and track Notes linked to items etc.
- Ability to enter and track alternate items
- Ability to enter and track Item serials
- Ability to enter and track Amortization- apportions costs across whole fleet for specified period
- Ability to enter and track Stock transfer from one warehouse to another
- Ability to adjust stock QTY's or average prices
- Ability to enter and track set opening QTY on hand by stock adjustment at the time of new item creation
- Ability to run annual or cyclical Stocktakes
- Ability to generates a stocktake list of all items
- Ability to randomly generate stocktake -according to variables (A,B,C)
- Ability to enter and track stocktake item category wise
- Ability to create stocktake with Start/end item – e.g. all items between codes 00001-10000
- Ability to enter and track stocktake based on Start/end location- one shelf at a time
- Ability to apportion the total costs of a consumable item onto work orders over a period as specified by the user
- Ability to do non tracked item setup e.g. C-ELE
- Ability to enter and track service codes during item setup
- Ability to enter and track a portion of the total cost for that item onto work orders that contain those service codes
- Ability to enter and track work order in completed and posted phases
- Ability to create and receive orders for parts stock
- Ability to direct parts to a vehicle
- Ability to enter and track items for subcontract work
- Ability to enter and track purchase orders for stock items
- Ability to create purchase orders for ad-hoc purchases (i.e. one off items)
- Ability to enter and track purchase orders for subcontractors
- Ability to enter and track purchase order from a work order
- Ability to enter and track posting receiving's to update inventory, vehicle records
- Ability to enter and track purchase order authorisation, can be enabled to set users' maximum $ value spend per item on a purchase order
- Ability to send an email If exceeds the PO limit to authorised user for approval
- Ability to automatically generate purchase orders for stock items where the quantity on hand < than the re-order level amount
- Ability to track reorders generated from Service Template

- The following MIS reports form the tentative list. Additional reports might be added during design/pilot stage.
  - Monthly Stock detail
  - Item wise Stock
  - Item name & code with Warranty
  - Stores accounting value
  - Utilized stock
  - Inventory control
  - Maintenance of stock record
  - Stock transfer
  - Asset Detail
  - Asset Summary – depot wise, division wise

7.3.13. Computer Aided Dispatch

CAD systems shall assist the processes of dispatching revenue & non-revenue service vehicles. The system will manage dispatch of buses from their terminal / depot points in case of public transport and dispatch of other vehicles to destination areas based on requests.

The objectives of a CAD system shall be:

- To dispatch vehicles according to the operational plan.
- To dispatch the vehicle at the scheduled time; or
- To dispatch vehicles according to a headway plan (e.g. vehicles at 5 minute intervals in the peak, 8 minutes in the inter-peak, 15 minutes in the evenings)
- In case of late arrival of incoming vehicles and/or other disruptions, to arrange the departures as close as possible to the service plan, and maintain proper intervals
- In case of more serious disruptions, to manage the departures to provide the best service possible with the resources available
- In case of one or more vehicles being unavailable, to smooth the intervals
- To liaise with support services for replacement vehicles and/or drivers
- To record all departures for administration, analysis, planning and intervention measures

Dispatch in case of VSCDL will be based on both centralization and hierarchy basis depending on the type of vehicle and department. E.g. public transit could be based on centralized policy of dispatch and other municipal vehicles could be on intervention basis.

CAD system shall provide the following core functions to assist the dispatcher in the operations management and dispatch functions:

- Display the routes and/or terminal points in graphical format
- Present the current locations of the vehicles operating on the relevant routes, usually with indication of the their status (early/late)
- Provide supporting information on schedules, dispatching sequence, vehicle availability
- Provide status information and alerts about actual and missing departures
- Support voice and data communication with drivers, vehicles and support staff to facilitate on-time departure
- Capture data on all departures

The CAD application shall be integrated with other operations management functions like AVL to ensure end use requirement is met.

7.3.14. Schedule Adherence Support

Schedule adherence process shall provide information and tools to assist dispatchers to keep the service operating to schedule. The approach can be somewhat different depending on whether the service is operated to schedule/timetable, or to planned headways. Schedule adherence applications are invariably implemented within CAD / AVLS systems.

Schedule adherence applications can be split among:

- the CAD/AVM Control Centre, where the Dispatcher uses the information to determine the interventions required to improve schedule adherence
- the vehicle, where schedule and relative headway information is provided to the driver, assisting him/her to manage schedule adherence on the road
- the traffic priority system, which can grant priority to vehicles on-schedule or in delay, but not to vehicles running early, to reduce the risk of bunching (future scope)
- the planning function, which uses information from the CAD/AVLS system to identify where the schedule may need to be adjusted to optimize schedule adherence

The basic tools for schedule adherence are Computer-Aided Dispatch and Route Condition Monitoring. The dispatcher uses the information and tools available from these applications to make decisions on how to manage the service, and to get vehicles to depart on time or according to headway specification.

Three additional software facilities can provide further assistance for Schedule Adherence:

- Highlight delays and excessive intervals, so that the dispatcher focuses on these items

- Predict and highlight to the dispatcher any vehicles that will arrive at the terminal point too late to commence their next trip on time. This uses a combination of current location, current delay status, and known sectional running times. This gives the dispatcher advance warning of delay events, allowing him/her to plan mitigating actions.

- Predict and highlight to the dispatcher any vehicles that are likely to be in delay for a scheduled crew change or meal break, and thus cause cascading delays in services. This gives the dispatcher the opportunity to prioritize such vehicles for intervention, so that the change-over or meal-break happens on time.

7.3.15. Route Condition Monitoring

Route Condition/Status Monitoring application provides real-time information about the operational status of the route. They identify how the route is performing compared to the planned performance. They are typically implemented as a supporting application within a CAD/AVLS system.

The application compares the real-time information about the route (vehicle location, speed, speed variances, delays) with the planned service (timetable, headways, running times). It identifies where the service is operating as planned, where it is at variance with the plan, and usually also analyses the severity of the variance. Optionally, it may acquire real-time and pre-planned information from external sources about events, disruptions, etc.

The application presents the route condition to specified end-users. Most typically, this is to the CAD/AVLS dispatcher. In these cases, the route condition is presented in graphic and numeric format. This includes:

- Summary indicator of status of all routes
- Summary indicator of status of all routes assigned to the dispatcher or dispatcher cluster
- Condition status of individual routes
- Optionally, only alerts and variances beyond performance tolerance are shown

Route condition monitoring application shall use visual tools to highlight the important information. Methods include:

- Representation of the intervals between vehicles, either on the route map or as a separate screen
- Color-coding of variances to indicate early/late running, bunching, excessive intervals
- Flashing symbols for variances that need close attention
- Audio alerts
- Listing of key variances, optionally ordered by priority

Route Condition Monitoring can also feed other systems. Real-time passenger information, traveler alert services, and journey planners can receive route condition information and include it in the advice provided to passengers. It can also be channeled to operations support staff, and to external entities.

7.3.16. Dynamic rescheduling

Dynamic Rescheduling is a facility within a CAD/AVLS system that allows the schedule to be adjusted in real time or semi-real time in response to prevailing circumstances.

Dynamic rescheduling can operate at various levels of complexity, including the following situations:

- Smoothing the schedule or headway pattern when a vehicle is missing
- Recalculating the schedule or headway pattern when one or more additional vehicles are operated on a route (e.g. in response to unusually high demand)
- Recalculating the schedule and intermediate times when a route diversion takes place
- Recalculating the schedule based on the actual overall or sectional running times
- Creating an alternative schedule in case of serious disruption

In some cases, following the dynamic rescheduling process, the revised schedule is transmitted to the in-vehicle devices and to the real-time traveler's information channels. This ensures that the information channels can provide a reasonably accurate level of information to travelers. This is particularly important if the route or list/sequence of stops is adjusted.

7.4. Depot Management System

Depot management plays a very important role in ensuring availability and safety of the transit system buses. Depot resources are required to carry out day-to-day maintenance of vehicles, preventive& predictive maintenance schedules. The depot management process shall be primarily responsible to following functions are carried out:

- Crew Rostering using DMS
- Vehicle Scheduling using scheduling system
- Vehicle Dispatch using CAD system
- Vehicle maintenance and operational requirements like fuel etc. using DMS
- Maintenance expenses

Depot management system shall primarily manage crew required for bus operations, vehicles, routes, schedule management etc. The operations & maintenance processes with respect to buses shall be captured by the system. The Bidder shall provide customization to the software based on the functional and technical requirements of the project.

Crew Rostering module shall be able to create group of users based on set of defined

Parameter's by VSCDL. The proposed rostering module shall plan, optimize and generate the rostering automatically for month to one year.It shall allow admin or authorized user to create and view the planning for a defined period of time.The proposed rostering application shall display or provide rostering using graphical representation for the selected period and shall interface with scheduling module to assign crews automatically to the schedule. The Rostering module shall interface with HR system to update crew absence, holidays, etc. In event schedule deviations, rostering shall update crew's operation hours, ideal hours, etc., for day to improve the operation. Rostering system shall have optimization technique to minimize and identify the underperforming crew. The proposed rostering shall provide individual or group wise performance in graphical user interface. That including working, non-working hours, holiday, leave, over time, etc.

DMS process shall provide productivity reports to ensure insights into operations such as:

- Crew allocation
- Schedule allocation
- Crew utilization report
- Fleet departure at depot
- Fleet dead KM per route/ fleet wise
- Revenue kilometre
- Schedule or trip cancellation
- Crew license renewal history
- Over time details per staff wise
- Fuel stock per month/ week/ per day
- Fuel consumption every day
- Fleet wise fuel consumption
- Vehicle service alerts

DMS shall also provide functionality for workshop management and following modules shall be offered:

- Body repairs
- Fitness Certificate Renewal
- Reconditioning of assemblies and engines
- Retrieving of spares
- Tyre re-treading
- Repairs and reconditioning

The application shall provide query by fleet to view and update the fleet status. The application shall have features to capture daily progress of particular vehicle department-wise to track progress by type of workshop activity (accident, engine rebuild, fitness certificate, etc.). All the documents related to vehicles like vehicle registration, FC, Road permit, Staff ID proof, License, purchase orders etc. shall be scanned and uploaded into corresponding sub systems like DMS, WMS, Stores, and HR & Payroll.

Application shall have features to capture and report vehicle-wise insurance claims, road permit, etc. DMS module shall interface with workshop module to update maintenance detail.

The following MIS reports form the tentative list. Additional reports may be added during design discussions and pilot implementation.

- Breakdown
- Accident
- Vehicle in/ out
- Pending Maintenance
- KMPL for each Fleet
- Vehicle FC, Road permit history
- Complete history of each vehicle maintenance by month and year

7.4.1. Stores and Inventory

The proposed Stores and Inventory application shall have features to generate purchase orders, maintenance contractor details, previous quotes, etc. Asset management system to maintain all the physical items belongs to this project. Application shall have receipt of incoming goods/ GRN. The application shall support barcode reader to read the item information, warranty, etc. and register into application. Barcode reader to read the goods while procuring and it shall register into the system for inventory.

Barcode reader to check the goods warranty, batch, year of manufacture, etc. by reading the barcode label on the goods. The application shall have provision to track goods transferred to other depots. Each item shall set with threshold level for stock. When the stock is going below threshold then system shall send alerts to concerned person(s) or department.

The system shall have warranty information for each item. There shall be a provision to note the physical stock location number on the application to identify the stock easily. All the items entered into system with date of manufacture, date of warranty expiry, batch, date of purchase, etc. Query screen to check warranty information of particular item shall be available. Asset will have unit make, model, part number and location of asset for both movable and immovable. Stock management shall be able to capture new and used items.

The following MIS reports form the tentative list. Additional reports might be added during design/pilot stage.

- Monthly Stock detail
- Item wise Stock
- Item name & code with Warranty
- Stores accounting value

- Utilized stock
- Inventory control
- Maintenance of stock record
- Stock transfer
- Asset Detail
- Asset Summary – depot wise, division wise

7.4.2. Depot Personnel HR and Payroll

The proposed application shall store employee related master details without any limitation. The employees from VSCDL, VMC, Contractors, etc.as identified during the design stage. Attendance shall be recorded using Proximity Readers installed at various places depots. The system shall not allow any records to be deleted. But it shall allow admin to edit employee personal info, others as required.HR & Payroll System is expected to be accessible from all the depots, terminals, Inter-changes and main office. Additional locations shall be identified during design stage.

HR & Payroll System access shall be configurable based on location/user type/user group.

The Super User or Admin shall have access to all the data. The Master table will have minimum of Date of birth, Date of Joining, Earlier Service Experience, Department, Designation, Seniority, Salary, etc.HR system shall interface with Depot Management System to provide crew absence. The system shall maintain staff's ESI, PF and other mandatory processes. Application shall have provision to request transfer to other depots or other places. Staff shall be able to generate their salary slip using their ID & password.

Staff shall be able to check available vacation and sick leave using the system.

The following MIS reports form the tentative list. Additional reports might be added during design/pilot stage.

7.4.3. Human Resource Management

- Employee Management
- Leave Management
- Service Management
- Training Management reporting

7.4.4. Payroll Application Requirements:
Standard payroll application with following features:

- Monthly Salary management with statutory management functions like standard deduction, Payroll summary, Income tax, Form 16A and other reports as per Govt. of India

- PF, ESI, Professional Tax, Labour laws etc.

- Over time details and salary

- Bonus statement & Insurance

- Disbursals Management

7.5. Incident Management System

Incident management is the process of managing multi-agency, multi-jurisdictional responses to disruptions. Efficient and coordinated management of incidents reduces their adverse impacts on public safety, traffic conditions, and the local economy. Incident management yields significant benefits through reduced vehicle delays and enhanced safety to motorists through the reduction of incident frequency and improved response and clearance times.

Incident management is a planned effort to use all resources available to reduce the impact of incidents and improve the safety of all involved.

7.5.1. Emergency/incident management

- Emergency/incident Management shall be handled through the CAD/AVLS. In general, the strategies for emergency/incident management will be developed at a broader organizational level, and shall involve many stakeholders including the CAD/AVM system.

Emergency/incidents can be clustered in three levels, which have differing levels of response:

- Individual vehicle or location
- Impacting only the public transport services
- Impacting the urban area and utilities, of which public transport is one

Emergency/incidents cover the following scenarios:

Specific ITS supports for emergency/incident management include:

- Alarm/alert initiated by the driver. This can override the normal communication protocols and get priority alert to the dispatcher.
- For known disruptions (e.g. planned road work, events) temporary route diversions, temporary schedules and adjusted sectional running times can be pre-programmed into the CAD/AVLS system and activated for the period of the works
- For occasional disruptions (e.g. key street unavailable), alternative plans can be stored within the CAD/AVLS system, and activated whenever a trigger event occurs (e.g. weather alert, demonstration).
- Data exchange among the transportation and security agencies
- Traffic signal adjustment in the vicinity of the disruption areas

The incident management process shall include:

- Detection
- Verification
- Motorist Information
- Response
- Site Management
- Traffic Management
- Clearance

This system would ideally execute following phases:

- Notification phase
- Response phase
- Recovery phase
- Restoration phase

Incident management system is envisaged to be implemented as part of ITMS which shall facilitate communication of activities internally and externally as well.

7.6. Bus Control Centre (BCC)

The central control centre represents the operational centre of the transport service where AVLS application system shall be used to manage inputs from the field devices, the schedule system, bus-stop database and radio system for general operational control, including vehicle dispatch and dynamic scheduling. Information retrieved by the control centre from the on-board AVLS devices shall be processed by PIS application for distribution of real-time passenger information services.

The central control centre shall act as a nerve centre for the purposes of operations management. The systems implemented as part of ITMS allow variety of technical and operations profiles to be deployed to manage transit needs on real-time basis. Some of the profile types are such as transit controllers, incident managers etc. including the technical staff ensure business services are delivered as expected and in-event of exceptions, the same are managed to reduce any impact on operations and business.

The job involves monitoring and maintaining operational functions of an electronic reporting facility requiring the ability to monitor and maintain a range of electronic & software services, security and telecommunications systems, receive, interpret and transmit information and determine responses to incidents and; monitoring the security of persons and infrastructure from a control room perspective requiring the ability to effectively operate security systems to monitor activities, co-ordinate appropriate responses to incidents and organise relevant procedures via stand operating procedures.

Some of the common functions to be carried out at BCC are:

- Monitor and maintain electronic & software systems
- Process and organise data
- Respond to incident
- Prepare for operations
- Monitor security activities
- Maintain systems and information

System Description of BCC

The Bus Control System shall act as the integration and common ITS infrastructure management centre which includes central applications, computing infrastructure and communication system. BCC will enable data and information from all equipment's installed at Bus station/ Buses / Bus Terminals and other vehicles to be collected and processed for requirements mentioned in the scope of the implementation.

The BCC shall process data in real time and schedule basis based on the process requirements from all the equipment through an online connected compute infrastructure to enable AVLS functions, service control and management, compliances and planning purposes.

The service provider shall consult with the VSCDL on proposals for the type and range of operational and maintenance information to be prepared. The final content and format of presentation of processed data shall be discussed and finalized with VSCDL. All process as may be agreed between VSCDL and service provider at requirement finalization stage shall be process in term of SOP's and implemented on the integrated platform using appropriate applications within the scope of implementation.

The operator interface to the CCS shall facilitate operations management, reporting and service delivery based on the individuals functions identified for such resources. The service provider shall provide sufficient number of CCS workstations to facilitate audit, engineering, operations and maintenance functions.

A hierarchical Access control system shall be incorporated across the system to ensure that persons can only gain access to the information or facilities that are relevant and authorized to their specific job.

The CCS shall be capable of connectivity with various suitable communication service providers providing GPRS / CDMA / fixed line connectivity through leased lines. All communication networks shall be set up, managed and maintained by the service provider through appropriate contracting terms with communications service providers.

The CCS shall be protected by appropriate fire walls from external access and outside world connections. The data transferred from the field to the CCS shall include, as minimum, information such as usage of various equipment.

The CCS shall download configuration data to the equipment through Depot Management System/OTA for updating purposes. The information shall include system parameters, device parameters date and time synchronization, sub-system application updates and employee identification number and password updates.

The CCS shall be designed for autonomous operation of the various components of the ITMS to ensure that a failure in any one component of the system shall not disrupt the system as a whole.

The CCS shall also provide stand-in facilities, in the event of prolonged communication failure with the systems. Such facilities may include updating on bus equipment via communication channels set up at Bus depots and other means for Bus station equipment.

Depot configuration data files on the CCS shall be copied onto a backup media and hand carried to the Depots for Bus devices, if necessary.

The system provider shall create a visual tracking space on the video wall using LED TV (Professional display) to enable control centre staff to monitor different tracking activities. This shall include and not limited to vehicle tracking console, Alerts console, Violations Console, Trip summary Controls etc.

The central control centre operators should be provided with multi-screen option to perform analysis and event tracking in a way that data collaboration can be done.

The system should additionally provide ad-hoc query based interface for the analysts to perform complex analysis. The system should provide functions to create new analysis / reports based on the user needs and same shall become part of the user report bin.

The Bus Control System shall generate the necessary management reports from all transaction information received from the field equipment's.

The CCS shall automatically collate all operations data; authenticate security features of operations data from the AVLS to provide secure and accurate audit and traffic statistics for the Buses / Routes of the depot.

The Bus Control System shall provide integrated console management for vehicle tracking and alerts management

Controllers Responsibilities

Controllers shall be responsible for ensuring safe and effective delivery of transit services to customers through responsible supervision and communication with Bus Operators. Controllers are responsible for direct supervision, prudent communications and support of operations service transit staff with regards to safety, service, scheduling and detailed documentation. Goals are to ensure a high quality transit service to customers, while maintaining a safety-first environment and cost effective system. The BCC shall be responsible for public transit communications, vehicle fleet management, planning and directing bus operations, utilization of transit supervisors, spontaneous decision-making, answering phone calls, performing detailed data entry, and overall street management of public transit operations. The BCC shall maintain duties including Help Desk and support functions, with a complete working knowledge of the Radio System, Reporting, AVL mapping and scheduling software. BCC Staff must be knowledgeable of work rules, transit contract parameters and be proficient with Microsoft Windows Applications. The BCC creates and implements all text/audio announcements for the transit system. BCC Controllers work closely with and in support of bus operators, transit supervisors, and any other contractor or city department / personnel, to ensure a high quality customer service experience to ridership. Primary Controller duties include; responding to all communications in a professional and helpful manner, ensuring that actions taken are quick and effective in handling the variety of situations that occur on a daily basis, including routine and emergency situations. Controller duties involve a high level of stress, while maintaining composure, professionalism and courtesy. Controllers are responsible for making on-the-spot analyses and decisions within the realm of authority, transit policy, contract terms and agreements. Controllers work varied hours, days and shifts, and may fill in as necessary. Controllers will perform other BCC related duties as assigned.

The system should be able to provide Decision Support System to the control centre managers to dynamically manage dispatch and scheduling system

General Software Architecture for VSCDL
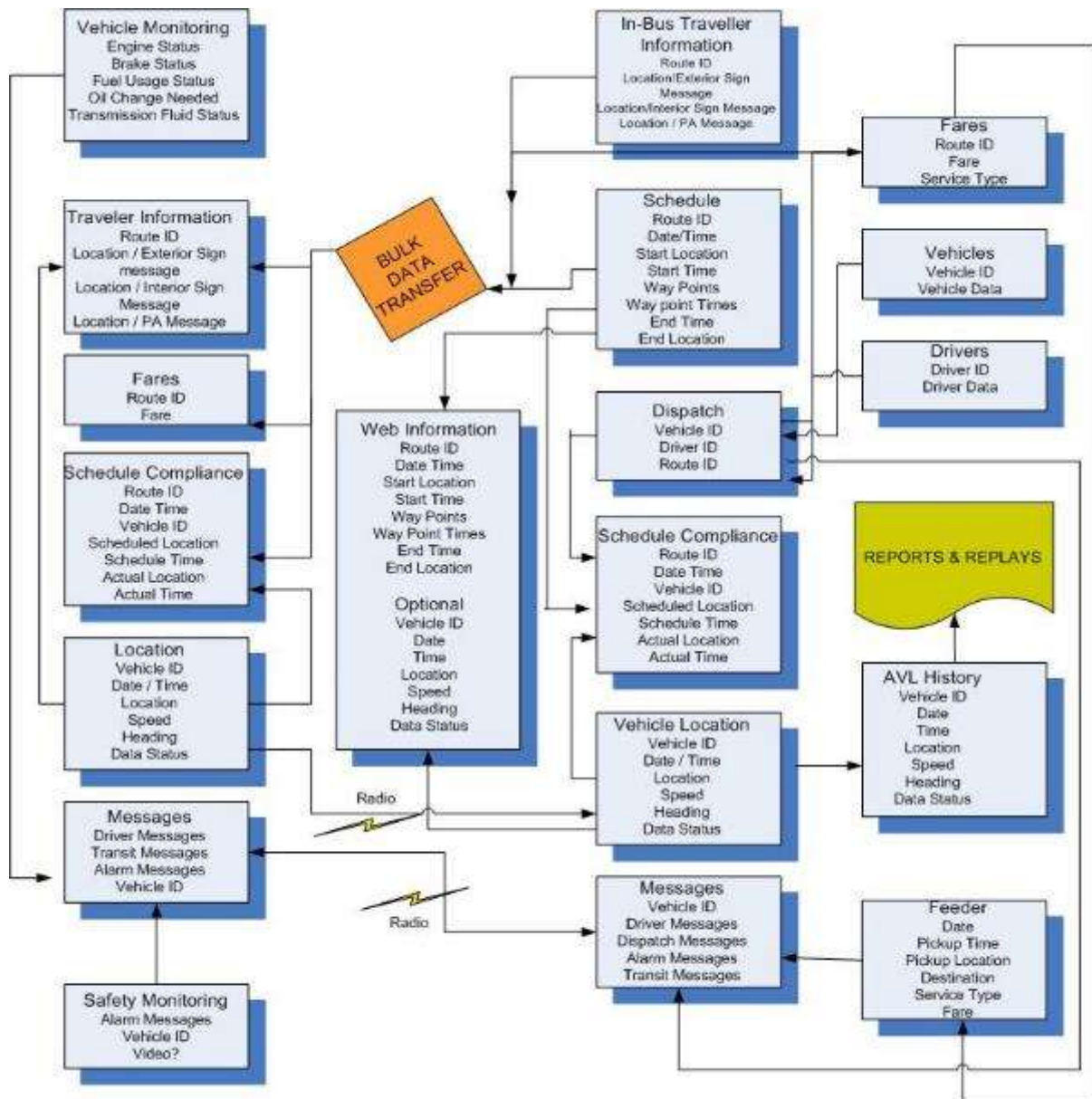
Typical View for Software Components and Interfaces
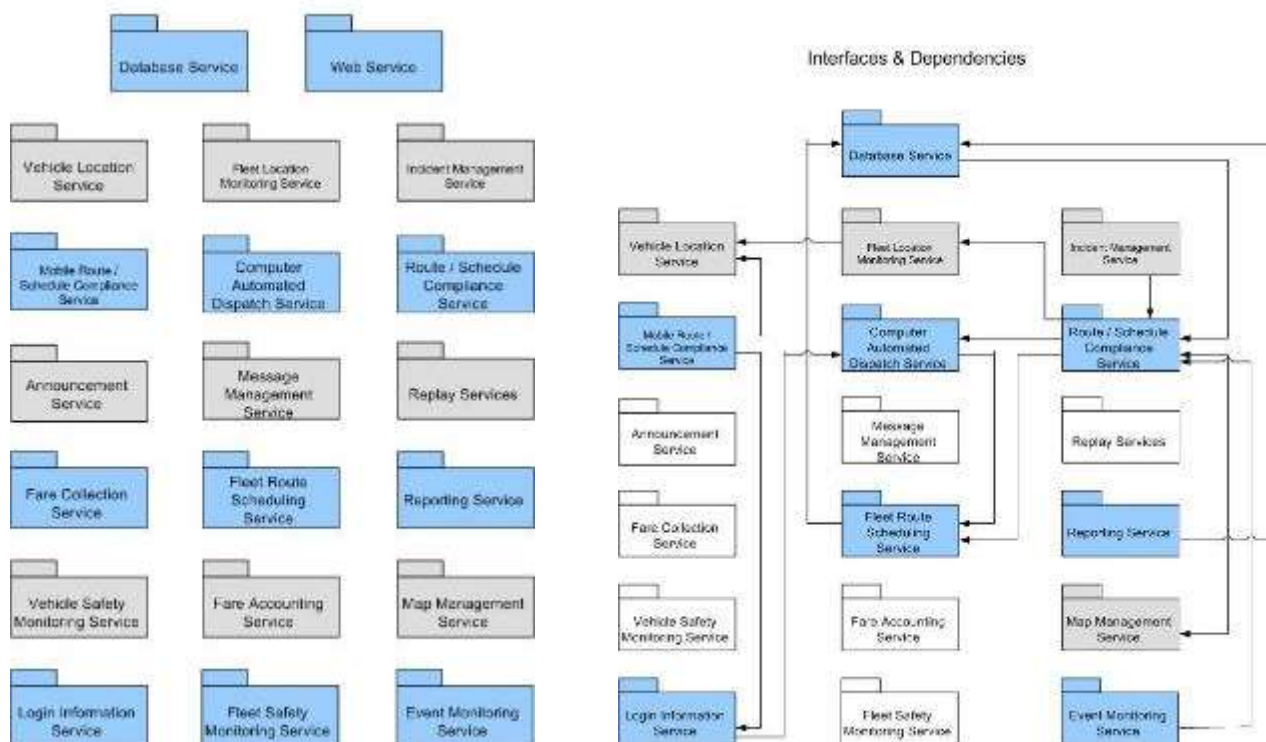
CCS Communication Links:

The Service provider shall provide a reliable method of verifying the integrity of the data and programme files sent from the CCS to the field equipment's and the correct reception of data uploads received from the devices at the CCS.

CCS hardware and software

The proposed set up should be capable to cater to meet the needs of a Real time Transit system involving more than 200 vehicles and minimum 10,0,000 transactions per day. Additionally, the system should be capable of expanding and scaling with additional deployment of hardware and necessary amendments to software for operations of 2 times the sizing stated above.

The vendor is expected to deploy state of art monitoring screen systems for monitoring various activities like vehicles, exceptions, late & early buses, etc. on a video wall setting.

Software:

The software deployed shall include a package consisting of computer operating system software, diagnostic, testing, development and support software for the generation and modification of report contents and presentation.

Security features shall be incorporated to prevent tampering with any data, programs, or other facilities of the CCS.

The service provider shall provide an inventory / asset management and tracking tools for the management of all devices supplied.

All computer software documentation for the CCS including workstations shall be provided by the service provider. Necessary technical information, concerning hardware, software and firmware including system architecture, shall be provided to VSCDL by the service provider upon full deployment of the system.

Scope of software includes full functional AVLS and PIS etc. as mentioned in RFP document. The service provider shall provide asset / inventory management system managed through electronic tagging process. All equipment's which form part of hardware supply shall have tags attached to them.

Configuration Data Management

Configuration data (CD) is the information transmitted from CCS to each device as a minimum package shall contain

1. Equipment Operations parameters

2. Configuration parameters

3. Application updates

The CCS shall be capable of checking and handling exception, missing, duplicate, delayed and fabricated data. The system shall be able to track the continuity of all types of data of system devices in case the above problems occur.

The CD Parameters shall have an effective date and time which may be any time in the future such that they are applied with immediate effect. If the effective date and time is set in the future, these parameters shall take effect on the specified date and time without further operator intervention. All the devices shall be able to handle at least one version of future CD parameters. However, there shall only be one current CD parameter list in the system and the system shall ensure that only one version of parameters takes effect in the system at any one time. Once a version of the CD parameters is deployed, it shall be locked to prevent any modification.

The system shall allow only authorized staff to maintain parameters. A facility shall be provided as part of the CCS whereby the operational parameters can be modified and once verified and AUTHORISED can be transmitted to the Systems for implementation at a date and time to be specified. It shall be possible to use back-up media to allow for change in operational parameters to be implemented in the event that the communication links are down.

The system shall allow CD parameters to be highly directive to the level of individual devices by the device ID and IP address

The CD parameters shall be communication media independent, Shall be able to be sent via depot WAN / WiFi or via GPRS connections.

The Configuration database shall be provided with a reporting tool to produce reports of various parameters and groups of parameters set on the system, sub-systems and devices

Data Storage

The database system shall satisfy the following requirements:

Full-function RDBMS to Support complicated data structure will be deployed, multi-user, multiprocessing, large capacity operation, Offer data integration, data recovery and security, Support parallel processing, Provide disk mirroring functions , Authority control shall be independent of that of the operating system and Offer multilevel security management of database.

Data storage capacity shall be sufficient to maintain six months transaction data available on line for ad hoc report generation and other investigations. The volume of data to be calculated for this requirement shall assume more than 10,0,000 transactions per day. The database shall be easily expandable to handle another 1 million transactions a day minimum.

To maximise the utilization of the disk space of the system, system data shall undergo a regular housekeeping process. Housekeeping shall cover the files created by the CCS and the files relative to each subsystem. Any outdated or invalid files shall be archived. Duplicated records in the database and records where only the latest data need to be retained shall be merged and archived.

The system shall be able to backup and recover data according to different modes and periods of backup required based on their criticality and data volume. The system shall have the functionality to backup and recover all key data (usage data, system data) and files.

BCC Security

Access security shall be implemented for Central Control System including data centre to manage authorized and authenticated movements only. The service provider shall be required to install biometric and card based system to secure operations centre.

Clock Management

The Central Control System shall obtain the standard date and time and synchronize its clock automatically from VSCDL or its designated master clock system. The CCS shall synchronize its clock at least once every 15 minutes. If the clock is not synchronous to the standard time, the correction shall be completed in one second.

The clock information shall be downloaded to all equipment's. When the clock time of a device is different to the downloaded clock time, the device's clock shall be corrected automatically to the downloaded clock time. The correction shall not happen with the trip of a bus to avoid incomplete transactions due to time variation.

Reports

The system as a minimum shall be delivered with capability to generate following reports, a comprehensive list of reports further than the mentioned below shall be finalized at the time of requirement finalization stage:

> a. Conductor / Driver Login reports for Day, week, month
> b. Non Compliance issues of different driver / conductors for the shift
> c. Trip summary.

d. Bus Equipment Fault Summary
e. Hourly Bus Usage Summary
f. Total Commuters and revenue per Route, per Bus, per shift
g. Revenues collected on same bus, same route, same trips by different Conductors
h. ROI route wise, trip wise, shift wise
i. Passengers boarding bus at a Bus stop – Time of day
j. Daily pass usage and its ROI for the passes validated
k. Student pass usage and the Cost of the subsidy that has to be refunded by Government- daily, weekly, monthly, yearly.
l. Origin – Destination
m. SC Bus Usage By Route Number
n. Test Card Usage by route Number
o. VSCDL employees usage of services
p. Bus Service Disruption
q. En-route Ticket Inspector Summary
r. Boarding and Alighting Service
s. Boarding and Alighting statistics
t. Passenger KMS analysis per trip configurable by the user
u. Bus Rides and Revenue Statistics By Fare Code
v. Bus Equipment Transactions
w. Bus Faults Per Transactions Processed By Device
x. Cash Revenues as per VSCDL MIS
y. SCs not used for the week , Month
z. Bus Equipment Fault Summary
aa. Half-Hourly Bus Usage Summary
bb. Total Patronage
cc. Bus Patronage And Revenue Statistics By Service Number
dd. Bus Service Revenue And Passenger Statistics Summary
ee. Boarding Ride Bus Stop
ff. Summary Of Bus Passengers Boarding By Service Number
gg. System, Depot, Devices, STT CD parameters set current and pending future CD sets
hh. Transfer Statistics

The above state reports are only indicative, actual list could be exhaustive based on VSCDL's requirements.

The Service provider shall provide VSCDL a GRAPHICAL DASHBOARD to have visual view of all / some key reports/ parameters enabling quick decision making.

Audit Mobile Applications and Executive Dashboard

The service provider shall be required to deliver audit application for service audit based on the reporting requirement mobile based audit application to ensure automation of field compliance data. The audit application shall be driven by a central application interface for the purpose of management and reporting.

Executive Dashboard application shall also be designed and delivered using mobile apps (iOS & Android) for the executive management of transit systems to view KPI and operational information. The KPI's and information required for the purpose of mobile dashboard shall be finalized during system study phase. The app delivered shall work on real-time basis and shall have privileged access for authorized users only.

7.7. CCTV Surveillance for City Bus System

CCTV surveillance implementation is aimed at providing safe travel experience to commuters using city buses. Public safety has emerged as an important function for governments across the world. It refers to the duty and function of the state to ensure the safety of its citizens, organizations and institutions against threats to their well-being as well as the traditional functions of law and order. With more than half the global population today living in urban areas, safe city is increasingly being considered essential in ensuring secure living and prosperity. Crime, violence and fear in cities pose significant challenges. The basic principles of good governance must find a direct application in any urban safety strategy, aimed at reducing and preventing common problems of crime and insecurity.

VSCDL has planned to implement Surveillance monitoring and communication infrastructure for city buses in Vadodara.

- The SI shall install Two CCTV Minidome Cameras in each bus

- The SI shall install a Mobile DVR in each bus. This mobile DVR will have facility to download the video streams in Wifi Mode, to a receiving station to be setup in Bus Control Room

- The SI will setup this Video Feed receding station at Bus Control Room

7.8. Transit Website

The Service Provider will create a website with the following functionality:

- All functionality mentioned in the Mobile App
- HTML5 and CSS3 Website

The website should have an uptime as described in the Service Provider incentives.

7.9. Smartphone Application

Transit Mobile application provides

1. Login via user name as well as usage without any registration
2. Multiple options to search routes
    i. Search for route number
    ii. Search by Bus Number
    iii. Search travel options using Start and End stop
3. Schedules can be searched using Stops.
4. ETA of buses at any given bus stop (which is given a unique ID), Auto location of own position via GPS
5. Map showing exact route and bus stops of a bus route
6. User level Features
    i. Feedback
    ii. Invite Friends to download app Via Email, Whatsapp etc
    iii. Create user profile, photograph, mobile number
    iv. Favourites routes

The following requirements should be met for the Mobile App:

- The Mobile App development should follow Agile Development model. The Application has to be developed in incremental, rapid cycles. This should, therefore, enable incremental releases with each release building on previous functionalities, after they are thoroughly tested.

- The Mobile App should work on Android (all flavors), iOS (all flavors). It must also be compatible with Tablets and iPads.

- The Mobile App should provide clear method and roadmap to incorporate any future changes in Policy of the government from time to time.

- The Mobile App must allow for integration with existing and envisaged One Vadodara Mobile App.

- The Mobile App and Web Portal should present the same information.

- The interface of the App should be well-designed, easy-to-use and intuitive. It should support proper error handling during the operations of the App.

- The App must support push notifications services.

- Application Size: Necessary efforts should be taken to ensure that the Application size is optimal.

- Start Up Time: Start-up time should be less than 5 seconds.

- Responsiveness: Mobile App should render properly on all devices of different size and resolution. (i.e. it should support all standard resolutions).

- Homogeneity: The App should be homogeneous in nature. The UI of the Application should be uniform throughout.

- Memory: App should support devices having memory capacity of minimum 1 GB

- Battery Life: While developing Mobile App, vendor should use standard SDKs of Android and iOS along with battery life saving APIs (Google Play Services) such that App consumes minimum battery of device. Few features that should be used to minimize battery life

- Request data once and use multiple times for different operations

- Caching

- Less download and perform one large operation v/s number of small ones

- Support for different network channels: App should support different network channels like Wi-Fi, 2G, 3G & 4G.

- Interrupts, notifications and multi-tasking: App should not come in the way of the OS's processing the user's decision to respond to the interrupt (such as accepting a call or reading an SMS), and it does not result in any damage to Application's ability to function normally after the OS 'foregrounds', i.e. resumes Application after the user finishes handling the interrupt or after they choose to ignore the interrupt.

- Maintenance: Mobile App should be easy to maintain. Technical design should not be monolithic in such a way that any change/repair of a single module affects entire Application which needs to be tested every time. Design should be modular so that only affected module needs to be deployed and tested in case of any change in that module.

- Integrations: The Application should support integration with Beacons and QR code, and should be designed in such a way that future integrations with other technologies is facilitated.

7.10. Business Intelligence Platform for Reporting

BI platform shall enable VSCDL to build reports from operations data to perform multi-dimensional analysis enabling to have better insight into parameters and enable VSCDL to take business decisions leading to higher operational efficiency. The BI tool hence should offer following:

7.10.1. Management Dashboard

Interactive Visualization

1. Display information in an easy-to understand format and use intuitive and interactive visualization to enable management users within VSCDL to quickly navigate, understand, and investigate data elements to make informed decisions.

2. Allow users to capture and export the current display through electronic reports and in different printer-friendly formats, including, at a minimum, MS-Excel, PDF, and Web formats.

3. Have a default configuration and landing page for each user or user-group that are editable.

4. Allow multiple visual elements to be laid out on the same display.

5. Have the ability to display dashboards and reports using different visual elements including charts, maps, calendars, gauges, images, tables, visual and textual lists, and alerts as follows:

   - All visual elements shall have editable titles, labels, legends, axes, icons, and colors, where applicable.

   - Interactive visualization component shall display the overall aggregate status of a VSCDL's KPI with proper color coding (green, yellow, red, or as defined by VSCDL's preferences). It will allow the user to drilldownand switch between differentKPIs (e.g. KPI for average vehicle utilization, average vehicle duration, etc.)

   - Display clickable contextual information related to the metrics being viewed and allows the user to drilldown on contextual information as required. Charts shall support at least the following chart types:

     a. Bar Charts

      b.   Histograms
      c.   Line Charts
      d.   Heat Maps
      e.   Pie Charts
      f.   Grids
      g.   Area Charts
      h.   Timeline Charts
      i.   Bubble Charts
      j.   Radar Charts
      k.   Scatter Plots
      l.   Doughnut Charts
      m.   Pyramid Charts

6. Maps shall have GIS Maps extension to allow plotting different mark-ups and indications on a map view using base and spatial map layers and allow the user to zoom and pan freely through the map, and be able to present heat map visualizations on GIS map data.

7. Calendars shall allow the user to intuitively navigate through calendar fields, such as day, month, and year. Calendars shall allow the user to intuitively navigate through calendar fields, such as day, month, and year. Gauges shall have the look and feel of an analog gauge (needle) with configurable level markings (green, yellow, red, or as defined VSCDL's management preferences) that gives a visual display of the amount, level, and measure of defined KPI

Tables shall be able to:

- Hold a large amount of data.

- Allow the user to scroll through the data in all directions.

- Freeze the header columns and rows when the user scrolls.

- Allow the user to enlarge/decrease the font.

Visual and textual lists shall allow the user to scroll through all of the available list items with smooth scrolling. Allow the user to choose the proper visual element required to display the required KPI data and allow the user to easily switch between alternative visual elements.

8. Have view-management tools, allowing the user to move, reorder, enlarge, shrink, open, and close visual elements with intuitive interaction.

9. Allow the user to create a new visual element based on the available visual element types and customize an existing visual element with an easy-to-use graphical interface.

10. Allow the user to save any customization done on a visual element.

11. Have zero-programming mashup capability that allows the user to configure queries and data mashups visually through drag-and drop functionality.

12. Allow the user to drill down to display increasingly detailed data on various data elements

13. Allow intuitive visual filtering, focusing, and selection of the displayed data and information.

14. Automatically update the parameters and filters of the displayed data when the user drills down through visual elements and update the other visual elements accordingly. Also, enable selection of filters through the visual elements and propagate selection to all visual elements in the dashboard.

15. Allow the user to filter and sort the presented data based on a number of attributes including the time period or on multiple attributes simultaneously.

16. Allow the user to search through visual elements that display numerous data entries such as tables and lists.

17. Allow the user to save the current filter and selection parameters.

18. Understand different types of structured data including numbers, percentages, fractions, general text, coordinates, and objects.

19. Store the user configuration and customizations information.

20. Have the ability to mashup different types of data from multiple sources with automatic detection of relationships between the data components and an option to manually define/overwrite relationship.

21. Run mathematical, statistical, and analytical operations on available data.

22. Compute trends and projections from data based on available historical data and based on data from external systems to enable informed decision-making.

7.10.2. Searching & Filtering

1. Allow the user to drill down and search through the large amounts of data easily and quickly by time periods and other search criteria defined by the user. Also, provide user guidance for searching & filtering through data

2. Generate reports from the current view in different electronic formats including at least MS-Word, MS-Excel, PDF, and Web formats and that are printer-friendly Not require programming knowledge or knowledge of SQL or databases to perform searches, queries, and filters.

3. Allow reports to be sent directly to a network printer.

4. Display a huge amount of data in a clear and organized view

5. Allow the user to hide or show parts of the data

6. Offer the capability to search multiple data sources effortlessly through a GUI

7. Allow the user to search, filter, and sort the presented data based on any attribute or on multiple attributes simultaneously

8. Allow the user to graphically define complex queries that contain multiple parameters and span different data sources.

9. Allow the user to search through historical data

10. Allow the user to save the current queries, filters, and selection parameters

11. Have data-pivoting capabilities

12. Understand different types of structured data including numbers, percentages, fractions, general text, coordinates, and objects

13. Store saved custom queries

7.10.3. Reporting

1. The system shall have the ability to allow the user to generate reports based on predefined report templates or by manually selecting the data and the corresponding visual elements.

2. The system shall have the ability to provide a GUI with drag-and-drop functionality for creating custom formatted reports that include visual elements, objects, and formulas.

3. The system shall have the ability to Display the list of available report templates, saved reports, and recently used report templates when the user logs in.

4. The system shall have the ability to Allow the user to create, load, modify, delete, and save report templates graphically.

5. The system shall allow reports to be generated and published on an ad-hoc or scheduled basis with the ability to predefine a list of recipients and a regular schedule through a GUI.

6. The system shall be able to generate reports in different electronic formats including at least MS-Word, MS-Excel, PDF, and Web formats and that are printer-friendly.

7. The system shall allow reports to be sent directly to a network printer.

8. The system should have the ability to generate planning and forecasting reports for providing the information related to planning for no of buses to be transported

9. The system shall have the ability for the reports to have the ability to drill down to multiple levels

10. Reports should have the ability to print

11. Publish reports and dashboards for planned Vs. actual data, for example the system should allow the management user to view the planned budget vs. the actual revenue spent for a particular route

12. The system shall allow to publish reports and send them to recipients through email attachments and to a central data store to be accessed by different users.

13. The system should not require any programming knowledge, knowledge of SQL, or dataset to create self-service ad-hoc reports.

14. The system shall allow the user to use previously defined objects and formulas or create new custom objects and formulas and save them for repeated use.

15. The system shall allow the user to save any configuration done on a visual element.

16. The system shall have the ability to display data elements using different visual elements including charts, maps, calendars, gauges, images, tables, visual and textual lists, and alerts as follows:

    • All visual elements shall have editable titles, labels, legends, axes, icons, and colors where applicable.

    • Display the overall aggregate status of KPI with proper color coding (green, yellow, red, or as defined per VSCDL's preference) and allow the user to perform an interactive visual drilldown and to switch between different KPIs.

    • Display clickable contextual information related to the KPI being viewed and allows the user to drill-down on contextual information as required.

    • Charts shall have different types including: Bar Charts, Histograms, Line Charts, Heat Maps, Pie Charts, Grids, Area Charts, Timeline Charts, Bubble Charts, Radar Charts, Scatter Plots, Doughnut Charts, and Pyramid Charts.

    • Maps shall have capabilities to show different mark-ups and KPIs on a map and allow the user to zoom and pan freely through the map.

    • Calendars shall allow the user to intuitively and visually change the selected day, month, and year.

    • Images shall allow the user to zoom and pan within an image and move between images intuitively.

    • Tables shall be able to hold a large amount of data, allow the user to scroll through the data in all directions, freeze the header columns and rows when the user scrolls, and allow the user to enlarge/decrease the font.

    • Visual and textual lists shall display an unlimited number of entries and allow the user to scroll through them.

    • Alerts shall be configurable allowing for different alerts with various icons and colours to be defined and displayed.

17. The system shall allow conditional formatting, based on thresholds or data ranges, for any cell/object in the report.

18. The system shall allow the display of multiple data elements and result sets in the same report.

19. The system shall allow the user to display historical data side-by-side or overlapping in views where applicable.

20. The system shall display the generated report on screen.

21. The system shall have zero-programming mashup capability that allows the user to configure queries and data mashups visually through drag-and-drop functionality.

22. The system shall automatically update the parameters and filters of the displayed data when the user drills down through views.

23. The system shall allow the user to display historical data for the current filter and selection

24. The system shall offer the capability to add new data sources easily through a GUI.

25. The system shall allow the user to filter and sort the presented data based on any attribute including time period

26. The system shall allow the user to filter and sort the presented data based on one or multiple attributes simultaneously.

27. The system shall have mathematical capabilities to be used to manipulate data, including basic and advanced arithmetic and statistical operations.

28. The system shall allow the user to filter and search through the different data sources.

29. The system shall allow the user to save the current queries, filters, and selection parameters.

30. The system shall have data-pivoting capabilities.
31. The system shall store the report templates and generated reports.

32. The system shall understand different types of structured data including numbers, percentages, fractions, general text, coordinates, and objects.

33. The system shall have the ability to mashup different types of data from multiple sources with automatic detection of relationships between the data components and an option to manually select the required relationship.

34. The system shall run mathematical and statistical operations on available data.

35. The system shall compute trends and projections from data series.

7.10.4. Data Retrieval & Management

General Data Retrieval

1. Provide fast, secure, reliable, and easy mechanisms to retrieve information and data from the different data sources to meet the dashboard KPI requirements.

2. Provide different mechanisms for retrieving data from different data sources including ETL, File Transfer, and Real-time integration.

3. Log all received information from entities.

4. Allow the user to define and connect new data sources and data stores effortlessly through a GUI.

7.10.5. ETL

1. Perform ETL to extract, transform, and load operations to move the data from internal and external data sources to the staging environment and from the staging environment to the Storage environment.

2. The system shall have the ability to perform multiple transformations on data including but not limited to

    a. Selection
    b. Translation
    c. Encoding
    d. Derivation
    e. Sorting
    f. Joining (merging)
    g. De-duplicating
    h. Aggregation
    i. Transposing (pivoting)
    j. Splitting
    k. Lookup

3. Provide the ability to define, configure, and manage ETL jobs

4. Support import and export wizard and supporting connections with source and destination adapters including but not limited to OLEDB, flat files, and XML formats

5. Have scheduling capabilities based on time, events, and triggers

6. Offer the capability to define and connect new data sources and destinations effortlessly through a GUI

7. Provide a user-friendly GUI to allow the user to handle ETL processes including:
    a. Modifying data feeds
    b. Changing of business logic used for data ETL
    c. Modifying ETL parameters
    d. Creating
    e. Editing
    f. Executing a large number of transformation rules

8. Allow the user to view the data at different stages

9. Allow the user to search, filter, and sort the data by stage, source, and type
10. Allow the user to search the metadata
11. Support batch data extraction, transformation and loading
12. Store ETL rules and schedule
13. Store the data at different stages including the raw data

Real-Time Integration with data sources

1. The system shall have the capability to integrate with data sources on the real time basis to fetch the information

2. The system shall be able to quickly retrieve the data with minimal time lag
3. The system shall have the ability to capture the failed transaction

File Transfer

1. The system shall support data retrieval through transferring files automatically using secure file transfer protocols such as the Secure File Transfer Protocol (FTP over SSL) protocol.

2. The system shall support automatic file upload capabilities that can detect a new file and upload it.

3. The system shall automatically rename the uploaded file to a proper filename including the source, date and version, based on configurable file-naming rules

4. The system shall properly manage duplicate submissions by keeping the old file and applying proper versioning and renaming

5. The system shall provide an intuitive graphical interface to AVLS Backend Users to:

   - Define the methods and rules for the file transfer such as maximum file size and supported types.

   - Define and manage the connections, file sources, file destinations, file processing, and file storage.

6. The system shall allow the Backend Users to view file transfer history with filter and sort capabilities

7. The system shall perform quality management on data provided through file transfer including validation and verification of file type and size and return errors and required corrections accordingly.

8. The system shall be able to receive and store large files as specified in the configurable file transfer rules

9. The system shall Be able to store a history of uploaded files information and content

7.10.6. Data Quality Management

1. Perform data cleansing, verification, validation, and reconciliation automatically and based on defined rules

2. Allow the user to manage the data quality process workflow and rules using a GUI

3. Compare the data to historical data as reference data for detecting anomalies

4. Rank the completeness and validity of the processed data

5. Store data quality verification rules and process workflow

6. Store historical data

Data Stores

1. Retrieved data from different data sources should be temporarily stored and processed in separate Operational Data Stores (ODSs).

2. Data used to perform visualization, reporting, and searching operations should be stored in appropriate Storage environment (e.g. Data warehouse)

7.10.7. BI Configuration and Management

BI Configuration Management

1. The system shall allow the authorized user to complete the following functions:

   - Manage the different KPIs available by adding, modifying, or deleting KPIs or KPI groups areas using a GUI.

   - Enable or disable KPI which activates or inactivates it but does not delete it (soft deletion).

   - Configure a KPI including its ID, name, description, area, data source, format, unit, frequency, and formula.

   - Configure the user access level required to view each KPI.

   - Choose the default and alternate views for displaying a KPI.

   - Drill down by clicking on a KPI to view its details and edit it.

   - Search, sort, and filter KPIs by ID, name, frequency, measure, and indicator area.

   - Show/hide disabled KPIs from the KPI management screen.

   - Manage data sources for the KPIs easily through a GUI.

2. The system shall have the ability to present an intuitive GUI allowing the authorized user to configure the threshold values and levels (green, yellow, red, or as defined per management preference) for a KPI by defining score card algorithms.

3. The system shall have the ability to clearly present multiple KPIs in the same view

4. The system shall have the ability to Configure KPIs that are aggregates of multiple other KPIs from different areas

5. The system shall have the ability to instantly and automatically update the other dashboard components with any new KPI or changes to the configuration of current KPIs

6. The system shall have the ability to Store each KPIs current and historical measure

7. The system shall have the ability to Configure KPIs with multiple data sources

8. The system shall have the ability to run algorithms to calculate the measure of a KPI based on data from subset KPIs

9. The system shall have the ability to Store the different access levels for each of the authorized users.

7.10.8. Dashboard and Reporting Requirement for ITMS

The list of reports given below is partial list and is being provided for the sake of understanding from the perspective of providing insight into the type of solution required to meet VSCDL's business process requirement.

List of Daily Reports needed for the service performance monitoring:

Category: Bus Maintenance and Availability

- o **Bus Availability**

How many buses are available in the depot at the beginning of the shift daily?

- o **Bus Breakdowns**

How many buses are in the workshop for repairs, how many buses breakdown during while in service? When multiple routes are operations, this information will be needed per individual route as well.
Bus kilometers between two breakdowns of same bus (individual bus wise)

- o **Bus Maintenance**

Individual Bus report consists of preventive maintenance and all other work done on that bus with kilometers.

- o **Schedule Adherence of individual trip of bus**

Scheduled adherence report based on published schedule and actual schedule. Ability to sort the report by the operator by the trip will be useful.

- o **Operational Issues on Field: Bus bunching etc.**

Incident reports to be generated based on information gathered by the control room on a daily basis. These reports should have bus number, trip number, operator number, time of the day, type of incident.

Category: On Time Performance

Definition of On Time Performance will be finalized in consultation with VSCDL. Time Points within individual routes will be introduced for OTP. For all OTP, need % early, % OT and % late.

- o Scheduled KM by trip versus Actual KM by trip and Summary for day

The report will have scheduled kilometers against actual kilometer by trip and by day. When multiple routes are operational, this information will be needed per individual route as well. The report should generate missed trips or missed kilometers per individual routes.

- o On Time Performance (OTP) for Individual Trip

System and trip on time performance report for individual routes and feeder routes.

- o Daily peak, base and evening performance OTP
- o Cumulative daily performance OTP
- o Weekdays and weekend performance OTP
- o Waiting time of bus at the junction and time to clear the junction during off peak, medium peak and peak hours.
- o Speed of a bus between stations
- o Speed violation

Category: Station and Passenger Information

    o   Arrival and departure per station by individual trip

The report should be generated to give arrival and departure information per station for individual trips. Then for each station, the average dwell time should be calculated and measured against the total number of boarding if available.

    o   Using Smart Card
        o   Origin and destination of a trip and length of trip
        o   Boarding and alighting information by individual stations by direction of route
        o   No of trips per day and per month
        o   No of trips per day and per month of individual smart card user
        o   Per station Revenue
        o   Per Bus Revenue
        o   Ticket Consolidation report
        o   Settlement report

Data for fare and revenue shall be provided by the current bus service operator.

7.10.9. Transit Performance Measures

	Service Offered / Utilization	
1	Average Daily Ridership	Total no. of passengers travelled in a month / No. of days
2	Total Monthly Ridership	Total no. of passengers travelled in a month
3	Average Trip Length Week day Week End	Total of (Passenger * KMS travelled) in a day / Total passengers travelled in a day
4	Vehicles operated in Maximum Service / day	Total no. of buses operated during peak hours
5	Vehicle utilization / day	Total KMS travelled by a bus in a day
	Economics	
6	Passenger / revenue KM	Total passengers travelled in a bus / total revenue KMS of buses in a month
7	Fares / revenue km	Total fare collection in a month / total revenue KMS of buses in a month
8	Vehicle Operating expenses / revenue km	As per contract
9	Operating Ratio	Cost per bus / earning per bus
10	Staff / bus ratio	Total staff utilized for each bus operations
	Availability	
11	Service Coverage	As per the corridor in operation
12	Frequency of buses During Peak Medium Peak	

	During off peak	
13	Hours of Service	No. of operational hours of Bus Service
14	Average Waiting Time for users	
Convenience		
15	Passengers / trip	Total no. of passengers in a day / total no. of trips of buses in a day
	During peak hours	
	During off peak hours	
16	Dwell Time	Avg. dwell time of buses at bus stops
17	Load factor	(passenger-km / capacity-km) * 100
		Inverse of (Breakdown/million KM)
18	Safety	Inverse of (accidents/million KM)
	Fatality rate / Km	Total fatalities / total length of Bus corridors
	Fatality rate for pedestrian & NMT	Total no. of fatalities of pedestrian and NMT / total fatalities on road
19	Signalized intersection delay for pedestrians	Waiting time of pedestrians at intersections to reach bus stop
Vehicular Capacity		
20	Bus Capacity	Designed capacity of bus
21	Bus lane Capacity	Passengers in peak hour peak direction
22	Volume–to–capacity ratio	Comparison of capacity usage
Speed / Delay		
23	Average Travel Speed of bus	Average travel speed of city bus during peak hours
24	Signalized intersection delay of bus	

7.11. Enterprise Computing Security

Security technologies/solutions requirements for ITMS shall be required to protect the servers, data, storage, and operating system. The Enterprise Computing Security includes host anti-malware/virus, host IDS/IPS, data encryption (data in rest & data in motion), data access control, data backup, and data restore requirements. The following shall be the requirements of enterprise computing security:

7.11.1. Server security

The server security solution shall provide:

- Real-time monitoring of malicious attacks on the servers/end user machines

- Automatic update and push of malware signatures

- Configuration of different actions based on identified malware

- Configuration of scheduled scanning jobs

- Automatic reporting/alerting of machine status to centralized anti-malware solution in addition to local alerting feature

- Centralized control/policy of functionalities so that end user cannot disable key functionalities of the host antimalware agent

7.11.2. Data security

The data security solutions shall restrict access of business data, and utilize data encryption and data backup. The solution shall:

- Restrict database administrators to view, modify and delete business data stored in the database.
- Create log for all the database administrator activities.
- Prohibit modifying or deleting system-created logs.
- Encrypt data using international and industry standards, such as AES, SHA1, RSA, based on data sensitivity as agreed with VSCDL. Encryption support for data-at-rest and data-in-motion.
- Support scheduled unattended backup using policy-based management for all server and OS platforms of the project (utilizing disk and tape media).
- Support on-line backup and restoration of any running applications and databases.
- Allow multiple back-up sessions simultaneously.
- Support different types of backup such as full backup, incremental backup, differential backup, selective backup, point in time backup and progressive incremental backup and snapshot.

7.11.3. Network Security

Security technologies/solutions shall be required at the network layer to secure the communications and exchange of data across the network LAN and WAN. The network security includes requirements for edge security, Authentication, Authorization and Accounting (AAA), and secure communication over virtual private network (VPN). The Service Provider can leverage the existing security services if sufficient. The following are the components of network security:

7.11.4. Edge security

The edge security solutions shall provide network access to the authorized user and identify, detect, and prevent any unauthorized access by implementing the following requirements:

- Filter network traffic based on identifiers such internet protocol (IP address), port and protocol.

- Provide protection features against attacks such as denial of service (DoS), distributed denial of service (DDoS), (SYN) flood, transmission control protocol (TCP) flood, (UDP) flood and (SSL) based attacks.

- Provide protection against security exploits and threats.

- Monitor and analyse unusual or anomalous network behaviour.

- Provide mechanism for data and time synchronization with all the components such as network elements, operating system, and applications.

- Support redundant, fault-tolerant protection with state-full packet inspection capabilities (e.g. signature detection with automatic, scheduled updates of signature files).

- Support detection and prevention mechanisms such as protocol decode, anomaly detection, simple pattern matching, state-full pattern recognition.

- Support protection for Layers 3–7 of the Open System Interconnect (OSI) model.

- Define custom rule sets for packet analysis and filtering.

7.11.5. Communication Security

The communication security solutions shall:

- Provide secure connection to remote users by creating a VPN tunnel based on industry standards such as IPsec.

- Provide network access to users only after authentication and authorization.

- Create authentication and access logs.

- Store private keys or digital certificates in a secure manner according to Federal Information Processing Standards (FIPS) Levels 2 and 3.

- Provide AAA services based on industry standard protocols such as Remote Authentication Dial-in User Service (RADIUS) and Diameter.

- Provide internet security and be able to block or filter internet traffic based on the aspects such as content and URL.

7.12. Training to Bus Operator Staff

The service provider shall set up training and test facility adequate for training all staff of the bus operator. Each staff member shall be deployed on the front end or at CCS centre only after certification jointly by Service provider and VSCDL.

Service provider shall create training manuals and other necessary aids to ensure the perpetual need for training as and when required for VSCDL/Operator Personnel is required.

The training room shall have all facility pertaining to training for all ITMS components and operational requirements. VSCDL will make available room infrastructure (Room with chairs, Projector, A few Desktop PC etc), for conducting training sessions by the ITMS System Integrator.

Handover/Takeover

The service provider shall ensure that VSCDL is sufficiently trained and skills are continuously upgraded to ensure complete takeover of the system at completion of the contractual agreement.

The service provider is required to impart training and necessary tools in-order to take-up operations whenever necessary. Service provider shall six months before the end of the contractual period go through a process of hand-over take-over with VSCDL personnel's and act in supervisory role for smooth take over.

Functional Requirements:
The devices and sub-systems shall be connected to the test CCS by an independent LAN / WAN that will permit the exchange of controls and data in a similar manner to that implemented for equipment installed in field.

Use as Prototype
The service provider shall develop software applications / manufacture equipment or accessories at the training and testing facility for testing as a prototype. Deployment will follow after joint evaluation by VSCDL and the service provider.

7.13. Human Resource Management
There shall be a Project manager as a representative of the service provider at the time of implementation followed by an Operations manager, employed as the head of operations by the service provider, after the start of commercial operations. Project manager shall act as the single point of contact and shall be responsible for all the deliverables of this agreement. The operations manager shall be the single point of contact with VSCDL after the start of operations.

Central Control System
All the manpower required for Central Control System including the hardware maintenance shall be arranged by the service provider. Required database, SW and report experts shall be organised by the service provider. The proposal must include the costs for these operational personnel. Any shortcomings shall be made good by service provider, and if needed, deploy additional personnel to ensure satisfactory services.

7.13.1. Commercial Operations and Maintenance - Bus stations, Bus Depots, Buses, Control Centre
The service provider shall provide cost of such services on annuity basis, payable monthly. This should be clearly indicated in the financial proposal. The personnel shall be responsible for the smooth functioning of equipment's and its connectivity to CCS. They shall attend to the problems with tracking devices, fare equipments, PIS equipment, connectivity problems and any other hardware related at stations and bus depots. Service provider personnel shall also attend to any problem with equipment on bus installed by it.

At least second and third line maintenance shall be provided and may take the form of remote connectivity and help desk.

7.14. Business Continuity Plan
The service provider has to design control centre system in high availability mode to mitigate risk of any outages on account of Hardware /Software / Connectivity failure. The service provider has to guarantee up time of 99.9%.

The Business Continuity Plan will be based upon Backup and Restore strategy. The devices (such as SCU) will be able to retain usage data up to a period of 7 days.

Nevertheless, our backend solution will be able to support the replication/hot redundancy if it is needed in a later phase of the implementation.

7.14.1. Application and System Audit

VSCDL shall at its discretion appoint a third party auditor capable of auditing IT systems envisaged as part of ITMS implementation. The service provider shall be required to provide necessary information to the third party auditor to facilitate testing and audit of hardware, software and processes related to ITMS.

7.15. Scope of Pilot Implementation

ITMS

Bus Station

- Local LAN at Bus Station
- PIS

Central Computer System

- Central Computer System
- One System with the required software will be installed at Bus Station
- Upload data from Field equipment's to Central computer system
- Processing the data and generating the reports
- Backend Hardware and Software Setup (Not needed on actual configuration systems, can be demonstrated over service providers test systems)
- Reports and MIS will be generated

GPS Based Fleet Management System

- Integration of GPS Units installed in city buses.
- Backend Hardware and Software Setup
- System can be accessed over the internet
- MIS & Reports will be generated
- Passenger Information System
- Two Destination Sign and one Next Bus Stop Sign with Announcement
- Backend Hardware and Software Setup

Public Information System

- Bus Stop Display Boards will be fitted at one bus stop and they will fetch the information over GPRS currently
- System can be accessed over the internet
    - MIS & Reports will be generated

Vehicle Dispatch & Scheduling System

7.16. Change Management Procedure

Any changes having technical or commercial implications will have to be mutually agreed upon in advance, prior to making the change. In case of situations, that the

impact is not dependent on one or both parties' agreement, the revised commercials will be effective from the date of impact.

For avoidance of doubt, the parties expressly agree that

- Change Request shall not be effective and binding unless agreed in writing and signed by both VSCDL and Service Provider.

- The payment of any additional cost agreed under a Change Request shall be in addition to the payments agreed upon under this Agreement.

- Upon a Change Request becoming effective, the Project Schedule shall automatically stand adjusted by the additional time required for implementing the Change Request.

7.17. Computerized Call Management System

The service provider shall be required to implement service call management system capable of logging service request call within the enterprise of VSCDL ITMS. The system shall uniquely identify all calls by way of assigning ticket numbers and resolution procedure. This system shall provide VSCDL a computerized log of all incidents logged as part of the ITMS operations. The system should further provide analytical reports to evaluate problem areas and escalation system to ensure problems are reported properly and resolved.

7.18. Project Management Requirements

The scope, duration and size of this project require the service provider to create an effective Project Management team to assure the success of the work. The following Project Management elements shall be incorporated as a key component of the project.

7.18.1. Project Management Personnel

The Service Provider shall establish a Project Manager, who shall be highly responsive to the needs of VSCDL as required in these Specifications and subject to VSCDL acceptance. The Project Manager shall coordinate design and engineering activities and provide a technical liaison to VSCDL. This person shall be highly competent and fully qualified in all aspects of the System. Where support is provided from individuals or groups outside the project, the support personnel shall be under the control of the Project Manager during the period of support, and support groups shall be required to provide support as their highest priority. An organization structure that diffuses responsibility and does not require that resources be assigned at management request is not responsive to this Contract and will not be accepted or tolerated by VSCDL. To accomplish the above, the Service Provider shall assign a permanent Project Manager and Senior Technical Staff Member (STSM), subject to VSCDL approval and assure compliance with the project management requirements of the Specifications and Agreement.

7.18.2. Project Manager

The Project Manager shall be identified to VSCDL, within seven (7) days after notice to proceed.

Authority

The Project Manager shall have the contracting authority to issue and approve purchase orders and to contractually bind the Service Provider. The Project Manager shall have the

authority to assign and schedule Service Provider to perform all of the Work required by this Agreement, and act as Service Provider's representative for dispute resolution.

Responsibility

The Project Manager shall provide a single point of contact for VSCDL to resolve all issues related to this Contract. The Project Manager shall be responsible for directing all Subservice providers' designs and work.

Project Understanding

The Project Manager shall have a full and complete understanding of the Contract Documents and site conditions sufficiently to provide adequate direction for coordination of work.

Qualifications

The Project Manager shall have at least 5 years' experience in design and management of Transit ITS projects, with at least one completed project assignment for a fleet in excess of 200 vehicles. VSCDL shall be the sole determinant of the suitability of the proposed Project Manager's qualifications. VSCDL reserves the right to have the service provider replace the Project Manager if qualifications are not met.

Availability to the Project

The Project Manager shall be available to VSCDL on a twenty-four hour per day, seven days per week basis and shall respond promptly to any reasonable VSCDL request. Coverage of this requirement by any alternates shall be subject to approval by VSCDL.

The Project Manager shall be on site during all significant project events, as necessary to facilitate meetings, project activities, and information flow between the service provider and VSCDL, and as requested by VSCDL.

7.18.3. Senior Technical Staff Member

The STSM shall be available to the Project within seven days after LOI issuance.

Responsibility

The STSM shall act as a technical resource for coordinating all system design and implementation issues. The STSM shall check each technical submittal prior to its being sent to VSCDL for approval. The STSM shall all technology related work to assure quality.

Project Understanding

The STSM shall have a complete understanding of the technical requirements of the Contract Documents and site conditions sufficiently to provide design direction and to determine compliance of the service provider's design submittals and work.

Qualifications

The STSM shall be a Professional Engineer, who qualifies as acceptable to VSCDL. The STSM will have a minimum of 10 years of experience, including three years or equivalent experience in coordinating engineering and administrative support activities for ITMS. VSCDL shall be the sole determinant of the suitability of the proposed STSM's qualifications. VSCDL reserves the right to have the service provider replace the STSM if these qualifications are not met.

Availability to the Project

The STSM shall be on site during all significant project events, as necessary to facilitate meetings, project activities, and information flow between the service provider and VSCDL, and as requested by VSCDL. In no case shall it be considered acceptable for the STSM to be on site less than ten (10) days per month. Coverage of this requirement by any alternates shall be subject to approval by VSCDL.

7.18.4. Hardware, Network & Data Centre Staff Member – System Administrator

The NDCS shall be available to the Project within seven days after LOI issuance.

Responsibility

The NDCS shall act as a technical resource for coordinating all network and compute design and implementation issues. The NDCS shall check each technical submittal prior to its being sent to VSCDL for approval. The NDCS shall be responsible for all technology related work to assure quality. This resource will work as System Administrator in O&M Phase.

Project Understanding

The NDCS shall have a complete understanding of the technical requirements of the program requirements to provide design direction.

Qualifications

The NDCS shall be a professional engineer, who qualifies as acceptable to VSCDL. The NDCS will have a minimum of 5 years of experience, including two years or equivalent experience in coordinating network and data centre support activities for ITMS. VSCDL shall be the sole determinant of the suitability of the proposed NDCS's qualifications. VSCDL reserves the right to have the service provider replace the NDCS if these qualifications are not met.

Availability to the Project

The STSM shall be on site during all times, as necessary to facilitate meetings, project activities, and information flow between the service provider and VSCDL, and as requested by VSCDL. In no case shall it be considered acceptable for the NDCS to be off site. Coverage of this requirement by any alternates shall be subject to approval by VSCDL.

7.18.5. Control Room and Process Analyst (Operations Manager)

The CRPA shall be available to the Project within seven days after LOI issuance.

Responsibility

The CRPA shall act as operations management expert for coordinating all operations related decision making and controller staff / work management. The CRPA shall be responsible to manage SOP's and operational requirements required for the control room operations and

shall work along VSCDL designated authorized resources for management and operations purposes.

Project Understanding

The CRPA shall have a complete understanding of the technical requirements of the program requirements to provide operations direction.

Qualifications

The CRPA shall be a professional engineer with specialization in urban transport management, who qualifies as acceptable to VSCDL. The CRPA will have a minimum of 10 years of experience, including three years or equivalent experience in coordinating operations management support activities for ITMS. VSCDL shall be the sole determinant of the suitability of the proposed CRPA's qualifications. VSCDL reserves the right to have the service provider replace the CRPA if these qualifications are not met.

Availability to the Project

The CRPA shall be on site during all times, as necessary to facilitate meetings, project activities, and information flow between the service provider and VSCDL, and as requested by VSCDL. In no case shall it be considered acceptable for the CRPA to be off site. Coverage of this requirement by any alternates shall be subject to approval by VSCDL.

7.18.6. Planning and Scheduling Expert

The PSE shall be available to the Project within seven days after LOI issuance.

Responsibility

The PSC shall act as a technical resource for coordinating all system design and implementation issues and Management of scheduling and planning of buses etc. The PSC shall check each technical submittal prior to its being sent to VSCDL for approval. The PSC shall undertake all technology related work to assure quality.

Project Understanding

The PSE shall have a complete understanding of the technical requirements of the Contract Documents and site conditions sufficiently to provide design direction and to determine compliance of the service provider's design submittals and work.

Qualifications

The PSE shall be a Professional Engineer, who qualifies as acceptable to VSCDL. The PSE will have a minimum of 5 years of experience, including two years or equivalent experience in coordinating engineering and administrative support activities for scheduling and

planning. VSCDL shall be the sole determinant of the suitability of the proposed PSE's qualifications. VSCDL reserves the right to have the service provider replace the PSE if these qualifications are not met.

Availability to the Project

The PSE shall be on site during all times during the contract period and shall be acting as internal resource for planning and scheduling purposes, facilitate meetings, project activities, and information flow between the service provider and VSCDL, and as requested by VSCDL.

7.18.7. Control Centre Controllers

The control center resources shall be required to act as service controllers and shall be professional trained in delivering such services. The resources shall be required to have prior experience of delivering such services as controllers and shall an important role in ensure service delivery objectives of VSCDL City Bus Operations. The resources shall be required to have professional qualification in urban transportation management.

Project Meetings

Attendance

The service provider's Project Manager and STSM shall attend Progress Meetings held weekly.

The service provider's Project Manager and STSM shall conduct a Project Kickoff Meeting with VSCDL stakeholders, Steering Committee, and the VSCDL Consultants.

The service provider's Project Manager and STSM shall attend additional meetings, as requested by VSCDL and the VSCDL Consultants pursuant to the coordination of the Work.

Location

Progress meetings shall be held at VSCDL facilities unless otherwise specifically approved by VSCDL. Other meetings shall be held at a mutually agreeable location, conducive to the topic of the meeting. For any project meetings conducted by conference call, service provider shall, at the service provider's expense, provide a conference call-in number.

Meeting Minutes

The service provider shall prepare minutes for each meeting, unless specifically instructed otherwise by VSCDL. The Service provider shall prepare the minutes and distribute them to the attendees within two working days after the meeting. Minutes of Meetings shall include names of attendees, significant proceedings, decisions, unresolved issues, and a list of information requested by VSCDL. The minutes shall be of sufficient detail to record any decisions made at the meeting and any follow-up actions required. The minutes shall include a summary of open action items, the party responsible for each, scheduled date for the action, and the respective resolution. Service provider shall provide a rolling project report, adding and deleting items as necessary.

Agenda

The Service provider shall prepare the agenda for each progress meeting. The Service provider shall provide a draft agenda to VSCDL at least one week prior to each meeting and request that VSCDL add any additional items. Review of the previous meeting minutes and any outstanding action items shall be included on the agenda for each meeting. Each progress meeting agenda shall also include the item, "Additional VSCDL Issues and Concerns."

Schedule

Detailed Contract Schedule

The detailed contract schedule shall be a critical-path-method schedule constructed using Microsoft Project or other software application acceptable to VSCDL. The detailed contract schedule shall show each activity, including interface activities, for completion of the Work, and shall be properly ordered and sequenced. Printed copies (if required) and one electronic copy of the detailed contract schedule shall be submitted for VSCDL approval within 07 calendar days after LOI.

Task Duration Limits

The detailed contract schedule shall be sufficiently detailed to preclude the use of activity durations greater than 07 working days. Activity durations shall include allowances for lost time and inefficiencies.

Task Designations

Each task designation shall delineate the phase or stage of the work, and the component of the work such as design, submittal, submittal review, procurement, fabrication, delivery, installation, and testing.

Task Details

Where appropriate to the understanding of the task, additional details shall be provided, such as:

• A clear description of the activity, including its location.

• The duration expressed in full working days.

• A responsibility code denoting the Service provider, a subservice provider, VSCDL, a government Agency, or a utility performing the activity.

• BOM, Activities.

• The integer percent complete representing the installed progress.

• The actual start and finish dates when applicable.

• Unless specifically agreed to in writing by VSCDL, Service provider is responsible for all Work to complete any task.

Critical Path

The detailed contract schedule shall show a clear and definable critical path(s) for the Work and each specified milestone. Requirements and events which impose limitations, as well as dates and milestones which constrain the time, shall be clearly identified. Days of float time shall be shown. Items that require VSCDL inputs and response shall be clearly identified.

Updates

The detailed schedule shall be updated every 07 days or as decided by VSCDL from time-to-time to show actual progress and changes to projected dates. Each update shall include a narrative describing the changes made since the last update. Each update shall be provided to VSCDL within 5 working days from the month end cut-off date and submitted with each invoice. Hardcopies and one electronic copy shall be provided.

Four-Week Rolling Schedules

The four-week rolling schedule shall show one week of historical information and two weeks of planned activities in support of and consistent with the detailed contract schedule.

Format

The four-week rolling schedule shall be presented as a chart with tasks along the left side and days along the top of the table. A shaded bar or "X" entered in the chart shall indicate work to be performed on each day for that task.

Task Detail

The level of detail shown on the four-week rolling schedule shall be greater than the level shown on the detailed contract schedule. In general, it shall show the Work to be done each day and the location(s) where the work will be done and by whom. Work done in buses and other vehicles shall be identifiable uniquely or as part of an easily traceable group of buses. Work that requires VSCDL input or response shall be clearly identified.

Updates

The four-week rolling schedule (or as decided by VSCDL) shall be updated weekly and provided to VSCDL by the end of the first day of the active week. Printed copies and one electronic copy shall be provided.

Submittals

General

This Section describes general requirements and procedures for preparing and transmitting information to VSCDL for review, acceptance or approval.

Scheduling of Submittals

Transmit submittals sufficiently in advance of contract requirements to permit at least Ten (10) calendar days for review (or need basis), checking and appropriate response by VSCDL or designated representative.

Transmittal Forms

Furnish the transmittal forms sequentially numbered and clearly indicate the Project Name;

Project Number; Date; "To:"; "From:"; names of subservice providers, suppliers or manufacturers; required Specification references; category and type of submittal; purpose; description; distribution record (for transmittals and submittals); and signature of transmitter.

Checking of Submittals

Examine and check the submittal for accuracy, completeness, and compliance with the Contract before delivery to VSCDL. Stamp and sign each submittal with the statement reading as follows: "Having checked this submission, we certify that it conforms to the requirements of the Contract in all respects, except as otherwise indicated". By reviewing, approving, and submitting a submittal, the Service provider has determined and verified materials, field measurements, and field implementation criteria related thereto, and has checked and coordinated the information contained within such submittals with the requirements of the work and the Contract.

Record of Submittals

Maintain at the worksite a complete up-to-date, organized file of all past and current submittals including an index and locating system, which identifies the status of each submission.

- Assign sequential numbers to each submittal.

- Assign revisions levels (A, B, C, etc.) to all re-submittals. Assign new transmittal numbers and cross references to previous submittals.

Electronic Format

All submittals shall be provided in electronic format as well as hardcopy. File formats for electronic copies shall be subject to VSCDL approval. Current version, industry prevalent software shall be utilized for preparing all submittals. Relevant drawings shall be submitted in AutoCAD & PDF format. Drawings or studies involving geographic information shall be submitted in a format that can be viewed by GIS software.

VSCDL Review

VSCDL and/or designated representative will review and approve or take other appropriate action upon the Service provider's submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract requirements. VSCDL's action will be taken as to cause no delay in the Work or in the activities of the Service provider. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of Equipment or systems, all of which remain the responsibility of the Service provider as required by the Contract. VSCDL's or designated representative's review will not constitute approval of safety precautions or, unless specifically stated by VSCDL or designated representative of any construction means, methods, techniques, sequences, or procedures. VSCDL's or designated representative's approval of a specific item does not indicate approval of an entire assembly of which the item is a component.

VSCDL Review Stamp

All Service provider's submittals will be stamped by VSCDL or designated representative with (a) the date of receipt, and (b) one of the following dispositions (see Review Stamp Exhibit hereafter).

1. APPROVED

2. APPROVED AS NOTED (Correct and resubmit): Work may proceed, provided:

   a. It complies with the Contract as well as the corrections on the submittals, and the Service provider resubmits within fifteen (7) days corrected copies of the specifications or miscellaneous submittals for final approval; and

   b. Work performed by the Service provider prior to receiving final approval will be at the Service provider's risk.

3. DISAPPROVED (Revise and Resubmit): Work not recognized as being able to proceed.

Revise submittal in accordance with notations thereon, and resubmit without delay. Handle re-submittals in the same manner as first submittals, except designated with suffix A, B, C, etc. to indicate 1st, 2nd, or 3rd re-submittals. On re-submittals, direct specific attention in writing on re-submitted documents, working drawings, samples, mock-ups, sample panels, or miscellaneous submittals to revisions other than the corrections required on previous submissions. Make corrections required by VSCDL or designated representative.

Actions Following Review

If APPROVED, each of the documents will be identified as having received such approval by being so stamped and dated. Documents stamped DISAPPROVED and with required corrections shown will be returned to the Service provider for correction and re-submittal.

Drawings

Quality of Drawings

The Service provider shall be responsible for accuracy and correctness of all drawings. The Service provider's Project Manager and STSM shall initial each drawing after checking it, indicating that it complies with all requirements of this Specification and accurately reflects intended or actual field conditions.

The Service provider shall check each drawing for:

- Conformance with Contract Documents

- Logical grouping and arrangement

- Accuracy

- Legibility

- Neatness

- Line Quality

- Lettering Quality

- Reproduction Quality

- Completeness

Product Data Submittals

Quality of Submittals

A submittal shall be prepared for each major piece of material or Equipment that the Service provider intends to furnish. These submittals shall be known as "Product Submittals". Copies of each product submittal shall be furnished. Each submittal shall be accompanied by a cover letter with reference number, signed by the Project Manager. Each submittal shall contain a list of any parameters for which the submitted products do not meet the Specifications and a description of how these changes will affect system design. Each submittal shall contain a description of any changes in design or products that the submitted products will cause.

Content

Each submittal shall contain sufficient information to determine that the System Component complies with the Specifications and Agreement. Actual values of all specified parameters shall be listed; a simple statement that the product complies will not be sufficient. Each product submittal shall be accompanied by appropriate documentation necessary to determine the product's applicability to VSCDL ITMS design. All closely related products shall be submitted as a single package. When pre-printed material is used in a submittal, the specific model

number and options to be furnished shall be clearly identified. Standard data sheets can be used, subject to the following:

- Modify manufacturer's standard and/or schematic drawings to delete information, which is not applicable to the Contract. Supplement standard information with additional information applicable to this contract.

- Modify manufacturer's standards, diagrams, schedules, performance charts, illustrations, calculations, and other descriptive data to delete information, which is not applicable to the contract. Indicate dimensions, clearances, performance characteristics, capacities, and any other diagrams, as applicable.

- Modify installation, erection, application, and placing instructions to delete information, which is not applicable to the Contract.

Test Procedures

The Service provider shall submit copies of each test procedure description, accompanied by a cover letter with reference number.

Submittal Organization

Each test procedure description shall include the following information:

- A statement of the purpose of the tests.

- The location, date(s) and time(s) tests will be performed.

- The quantity of units to be tested.

- The test equipment to be used, identified by manufacturer and model number.

- A step by step description of the procedure to be performed.

- Specific pass/fail criteria for each test.

- A sample of the form(s) to be used to record test data. Each test form shall include the following information:

  a. Test title

  b. The manufacturer, model number and calibration date of each piece of test equipment.

  c. A table to record individual readings taken and inspections performed for each unit tested, identified by the serial number of the unit tested.

  d. An indication that the unit has passed or failed each individual test.

  e. A line for signature of the technician performing the test and date.

  f. A line for signature of the Project Manager and date.

  g. A line for signature of VSCDL representative witnessing the test.

  h. Drawings illustrating the configuration of the Equipment tested and all test equipment utilized.

Test Results

Content

One original and copies of the results of each test shall be submitted. The original of the test results shall contain the original test forms filled out by the technician(s) performing the tests and original signatures. Test forms shall be filled out in ink and no erasures shall be made.

Errors shall be crossed out with a single line and initialed by the person making the correction. Each set of test results shall be accompanied by a cover letter with reference number.

Organization

Each set of test results shall include the following information:

- The complete test procedures used.

- The completed, signed test forms.

- A summary of the test, indicating quantity tested, quantity that failed, quantities that failed each individual procedure, and a statement of the remedy to be applied for failed units.

AS-BUILT DOCUMENTATION

As-built documentation shall include drawings and software documentation. As-built documentation shall include:

- Design and Installation Plans of the On-Bus Subsystems for each Bus and Vehicle Type
- Design and Installation Plans of the Bus station Subsystem
- Design and Installation Plans of the Central Control Centre Subsystem
- Design and Installation Plans of the LAN and WAN.
- Design and Installation Plans of the Scheduling & Dispatch Subsystem
- Design and Installation Plans of the communication Subsystem
- Design and Installation Plans of the AVLS Subsystem
- Design and Installation Plans of the Passenger Information Subsystem

As Built Software Documentation

The Service provider shall provide all "Computer Software" and "Data" to allow VSCDL to fully maintain and update all "Applications Software". "Computer Software" and "Data" shall include as-built versions of ITM:

- Software Requirements Specification;
- Software Version Description Document, or equivalent;
- All "batch" or equivalent files, and all object libraries and "include" files, for editing, compiling, linking, and installing application software. Corresponding instructions shall also be provided;
- All files required to define, allocate, and load the database, and any other data files required to define, configure, load, or operate the system. Corresponding instructions shall also be provided.
- All protocols and interfaces used within ITMS project (Mandatory)

Copies of each document shall be submitted in electronic form (CD-ROM, DVD ROM or other media and in a format that is accessible by VSCDL) in order for it to be incorporated into VSCDL's Electronic Document Library.

Proposers shall explain, in detail, the documentation to be supplied, provide samples, and guarantee of content with proposals.

PROJECT CLOSEOUT

Project closeout shall include an initial survey and a final survey.

Initial Survey

Pre-Requisites

Prior to requesting an initial closeout survey of ITMS, the following conditions shall have been met:

- The systems acceptance test has been conducted.
- The Service provider has listed those items yet to be completed or corrected and has submitted a detailed plan of action and schedule for completion of the outstanding items.
- The Service provider has submitted special guarantees, warranties, maintenance agreements, final certifications and similar documents.
- The Service provider has obtained and submitted operating certificates, if required, final inspection and test certificates, and similar releases enabling full and unrestricted use of the work.
- The Service provider has submitted operations and maintenance manuals and final as-built documentation.
- The Service provider has delivered tools, including special tools, test equipment, standby equipment, and similar items.
- The Service provider has submitted all protocols, API's and interfaces used within ITMS

Conducting the Survey

Upon receipt of the request for initial survey, VSCDL will prepare a listing of any additional work items that are outstanding.

Final Survey

Pre-Requisites

The Service provider shall perform the Work necessary to complete and correct the items noted during the initial survey. The Service provider shall provide written notice to VSCDL that the items have been completed and ITM is ready for final survey.

Conducting the Survey

Upon receipt of the notice, VSCDL will schedule a final survey to verify that all of the Work items have been completed satisfactorily.

SYSTEM DELIVERABLES

ITM deliverables provided by the Service provider shall include all work required to deliver the System and System Components in accordance with this Specification and Agreement.

Manuals, Training, and Training Tools

The Service provider shall provide manuals, training, and training tools for the proper operation, maintenance, and repair of ITM equipment's and applications. Delivery of the manuals, training, and training tools shall be accomplished per the Service provider-provided and VSCDL-approved schedule.

Design Submittals

The Service provider shall provide preliminary and final design submittal packages, as well as individual design details for all elements specified herein. The Service provider shall provide detailed cut-over plans and procedures. All submittals shall be in both hardcopy and electronic format.

As Built Documentation

The Service provider shall provide As Built Documentation. Delivery of the As Built documentation shall be accomplished per the Service provider-provided and VSCDL-approved schedule. All as-built documentation shall be provided in both hardcopy and in electronic format.

Monthly Status Reports

Monthly status reports shall be submitted to VSCDL on the 7th of each month detailing the previous month's progress. The monthly status report shall contain a description of the activities and accomplishments, an updated schedule showing the progress, and any issues or concerns. Service provider format is acceptable.

Test Plans/Procedures and Test Results

Service provider shall provide all Test Plans/Procedures required for the ITM project and the Test Results. The Test Plans/Procedures and Test Results format shall be submitted to VSCDL for approval.

System Support

Prior to System Acceptance

Support for the maintenance and operation of installed ITMS subsystems shall be provided after incremental acceptance and prior to System Acceptance. It is VSCDL's intent to begin operating ITMS after completion of the first incremental acceptance.

- Support shall be provided on-site at VSCDL during testing and cut-over of Equipment on a continuous basis.

- Support for in-service ITMS Equipment shall be provided twenty-four hours per day, seven days per week. A request by VSCDL for assistance shall be answered within SLA parameters as required by VSCDL.

Post System Acceptance

The Service provider shall provide end-to-end support during the contract period as mentioned in part -1 of this RFP.

7.18.8. Quality Assurance

The Service provider shall submit to VSCDL within 07 days of the Notice-To-Proceed (NTP) or LOI a comprehensive Quality Assurance (QA) Program Plan designed to ensure the quality of all activities, including design, purchasing, inspection, handling, assembly, fabrication, testing, storage, shipping, and warranty/repair work. The plan shall describe all quality control procedures of the Service provider and any sub-suppliers. The Service provider shall conduct regular inspections in accordance with guidelines defined by the QA Program Plan. Project work shall not commence until the Quality Assurance and Control Plan relating to such Work has been accepted by VSCDL. The Service provider shall update the QA Program Plan as necessary, when any deficiencies in the Work are discovered.

VSCDL will, at its own discretion, perform QA monitoring of work done under this Contract, including monitoring of the Service provider's or Subservice provider's QA activities. Upon request, the Service provider's QA records shall be made available to VSCDL for inspection. Such QA activities performed (or not performed) by VSCDL shall not reduce nor alter the Service provider's QA responsibilities or its obligation to meet the requirements of this document.

At any time during the manufacturing process, VSCDL may choose to visit the Service provider's facility or a Subservice provider's facility during normal working hours to audit the manufacturing and quality control processes.

Technical Documents

A key component of the ITMS implementation is the accuracy and value of all deliverables. The technical documents prepared by the Service provider during the course of this project will include design reports, installation drawings, test plans, test reports, progress reports, and other technical memos. A review process shall be established by the Service provider to assure all System Components are checked for accuracy, correctness, uniformity, and compliance with standards of practice.

The various tiers of the review cycle are detailed below:

- The Service provider's Project Manager shall review project products for adherence to the standards of care common to the profession.
- The Service provider's Project Manager shall be responsible for assigning qualified professionals to check all work products for accuracy, uniformity, and clarity. Responsibility for interface, control, and integration of disciplines into a uniform and coordinated document set is also included in this role.
- The Senior Technical Staff Member and individuals assigned as technical discipline leaders within the Service provider team shall provide another review. The reviews shall be initiated by the Project Manager and shall focus on a technical discipline review of selected project products.
- VSCDL will provide a final review. This review will occur only after the Service provider's internal review cycles have been completed. When review comments result in a change to any technical document, the Service provider's Project Manager shall be responsible for change coordination and document back-check. In addition to the formal and on-going quality control review, timely coordination meetings with all project staff shall be held to provide for interdisciplinary liaison and interface coordination. These meetings shall be utilized to schedule work assignments, identify and resolve coordination issues, and track progress associated with any problems encountered and their resolution.

Document Management

Due to the substantial amount of documentation involved in this project, Service provider shall work with VSCDL's Project Manager to develop and submit to VSCDL a Documentation Management System (Open Source). The Document Management System shall include an organized electronic library of all versions of all submittals and a log of the contents. This shall be completed within 30 days after Notice-to-Proceed. VSCDL and the Service provider shall mutually agree on a documentation file index that shall provide an overall methodology for referencing documents generated in the course of the project. File type and organization of electronic versions of documentation shall be mutually agreed on by VSCDL and Service provider. All subsequent documentation shall be referenced to the file index, and Service provider and VSCDL shall mutually maintain the file index in current condition so as to show all documents that have been generated and their status.

Documentation in the DMS should be readily available to VSCDL's Project Manager, designated personnel within the Service provider's organization, ITMS Consultant, and VSCDL-designated additional personnel. Security methods shall be available to restrict access by others.

System Components

The Service provider shall conduct regular inspections and audits in accordance with guidelines defined by the QA Program Plan. The Service provider's Project Manager shall establish a quality assurance process and be responsible for assigning qualified professionals to check all system Components for compliance with the ITMS Specifications and consistency in production quality. This quality assurance program shall supplement the formal testing requirements to verify that:

- Prior to installation, all System Components delivered by the Service provider shall pass rigorous screening that complies with standards of practice.
- All delivered System Components shall be tested after installation. Testing shall include hardware and software interface tests.

Manufactured Products

The Service provider shall utilize products manufactured by companies that utilize formal, documented quality assurance practices that meet or exceed the standard of care established by the industry. The Service provider shall proactively monitor each supplier's quality system. Quality systems that conform to ISO/CMMI practices are preferred or as may be relevant to product type by international standards.

MANUALS

This section identifies the manuals to be provided to support training and give on-going documentation needed for VSCDL staff to manage, maintain, and expand the ITMS.

GENERAL REQUIREMENTS FOR MANUALS

Development Process

The Service provider shall prepare a complete plan for providing the manuals described herein.

The plan shall include at least the following:

- Service provider shall submit for approval the outline of each manual as a part of the Preliminary Design Review.
- Service provider shall develop and submit a draft version of each manual submitted with the Final Design Review.
- Service provider shall deliver one complete set of manuals prior to the start of the acceptance testing.
- Service provider shall incorporate information gathered during installation and acceptance testing, throughout the maintenance and warranty period into the manuals for the updated and final submittals.

Content

Manuals shall contain all of the information material required to support the area of activity.

All Manuals

All manuals shall:

- Be in concise form, with minimal redundancy.
- Be organized in clear, logical fashion, and indexed and tabbed for rapid access.
- Be in English.
- Be written for comprehension by persons with a high school education.
- Contain table of definitions for all abbreviations and special terms.

All Operations Manuals

All operations manuals shall contain:

- Instructions on navigation from one function to another.
- The meaning of all display symbols and labels.
- The meaning and interpretation of all alarms and messages, and the recommended remedial action for each alarm and message.
- A reference card defining each cursor command, control key, and status indication.

All Equipment Maintenance Manuals

All Equipment maintenance manuals shall contain:

- A section on safety procedures and precautions necessary to prevent damage to equipment, injury to personnel, and unsafe operational conditions.
- A section with an overview of the test equipment and tools necessary to troubleshoot and maintain ITMS equipment's.
- Wiring diagrams and physical layout drawings for all equipment
- A section addressing the intervals and procedures for all preventive maintenance including level adjustments and cleaning.

Medium and Formats for Delivery

Hardcopy

The Service provider shall deliver to VSCDL the manuals for all sub-systems in hardcopy form, with appropriate binding and labeling.

Manuals shall be designed for continuous, long-term service in a maintenance shop or vehicle environment.

- Manuals shall lie flat when opened
- Pages shall be printed on both sides.
- Manuals shall permit adding and replacing pages.
- Covers shall be oil, water, and wear resistant.

Softcopy

In addition, the Service provider shall deliver to VSCDL in electronic form all manuals and manuals components that are developed by the Service provider, or by vendors in response to the requirements of this Contract.

- The electronic form shall consist of two good copies of each final manual on an electronic storage medium (CD-ROM or other approved media).
- The format of the storage medium shall be one that is widely used and easily available to VSCDL.
- The manuals shall be stored as MS Word, Portable Document File, or other VSCDL-approved format.

BUS OPERATORS MANUAL

The Service provider shall provide a manual for bus operators. The manual shall provide a clear and concise description of operator interface with ITMS and related VSCDL operating policies and procedures. It shall include:

- Overview of the ITMS System
- On-Bus Subsystem Description

- How the Bus Operators are to perform all communications and bus fleet management functions provided at the Bus Driver Console.
- Procedures for wireless calls.
- Procedures for sending canned messages and receiving text messages.
- Procedures for SOS.
- Procedures for logon/logoff.
- Help guide for functional failures and problems.
- Pocket size Reference Card.

SUPERVISOR MANUAL

The Service provider shall provide a manual for supervisors. The manual shall provide a clear and concise description of supervisor interface with ITMS and related VSCDL operating policies and procedures. It shall include:

- Overview of the ITMS System
- On-Bus Subsystem Overview
- Procedures for radio calls using mobile or as applicable.
- Procedures for sending and receiving text messages.
- How the supervisors are to perform all communications and bus fleet management functions provided at the BCC.
- Help guide for functional failures and problems

DISPATCH CENTER DISPATCHER AND SUPERVISOR MANUAL

The Service provider shall provide a manual for Dispatch Center dispatch supervisor, dispatchers, and supervisors performing dispatch duties. The manual shall provide a clear and concise description of the ITMS operator interface for Dispatch Center dispatchers and supervisors for all console functions provided, including normal call, messaging, and schedule and route adherence functions. It shall include:

- ITMS Overview
- On-Bus Subsystem Overview
- CAD Subsystem Description
- How the dispatchers and supervisors are to perform all communications and bus fleet management functions provided at the dispatcher consoles.
- How the Dispatch Supervisor can assign work assignments.
- How to manage work assignments, the work queue, and incident reports at their various stages.
- How to perform rudimentary remedial action for limited-scope failures, including: shutting down and restarting console processors, shutting down and restarting console-based software processes, and replacing printer paper, restarting printers, restarting printer queues.

Depot SUBSYSTEM USER MANUAL

The Service provider shall provide a manual for users of the depot Subsystem. The manual shall provide a clear and concise description of the ITMS operator interface for depot Subsystem users for all console functions provided, including:

- ITMS Overview
- Depot Subsystem Description
- On-Bus Subsystem Overview
- How the Depot Subsystem functions are provided.
- How the Depot Subsystem users are to perform all communications and fleet management functions provided at the depot Subsystem workstations.

- How to perform rudimentary remedial action for limited-scope failures, including: shutting down and restarting console processors, shutting down and restarting console-based software processes, and replacing printer paper, restarting printers, restarting printer queues.

VEHICLE COMMUNICATIONS MAINTENANCE MANUAL

The manual shall provide a logical structure and organization for the maintenance manuals provided by the manufacturers of the On-Bus subsystem communication equipment, and shall provide any necessary information to supplement them to fulfill the requirements of this section. Manuals shall include the following topics, as a minimum:

- ITMS Overview,
- On-Bus Subsystem Description
- Communication Subsystem Description
- How to identify the source of a problem to a specific replaceable element. Provide a logical procedure for isolation a problem.
- How to replace an element. Provide detailed procedure, or reference to a manufacturer manual detailed procedure, for removal and replacement of each on bus subsystem element. This shall include setting and verification of options, programming, and testing of the replaced unit and associated equipment to verify correct On-Bus subsystem operation.
- Verification of correct operation of the repaired on-bus subsystem.

FIXED COMMUNICATIONS MAINTENANCE MANUAL

The fixed communications and radio subsystem maintenance manual shall complement the maintenance training provided. The manual shall supplement the maintenance manuals provided by the manufacturers of the fixed radio subsystem equipment. The manual shall provide a logical structure and organization for the maintenance manuals provided by the manufacturers of the On-Bus subsystem radio equipment, and shall provide any necessary information to supplement them to fulfill the requirements of this section. Manuals shall include the following topics, as a minimum:

- ITMS Overview
- Radio Subsystem Functional Description
- System diagnostic procedures
- Identification of the source of a problem to a specific replaceable element, provide a logical procedures for isolating a problem. Provide a description of self-diagnostic features and system administrator reports.
- How to replace an element. Contain detailed procedure, or reference to a manufacturer manual detailed procedure, for removal and replacement of each fixed radio subsystem element.
- Verification of correct operation of the repaired radio subsystem. Include instructions for setting and verification of options, programming, and testing of the replaced unit and associated equipment to verify correct operation.
- This requirement shall apply only if the Service provider provides the fixed data radio system.

IN-VEHICLE EQUIPMENT MAINTENANCE MANUAL

The manual shall focus on guiding technicians in verifying the presence of a failure and performing first echelon replacements. Manuals shall include the following topics, as a minimum:

- ITMS Overview
- On-Bus Subsystem Functional Description
- Identification of the source of a problem to a specific replaceable element, provide a logical procedures for isolating a problem. Provide a description of self-diagnostic features.

- How to replace an element. Contain detailed procedure, or reference to a manufacturer manual detailed procedure, for removal and replacement, and verification of first echelon replaceable elements.
- Verification of correct operation of the repaired On-Bus Subsystem. Include instructions for setting and verification of options, programming, and testing of the replaced unit and associated equipment to verify correct operation.

DISPATCH CENTER AND Depot WORKSTATION MAINTENANCE MANUAL

The manual shall focus on guiding technicians in identifying the source of a problem to a specific replaceable element, replacement of the element, and verification of correct operation of the repaired subsystem. Manuals shall include the following topics, as a minimum:

- ITMS Overview
- CAD Subsystem Functional Description
- Depot Subsystem Functional Description
- Identification of the source of a problem to a specific replaceable element, provide a logical procedures for isolating a problem. Provide a description of self-diagnostic features and reports.
- How to replace an element. Contain detailed procedure, or reference to a manufacturer manual detailed procedure, for removal and replacement or repair of an element.
- Verification of correct operation of the repaired ITMS Workstations and Dispatch Center equipment. Include instructions for setting and verification of options, programming, and testing of the repaired unit and associated equipment to verify correct operation.

COMPUTER SYSTEM ADMINISTRATOR MANUAL

The Service provider shall provide a system administrator's manual that provides a clear, organized description of all of the configurable computers of ITMS, the tools and procedures for managing their configuration, and for diagnosing their performance and problems. It shall contain at least the information described below.

Fleet Management Reporting

This section shall provide details on the standard reports that are automatically generated by ITM and instructions on how to perform custom queries to generate ad-hoc reports.

ITMS Computer Configuration

The configuration section shall contain at least:

- A high level and detailed description of computer configurations and interfacing equipment at the Dispatch Center, bus depots, fixed communication site(s), mobile units, configuration of ITM LAN/WAN logical and physical entities, and connections to VSCDL LAN/WAN.
- Description of operation of interfaces to connected systems (VSCDL LAN/WAN, Vehicle Health System, depot Subsystem.)
- A listing and functional description of software components for each computer.

Configuration Management and Operation

The Configuration Management and Operation section shall contain at least:

Procedures and tools for defining ITMS users, function access and privileges, and console function assignments.

Computer startup, interconnected systems communications restart, and shutdown procedures.

Overview and details of procedures and tools for installing and verifying new software and rolling back old software for Dispatch Center, Computer Subsystem, Depot Subsystem, fixed communication site(s), and mobile units.

Monitoring, maintaining, archiving, and restoring the ITMS database.

Maintaining, updating AVLS databases.

- Procedures for modifying the Route and Stop databases.
- Procedures for importing updated route and schedule databases.
- Monitoring, analysis, and optimization of computer/LAN/WAN performance

Manual shall include procedure for configuring ITMS for each separate fleet, setting access privileges for VSCDL personnel and VSCDL service provider personnel.

Diagnostics and Troubleshooting

The Diagnostics and troubleshooting section shall contain at least the following:

- Equipment and operating system error messages and diagnostics, with remedial action for each.
- Tools and procedure to troubleshoot equipment and software problems on all ITM equipment
- Procedures to manage and diagnose interfaces with connected systems.

COMPUTER SOFTWARE MAINTENANCE MANUAL

The Service provider shall provide a programmer's guide for each of the programmable computers in ITM. For each, the guide shall:

- Provide an overview of software organization.
- Provide internal / external interfacing data format, semantics, and protocols for all the equipment's, software and hardware supplied.
- Define internal modules, data interfaces, tasking, and considerations for timing, priorities, and resource use.
- Identify and detail use of programming and database maintenance tools used to create the software.
- Include complete documentation of non-application components such as operating system, communications handlers, database, and report generators.
- Detail the procedures for building and managing software configuration.
- Describe the metrics embedded in ITM to evaluate its performance.
- Identify the error conditions detected within the software, and the messages or indications for those conditions.
- Identify parameters used to adjust ITM operation

7.19. CCTV Cameras in Bus Stops & Buses, and Mobile DVR in buses

Functional Requirement of the overall Surveillance System can be categorised into following components:

1. Information to be Captured by Edge Devises

2. Information to be analysed at Command Centre
3. Role Based Access to the Entire System
4. Storage / Recording Requirements
5. Other General Requirements

7.19.1. Information to be captured by CCTV camera in buses

Surveillance Cameras being one of the core sub modules of project, it is important that their selection and placement is carefully done to ensure the maximum coverage. These cameras need to work on 24 X 7 basis and record quality video feeds in the Mobile DVR

Sr No	CCTV Camera operations (Fixed)	FPS	Resolution
1	Normal time / Day time – 18 hours	15	1920x1080
2	Less movement time / Night time – 8 hours	8	1920x1080

However, VSCDL authorities may take the regular review of the requirements for video resolution, FPS and may change these numbers to suit certain specific requirements (for example, there could be a situation when certain cameras are required to be viewed at higher FPS for specific period. It is estimated that not more than 5% of the cameras would be required to be viewed at higher FPS at a given point of time). Video feeds will be stored as per following:

Central Storage

Sr No	Type of Storage	DC Storage for days	DR storage for days
1	Primary Storage	7 for CCTV feeds,	7 days, flagged feeds/incident only

The CCTV video feeds from mDVR shall be automatically transferred to a Receiving System (A desktop with wireless/Network Adapter to copy the feeds) at the Bus Control Room. This operation shall be performed automatically, whenever bus is positioned at the receiving station. The CCTV feeds shall be flashed (cleared), after confirming that those feeds have been copied into the Central Storage, as specified above

It is recommended to clearly identify in SLAs that cameras need to transmit quality video feed (appropriately focused, clear, un-blurred, jitter free, properly lit, unobstructed, etc.). Packet loss is to be less than 0.5 percent.

7.19.2. Information to be analysed at Bus Control Centre

#	Minimum Requirements	Bidder Compliance(Yes/No)
1	The proposed Video Management System should provide a complete end-to-end solution for security surveillance application. The control centre shall allow an operator to view live / recorded video from any traffic surveillance camera on the IP network.	

	The combination of control centre and the IP network would create a virtual matrix, which would allow switching of video streams around the system	

7.19.3. Role Based Access to the Entire System

Various users should have access to the system using single sign on and should be role based. Different roles which could be defined (to be finalized at the stage of SRD) could be Administrator, Supervisor, Officer, Operator, etc. Apart from role based access, the system should also be able to define access based on location. Other minimum features required in the role based authentication systems are as follows:

#	Minimum Requirements	Bidder Compliance(Yes/No)
1	The management module should be able to capture basic details (including mobile number & email id) of the Police Personnel & other personnel requiring Viewing / Administration rights to the system. There should be interface to change these details, after proper authentication.	
2	Rights to different modules / sub-modules / functionalities should be role based and proper log report should be maintained by the system for such access.	
3	Biometric standardized coupled with login name & password should be enabled to ensure that only the concerned personnel are able to login into the system	
4	There should be provision to specify hierarchy of operators / officers for control of the cameras from various locations.	
5	The number of users shall increase as per phase wise implementation. SI is expected to estimate and provision the same based on the phase wise requirements given in RFP. Windows Active Directory/LDAP or any such system can be used to design role based access.	

7.19.4. Storage/Recording Requirements

It is proposed that the storage solution shall be modular enough to ensure compliance to the changes in storage / recording policy, to be evolved upon initial deployment of the system. The following storage requirements shall be fulfilled by the SI as scope for the project:

a) 30 days of storage (7 days on primary) for all Bus CCTV camera feeds

b) Data on storage would be over-written automatically by newer data after the stipulated time period. If some data is flagged by police personnel (or by designated personnel) as important data / evidence data due to some reporting of crime or accident in the area or due to court order or due to suspicious activity, it would need to be stored for longer duration, as per requirements. VMC/VSCDL/Vadodara Police would analyse such flagged data every 3 months to take such decisions for preservation of the flagged data beyond 90 days.

c) Full audit trail of reports to be maintained for 90 days.

Please refer **Annexure III** of this document of Tender for specifications for storage.

#	Minimum Requirements
1	Retrieval time for any data stored on secondary storage should be max. 4 hours for critical data & 8 hours for other data.
2	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.
3	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.
4	The system shall support H.264 or better, MPEG-4 and MJPEG compression formats for all analog cameras connected to encoders and all IP cameras connected to the system.
5	The system shall record the native frame rate and resolution supplied by the camera or as configured by the operator from the system administration server.
6	The system should not limit amount of storage to be allocated for each connected device.
7	The on-line archiving capability shall be transparent and allow VSCDL/VMC/Police to browse and archive recordings without the need to restore the archive video to a local hard drive for access.
8	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.
9	The system shall support archiving or the automatic transfer of recordings from a camera's default database to another location on a time-programmable basis without the need for user action or initiation of the archiving process. Archiving shall allow the duration of the camera's recordings to exceed the camera's default database capacity. Archives shall be located on either the recording server or on a connected network drive. If the storage area on a network drive becomes unavailable for recording the system should have the ability to trigger actions such as the automatic sending of email alerts and sound alerts to necessary personnel.
10	The Recording Server / System shall offer different codec (H.264, MJPEG, MPEG-4, etc.) frame rate & Resolution (1080P, 960P, 720P, 4CIF, CIF, QCIF) options for managing the bandwidth utilization for live viewing on the Client systems. (through use of multiple systems such as transcoding server)

7.19.5. Other General Requirements

Management/Integration functionality

#	Minimum Requirements
1	The Surveillance System shall offer centralized management of all devices, servers and users.

#	Minimum Requirements
2	The Surveillance System should not have any limit on the number of cameras to be connected for Surveillance, Monitoring and recording. Any increase in the no. of cameras should be possible by augmentation of Hardware components.
3	The Surveillance System should have ability to knit the video streams from multiple cameras, based on the date/time stamp. Every video stream shall have date, time, source camera location, FPS etc. water-marked. These attributes shall be finalized at the System Design time. There shall be a centralized NTP server, from which all devices shall synchronize the date and time.
4	The Surveillance System shall support distributed viewing of any camera in the system using Video walls or big screen displays.
5	The Surveillance System shall support alarm management. The alarm management shall allow for the continuous monitoring of the operational status and event-triggered alarms from system servers, cameras and other external devices.
6	It should be possible to integrate the Surveillance System with 3rd-party software, to enable the users to develop customized applications for enhancing the use of video surveillance solution. For e.g., integrating alarm management to initiate SMS, E-Mail, VoIP call etc.
7	It should be possible to integrate social media platforms to Surveillance System to enable VSCDL/VMC/Police to track and monitor certain trending incident or crime.
8	The Management system shall store the overall network elements configuration in central database, either on the management server computer or on a separate DB Server on the network.
9	System should be able to be integrated with Event Management / Incident Management System, if implemented by VSCDL/VMC/Police in future.
10	From the VSCDL/VMC/Police, 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.
11	The Recording Server / System shall support camera (analogue and IP cameras) devices from various manufacturers.
12	The Recording Server / System shall support the PTZ protocols of the supported devices listed by the camera OEMs.
13	The system shall support full two-way audio between Client systems and remote devices. (Audio from certain set of cameras can be recorded in future).
14	
a.	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. Recordings shall be synchronized back to the original recording server once it is back online.
b.	The system shall support multiple failover servers for a group of recording servers.
15	

#	Minimum Requirements
a.	The system shall support Simple Network Management Protocol (SNMP) in order for third-party software systems to monitor and configure the system.
b.	The system shall act as an SNMP agent which can generate an SNMP trap as a result of rule activation in addition to other existing rule actions.

Rules

The system shall support the use of rules to determine when specific actions occur. Rules shall define what actions shall be carried out under specific conditions. The system shall support rule initiated actions such as:

#	Supported Rules
1	Start and stop recording
2	Set non-default live frame rate
3	Set non-default recording rate
4	Start and stop PTZ patrolling
5	Send notifications via email
6	Pop-up video on designated Client Monitor recipients

Client System

The Client system shall provide remote users with rich functionality and features as described below.

#	Functionality
1	Viewing live video from cameras on the surveillance system
2	Browsing recordings from storage systems
3	Creating and switching between multiple of views.
4	Viewing video from selected cameras in greater magnification and/or higher quality in a designated hotspot.
5	Controlling PTZ cameras.
6	Using digital zoom on live as well as recorded video.
7	Using sound notifications for attracting attention to detected motion or events.
8	Getting quick overview of sequences with detected motion.
9	Getting quick overviews of detected alerts or events.
10	Quickly searching selected areas of video recording for motion (also known as Smart Search).

Other Miscellaneous Requirements

#	Minimum Requirements
1	System should have a facility to create CDs or other storage media for submission to Judiciary, which can be treated evidence for legal matters. Such storage media creation should be tamper proof and SI to provide appropriate technology so that integrity and quality of evidence is maintained as per requirements of the judiciary. Bidder is required to specify any additional hardware / software required for this purpose & the same can be listed in miscellaneous section of the commercial bid. SI will also prepare the guideline document to be followed by the Police Personnel for the retrieval of Video / images from the CCTV System so as to maintain integrity of the evidence. Such

#	Minimum Requirements
	a guideline document should include methods of retrieval of data, check-list to be followed and flowchart of the entire process to be followed.
2	Video clips should be converted into .AVI file which can be used by the Police as an evidence
3	All the systems proposed and operationalization of Video Management System should comply with requirements of IT Acts.
4	Any hardware or software required to achieve the functional requirement and technical solution of the overall Project (may not be not specified in the schedule) is to be proposed in the Bid and borne by the SI.
5	Surveillance System being implemented a part of this project, and ensure that all the necessary access is given to these mobile users. Functionalities to be provided through mobile application: Viewing of any video steam from Central VMS, uploading of video / pictures central VMS, Location based GIS Map access, tagging of mobile device/location information for all relevant functionalities.

7.20. Integration of ITMS with CCC

#	Projects	Activity/Component of ITMS System	Integration with CCC
1	One Vadodara Mobile App	Mobile App for Transit (for citizen and commuters)	Mobile App integration
2	SmartCity Websites	Transit Portal for (for citizen and commuters)	Integration of Transit portal with smartcity website
3	Integrated CCC Project	ITMS Applications as defined in this RFP	Integration with CCC Solution (IBM IOC), including GIS Integration

8. *Annexure IV- Technical Specification of Hardware*

Existing Equipment in City Buses (Procured / Rented by Bus Operator)

The Bus Operator, commissioned by VSCDL, has procured following major IT Solutions as part of existing Projects. In order to maintain homogenous and integrated environment, the selected bidder is required to integrate the same with offered solution. There shall not be any degradation of features/facilities of the existing systems

#	Equipment	Make and Model	Remarks
1	GPS Unit in Buses	CB0399 from Lerepere (OEM unit Teltonica FM1202	Currently Buses are being tracked on www.lerepere.com
2	PIS Displays in Buses type 1	Chemito BDC720, BD720	The bus operator has been asked to provide PIS Displays as per Urban Bus Specs II
3	PIS Displays in Buses type 2	Power Electronics	The bus operator has been asked to provide PIS Displays as per Urban Bus Specs II

8.1. Bus Driver Console and OBU

Note : This should work with GPS unit and PIS Displays installed in existing buses.

Sr. No	Minimum Specifications
Functionality	
	Acquire data related to the bus real-time scenarios and transmit it to the control centre.
	Fetch driver demands to the control centre and send them through the communications system.
	Receive messages and voice communications from the CCC controllers.
	Data received from OBU shall provide following (this is minimum list and actual list may vary depending on requirement finalization):
	Geographic position of the bus, calculated with the GPS receiver and odometer data if available 'CAN BUS'.
	Service related data: driver number, line, route etc.
	Real-time Stop information.
	Current speed.
	Bus ignition status.
	The BDC shall provide functions for drivers to login / log-off, read predefined messages, read messages received form control centre, voice call request, volume control etc.
	The bus driver console shall provide facility for drivers to send information to control centre like call initiation, Message retrieval, vehicle stoppage, detour information, occupancy, medical help, accident info, service requirement etc.
Architecture	
	The architecture defines the overall inter connectivity of the different sub system inside the vehicle, communication within the sub systems and

	connectivity to the backend solution for the transmission of the real time vehicle information. It shall consists of following sub systems
	i Passenger information system (PIS) On-Bus
	ii Automatic vehicle location system (AVL) On –Bus
	iii Controller and Bus Driver Console-On Bus
Controller and BDC architecture	
Usability/Functionality/Capability	
	a Provide the driver/user interface/display on BDC
	b Control PIS functionality as specified elsewhere in the document
	c Provide two-way voice and data link with control centre to communicate data and information.
	d The link will be based on open public communications network services 3G (GSM) with downward compatibility with 2G
	e Provide audio interface to the driver's microphone and earpiece or speaker using wired link to Controller
	f BDC ,on a selectable ‗menu‗ will have ‗panic‗ options‗ for communicating pre-configured messages to control centre
	g BDC should provide Mic and speaker system for manual announcement.
	h It should be possible to transmit to CCC : Device IMEI, SIM No., Driver ID, Conductor ID, Panic Button (E) pressing, Ignition on/off, Door Open Close, Battery Volts any other.In case of Electronic engine it should also transmit: Vehicle Speed, Engine RPM, Engine Coolant temperature, Engine Oil Pressure, Accelerator Pedal position(%).. In case of Automatic Transmission it should also transmit :Transmission sump oil temperature, Transmission oil level, Transmission service indicator
	i It should be able to provide Time Table related information to the Driver and CCC
	j Two way communication with central control centre (CCC) via Controller
	It should be possible to change/choose/select a 'route' remotely over the air from back office and provide current route information to back office
	It should be possible to transmit ad-hoc messages (English) from back office to internal sign.
	k To comply with test standards– attached below
37Technical specifications: Controller	
	a Processor : 32 bit minimum
	b Operating system: embedded Windows/Linux with programming software
	c Memory : flash: 2 GB minimum, RAM 512 MB minimum (RAM memory includes SCU and BDC)
	d Interface : As required for the functionality
	e Interface protocols :as specified elsewhere in this document
	f In built GPS and 3G(GSM) modules
	g Combi antenna
	h In built /external two channel amplifier minimum 10 Watts rms each suitable for 4 ~8 Ohm impedance with input for external microphone
	i In-built MP3 files storage/playback function.
	Technical Specifications: BDC
	a Display
	i Size 5.7‖ diagonal minimum

	ii Full color graphic TFT-640 x 480 dots minimum, capable of showing minimum 20 lines in English.
	iii Viewing angle (horizontal) 70°/70° (right/left)/ (vertical) 60°/60° (up and down)
	iv Adjustable back lighting
	b Key board :4 keys minimum
	Technical specifications: GPS modules
	a Tracking sensitivity :-165 dBmtyp
	b Navigation sensitivity ; -148 dBmtyp
	c Update rate I Hz (configurable to 10 Hz)
	d Time to first fix cold acquisition 35-42 seconds typ
	e Hot acquisition 1-2 second typ.
	f Navigation accuracy 3M horizontal
	Technical specifications: 3G(GSM) modules
	a GSM/GPRS SMT quad band and UMTS (3G)
	b Temperature range -15°C to +80°C
	Technical specifications: 'Combi' Antenna
	a AMPS 850MHz, GSM900MHz, DCS1800MHz, PCS1900MHz, 3G UMTS 2.1GHz, GPS (1575.42MHz).
	b GPRS
	i Impedance 50 Ohm
	ii Radiation pattern Omni-directional
	iii Polarization linear (vertical)
	c GPS
	i Impedance 50 Ohms
	ii VSWR <1.5:1
	iii Polarization RHCP
	d Waterproof IP-66
	e Temperature range -15°C to +80°C
	f RG174 cable
	Fitment on bus
	a All equipment including wiring harness, antennas to be original factory fitment.
	b Front, side, rear signs should be mounted with a gap with the glass so that the glass on signs and of the bus can be cleaned by swiping
	All equipment should be fitted in a way to minimize unintentional damage, shielded from direct engine heat, protected from water splash and dust.
	d All cables need to be properly anchored
	e Others:
	i Front sign: central
	ii Rear sign: central
	iii Side sign: first window ahead of rear door (central line of sign should coincide with central line of window)
	iv Inner sign: centralize along the width of bus behind the driver's partition
	v Speakers with protective grill : one each near the doors and others equally distributed across the length of the bus- Total no. 4
	vi Controller, recorder, amplifier : secured and ventilated compartment right above the driver
	vii BDC: ergonomically placed for driver ease
	viii Camera: as specified else where

	ix Combi antenna: suitable place to define inside the bus (preferably) with direct line of view for 'affixing' the unit.	
	Communication amongst sub systems a 'Signs' to 'SCU'/'BDC' RS 485	
	b Controller to 'BDC' Ethernet/DVI/VGA/HDMI/RS232/RS485 as required.	
	Approvals	
	a The notified agencies, as under rule number 126 of CMVR, will be responsible for approvals and certification of the system as defined above.	

8.2.   GPS Unit for City Bus/Other Vehicles

#	Parameter	Minimum Specifications
1.	Unit Type	Basic GPS Controller with GPRS , with Display
2.	GPRS Connectivity	Quad Band GSM/GPRS or Higher Modem GSM, GPRS, UMTS (3G) External/ Internal SIM card must be provided
3.	GPS Acquisition	Cold Start<55 sec
		Hot Start < 10 sec
4.	GPS Receiver Channels	Minimum 16
5.	GPS Sensitivity	Tracking -165 dBm
		navigation -148 dBm
		Acquisition -142 dBm
6.	Antenna	Internal Active Antenna for GPS and GPRS
7.	Horizontal Position Accuracy	3 Meters
8.	GEO Fence	User settable Distance range, SMS alert packet when out of Geo-fence
9.	Over speed	User Settable Speed limit, SMS alert packet when speed cross over speed limit (maximum 180 kmph)
10.	Movement control	100 metre range, SMS alert packet when vehicle moves out of movement area
11.	Parameters Setting Through SMS	APN, live ip1, live ip2, unit id, server reconnect frequency, server_change frequency, reset odometer, geofence control, over speed control, movement control , sms serving numbers, UTC time configuration, factory setting, digital output control, memory data erase
12.	GPS Track Recording and Resending	Built in adequately large flash memory to store data when out of GPRS radio coverage
		Automatically resend Non- GPRS coverage data when device goes into GPRS coverage
13.	Ignition status	ON/OFF status
14.	Power Supply	External Power & Internal Battery
15.	Internal Battery	Should provide GPS data for at-least 4 hours when external power supply is disconnected.
16.	Battery Status Indication	Battery Health indication

17.	GPS based Speed measurement Range:	up to 120 KMPH
18.	GPS based Odometer	Required
19.	Factory setting	Switch for default factory setting
20.	Data send frequency settable	Adjustable interval of 8 seconds or more, NMEA protocol
21.	LED status	Power
22.	USB for parameter configuration	Required
23.	Multi IP connection two server	Primary, Secondary (mandatory)
24.	AGPS supported	Required
25.	Operating Temperature	0°C to +70°C
26.	Humidity	95% non-condensing
27.	Protection	IP 40 Minimum

8.3. Mobile NVR for buses

#	Minimum Specifications
1.	1 DIN Standard Size
2.	Shock Absorbent Design
3.	1 x 2.5 inch Hard disk (1 TB), 1 Memory card (
4.	Wifi module (802.11 b/g/n supported, 2.4GHz)
5.	4 Channel Realtime H.264 encoding, 25 fps
6.	25 fps
7.	Signals, Ethernet and USB Interfaces
8.	0 to 55 C working temperature

8.4. Fixed Minidome camera for buses and Bus Stops

#	Parameter	Minimum Specifications or better
1.	Video Compression	H.264
2.	Video Resolution	1920 X 1080, 4MP
3.	Frame rate	Min. 25 fps
4.	Image Sensor	1/3" Progressive Scan CMOS
5.	Lens	Internal 2.8mm-12mm HD motorized zoom lens
6.	Minimum Illumination	Colour: 0.01 lux, (at 30 IRE)
7.	Day/Night Mode	IR-Cut Removable (ICR) Filter for Day/Night switching
8.	S/N Ratio	≥ 50 Db
9.	IR	30 meter IR

10.	Wide Dynamic Range	True WDR up to 100 db
11.	Audio	Full duplex, line in and line out, G.711, G.726
12.	Local storage	microSDXC memory card of 32GB (Class 10) In the event of failure of connectivity to the central server the camera shall record video locally on the SD card automatically. After the connectivity is restored these recordings shall be automatically merged with the server recording such that no manual intervention is required to transfer the SD card based recordings to server.
13.	Protocol	HTTP, HTTPS, FTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, ONVIF Profile S
14.	Security	Password Protection, IP Address filtering, User Access Log, HTTPS encryption
15.	Intelligent Video	Motion Detection & Tampering alert
16.	Protection	IP66 and IK10
17.	Operating conditions	0 to 50°C
18.	Casing	IP66 and IK10 rated
19.	Certification	UL/EN, CE, FCC Certifications
20.	Power	802.3af PoE (Class 0) and 12VDC/24AC

8.5. PTZ Camera for Bus Terminal

#	Parameters	Minimum Specifications or better
1.	Video Compression	H.264
2.	Video Resolution	1920 X 1080, 2MP
3.	Frame rate	Min. 25 fps
4.	Image Sensor	1/3" OR ¼" Progressive Scan CCD / CMOS
5.	Lens	Auto-focus, 18 X Optical Zoom, 16X Digital Zoom
6.	Minimum Illumination	Colour: 0.05 lux, B/W: 0.01 lux (at 30 IRE, F 1.2) or better
7.	Day/Night Mode	Colour, Mono, Auto
8.	Wide Dynamic Range	True WDR up to 100 db
9.	S/N Ratio	≥ 50dB
10.	PTZ	Pan: 360° endless/continuous, 450°/s (auto), 0.1 to 350°/s (Manual) Tilt: 180° auto flip, 0.2 to 100°/s (Auto), 0.1 to 180°/s (Manual) Pre-set tour 255 preset positions, Tour recording
11.	Auto adjustment + Remote Control of Image settings	Colour, brightness, sharpness, contrast, white balance, exposure control, backlight compensation, Gain Control, , Electronic Image Stabilisation

12.	Protocol	HTTP, HTTPS, FTP, RTSP, RTP, TCP, UDP, RTCP, DHCP, ONVIF Profile S & G
13.	Security	Password Protection, IP Address filtering, User Access Log, HTTPS encryption
14.	Local Storage	microSDXC memory card of 64GB (Class 10) In the event of failure of connectivity to the central server the camera shall record video locally on the SD card automatically. After the connectivity is restored these recordings shall be automatically merged with the server recording such that no manual intervention is required to transfer the SD card based recordings to server.
15.	Intelligent Video	Motion Detection & Tampering alert
16.	Alarm I/O	Minimum 1 Input & Output contact for 3rd part interface
17.	Operating conditions	0 to 50°C
18.	Casing	NEMA 4X / IP-66 rated & IK10
19.	Power	802.3at PoE+ (Class 4) or 24VDC/24AC
20.	Certification	UL/EN, CE, FCC Certifications

8.6. 3G/4G Router with built-in Switch at bus Stops

#	Parameter	Minimum Specifications
1	Type	Managed 3G/4G Branch Router with Switch ports
2	WAN Port	One 10/100 Mbps Ethernet
3	Wireless Connectivity	• 4G, 3G Connectivity • Dual SIM support
4	LAN Ports	• 4-port 10/100-Mbps managed switch With Two Power over Ethernet (PoE) ports
5	Memory	• Minimum 1 GB DRAM
6	Protocols	• IPV4,IPV6 • Support 802.1Q VLAN • DHCP support • IGMP • SNMP Management
7	Security	• Support IPSec • Support 3DES • Support AES
8	Operating Temperature	0 -50 C or better Industrial Grade Rating
9	Management	Console port for management via a console terminal or PC
10	Compliance	UL, EN, IEC

8.7.   Bus Stop PIS Display Unit (2 Rows)

Parameter	Minimum Specifications
Configuration	
Display Size	Two horizontal LED panels, joined horizontally Size of each display : As per following 1 900 mm x 210 mm 2 900 mm x 210 mm
LED Parameters	
Type of LED	Diffused lens 4 mm (minimum)
Colour	Amber colored LED
Wavelength	Wave length 591~595nm
Viewing distance	30 meters, for single line text, in day and night
Viewing Angle	120°H / 60°V
Readability	Ensure readability with full clarity (no jitter) on scrolls and long life usage
Light Sensor	In-built light sensor with continuously variable brightness control to enable the display intensity to change based on ambient light conditions
Usability/Functionality/Capability	
Graphics	Alphanumeric text with customized graphic capability
Language	English, Hindi, Gujarati
Messages	Fixed, scrolling and flashing mode Display of Stop Name, ETA of bus with bus route number Display public service information / adhoc messages Current date and time
Memory	Ability to retain the last message displayed in the memory of the sign even in the event of power failure and without the message being reloaded.
Standard compliances and Cabinet/Structure	
Design	Light weight structure with toughened glass at the front side Antitheft and anti-vandalism proof
IP Projection	IP66
Protection	The Display unit to be mounted inside an anti-theft and anti-vandalism proof Enclosure
EMI/EMC	Test complied as per – AIS004 Part 3
Temperature	Operating Temperature 0 to 50 Degree C
Humidity	0 to 95% RH
Usage	24x7x365 usage
Communication	
Data	Through GPRS (SIM based) or Local LAN port (to be connected to switch)
Power	Power Supply: 12/24 Volt DC, supplied through external AC Adapter
Protection	Over voltage, Reverse Polarity, ESD, Communication lines protection

8.8. Voltage Stabilizer

#	Parameter	Minimum Specifications
1.	Capacity and Features	Input : 90V - 300V AC Capacity 15A Low & High Voltage Cut-off Protection Built In Thermal Overload Protection

8.9. Junction Box at Bus Stop/Field

#	Parameter	Minimum Specifications
1.	Size	Suitable size as per site requirements to house the field equipment
2.	Cabinet Material	GI or Aluminium
3.	Material Thickness	Min 1.2mm
5.	Number of Locks	One
6.	Protection	IP 55, Junction Box design should ensure to keep the temperature within suitable operating range for equipment's and should also avoid intentional water splash and dust intake
7	Mounting	On Bus Shelter/ Ground mounted on concrete base
8.	Form Factor	Rack Mount/DIN Rail
9.	Other Features	Rain Canopy, Cable entry with glands, proper earthing and Fans/any other accessories as required for operation of equipment's within junction box.

8.10. Bus Terminal Ultra Stretch Display

#	Parameter	Minimum Specifications
1.	Technology	HD IPS LED Display , Direct LED Backlight
2.	Computer Connectivity	HDMI (Including HDMI cable), VGA
3.	Screen Size	85 inch or more diagonal
4.	Resolution	Full High Definition (Min 3840 x 540) 58:9 Ultra Stretch
5.	Contrast ratio	Native (standard) 2000:1 or more
6.	Brightness	500 nit or more
7.	Viewing angle	178 degree/178 degree (H/V)
8.	Response time	8ms or less
9.	Controls	• On Screen Display (OSD) • IR remote control
10.	Operations	Rated for 24x7 operations

8.11. Bus Terminal LED PIS Multi-line Display

Parameter	Minimum Specifications
Configuration	
Display Size	Six horizontal LED panels, joined horizontally Size of each display : As per following 1 900 mm x 100 mm 2 900 mm x 100 mm 3 900 mm x 100 mm 4 900 mm x 100 mm 5 900 mm x 100 mm 6 900 mm x 100 mm Overall cabinet 1000 mm x 700 mm (approx.)
LED Parameters	
Type of LED	Diffused lens 4 mm (minimum)
Pitch	6.25 x 6.25

Colour	Amber colored LED
Wavelength	Wave length 591~595nm
Viewing distance	30 meters, for single line text, in day and night
Viewing Angle	120° all sides
Readability	Ensure readability with full clarity (no jitter) on scrolls and long life usage
Light Sensor	In-built light sensor with continuously variable brightness control to enable the display intensity to change based on ambient light conditions
Usability/Functionality/Capability	
Graphics	Alphanumeric text with customized graphic capability, 50 mm minimum for English Characters
Language	English, Hindi, Gujarati
Messages	Fixed, scrolling and flashing mode Display of Stop Name, ETA of bus with bus route number Display public service information / adhoc messages Current date and time
Memory	Ability to retain the last messages displayed in the memory of the sign even in the event of power failure and without the message being reloaded. (minimum 8 GB memory)
Standard compliances and Cabinet/Structure	
Design	Light weight structure with toughened glass at the front side Antitheft and anti-vandalism proof
IP Projection	IP65
Protection	The Display unit to be mounted inside an anti-theft and anti-vandalism proof Enclosure
EMI/EMC	Test complied as per – AIS004 Part 3
Temperature	Operating Temperature 0 to 50 Degree C
Humidity	0 to 95% RH
Usage	24x7x365 usage Minimum 30000 hours life
Communication	
Data	Through GPRS (SIM based) or Local LAN port (to be connected to switch)
Power	AC Power (100-240V AC)
Protection	Over voltage, Reverse Polarity, ESD, Communication lines protection

8.12. LED TV (Professional Displays) for Video Wall

#	Parameter	Minimum Specifications
1.	Technology	HD IPS LED Display , Direct LED Backlight
2.	Computer Connectivity	HDMI (Including HDMI cable), VGA
3.	Screen Size	50 inch diagonal
4.	Resolution	Full High Definition (Min 1920 x 1080) 16:9 Widescreen
5.	Contrast ratio	Native (standard) 5000:1 or more
6.	Brightness	350 nit or more
7.	Viewing angle	178 degree/178 degree (H/V)
8.	Response time	8ms or less
9.	Controls	• On Screen Display (OSD) • IR remote control

10.	Operations	Rated for 24x7 operations

8.13. Desktop PC

Sr No	Item	Minimum Specifications
1.	Processor	Intel Core i7-latest generation (3.0 Ghz) or higher OR AMD A10 7850B (3.0 Ghz) processor or higher OR Equivalent 64 bit x86 processor
2.	Memory	8 GB DDR3 RAM @ 1600 MHz. One DIMM Slot must be free for future upgrade
3.	Motherboard	OEM Motherboard
4.	Hard Disk Drive	Minimum 1 TB SATA III Hard Disk @7200 RPM or higher
5.	Audio	Line/Mic In, Line-out/Speaker Out (3.5 mm)
6.	Network port	10/100/1000 Mbps auto-sensing on-board integrated RJ-45 Ethernet Port
7.	USB Ports	Minimum 4 USB ports (out of that 2 must be in front)
8.	Display Port	1 Display Port (HDMI/VGA) port
9.	Power supply	Maximum Rating 250 Watts, 80 plus certified power supply
10.	Keyboard	104 keys Heavy Duty Mechanical Switch Keyboard (USB Interface) with 50 million keystrokes life per switch. Rupee Symbol to be engraved.
11.	Mouse	Optical with USB interface (same make as desktop)
12.	Monitor	Minimum 21.5" diagonal LED Monitor with 1366x768 or higher resolution. (Same make as desktop). Must be TCO05 certified
13.	Operation System and Support	Pre-loaded Windows 10 (or latest) Professional 64 bit, licensed copy with certificate of authenticity (or equivalent authenticity information) and all necessary and latest patches and updates. Can be downgraded to Windows 7 Professional (64 bit). All Utilities and driver software, bundled in CD/DVD/Pen-drive media
14.	Certification for Desktop	Energy Star 5.0 or above / BEE star certified
15.	Other pre-loaded software (open source/ free)	Latest version of Libre-office, 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 MCGM offices/locations.

8.14. Video Feed Receiving Station

#	Minimum Specifications
1.	Operate on Wifi (802.11 b/g/n supported, 2.4GHz) to receive video feeds from mobile NVR

#		
2.		Can be attached to Desktop PC (PC not part of this station)

8.15. Rack Server for Bus Control Room

#	Parameter	Minimum Specifications
1.	Processor	Latest series/ generation of 64 bit x86 processor(s) with Ten or higher Cores Processor speed should be minimum 2.4 GHz Minimum 2 processors per each physical server
2.	RAM	Minimum 128 GB ECC Memory per physical server, upgradable up to 256 GB
3.	Internal Storage	2 x 300 GB SAS (10k rpm) hot swap disks
4.	Network interface	2 X 20GbE LAN ports for providing Ethernet connectivity
5.	RAID support	RAID 0 (mirroring)
6.	Operating System	Licensed version of 64 bit latest version of Linux/ Unix/Microsoft® Windows based Operating system)
7.	Form Factor	Rack
8.	Virtualization	Shall support Industry standard virtualization hypervisor like Hyper-V, VMWARE, Oracle VM etc. OEM of the blade chassis and servers offered should in "Validated Configuration" list and certified by OEM to run virtualisation.

8.16. Layer 2 LAN Switch

#	Parameter	Minimum Specifications
1	Ports	• 24 or 48 (as per requirements) 10/100/1000 Base-TX ports and extra 2 or 4 nos of 10G Base SX/LX ports as per network solution offered. • All ports can auto-negotiate between 10Mbps/ 100Mbps/ 1000Mbps, half-duplex or full duplex and flow control for half-duplex ports.
2	Switch type	Layer 2
3	MAC	8 K or more
4	Backplane	56 Gbps capacity (as per network configuration to meet performance requirements of wire speed switching for the connected devices)
5	Forwarding Rate	Packet Forwarding Rate should be 70.0 Mpps or better
5	Port Features	Must support Port Mirroring, Port Trunking and 802.3ad LACP Link Aggregation port trunks
6	Flow Control	Support IEEE 802.3x flow control for full-duplex mode ports.
7	Protocols	• IPV4, IPv6 • Support 802.1D, 802.1S, 802.1w, Rate limiting • Support 802.1Q VLAN encapsulation, IGMP v1, v2 and v3 snooping • 802.1p Priority Queues, port mirroring, DiffServ • DHCP support

#	Parameter	Minimum Specifications
		• Support upto 1024 VLANs
8	Access Control	• Support port security • Support 802.1x (Port based network access control). • Support for MAC filtering. • Should support TACACS+ and RADIUS authentication
9	VLAN	• Support 802.1Q Tagged VLAN and port based VLANs and Private VLAN • The switch must support dynamic VLAN Registration or equivalent • Dynamic Trunking protocol or equivalent
10	Protocol and Traffic	• Network Time Protocol or equivalent Simple Network Time Protocol support • Switch should support traffic segmentation • Traffic classification should be based on user-definable application types: TOS, DSCP, Port based, TCP/UDP port number
11	Management	• Switch needs to have console port for management via PC • Must have support SNMP v1,v2 and v3 • Should support 4 groups of RMON • Should have accessibility using SSH, Console access, easier software upgrade through network using TFTP etc. Configuration management through CLI, GUI based software utility and using web interface

8.17. UPS for Bus Control Room/ Bus Terminals

Sr No	Parameter	Minimum Specifications
1.	Capacity	Adequate capacity to cover all above IT Components at respective location - Minimum 6 KVA Minimum 1 hour backup
2.	Technology	IGBT based PWM Technology, True Online UPS or DC Power Supply
3.	Input Frequency Range	45 to 55 Hz
4.	Output Frequency Range	45 to 55 Hz
5.	Output Voltage	220VAC - 230VAC
6.	Voltage Regulation	+/-2% (or better) and with built-in Over Voltage Cut off facility in the Device
7.	Frequency	50 Hz +/- 0.1% (free Run Mode)
8.	Harmonic Distortion (THD)	< 3% (linear load)
9.	Output Waveform	Pure Sine wave
10.	Output Power Factor	0.8 or more

Sr No	Parameter	Minimum Specifications
11.	Battery Backup	Adequate and required battery backup to achieve required uptime of field device as well as SLA of the overall solution..
12.	Battery Type	Lead acid, Sealed Maintenance Free (SMF)
13.	General Operating Temperature	0 to 40 Degree Celsius
14.	Alarms & Indications	All necessary alarms & indications essential for performance monitoring of UPS like mains fail, low battery & fault detection
15.	Bypass	Automatic, Manual Bypass Switch
16.	Certifications	For Safety & EMC as per international standard

8.18. Internal Firewall

#	Item	Minimum Specifications
1.	Physical attributes	• Should be mountable on 19" Rack • Modular Design • Internal redundant power supply
2.	Interfaces	• 4 x GE, upgradable to 8 GE • Console Port 1 number
3.	Performance and Availability	• Encrypted throughput: minimum 1 Gbps • Concurrent connections: up to 100,000 • Simultaneous VPN tunnels: 2000
4.	Routing Protocols	• Static Routes • RIPv1, RIPv2 • OSPF
5.	Protocols	• TCP/IP • RTP • IPSec, DES/3DES/AES • FTP, HTTP, HTTPS,SNMP, SMTP • DHCP, DNS, Support for IP v4 & IPv6 • IPSEC
6.	Other support	• 802.1Q, NAT, PAT, IP Multicast support, Remote Access VPN, Time based Access control lists, URL Filtering, support VLAN, Radius/ TACACS, Support multilayer firewall protection, Traffic shaping, Bandwidth monitoring
7.	QoS	• QoS features like traffic prioritisation, differentiated services, committed access rate. Should support for QoS features for defining the QoS policies.
8.	Management	• Console, SSHv2, Browser based configuration • SNMPv1, SNMPv2, SNMPv3
9.	Certifications	ICSA

8.19. Blade Servers

(As Building block, to establishing computing solution for sub-systems/solutions)

#	Parameter	Minimum Specifications
9.	Processor	Latest series/ generation of 64 bit x86 processor(s) with Ten or higher Cores Processor speed should be minimum 2.4 GHz Minimum 2 processors per each physical server
10.	RAM	Minimum 128 GB ECC Memory per physical server, upgradable up to 256 GB
11.	Internal Storage	2 x 300 GB SAS (10k rpm) hot swap disks
12.	Network interface	2 X 20GbE LAN ports for providing Ethernet connectivity Optional: 1 X Dual-port 16Gbps FC HBA (or FCoE) for providing FC connectivity If bidder is offering FCoE based solution, corresponding ports must be present in server as well as storage controllers.
13.	RAID support	As per requirement/solution
14.	Operating System	Licensed version of 64 bit latest version of Linux/ Unix/Microsoft® Windows based Operating system)
15.	Form Factor	Blade
16.	Virtualization	Shall support Industry standard virtualization hypervisor like Hyper-V, VMWARE, Oracle VM etc. OEM of the blade chassis and servers offered should in "Validated Configuration" list and certified by OEM to run virtualisation.

8.20. Blade Chassis

#	Minimum Specifications
1	Minimum 6U size, rack-mountable, capable of accommodating minimum 8 or higher hot pluggable blades
2	Dual network connectivity of 10 G speed for each blade server for redundancy shall be provided
3	Backplane shall be completely passive device. If it is active, dual backplane shall be provided for redundancy.
4	Have the capability for installing industry standard flavours of Microsoft Windows, and Enterprise RedHat Linux OS
5	Shall support Industry standard virtualization hypervisor like Hyper-V, VMWARE, Oracle VM etc. OEM of the blade chassis and servers offered should in "Validated Configuration" list and certified by OEM to run virtualization.
6	DVD ROM shall be available in chassis, can be internal or external, which can be shared by all the blades allowing remote installation of software
7	Minimum 1 USB port
8	Two hot-plug/hot-swap, redundant 10 Gbps Ethernet or FCoE module with minimum 16 ports (cumulative), having Layer 2/3 functionality.

#	Minimum Specifications
	If bidder is offering FCoE based solution, corresponding ports must be present in server as well as storage controller.
9	Two hot-plugs/hot-swap redundant 16 Gbps Fibre Channel module for connectivity to the external Fibre channel Switch and ultimately to the storage device
10	Power supplies shall have N+N (Hot Swap/Hot Plug). All power supplies modules shall be populated in the chassis. Required number of PDUs and power cables, to connect all blades, Chassis to Data Centre power outlet.
12	Hot pluggable/hot-swappable redundant cooling unit
13	Provision of systems management and deployment tools to aid in blade server configuration and OS deployment
14	Blade enclosure shall have provision to connect to display console/central console for local management such as troubleshooting, configuration, system status/health display.
15	Single console for all blades in the enclosure, built-in KVM switch or Virtual KVM features over IP
16	Dedicated management network port shall have separate path for remote management.

8.21.DC Switch / TOR Switch

#	Parameter	Minimum Specifications
1.	Ports	• 24 or 48 (as per density required) 1G/ 10G Ethernet ports (as per internal connection requirements) and extra 2 numbers of Uplink ports (40GE) • All ports can auto-negotiate between all allowable speeds, half-duplex or full duplex and flow control for half-duplex ports.
2.	Switch type	Layer 3
3.	MAC	Support 32K MAC address.
4.	Backplane	Capable of providing wire-speed switching
5.	Throughput	Required throughput to achieve non-blocking performance for switch when all ports are populated.
6.	Port Features	Must support Port Mirroring, Port Trunking and 802.3ad LACP Link Aggregation port trunks
7.	Flow Control	Support IEEE 802.3x flow control for full-duplex mode ports.
8.	Protocols	• IPV4, IPV6 • Support 802.1D, 802.1S, 802.1w, Rate limiting • Support 802.1X Security standards • Support 802.1Q VLAN encapsulation, IGMP v1, v2 and v3 snooping • 802.1p Priority Queues, port mirroring, DiffServ • DHCP support • Support up to 1024 VLANs • Support IGMP Snooping and IGMP Querying • Support Multicasting • Should support Loop protection and Loop detection

#	Parameter	Minimum Specifications
9.	Access Control	• Support port security • Support 802.1x (Port based network access control). • Support for MAC filtering. • Should support TACACS+ and RADIUS authentication
10.	VLAN	• Support 802.1Q Tagged VLAN and port based VLANs and Private VLAN • The switch must support dynamic VLAN Registration or equivalent • Dynamic Trunking protocol or equivalent
11.	Protocol and Traffic	• Network Time Protocol or equivalent Simple Network Time Protocol support • Switch should support traffic segmentation • Traffic classification should be based on user-definable application types: TOS, DSCP, Port based, TCP/UDP port number
12.	Management	• Switch needs to have a console port for management via a console terminal or PC • Must have support SNMP v1,v2 and v3 • Should support 4 groups of RMON • Should have accessibility using Telnet, SSH, Console access, easier software upgrade through network using TFTP etc. Configuration management through CLI, GUI based software utility and using web interface
13.	Resiliency	• Dual load-sharing power supplies • Redundant fans

8.22. SAN Storage

#	Parameter	Minimum Specifications
1.	Make	Must be specified.
2.	Model	Must be specified. All relevant technical brochures must be submitted.
3.	Solution/Type	• IP Based/iSCSI/FC/NFS/CIFS
4.	Storage	• Storage capacity should be as per Overall Solution Requirement (Minimum 10 TB usable, (or higher if required) - After configuring in offered RAID configuration. • RAID solution offered must protect against double disc failure • Disks should be preferably minimum of 1.2 TB capacity • To store all types of data (Data, Voice, Images, etc.) • Storage system capable of scaling vertically and horizontally
5.	Hardware Platform	• Rack-mounted form-factor • Modular design to support controllers and disk drives expansion
6.	Controllers	• At least 2 controllers in active/active mode

#		
		• The controllers/storage nodes should be upgradable seamlessly, without any disruptions/downtime to production workflow for performance, capacity enhancement and software/firmware upgrades
7.	RAID Support	• RAID 0, 1, 1+0, 5+0 and 6 or RAID DP
8.	Cache	• Minimum 64 GB of useable cache across all controllers. If cache is provided in additional hardware for unified storage solution, then cache must be over and above 64 GB.
9.	Redundancy and High Availability	• The storage system should be able to protect the data against single point of failure with respect to hard disks, connectivity interfaces, fans and power supplies
10.	Management Software	• All the necessary software (GUI Based) to configure and manage the storage space, RAID configuration, logical drives allocation, snapshots etc. are to be provided for the entire system proposed. • Licenses for the storage management software should include disc capacity/count of the complete solution and any additional disks to be plugged in in the future, up to max capacity of the existing controller/units. • A single command console for entire storage system. • Should also include storage performance monitoring and management software • Should provide the functionality of proactive monitoring of Disk drive and Storage system for all possible disk failures • Should be able to take "snapshots" of the stored data to another logical drive for backup purposes

8.23. Server/Networking Rack

#	Parameter	Minimum Specifications
1.	Type	• 19" 42U racks mounted on the floor • Floor Standing Server Rack - 42U with Heavy Duty Extruded Aluminium Frame for rigidity. • Top & Bottom cover with cable entry gland plates. Heavy Duty Top and Bottom frame of MS. • Two pairs of 19" mounting angles with 'U' marking. Depth support channels - 3 pairs with an overall weight carrying Capacity of 500Kgs. • All racks should have mounting hardware Packs, Blanking Panels as per requirements. • Stationery Shelf (2 sets per Rack) • All racks must be lockable on all sides with unique key for each rack • Racks should have Rear Cable Management channels, Roof and base cable access
2.	Wire managers	Two vertical and four horizontal minimum

#		
3.	Power Distribution Units	• 2 per rack • Power Distribution Unit - Vertically Mounted, 32AMPs with 25 Power Outputs. (20 Power outs of IEC 320 C13 Sockets & 5 Power outs of 5/15 Amp Sockets), Electronically controlled circuits for Surge & Spike protection, LED readout for the total current being drawn from the channel, 32AMPS MCB, 5 KV AC isolated input to Ground & Output to Ground
4.	Doors	• The racks must have steel (solid / grill / mesh) front / rear doors and side panels. Racks should NOT have glass doors / panels. • Front and Back doors should be perforated with at least 60% or higher perforations. • Both the front and rear doors should be designed with quick release hinges allowing for quick and easy detachment without the use of tools.
5.	Fans and Fan Tray	• Fan 90CFM 230V AC, 4" dia (4 Nos. per Rack) • Fan Housing Unit 4 Fan Position (Top Mounted) (1 no. per Rack) - Monitored - Thermostat based - The Fans should switch on based on the Temperature within the rack. The temperature setting should be factory settable. This unit should also include - humidity & temperature sensor
6.	Metal	Aluminium extruded profile
7.	Side Panel	Detachable side panels (set of 2 per Rack)

8.24. KVM Module

#	Item	Minimum Specifications
1.	KVM Requirement	Keyboard, Video Display Unit and Mouse Unit (KVM) for the IT Infrastructure Management at Data Centre
2.	Form Factor	19" rack mountable
3.	Ports	minimum 8 ports
4.	Server Connections	USB or KVM over IP.
5.	Auto-Scan	It should be capable to auto scan servers
6.	Rack Access	It should support local user port for rack access
7.	SNMP	The KVM switch should be SNMP enabled. It should be operable from remote locations
8.	OS Support	It should support multiple operating system
9.	Power Supply	It should have dual power with failover and built-in surge protection
10.	Multi-User support	It should support multi-user access and collaboration

8.25. Structured Cabling Components

#	Parameter	Minimum Specifications
1.	Standards	ANSI TIA 568 C for all structured cabling components
2.	OEM Warranty	OEM Certification and Warranty of 15-/ 20 years as per OEM standards
3.	Certification	UL Listed and Verified

8.26. Electrical cabling component

All electrical components shall be design manufactured and tested in accordance with relevant Indian standards IEC's

8.27. Networking Standards

- ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centres
- ANSI/TIA/EIA/568-C.1, Commercial Building Telecommunications Cabling Standard – 2009
- ANSI/TIA/EIA 568-C.2, Copper Cabling Components Standard
- ANSI/TIA/EIA 568-C.3, Optical Fibre Cabling Components Standard
- ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces
- ANSI/TIA/EIA-606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- ANSI/J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- Building Industries Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM) – Preferred

9. *Annexure V: Non-IT (Civil, Electrical, Mechanical) Requirements*

The selected bidder should adhere to the specifications given below for Non-IT components. It is essential that Fire Proof material be used as far as possible and Certification from Fire Department be taken for Command Centres before Go-Live.

9.1. Civil and Architectural work

a. Furniture and Fixture

- 6" high laminated strip using 1.5mm thick laminate over 10mm thick commercial board on all vertical surface in the entire server & ancillary areas including low height partition, brick wall, partition wall, cladding etc. complete with French polish in all respect.

- Enclosure for gas cylinder of Shutters and Partitions along with wooden support and 18 mm thick MDF board along with 1.5 mm approved laminate colour outside and 2 coat of enamel paint inside the shutter. The same should be provided with all the required accessories including the handle, lock, loaded hinges, tower bolt and necessary hardware etc. complete with French polish.

b. Partitions (wherever required as per approved drawing)

- Full height partition wall of 125 mm thick fireline gyp-board partition using 12.5 mm thick double fireline gyp-board on both sides with GI steel metal vertical stud frame of size 75 mm fixed in the floor and ceiling channels of 75 mm wide to provide a strong partition. Glass wool insulation inside shall be provided as required. Fixing is by self-tapping screw with vertical studs being at 610 mm intervals. The same should be inclusive of making cutouts for switch board, sockets, grill etc. It shall also include preparing the surface smoothly and all as per manufacture's specification etc. finally finishing with one coat of approved brand of fire resistant coating.

- With glazing including the framework of 4" x 2" powder coated aluminium section complete (in areas like partition between server room & other auxiliary areas).

- Fire Rated Wire Glass minimum 6 mm thick for all glazing in the partition wall complete. (External windows not included in this).

- All doors should be minimum 1200 mm (4 ft.) wide.

c. Painting

- Fire retardant paint of pre-approved make and shade to give an even shade over a primer coat as per manufacturers' recommendations after applying painting putty to level and plumb and finishing with 2 coats of fire retardant paint. Base coating shall be as per manufacturer's recommendation for coverage of paint.

- For all vertical Plain surface.

- For fireline gyp-board ceiling.

- POP punning over cement plaster in perfect line and level with thickness of 10 – 12 mm including making good chases, grooves, edge banding, scaffolding pockets etc.

- Fire retardant coating on all vertical surfaces, furniture etc. as per manufacturer's specification.

9.2. PVC Conduit

#	Description
1.	The conduits for all systems shall be high impact rigid PVC heavy-duty type and shall comply with I.E.E regulations for non-metallic conduit 1.6 mm thick as per IS 9537/1983.
2.	All sections of conduit and relevant boxes shall be properly cleaned and glued using appropriate epoxy resin glue and the proper connecting pieces, like conduit fittings such as Mild Steel and should be so installed that they can remain accessible for existing cable or the installing of the additional cables.
3.	No conduit less than 20mm external diameter shall be used. Conduit runs shall be so arranged that the cables connected to separate main circuits shall be enclosed in separate conduits, and that all lead and return wire of each circuit shall be run to the same circuit.
4.	All conduits shall be smooth in bore, true in size and all ends where conduits are cut shall be carefully made true and all sharp edges trimmed. All joints between lengths of conduit or between conduit and fittings boxes shall be pushed firmly together and glued properly.
5.	Cables shall not be drawn into conduits until the conduit system is erected, firmly fixed and cleaned out. Not more than two right angle bends or the equivalent shall be permitted between draw and junction boxes. Bending radius shall comply with I.E.E regulations for PVC pipes.
6.	Conduit concealed in the ceiling slab shall run parallel to walls and beams and conduit concealed in the walls shall run vertical or horizontal.
7.	The chase in the wall required in the recessed conduit system shall be neatly made and shall be of angle dimensions to permit the conduit to be fixed in the manner desired. Conduit in chase shall be hold by steel hooks of approved design of 60cm centre the chases shall be filled up neatly after erection of conduit and brought to the original finish of the wall with cement concrete mixture 1:3:6 using 6mm thick stone aggregate and course sand.

9.3. Wiring

#	Description
1.	PVC insulated copper conductor cable shall be used for sub circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be stranded copper conductors with thermoplastic insulation of 650 / 1100 volts grade. Colour code for wiring shall be followed.
2.	Looping system of wring shall be used, wires shall not be jointed. No reduction of strands is permitted at terminations.
3.	Wherever wiring is run through trunking or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required

#	Description
	regular intervals. Identification ferrules indication the circuit and D.B. number shall be used for sub main, sub circuit wiring the ferrules shall be provided at both end of each sub main and sub-circuit.
4.	Where, single phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain wiring fed from more than one phase in any one room in the premises, where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply.
5.	Circuits fed from distinct sources of supply or from different distribution boards or M.C.B.s shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phases, no two single-phase switches connected to difference phase shall be mounted within two meters of each other.
6.	All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.
7.	Metal clad sockets shall be of die cast non-corroding zinc alloy and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have push on protective cap.
8.	All power sockets shall be piano type with associate's switch of same capacity. Switch and socket shall be enclosed in a M. S. sheet steel enclosure with the operating knob projecting. Entire assembly shall be suitable for wall mounting with Bakelite be connected on the live wire and neutrals of each circuit shall be continuous everywhere having no fuse or switch installed in the line excepting at the main panels and boards. Each power plug shall be connected to each separate and individual circuit unless specified otherwise. The power wiring shall be kept separate and distinct from lighting and fan wiring. Switch and socket for light and power shall be separate units and not combined one.
9.	Balancing of circuits in three phases installed shall be arranged before installation is taken up. Unless otherwise specified not more than ten light points shall be grouped on one circuit and the load per circuit shall not exceed 1000 watts.

9.4. Cable Work

#	Description
1.	Cable ducts should be of such dimension that the cables laid in it do not touch one another. If found necessary the cable shall be fixed with clamps on the walls of the duct. Cables shall be laid on the walls/on the trays as required using suitable clamping/ fixing arrangement as required. Cables shall be neatly arranged on the trays in such manner that a criss-crossing is avoided and final take off to switch gear is easily facilitated.
2.	All cables will be identified close to their termination point by cable number as per circuit schedule. Cable numbers will be punched on 2mm thick aluminium strips and securely fastened to the. In case of control cables all covers shall be identified by their wire numbers by means of PVC ferrules. For trip circuit identification additional red ferrules are to be used only in the switch gear / control panels, cables shall be supported so as to prevent appreciable sagging. In

#	Description
	general distance between supports shall not be greater than 600mm for horizontal run and 750mm for vertical run.
3.	Each section of the rising mains shall be provided with suitable wall straps so that same the can be mounted on the wall.
4.	Whenever the rising mains pass through the floor they shall be provided with a built-in fire proof barrier so that this barrier restricts the spread of fire through the rising mains from one section to the other adjacent section. Neoprene rubber gaskets shall be provided between the covers and channel to satisfy the operating conditions imposed by temperature weathering, durability etc.
5.	Necessary earthling arrangement shall be made alongside the rising mains enclosure by Mean of a GI strip of adequate size bolted to each section and shall be earthed at both ends. The rising mains enclosure shall be bolted type.
6.	The space between data and power cabling should be as per standards and there should not be any criss-cross wiring of the two, in order to avoid any interference, or corruption of data.

10. Annexure VI: Detailed Scope of Work and Considerations

10.1. Scope of Work

The SI should ensure the successful implementation of the proposed ITMS Project and provide capacity building support to VSCDL authorities and Bus operator Staff as per the scope of services described below. Any functionality not expressly stated in this document but required to meet the needs of the VSCDL to ensure successful operations of the system shall essentially be under the scope of the SI and for that no extra charges shall be admissible. SI shall implement and deliver the following systems and capabilities (Summary information given here, detailed requirements shall be as per RFP)

1. ITMS Field Devices
2. ITMS Applications and System Software
3. Integration with systems in existing buses of City Bus Operator
4. Control Centre and Depot Infrastructure
5. ITMS DC Infrastructure
6. ITMS DR Infrastructures (on cloud)
7. Integration with CCC, Website, Mobile App etc.
8. Training and Capacity Building

The SI's scope of work shall include but will not be limited to the following broad areas. Details of each of these broad areas have also been outlined in subsequent sections of this document:

2. **Assessment and Feasibility Study:** Conduct a detailed assessment, feasibility study and develop a comprehensive project plan, including:

   a. Assess the existing infrastructure of CCTV Cameras, Water SCADA Systems, GIS System, ERP system, traffic Signals on junctions etc.

   b. Conduct the site surveys to finalize the location of all field devices including CCTV Cameras, traffic signal controller, number of traffic signal aspects, Camera distribution systems, locations and height of poles, cantilever, junction box, and cable routing etc.

   c. Conduct feasibility study for finalization of detailed technical architecture, gap analysis and project plan

   d. Develop traffic management plans for individual signal controls and groups of signal controllers along with pre-planned intervention strategies for special scenarios

   e. Obtain site Clearance obligations & other relevant permissions

3. **Design, Supply, Installation and Commissioning of Field Equipment** which includes the following major components:
   - Bus Driver Console

- Bus Stop PIS Display Unit
- Bus Stop Vertical Display
- Control Centre Hardware (Servers, Equipment, LAN, WAN etc.)
- Bus Stop UPS
- Depot Hardware
- CCTV Setup with DVR in Bus
- Camera on Bus Stops
- Switch on Bus Stops
- Router at Bus Stops
- UPS at Bus Stop
- Junction Box at Bus Stop

4. Provisioning **Network Connectivity** which includes design, supply, installation and commissioning of GPRS (SIM card based) and OFC based network connectivity for all project systems. This includes integration with CCC OFC Network (Active and Passive components) installed across city, as part of CCC Project to cover all project field locations. This also includes

   a. Procurement of additional network bandwidth services for connecting Smart DC and DR (optional)

   b. Procurement of 50 Mbps (each) Internet bandwidth at DC and DR site, 1:1 unshared premium bandwidth

   c. Integrating live data streams with ITMS DC, CCC DR Site, CCC, Bus Control Room and other project systems

5. Hosting of Hardware and Software Infrastructure which includes design, supply, and installation and commissioning of IT Infrastructure for at Data Centre, Bus Control Centre. This consist of:

   a. IT Infrastructure including server, storage, other required hardware, application portfolio, licenses at Main DC (Smart DC) within CCC Building as well as DR Site (hosted at third party/cloud).

   b. Bus Control Centre infrastructure including video walls, Desktops, Video feed receiving station etc.

   c. Establishment of LAN and WAN connectivity at Bus Control Centre, Bus Stops/Terminals and DC limited to scope of infrastructure procured for the project, as applicable.

   d. ITMS Application integration services with CCC Solution, One Vadodara Mobile App and Smart city Website.

6. **Integration with CCC Project, Smart City Website and Mobile App:** Integration with current CCC Project, Smart City Website and Mobile App, as per requirement listed out in relevant sections of this volume. Also support to vendors of future projects.

7. **Capacity Building** for VSCDL and BuS operators staff which includes preparation of operational manuals, training documents and capacity building support, including:

    a. Training of the VSCDL authorities, Bus Operator personnel and CCS operators on operationalization of the system

    b. Support during execution of acceptance testing

    c. Preparation and implementation of the information security policy, including policies on backup and redundancy plan

    d. Preparation of revised traffic signal control plans, alternate signal control plans, KPIs for performance monitoring of transport network, dashboards for MIS

    e. Developing standard operating procedures for operations management and other technical services to be rendered by ITMS System

    f. Preparation of system documents, user manuals, performance manuals, etc.

8. Warranty and Annual Maintenance which includes periodic maintenance services for the software, hardware and other IT infrastructure installed as part of ITMS project for a period of 5 years i.e. 3 year warranty & 2 years of CAMC and conducting periodic audits of the project from a third party, if required or instructed by VSCDL.

10.1.1. Inception Phase

The SI will be responsible for preparation of detailed project plan. The plan shall address at the minimum the following:

   i. Define an organized set of activities for the project and identify the interdependence between them.
   ii. Resource planning and loading for each phase/activity. This must also indicate where each resource would be based during that phase, i.e. onsite at the VSCDL office or off site at SI premises.
   iii. Establish and measure resource assignments and responsibilities
   iv. Highlight the milestones and associated risks
   v. Communicate the project plan to stakeholders with meaningful reports.
   vi. Measure project deadlines and performance objectives.
   vii. Project Progress Reporting. During the implementation of the project, the SI should present weekly reports. This report will be presented in the steering committee meeting to VSCDL. The report should contain at the minimum the under mentioned:
        a. Results accomplished during the period (weekly)
        b. Cumulative deviations from the schedule date as specified in the finalized Project Plan
        c. Corrective actions to be taken to return to planned schedule of progress
        d. Plan for the next week
        e. Proposed revision to planned schedule provided such revision is necessitated by reasons beyond the control of SI
        f. Support needed
        g. Highlights/lowlights

    h. Issues/Concerns

    i. Risks/Show stoppers along with mitigation

viii. Identify the activities that require the participation of client personnel (including VSCDL, the Program Management Unit etc.) and communicate their time requirements and schedule early enough to ensure their full participation at the required time.

10.1.2. Requirement Phase

The SI must perform the detailed assessment of the business requirements and IT Solution requirements as mentioned in this RFP. Based on the understanding and its own individual assessment, SI shall develop & finalize the System Requirement Specifications (SRS) in consultation with VSCDL and its representatives. While doing so, SI at least is expected to do following:

i. SI shall study and revalidate the requirements given in the RFP with VSCDL and submit as an exhaustive FRS document.

ii. SI shall develop the FRS and SRS documents.

iii. SI shall develop and follow standardized template for requirements capturing and system documentation.

iv. SI must maintain traceability matrix from SRS stage for the entire implementation.

v. SI must get the sign off from user groups formed by VSCDL.

vi. For all the discussion with VSCDL team, SI shall be required to be present at VSCDL office with the requisite team members.

vii. Prior to starting the site clearance, the SI shall carry out survey of field locations as specified in Annexure I, for buildings, structures, fences, trees, existing installations, etc.

10.1.3. Design Phase

The SI shall build the solution as per the Design Considerations detailed in section **9.1.** The solution proposed by SI should comply with the design considerations requirements as mentioned therein**.**

10.1.4. Development Phase

The SI shall carefully consider the scope of work and provide a solution that best meets the project's requirements. Considering the scope set in this RFP, the SI shall carefully consider the solutions it proposes and explicitly mention the same in the technical proposal. The implementation of the application software will follow the procedure mentioned below:

i. Software Products (Configuration and Customization): In case SI proposes software products the following need to be adhered:

    a. SI will be responsible for supplying the application and licenses of related software products and installing the same so as to meet project requirements.

    b. SI shall have provision for procurement of licenses in a staggered manner as per the actual requirement of the project.

    c. The SI shall perform periodic audits to measure license compliance against the number of valid End User software licenses consistent with the terms and conditions of license agreements, volume purchase agreements, and other mutually agreed upon licensed software terms and conditions. The SI shall report any exceptions to license terms and

conditions at the right time to VSCDL. However, the responsibility of license compliance solely lies with the SI. Any financial penalty imposed on VSCDL during the contract period due to license non-compliance shall be borne by SI.

ii.   SI shall also supply any other tools & accessories required to make the integrated solution complete as per requirements. For the integrated solution, the SI shall supply:

a. Software & licenses.
b. Supply tools, accessories, documentation and provide a list of the same. Tools and accessories shall be part of the solution.
c. System Documentation: System Documentation both in hard copy and soft copy to be supplied along with licenses and shall include but not limited to following. Documentation to be maintained, updated and submitted to VSCDL regularly :

- Functional Requirement Specification (FRS)
- High level design of whole system
- Low Level design for whole system / Module design level
- System Requirements Specifications (SyRS)
- Any other explanatory notes about system
- Traceability matrix
- Technical and product related manuals
- Installation guides
- User manuals
- System administrator manuals
- Toolkit guides and troubleshooting guides
- Other documents as prescribed by VSCDL
- Quality assurance procedures
- Change management histories
- Version control data
- SOPs, procedures, policies, processes, etc. developed for VSCDL
- Programs :
  - o Entire source codes
  - o All programs must have explanatory notes for understanding
  - o Version control mechanism
  - o All old versions to be maintained
- Test Environment :
  - o Detailed Test methodology document
  - o Module level testing
  - o Overall System Testing
  - o Acceptance test cases

(These documents need to be updated after each phase of project and to be maintained updated during entire project duration. The entire documentation will be the property of VSCDL.)

10.1.5.   Integration & Testing Phase

The Command and control centre should be integrated with feeds of all tracks/component deployed under this Vadodara Project. The SI shall provide the testing strategy including

traceability matrix, test cases and shall conduct the testing of various components of the software developed/customized and the solution as a whole. The testing should be comprehensive and should be done at each stage of development and implementation.

10.1.6. Go-Live Preparedness and Go-Live

i.   SI shall prepare and agree with VSCDL, the detailed plan for Go-Live (in-line with VSCDL's implementation plan as mentioned in RFP).

ii. The SI shall define and agree with VSCDL, the criteria for Go-Live.

iii. The SI shall ensure that all the data migration is done from existing systems.

iv. SI shall submit signed-off UAT report (issue closure report) ensuring all issues raised during UAT are being resolved prior to Go-Live.

v.   SI shall ensure that Go –Live criteria as mentioned in User acceptance testing of Project is met and SI needs to take approval from VSCDL team on the same.

vi. Go-live of the application shall be done as per the finalized and agreed upon Go-Live plan.

10.1.7. Operations and Maintenance for a period of 5 years

Success of the Project would lie on how professionally and methodically the entire Project is managed once the implementation is completed. From the System Integrator perspective too this is a critical phase since the quarterly payments are linked to the SLA's in the post implementation phases. System Integrator thus is required to depute a dedicated team of professionals to manage the Project and ensure adherence to the required SLAs. SI shall provide operations and maintenance services for the software, hardware and other IT and Non-IT infrastructure installed as part of project for a period of 5 years i.e. 3 year warranty & 2 years of comprehensive AMC. The SI will have to make provision for power supply and power supply meters at all locations. The electricity charges will have to be borne by the SI and reimbursed by VSCDL based on submission of actual bills.

10.1.8. Project Management & Facilities Management Services

The SI will be required to provide facilities management services to support the VSCDL and Police Department officials in performing their day-to-day functions related to this system. SI is required to depute a dedicated, centralised project management and technical team for the overall project management and interaction with VSCDL.

10.1.9. Provision of the Operational Manpower

The Current estimation of the man-power required from the SI for Operational Manpower as follows:

Sr No	Manpower	Overall Qty.
1	Project Manager	1
2	Control Room and Process Analyst (Operations Manager)	1
3	Planning and Scheduling Expert	1
4	Control Centre Controllers	1
5	Hardware, Network & Data Centre Staff Member (System Administrator)	1

The exact role of these personnel and their responsibilities would be defined and monitored by VSCDL System Integrator shall be required to provide such manpower meeting following requirements:

i. All such manpower shall be minimum graduate pass and having educational qualification a defined in RFP requirements

ii. All such manpower shall be without any criminal background / record.

iii. VSCDL reserves the right to carry out background check of the personnel proposed on the Project for verification of criminal record, at the beginning of deployment or during deployment.

iv. System Integrator shall have to replace any person, if not found suitable for the job.

v. All the manpower shall have to undergo training from the System Integrator for at least 15 working days on the working of project. Training should also cover dos & don'ts and will have few sessions from VSCDL on right approaches for monitoring the feeds & providing feedback to VSCDL and other associated government agencies.

vi. Each person shall have to undergo compulsory 1 day training every month

vii. Operational Manpower shall work in 3 shifts, with no person being made to see the feeds for more than 8 hours at a stretch.

Detail operational guideline document shall be prepared during implementation which shall specify detail responsibilities of these resources and their do's & don'ts.

10.1.9.1.   Basic Infrastructure Services

Following services shall be provided by the SI under the basic infrastructure services:

i. Ensure availability of the infrastructure (both physical and IT) including but not limited to Power, Cooling, Racks, Storage and other peripheral equipment installed at the time of Project commissioning as per the SLAs.

ii. Ensure scalability in terms of availability of racks and supporting infrastructure.

iii. Proactive and reactive maintenance, repair and replacement of defective components (physical and other peripheral IT infrastructure) installed for the Project through this RFP. The cost for repair and replacement shall be borne by the SI.

iv. Any component (Physical & IT installed at the time of Project commissioning) that is reported to be faulty / non-functional on a given date should be either fully repaired or replaced by temporary substitute (of equivalent configuration) within the time frame agreed upon in the Service Level Agreement (SLA).

v. Proactive monitoring of the entire basic infrastructure installed.

vi. SI shall maintain records of the maintenance of the basic infrastructure and shall maintain a logbook on-site that may be inspected by the VSCDL at any time.

10.1.9.2.   Integration Testing

This shall be a black-box testing role primarily to ensure that the application to be deployed does not disrupt the Vadodara operations and affect other Vadodara infrastructure in terms of performance and security. The technical tasks to be carried out shall be as follows:

i. Functional Testing: Ensuring that the application functionality as described by the VSCDL works adequately. The functional testing of application will necessarily be minimal as this is a core responsibility of the Supplier.

ii. Performance Testing: Ensuring that the application meets expressed performance

requirements on the Vadodara servers by using performance test tools and performance monitoring tools.

iii. Security Testing: Testing for exploitable application security weaknesses that undermine the application security or the security of the infrastructure.

10.1.9.3. Vendor Management Services

The activities shall include:

i. Coordination with all the project stakeholders to ensure that all Vadodara activities are carried out in a timely manner.

ii. SI shall coordinate and follow-up with all the relevant vendors to ensure that the issues are resolved in accordance with the SLAs agreed upon with them.

iii. SI shall also ensure that unresolved issues are escalated to respective departments.

iv. SI shall maintain database of the various vendors with details like contact person, telephone nos., escalation matrix, response time and resolution time commitments etc.

v. SI shall draw a consolidated quarterly SLA performance report across vendors for consideration of the VSCDL.

10.1.9.4. Physical Infrastructure Management and Maintenance Services

All the devices that will be installed in the project as part of the physical infrastructure should be SNMP enabled and shall be centrally and remotely monitored and managed on a 24x7x365 basis. Industry leading infrastructure management solution should be deployed to facilitate monitoring and management of the infrastructure on one integrated console. The physical infrastructure management and maintenance services shall include:

i. Proactive and reactive maintenance, repair and replacement of defective components (IT and Non-IT/ Hardware and Software). The cost for repair and replacement shall be borne by the SI.

ii. The SI shall have to stock and provide adequate onsite and offsite spare parts and spare component to ensure that the uptime commitment as per SLA is met. To provide this service it is important for the SI to have back to back arrangement with the OEMs. The SI needs to provide a copy of the service level agreement signed with the respective OEMs.

iii. Component that is reported to be down on a given date should be either fully repaired or replaced by temporary substitute (of equivalent configuration) within the time frame indicated in the Service Level Agreement (SLA). In case the selected SI fails to meet the above standards of maintenance, there will be a penalty as specified in the SLA.

iv. The selected SI shall also maintain records of all maintenance of the system and shall maintain a logbook on-site that may be inspected by the VSCDL at any time.

10.1.10. Exit Management

i. This sets out the provisions, which will apply on expiry or termination of the Master Service Agreement, the Project Implementation, Operation and Management SLA.

ii. In the case of termination of the Project Implementation and/or Operation and Management, the Parties shall agree at that time whether, and if so during what period, the provisions of this Schedule shall apply.

iii. The Parties shall ensure that their respective associated entities carry out their respective obligations set out in this Exit Management Schedule.

10.1.10.1.1. Cooperation and Provision of Information

During the exit management period:

i. The SI will allow the VSCDL or its nominated agency access to information reasonably required to define the then current mode of operation associated with the provision of the services to enable the VSCDL to assess the existing services being delivered;

ii. Promptly on reasonable request by the VSCDL , the SI shall provide access to and copies of all information held or controlled by them which they have prepared or maintained in accordance with this agreement relating to any material aspect of the services (whether provided by the System integrator or sub-contractors appointed by the SI). The VSCDL shall be entitled to copy of all such information. Such information shall include details pertaining to the services rendered and other performance data. The SI shall permit the VSCDL or its nominated agencies to have reasonable access to its employees and facilities, to understand the methods of delivery of the services employed by the SI and to assist appropriate knowledge transfer.

10.1.10.1.2. Confidential Information, Security and Data

i. The SI will promptly on the commencement of the exit management period supply to the VSCDL or its nominated agency the following:

- information relating to the current services rendered and customer and performance data relating to the performance of sub-contractors in relation to the services;
- documentation relating to Intellectual Property Rights;
- documentation relating to sub-contractors;
- all current and updated data as is reasonably required for purposes of *VSCDL* or its nominated agencies transitioning the services to its Replacement *SI* in a readily available format nominated by the *VSCDL or* its nominated agency;
- all other information (including but not limited to documents, records and agreements) relating to the services reasonably necessary to enable *VSCDL* or its nominated agencies, or its Replacement *SI* to carry out due diligence in order to transition the provision of the Services to *VSCDL* or its nominated agencies, or its Replacement *System integrator* (as the case may be).

ii. Before the expiry of the exit management period, the SI shall deliver to the VSCDL or its nominated agency all new or up-dated materials from the categories set out in Schedule above and shall not retain any copies thereof, except that the SI shall be permitted to retain one copy of such materials for archival purposes only.

10.1.10.1.3. Transfer of Certain Agreements

On request by the *VSCDL* or its nominated agency the *SI* shall effect such assignments, transfers, licences and sub-licences *VSCDL* , or its Replacement *SI* in relation to any equipment lease, maintenance or service provision agreement between *SI* and third party lessors, vendors, and which are related to the services and reasonably necessary for the carrying out of replacement services by the *VSCDL* or its nominated agency or its Replacement *SI*.

10.1.10.1.4. General Obligations of the SI

i. The SI shall provide all such information as may reasonably be necessary to effect as seamless a handover as practicable in the circumstances to the VSCDL or its nominated agency or its Replacement SI and which the SI has in its possession or control at any time during the exit management period.

ii. For the purposes of this Schedule, anything in the possession or control of any SI, associated entity, or sub-contractor is deemed to be in the possession or control of the SI.

iii. The SI shall commit adequate resources to comply with its obligations under this Exit Management Schedule.

10.1.10.1.5. Exit Management Plan

i. The SI shall provide the VSCDL or its nominated agency with a recommended exit management plan ("Exit Management Plan") which shall deal with at least the following aspects of exit management in relation to the MSA as a whole and in relation to the Project Implementation, and the Operation and Management SLA.

- A detailed program of the transfer process that could be used in conjunction with a Replacement *SI* including details of the means to be used to ensure continuing provision of the services throughout the transfer process or until the cessation of the services and of the management structure to be used during the transfer;
- plans for the communication with such of the *SI*'s sub-contractors, staff, suppliers, customers and any related third party as are necessary to avoid any material detrimental impact on the *VSCDL* 's operations as a result of undertaking the transfer;
- (if applicable) proposed arrangements for the segregation of the *SI*'s networks from the networks employed by *VSCDL* and identification of specific security tasks necessary at termination;
- Plans for provision of contingent support to *VSCDL* , and replacement *SI* for a reasonable period after transfer.

a. The SI shall re-draft the Exit Management Plan annually thereafter to ensure that it is kept relevant and up to date.

b. Each Exit Management Plan shall be presented by the SI to and approved by the VSCDL or its nominated agencies.

c. The terms of payment as stated in the Terms of Payment Schedule include the costs of the SI complying with its obligations under this Schedule.

d. In the event of termination or expiry of MSA, and Project Implementation, each Party shall comply with the Exit Management Plan.

e. During the exit management period, the SI shall use its best efforts to deliver the services.

f. Payments during the Exit Management period shall be made in accordance with the Terms of Payment Schedule.

g. This Exit Management plan shall be furnished in writing to the VSCDL or its nominated agencies within 90 days from the Effective Date of this Agreement.

10.2. Compliance to Standards & Certifications

a. For a large and complex set up such as the Project, it is imperative that the highest standards applicable are adhered to. In this context, the SI will ensure that the entire Project is developed in compliance with the applicable standards.

b. During project duration, the SI will ensure adherence to prescribed standards as provided below:

Sl. No.	Component/Application/System	Prescribed Standard
1.	Information Security	ISO 27001
2.	IT Infrastructure Management	ITIL specifications
3.	Service Management	ISO 20000 specifications
4.	Project Documentation	IEEE/ISO/CMMi (where applicable) specifications for documentation

c. Apart from the above the SI need to ensure compliance of the project with Government of India IT security guidelines including provisions of:
- The Information Technology Act, 2000" and amendments thereof and
- Guidelines and advisories for information security published by Cert-In/DeitY (Government of India) issued till the date of publishing of tender notice. Periodic changes in these guidelines during project duration need to be complied with.

d. While writing the source code for application modules the SI should ensure high-quality documentation standards to improve the readability of the software module. An illustrative list of comments that each module contained within the source file should be preceded by is outlined below:
- The name of the module
- The date when module was created
- A description of what the module does
- A list of the calling arguments, their types, and brief explanations of what they do
- A list of required files and/or database tables needed by the module
- Error codes/Exceptions
- Operating System (OS) specific assumptions
- A list of locally defined variables, their types, and how they are used
- Modification history indicating who made modifications, when the modifications were made, and what was done.

e. Apart from the above SI needs to follow appropriate coding standards and guidelines inclusive of but not limited to the following while writing the source code -
- Proper and consistent indentation
- Inline comments
- Structured programming
- Meaningful variable names
- Appropriate spacing
- Declaration of variable names
- Meaningful error messages

f. Quality Audits

- VSCDL , at its discretion, may also engage independent auditors to audit any/some/all standards/processes. The SI shall support all such audits as per calendar agreed in advance. The result of the audit shall be shared with the SI who has to provide an effective action plan for mitigations of observations/non-compliances, if any.

10.3. Project Management and Governance

10.3.1.   Project Management Office (PMO)

A Project Management office will be set up during the start of the project. The PMO will, at the minimum, include a designated full time Project Manager from SI. It will also include key persons from other relevant stakeholders including members of VSCDL and other officials/representatives by invitation. The operational aspects of the PMO need to be handled by the SI including maintaining weekly statuses, minutes of the meetings, weekly/monthly/project plans, etc. PMO will meet formally on a weekly basis covering, at a minimum, the following agenda items:

i.   Project Progress
ii.   Delays, if any – Reasons thereof and ways to make-up lost time
iii.   Issues and concerns
iv.   Performance and SLA compliance reports;
v.   Unresolved and escalated issues;
vi.   Project risks and their proposed mitigation plan
vii.   Discussion on submitted deliverable
viii.   Timelines and anticipated delay in deliverable if any
ix.   Any other issues that either party wishes to add to the agenda.

During the development and implementation phase, there may be a need for more frequent meetings and the agenda would also include:

i.   Module development status
ii.   Testing results
iii.   IT infrastructure procurement and deployment status
iv.   Status of setting up/procuring of the Helpdesk, DC hosting
v.   Any other issues that either party wishes to add to the agenda.

Bidder shall recommend PMO structure for the project implementation phase and operations and maintenance phase.

10.3.2.   Steering Committee

The Steering Committee will consist of senior stakeholders from VSCDL , its nominated agencies and SI. SI will nominate its Smart City vertical head to be a part of the Project Steering Committee. The SI shall participate in monthly Steering Committee meetings and update Steering Committee on Project progress, Risk parameters (if any), Resource deployment and plan, immediate tasks, and any obstacles in project. The Steering committee meeting will be a forum for seeking and getting approval for project decisions on major changes etc. All relevant records of proceedings of Steering Committee should be maintained, updated, tracked and shared with the Steering Committee and Project Management Office by SI. During the development and implementation phase of the project, it is expected that there will be at least fortnightly Steering Committee meetings. During the O&M phase, the

meetings will be held at least once a quarter. Other than the planned meetings, in exceptional cases, VSCDL may call for a Steering Committee meeting with prior notice to the SI.

10.3.3. Project Monitoring and Reporting

The SI shall circulate written progress reports at agreed intervals to VSCDL and other stakeholders. Project status report shall include Progress against the Project Management Plan, status of all risks and issues, exceptions and issues along with recommended resolution etc.

Other than the planned meetings, in exceptional cases, project status meeting may be called with prior notice to the Bidder. VSCDL reserves the right to ask the bidder for the project review reports other than the standard weekly review reports.

10.3.4. Risk and Issue management

The SI shall develop a Risk Management Plan and shall identify, analyse and evaluate the project risks, and shall develop cost effective strategies and action plans to mitigate those risks.

The SI shall carry out a Risk Assessment and document the Risk profile of VSCDL based on the risk appetite and shall prepare and share the VSCDL Enterprise Risk Register. The SI shall develop an issues management procedure to identify, track, and resolve all issues confronting the project. The risk management plan and issue management procedure shall be done in consultation with VSCDL .

The SI shall monitor, report, and update the project risk profile. The risks should be discussed with VSCDL and a mitigation plan be identified during the project review/status meetings. The Risk and Issue management should form an agenda for the Project Steering Committee meetings as and when required.

10.3.5. Governance procedures

SI shall document the agreed structures in a procedures manual.

10.3.6. Planning and Scheduling

The SI will prepare a detailed schedule and plan for the entire project covering all tasks and sub tasks required for successful execution of the project. The SI has to get the plan approved from VSCDL at the start of the project and it should be updated every week to ensure tracking of the progress of the project.

The project plan should include the following:

1. The project break up into logical phases and sub-phases;
2. Activities making up the sub-phases and phases;
3. Components in each phase with milestones;
4. The milestone dates are decided by VSCDL in this RFP. SI cannot change any of the milestone completion dates. SI can only propose the internal task deadlines while keeping the overall end dates the same. SI may suggest improvement in project dates without changing the end dates of each activity.
5. Key milestones and deliverables along with their dates including those related to delivery and installation of hardware and software;
6. Start date and end date for each activity;
7. The dependencies among activities;
8. Resources to be assigned to each activity;

9. Dependency on VSCDL

10.3.7. License Metering / Management

The SI shall track software usage throughout the IT setup so as to effectively manage the risk of unauthorized usage or under-licensing of software installed as part of this project. This may be carried out through the use of standard license metering tools.

10.4. Change Management & Control

10.4.1. Change Orders / Alterations / Variations

i. The SI agrees that the requirements given in the Bidding Documents are minimum requirements and are only indicative. The vendor would need to etch out the details at the time of preparing the design document prior to actual implementation. It shall be the responsibility of the SI to meet all the requirements of technical specifications contained in the RFP and any upward revisions and/or additions of quantities, specifications sizes given in the Bidding Documents required to be made during execution of the works, shall not constitute a change order and shall be carried out without a change order and shall be carried out without any time and cost effect to Purchaser.

ii. Further upward revisions and or additions required to make SI's selected equipment and installation procedures to meet Bidding Documents requirements expressed and to make entire facilities safe, operable and as per specified codes and standards shall not constitute a change order and shall be carried out without any time and cost effect to Purchaser.

iii. Any upward revision and/or additions consequent to errors, omissions, ambiguities, discrepancies in the Bidding Documents which the SI had not brought out to the Purchaser's notice in his bid shall not constitute a change order and such upward revisions and/or addition shall be carried out by SI without any time and cost effect to Purchaser.

10.4.2. Change Order

i. The Change Order will be initiated only in case (i) the Purchaser directs in writing the SI to include any addition to the scope of work covered under this Contract or delete any part of the scope of the work under the Contract, (ii) SI requests to delete any part of the work which will not adversely affect the operational capabilities of the facilities and if the deletions proposed are agreed to by the Purchaser and for which cost and time benefits shall be passed on to the Purchaser, (iii) the Purchaser directs in writing the SI to incorporate changes or additions to the technical specifications already covered in the Contract.

ii. Any changes required by the Purchaser over and above the minimum requirements given in the specifications and drawings etc. included in the Bidding Documents before giving its approval to detailed design or Engineering requirements for complying with technical specifications and changes required to ensure systems compatibility and reliability for safe operation (As per codes, standards and recommended practices referred in the Bidding Documents) and trouble free operation shall not be construed to be change in the Scope of work under the Contract.

iii. Any change order as stated in Clause 2 a. comprising an alteration which involves change in the cost of the works (which sort of alteration is hereinafter called a "Variation") shall be the Subject of an amendment to the Contract by way of an increase or decrease in the schedule of Contract Prices and adjustment of the implementation schedule if any.

iv. If parties agree that the Contract does not contain applicable rates or that the said rates are inappropriate or the said rates are not precisely applicable to the variation in question, then the parties shall negotiate a revision of the Contract Price which shall represent the change in cost of the works caused by the Variations. Any change order shall be duly approved by the Purchaser in writing.

v. Within ten (10) working days of receiving the comments from the Purchaser or the drawings, specification, purchase requisitions and other documents submitted by the SI for approval, the SI shall respond in writing, which item(s) of the Comments is/are potential changes(s) in the Scope of work of the RFP document covered in the Contract and shall advise a date by which change order (if applicable) will be submitted to the Purchaser.

vi. Any integrations with future systems at VSCDL (not listed as a part of current scope) will be done through the change management process. The SI will have to quote man month efforts for each of the integration components and the same will be vetted by VSCDL or its appointed PMC.

10.5. Testing and Acceptance Criteria

a. SI shall demonstrate the following mentioned acceptance criteria prior to acceptance of the solution as well as during project operations phase, in respect of scalability and performance etc. The SI may propose further detailed Acceptance criteria which the VSCDL will review. Once VSCDL provides its approval, the Acceptance criteria can be finalized. In case required, parameters might be revised by VSCDL in mutual agreement with bidder and the revised parameters shall be considered for acceptance criteria. A comprehensive system should be set up that would have the capability to log & track the testing results, upload & maintain the test cases and log & track issues/bugs identified.

b. The following table depicts the details for the various kinds of testing envisaged for the project:

Type of Testing	Responsibility	Scope of Work
System Testing	SI	1. SI to perform System testing 2. SI to prepare test plan and test cases and maintain it. VSCDL may request the SI to share the test cases and results 3. Should be performed through manual as well as automated methods 4. Automation testing tools to be provided by SI. VSCDL doesn't intend to own these tools
Integration Testing	SI	1. SI to perform Integration testing 2. SI to prepare and share with VSCDL the Integration test plans and test cases 3. SI to perform Integration testing as per the approved plan

		4. Integration testing to be performed through manual as well as automated methods 5. Automation testing tools to be provided by SI. VSCDL doesn't intend to own these tools
Performance and load Testing	• SI • VSCDL / Third Party Auditor (to monitor the performance testing)	1. SI to do performance and load testing. 2. Various performance parameters such as transaction response time, throughput, page loading time should be taken into account. 3. Load and stress testing of the Project to be performed on business transaction volume 4. Test cases and test results to be shared with VSCDL . 5. Performance testing to be carried out in the exact same architecture that would be set up for production. 6. SI need to use performance and load testing tool for testing. VSCDL doesn't intend to own these tools. 7. VSCDL if required, could involve third party auditors to monitor/validate the performance testing. Cost for such audits to be paid by VSCDL .
Security Testing (including Penetration and Vulnerability testing)	• SI • VSCDL / Third Party Auditor (to monitor the security testing)	1. The solution should demonstrate the compliance with security requirements as mentioned in the RFP including but not limited to security controls in the application, at the network layer, network, data centre(s), security monitoring system deployed by the SI 2. The solution shall pass vulnerability and penetration testing for rollout of each phase. The solution should pass web application security testing for the portal, mobile app and other systems and security configuration review of the infrastructure. 3. SI should carry out security and vulnerability testing on the developed solution. 4. Security testing to be carried out in the exact same environment/architecture that would be set up for production. 5. Security test report and test cases should be shared with VSCDL 6. Testing tools if required, to be provided by SI. VSCDL doesn't intend to own these tools 7. During O&M phase, penetration testing to be conducted on yearly basis and

		vulnerability assessment to be conducted on half-yearly basis. VSCDL will also involve third party auditors to perform the audit/review/monitor the security testing carried out by SI. Cost for such auditors to be paid by VSCDL .
User Acceptance Testing of Project	• VSCDL or VSCDL appointed third party auditor	1. VSCDL / VSCDL appointed third party auditor to perform User Acceptance Testing 2. SI to prepare User Acceptance Testing test cases 3. UAT to be carried out in the exact same environment/architecture that would be set up for production 4. SI should fix bugs and issues raised during UAT and get approval on the fixes from VSCDL / third party auditor before production deployment 5. Changes in the application as an outcome of UAT shall not be considered as Change Request. SI has to rectify the observations.

Note:

a. Bidder needs to provide the details of the testing strategy and approach including details of intended tools/environment to be used by SI for testing in its technical proposal. VSCDL does not intend to own the tools.

b. The SI shall work in a manner to satisfy all the testing requirements and adhere to the testing strategy outlined. The SI must ensure deployment of necessary resources and tools during the testing phases. The SI shall perform the testing of the solution based on the approved test plan, document the results and shall fix the bugs found during the testing. It is the responsibility of SI to ensure that the end product delivered by the SI meets all the requirements specified in the RFP. The SI shall take remedial action based on outcome of the tests.

c. The SI shall arrange for environments and tools for testing and for training as envisaged. Post Go-Live; the production environment should not be used for testing and training purpose. If any production data is used for testing, it should be masked and it should be protected. Detailed process in this regard including security requirement should be provided by the SI in its technical proposal. The process will be finalized with the selected bidder.

d. All the Third Party Auditors (TPA) as mentioned above will be appointed and paid by VSCDL directly. All tools/environment required for testing shall be provided by the SI.

e. STQC/Other agencies appointed by VSCDL shall perform the role of TPA. SI needs to engage with the TPA at the requirement formulation stage itself. This is important so that unnecessary re-work is avoided and the audit is completed in time. The audit needs to be completed before Go-Live of different phases. SI needs to prepare and provide all requisite information/documents to third party auditor and ensure that there is no delay in overall schedule.

f. The cost of rectification of non-compliances shall be borne by the SI.

10.6. Factory Testing

Success SI shall have to submit Factory Test Certificate from OEM for the below mentioned materials before the actual supply of the items.

1. Desktop Computers
2. PIS Displays

10.6.1. Final Acceptance Testing

The final acceptance shall cover 100% of the Vadodara Project, after successful testing by the VSCDL or its PMU; a Final Acceptance Test Certificate (FAT) shall be issued by the VSCDL .
Prerequisite for Carrying out FAT activity:

5. Detailed test plan shall be developed by the SI and approved by VSCDL . This shall be submitted by SI before FAT activity to be carried out.
6. All documentation related to Vadodara Project and relevant acceptance test document (including IT Components, Non IT Components etc.) should be completed & submitted before the final acceptance test to the VSCDL .
7. The training requirements as mentioned should be completed before the final acceptance test.
8. Successful hosting of Application, NMS and MIS Software.
9. For both IT & Non-IT equipment's / software manuals / brochures / Data Sheets / CD / DVD / media for all the Vadodara Project supplied components.

The FAT shall include the following:

6. All hardware and software items must be installed at respective sites as per the specification.
7. Availability of all the defined services shall be verified.
8. The SI shall be required to demonstrate all the features / facilities / functionalities as mentioned in the RFP.
9. The SI shall arrange the test equipment required for performance verification, and will also provide documented test results.
10. The SI shall be responsible for the security audit of established system to be carried out by a certified third party as agreed by VSCDL .

Any delay by the SI in the Final Acceptance Testing shall render him liable to the imposition of appropriate Penalties. However, delays identified beyond the control of SI shall be considered appropriately and as per mutual agreement between VSCDL and SI. In the event the SI is not able to complete the installation due to non-availability of bandwidth from the bandwidth service providers, the Supplier and VSCDL may mutually agree to redefine the Network so the SI can complete installation and conduct the Final Acceptance Test within the specified time.

10.7. Smart City-Design Consideration
10.7.1. Key Design Considerations

Key design considerations taken into account are as follows –

- Designed for 24x7 online availability of application.
- Scalable solution on open protocols
- API based architecture for Integration with other web applications and Mobile applications

The key guiding principles considered for building the integrated solution are the following:

- **Continuous adoption of rapidly evolving Technology** - Technology evolves too fast and Government projects similar to Smart City with its long procurement

cycles do not align naturally to adapt to this trend. Also, any changes to existing implementations require contract changes, new RFP (Request for Proposal), etc. Hence the entire system would be built to be open (standards, open API, plug-n-play capabilities), components coupled loosely to allow changes in sub-system level without affecting other parts, architected to work completely within a heterogeneous compute, storage, and multi-vendor environment.

- **Selection of best solution at best rate as and when required** - Large integrated systems of Smart City operations should be designed to get best cost and performance advantages of natural technology curve (constant increase of speed and decrease of cost) and still aligned to open procurement practices of the Government. For this to happen, architecture should be open and vendor neutral, use commodity hardware, and designed for horizontal scale. This allows buying of commodity compute, storage, etc. only when needed at best price.

- **Distributed Access and Multi-channel service delivery -**With high penetration of mobile devices and very large percentage of internet usage using mobile devices, it is imperative that the Smart City applications provide multiple channels of service delivery to its stakeholders. An important consideration is that the access devices and their screen capabilities (including browser variations) are numerous and constantly evolve. Hence, it is imperative to design the system such that the ecosystem of Smart City-integrated mobile apps also evolves.

- **Security and privacy of data** - Security and privacy of data within the integrated Project will be foundational keeping in view of the sensitivity of data and critical nature of the infrastructure envisioned to be built for Smart City operations. Security and privacy of data should be fundamental in design of the system without sacrificing utility of the system. When creating a system of this scale, it is imperative that handling of the sensitivity and criticality of data are not afterthoughts, but designed into the strategy of the system from day one.

- **Provision of a Sustainable, Scalable Solution-** The motive of the technological enhancements to provide a system that would be sustainable for the next few years. The expectation is that the system should sustain at least 7 years from GO-Live. The solution would be done keeping in mind the scalability of the system. The simplified procurement processes and ease of compliance is expected to lead to huge growth in contract's base. Every component of VSCDL system needs to scale horizontally to very large volume of data.

- **API Approach-** VSCDL has decided to adopt Open API as the guiding paradigm to achieve the above goals. Though VSCDL system would develop a portal but that would not be the only way for interacting with the VSCDL system as the stakeholders via his choice of third party applications, which will provide all user interfaces and convenience via desktop, mobile, other interfaces, will be able to interact with the VSCDL system. These applications will connect with the VSCDL system via secure VSCDL system APIs. This architectural approach has been taken as the UI based integration through a ubiquitous web portal requires manual interaction and does not fit most consumption scenarios. The following benefits are envisaged from API based integration,
    - Consumption across technologies and platforms(mobile, tablets, desktops, etc.) based on the individual requirements
    - Automated upload and download of data

- o Ability to adapt to changing taxation and other business rules and end user usage models
  - o Integration with customer software (GIS, Accounting systems).
- **Business Rule Driven Approach-**All configurations including policy decisions, business parameters, rules, etc. shall be captured in a central place within the system. The system shall provide facility to the decision makers to add new or edit/delete existing policies or make changes with appropriate permission control and audit trace. Managing these in a central repository ensures only once source of truth is used across many application servers and reduces issues of inconsistent application behaviour. Decoupling of the business parameters/rules/master data from the rest of the solution architecture and making them configurable allows for a great deal of flexibility.
- **Data Distribution Service-**As a future roadmap it is envisaged that the functionalities provided by the VSCDL Project should be available as services that could be offered to other stakeholders on request. Keeping this in mind the system shall be able to provide data on subscription-publication basis. The organization of the information exchange between modules is fundamental to publish-subscribe (PS) systems. The PS model connects anonymous information producers (publishers) with information consumers (subscribers). The overall distributed application (the PS system) is composed of processes. The goal of the DDS architecture is to facilitate efficient distribution of data in a distributed system. Participant using DDS can 'read' or 'write' data efficiently and naturally with a typed interface. Underneath, the DDS middleware will distribute the data so that each reading participant can access the 'most current' values.

10.7.2. Guiding Architecture Principle

The IT architecture principles defined in this section are the underlying general rules and guidelines that will drive the subsequent development, use and maintenance of architectural standards, frameworks and future state target architecture.

VSCDL system will be built on the following core principles:

10.7.2.1. Platform Approach

It is critical that a platform based approach is taken for any large scale application development, to ensure adequate focus and resources on issues related to scalability, security and data management. Building an application platform with reusable components or frameworks across the application suite provides a mechanism to abstract all necessary common features into a single layer. Hence the VSCDL system is envisaged as a faceless system with 100% API driven architecture at the core of it. VSCDL portal will be one such application on top of these APIs, rather than being fused into the platform as a monolithic system.

Open APIs designed to be used form the core design mechanism to ensure openness, multi-user ecosystem, specific vendor/system independence, and most importantly providing tax payers and other ecosystem players with choice of using innovative applications on various devices (mobile, tablet, etc.) that are built on top of these APIs.

10.7.2.2. Openness

Adoption of open API, open standards and wherever prudent open source products are of paramount importance for the system. This will ensure the system to be lightweight, scalable

---

and secure. Openness comes from use of open standards and creating vendor neutral APIs and interfaces for all components. All the APIs will be stateless. Data access must be always through APIs, no application will access data directly from the storage layer or data access layer. For every internal data access also (access between various modules) there will be APIs and no direct access will be there.

10.7.2.3.   Data as an enterprise asset

Information is a high value asset to be leveraged across the organization to improve performance and decision making. Accurate information would ensure effective decision making and improved performance

Effective and careful data management is of high importance and top priority should be placed on ensuring where data resides, that its accuracy can be relied upon, and it can obtained when and where needed.

10.7.2.4.   Performance

A best of breed solution using the leading technologies of the domain should be proposed in the solution ensuring the highest levels of performance. It will also ensure that the performance of various modules should be independent of each other to enhance the overall performance and also in case of disaster, performance of one module should not impact the performance other modules.

The solution should be designed in a manner that the following can be achieved:

- Modular design to distribute the appropriate system functions on web and app server
- Increase in-memory Operations (use static operations)
- Reduce number of I/O operations and N/w calls using selective caching
- Dedicated schemas for each function making them independent and avoiding delays due to other function accessing the same schema.
- Solution should provide measurable and acceptable performance requirements for users, for different connectivity bandwidths.
- The solution should provide optimal and high performance Portal Solution satisfying response time for slow Internet connections and different browsers.

10.7.2.5.   Scalability

The component in the architecture will be capable of being scaled up to more user requests or handling more no. of input resources in various modules. Even inclusion of additional application functionalities can be catered to by upgrading the software editions with minimal effort.

Forward and backward integration (in terms of functions - components, applications, devices, geographical coverage and volume) with all smart city components across the 7+1 layers defined in the overall solution architecture. Such forward or backward integration could take place at any of the layers defined in the over architecture viz. sensor and actuator layer, network layer, data centre layer, application layer, integration layer, service delivery layer, command centre layer, visualisation layer and security layer.

The design of the system to consider future proofing the systems for volume handling requirements

- The application functions to be divided logically and developed as Modular solution.
- The system should be able to scale horizontally & vertically.

- *Data Volume-* Ability to support at least 20 % projected volume growth (year on year) in content post system implementation & content migration.
- *Functionality –* Ability to extend functionality of the solution without significant impact to the existing functional components and infrastructure.
- **Loose coupling through layered modular design and messaging** - The architecture would promote modular design and layered approach with clear division of responsibility and separation of concerns at the data storage, service and integration layer in order to achieve desired interoperability without any affinity to platforms, programming languages and network technologies. The architecture has to be scalable, maintainable and flexible for modular expansion as more citizen and business services are provided through the Project. Each of the logical layers would be loosely coupled with its adjacent layers
- **Data partitioning and parallel processing** - Project functionality naturally lends itself for massive parallel and distributed system. For linear scaling, it is essential that entire system is architected to work in parallel within and across machines with appropriate data and system partitioning. Choice of appropriate data sources such as RDBMS, Hadoop, NoSQL data stores, distributed file systems; etc. must be made to ensure there is absolutely no "single point of bottleneck" in the entire system including at the database and system level to scale linearly using commodity hardware.
- **Horizontal scale for compute, Network and storage** – Project architecture must be such that all components including compute, network and storage must scale horizontally to ensure that additional resources (compute, storage, network etc.) can be added as and when needed to achieve required scale.

10.7.2.6. No Vendor lock-in and Replace-ability

Specific OEM products may only be used when necessary to achieve scale, performance and reliability. Every such OEM component/service/product/framework/SI pre-existing product or work must be wrapped in a vendor neutral API so that at any time the OEM product can be replaced without affecting rest of the system. In addition, there must be at least 2 independent OEM products available using same standard before it can be used to ensure system is not locked in to single vendor implementation.

10.7.2.7. Security

The security services will cover the user profile management, authentication and authorization aspects of security control. This service run across all the layers since service components from different layers will interact with the security components. All public contents should be made available to all users without authentication. The service will authenticate users and allows access to other features of the envisaged application for which the user is entitled to.

The system should be designed to provide the appropriate security levels commiserate with the domain of operation. Also the system will ensure data confidentiality and data integrity. The application system should have the following

- A secure solution should be provided at the hardware infrastructure level, software level, and access level.

- Authentication, Authorization & Access Control: 3 factors (User ID & Password, Biometric, and Digital Signature) security mechanisms should be implemented to enable secure login and authorized access to portal information and services.
- Encryption   Confidentiality of sensitive information and data of users and portal information should be ensured.
- Appropriate mechanisms, protocols, and algorithms necessary to protect sensitive and confirmation data and information both during communication and storage should be implemented.
- Data security policies and standards to be developed and adopted across the Smart City departments and systems
- In order to adequately provide access to secured information, security needs must be identified and developed at the data level. Database design must consider and incorporate data integrity requirements.
- Role based access for all the stake holders envisaged to access and use the system
- Appropriate authentication mechanism adhering to industry good practice of Password Policies etc.
- Ability to adopt other authentication mechanism such as Electronic Signature Certificates
- Authorization validity to be ensured for the users providing the Data to the system. Data should be accepted only from the entity authorized
- Data should be visible only to the authorized entity
- Audit trails and Audit logging mechanism to be built in the system to ensure that user action can be established and can investigated if any can be aided(e.g. Logging of IP Address etc.)
- Data alterations etc. through unauthorized channel should be prevented.
- Industry good practice for coding of application so as to ensure sustenance to the Application Vulnerability Assessment

System must implement various measures to achieve this including mechanisms to ensure security of procurement data, spanning from strong end-to-end encryption of sensitive data, use of strong PKI national standards encryption, use of HSM (Hardware Security Module) appliances, physical security, access control, network security, stringent audit mechanism, 24x7 monitoring, and measures such as data partitioning and data encryption.

Activities such as anti-spoofing (no one should be able to masquerade for inappropriate access), anti-sniffing (no one should be able get data and interpret it), anti-tampering (no one should be able to put/change data which was not meant to be put/changed) should be taken care for data in transit, as well as data at rest, from internal and external threats.

10.7.2.8.   User Interface

The architecture and application solutions to be designed should promote simplicity and ease of use to the end users while still meeting business requirements. It should provide a simpler and more cost-effective solution. Reduces development time and makes the solution easier to maintain when changes in requirements occur.

This will be accomplished by the implementation of rich User Interfaces along with its integration with the DMS, Relational Data Store, Messaging and other external applications.

- Efficient and layout design are the key considerations that enhance usability which should be factored in while designing the application. Standard and consistent usability criteria must be defined. An intuitive, user friendly, well-articulated

navigation method for the applications greatly enhances the usability of the application.

- Effective information dissemination
- Enhanced functionalities including personalized delivery of content, collaboration and enriching GUI features.
- Mobile Application Platform
  - Applications and services including all appropriate channels such as SMS/USSD/IVRS and development of corresponding mobile applications to the applications and services leveraging the Mobile Service Delivery Gateway (MSDG) and Mobile App Store.
  - Application platform should support the following smart phone mobile OS (Android 4.0 and above, iOS 4, 5 and above, Windows Phone OS 8.0 and above, Mobile Web App)
  - Support the target packaging components like (Mobile Website, Hybrid App, Native App, Web App and Application Development, Eclipse tooling platforms)
  - Support the ability to write code once and deploy on multiple mobile operating systems
  - Support integration with native device API
  - Support utilization of all native device features
  - Support development of applications in a common programing language
  - Support integration with mobile vendor SDKs for app development and testing
  - Support HTML5, CSS3, JS features for smartphone devices
  - Support common protocol adapters for connection to back office systems (i.e. HTTP, HTTPS, SOAP, XML for format)
  - Support JSON to XML or provide XHTML message transformations
  - Support multi-lingual and language internalization
  - Support encrypted messaging between server and client components

10.7.2.9. Reliability

This is a very crucial system and data are of high sensitivity, the data transfer and data management should be reliable to keep the confidence of the stakeholders. The system should have appropriate measures to ensure processing reliability for the data received or accessed through the application.

It may be necessary to mainly ensure the following

- Prevent processing of duplicate incoming files/data
- Unauthorized alteration to the Data uploaded in the VSCDL system should be prevented
- Ensure minimum data loss(expected zero data loss)

10.7.2.10. Manageability

It is essential that the application architecture handles different failures properly; be it a hardware failure, network outage, or software crashes. The system must be resilient to failures and have the ability to restart, and make human intervention minimal.

All layers of the system such as application, infrastructure must be managed through automation and proactive alerting rather than using 100's of people manually managing. The entire application must be architected in such a way that every component of the system is monitored in a non-intrusive fashion (without affecting the performance or functionality of

that component) and business metrics are published in a near real-time fashion. This allows data centre operators to be alerted proactively in the event of system issues and highlight these issues on a Network Operations Centre (NoC) at a granular level. The solution should be envisaged to utilize various tools and technologies for management and monitoring services. There should be management and monitoring tools to maintain the SLAs.

10.7.2.11. Availability

The solution design and deployment architecture will ensure that the application can be deployed in a centralized environment offering system High Availability and failover.
The solution should meet the following availability requirements

- Load Balanced across two or more Web Server avoiding single point of failure
- Deployment of multiple application instances should be possible
- Distributed or load balanced implementation of application to ensure that availability of services is not compromised at any failure instance.
- Network, DC, DR should be available 99.99 % time.

10.7.2.12. SLA driven solution

Data from connected smart devices to be readily available (real-time), aggregated, classified and stored, so as not to delay the business processes of monitoring and decision making, and will enable appropriate timely sharing across the Smart City organization.
Readily available and consumed device data will facilitate timely access of analytics reports at every level and department of the Smart City and provide timely analysis of data as well as monitoring of KPIs through SLAs resulting in effective service delivery and improved decision making.

10.7.2.13. Reconstruction of truth

System should not allow database/system administrators to make any changes to data. It should ensure that the data and file (data at rest) that is kept in the systems has tamper resistance capacity and source of truth (original data of invoices and final returns) could be used to reconstruct derived data such as ledgers and system generated returns. System should be able to detect any data tampering through matching of hash value and should be able to reconstruct the truth.

- Services/solutions should be flexible and extensible to respond to, accommodate and adapt to changing business needs and unanticipated requirements easily. Consolidate and simplify technology applications wherever possible to minimize complexity. Ongoing application, database and server consolidation may be required.
- Software should use meta-data to configure itself (using declarations rather than coding).
- Avoid proprietary solutions and technologies if possible. Consider adhering to latest industry best practices and technical standards.
- The infrastructure should support an environment that allows applications to start small, grow quickly, and operate inexpensively. An adaptable infrastructure provides the capability to add to the current infrastructure with minimum inconvenience to the user.
- The IT architecture should be designed to support the overall SLA requirements around scalability, availability and performance.

- Each application should be performance tested to identify performance issues. The potential performance bottlenecks need to be identified and cost-effective paths for performance improvements should be provided for these identified problem areas.
- The system infrastructure should be architected considering failover requirements and should ensure that a single server or network link failure does not bring down the entire system.
- The system should be reliable handling every request and yield a response. It should handle error and exception conditions effectively.

10.7.2.14. Integration Architecture

This section recommends the proposed integration architecture aligning with the overarching architectural principles.

The following are the integration specifications for the various integration scenarios -

Real-time integration

All the Smart City applications will be deployed in the Data Centre while any external application of the Smart City ecosystem will reside in outside premises.

The need for a Service Oriented Architecture (SOA) is felt that will facilitate VSCDL in defining an enterprise integration platform. An SOA platform will help in data exchange across applications in real-time mode (both synchronous and asynchronous), promote loose coupling with ease of maintenance and change, facilitate rapid composition of complex services, achieve scalability through modularity, and improved business visibility.

SOA is an architectural style that allows the integration of heterogeneous applications & users into flexible service delivery architecture. Discrete business functions contained in enterprise applications could be organized as layers of interoperable, standards-based shared "services" that can be combined, reused, discovered and leveraged by other applications and processes.

The following are the various integration modes and techniques that could be leveraged -

- SOAP web service based interfacing technique will be leveraged as the real-time point to point synchronous integration mode with external or third party systems. The following integration points could be considered for SOAP web service based interfacing -
  - o Payment gateway of the authorized banks to enable authorized users make financial transactions for the Smart City services availed by them. This should support a unified interface to integrate with all Payment Service Providers using web services over secured protocols.
  - o SMS application, acting as the SMS Gateway, will make use of APIs for SMS communication to GSM network using the GSM modem, which can be both event-driven as well as time-driven. The API will be exposed to initiate the broadcasting or alert notification.
  - o Social Media Apps and NoSQL data stores to exchange photos, videos and message feeds, based on interactions with Citizens and Business as well as comments/posts to inform stakeholders
  - o IVR/Customer Support solution with ERP and Transactional Data Repository to exchange citizen and business demographic, registration and payment data as well as transactional data related to citizen services and municipal operations.
- Message based interfacing technique will be leveraged for real-time asynchronous integration mode. The following integration points could be considered for message based interfacing -
  - o Central LDAP with ERP to synchronize member and employee user registration data

- o Payment solution and ERP to exchange payment data for tracking of beneficiary's payment transactions against different services (citizen, workers, transporter, vendor), master data (employee, vendor/supplier, location, facilities, price table)
  - o Employee attendance data with ERP (HR Module) to capture data pertaining to employee location and attendance
  - o Departmental applications with ERP (Asset Management module) to exchange data for procurement and maintenance of any assets or infrastructure items for each department.
  - o Municipal operations application with ERP (Material Management module) to capture materials related transaction and inventory data for public works
  - o Other government applications with Smart City application to exchange data for government procurement, public health schemes, welfare schemes, citizen health, etc.
- RESTful API service based interfacing technique will be leveraged for the following integration areas-
  - o Access and use of various services provided by the different departments for citizens and business community will be done through a RESTful, stateless API layer.
  - o Access and use of various internal functions related to operations and administration of Smart City for departmental and VSCDL employees will be done through a RESTful, stateless API layer
- Data integration in batch mode will be through ETL. The following integration points could be considered for ETL based data integration -
  - o Initial data migration to cleanse, validate and load the data extracted from source systems into target tables
  - o Data load from all the individual transactional systems like ERP, Grievance Redressal to central enterprise data warehouse solution for aggregation, mining, dashboard reporting and analytics.

Process Integration layer of the VSCDL solution will automate complex business processes or provide unified access to information that is scattered across many systems. Process Integration will provide a clean separation between the definition of the process in the process model, the execution of the process in the process manager, and the implementation of the individual functions in the applications. This separation will allow the application functions to be reused in many different processes.

An enterprise service bus (ESB) is a software architecture model used for designing and implementing the interaction and communication between mutually interacting software applications in Service Oriented Architecture. As software architecture model for distributed computing it is a variant of the more general client server software architecture model and promotes strictly asynchronous message oriented design for communication and interaction between applications. Its primary use is in Enterprise Application Integration of heterogeneous and complex landscapes. Following are the requirement for an ESB system:

- The solution should support static/deterministic routing, content-based routing, rules-based routing, and policy-based routing, as applicable in various business cases.
- The solution should have capabilities to receive input message in heterogeneous formats from various different systems, interpret those messages, process and transform those messages to generate output and feed them to various different clients as per formats applicable.
  - o The solution should have features to communicate across different services, process them and expose as single aggregate service to facilitate business functionality

- o ESB should support SOA standards such as XML, XSLT, BPEL, web services standards and messaging standards.
- o ESB should support all industry standards interfaces for interoperability between different systems

There are four integration gateways envisaged as part of the solution design. The key requirements with respect to each of these are mentioned below:

SMS Gateway: SMS services are envisaged to be made available as part of the solution design. The service provider may integrate the solution with MSDG (or existing one), and use the services available through it, or deploy its own SMS Gateway services at no extra charge to VSCDL but it is a mandatory requirement that all the SMS based services (alerts and notifications) should be available as part of the solution. Following are some of the key requirements for the SMS services through the solution:

- Should contain required details/information and targeted to the applicant or designated officers of tax departments and other stakeholders and users as per prevailing TRAI norms
- Facilitate access through access codes for different types of services
- Support automated alerts that allows to set up triggers that will automatically send out reminders
- Provide provision for International SMS
- Provide provision to receive messages directly from users
- Provide provision for personalized priority messages
- Resend the SMS in case of failure of the message
- Provide messaging templates

Email Services: Email services are envisaged to be made available as part of the solution design to send alerts/intimations/automated messages to registered email ids, based on preferences set up/opted by individual users. An authenticated SMTP mail service (also known as a SMTP relay or smart host) is envisaged to be integrated with the solution for sending mail from the solution, and delivered to intended inbox. Support antispam features.

Payment Gateway: The solution is envisaged to have integration with payment gateways, to enable authorized Users make financial transactions, as per rights and privileges provided to him/her. The service provider is required to make the provisions for integration with such third party gateways and provide payment services, as per requirement of the <<URBAN LOCAL BODY>>. Some of the key features of payment gateway are mentioned below:

- Should support secure integration with Payment Service Providers
- Should support a unified interface to integrate with all Payment Service Providers
- Should support integration with Payment Service Providers using web services and over HTTP/S protocol
- Should manage messages exchange between UI and payment service providers
- Should support beneficiary's payment transactions tracking against various services
- Should support bank accounts reconciliation
- Should provide logs for all transactions performed through the Payment Gateway for future financial dispute resolution that might arise between entities and either beneficiaries or Payment Service Providers
- Should maintain and keep transactions logs for time period required and specified by the financial regulations followed in country
- Should support redundant Payment Discovery
- Should submit Periodic Reconciliation Report to government entities

- Should support transaction reports to monitor and track payments
- Should support real-time online credit card authorization for merchants
- Should support compliance with emerging trends and multiple payment options such debit card, credit card, cash cards and other payment gateways
- Should provide fraud screening features
- Should support browser based remote administration
- Should support multicurrency processing and settlement directly to merchant account
- Should support processing of one-time or recurring transactions using tokenization
- Should support real time integration with SMS and emails

IVR Services: IVR services are envisaged as part of Call Centre facility, which will be integrated with the solution, to provide information and services to the people who would contact the Call Centre: Some of the key features of the IVR services are mentioned below:

- Should provide multi-lingual content support
- Should facilitate access through access codes for different types of services
- Should support Web Service Integration
- Should support Dual Tone Multi Frequency (DTMF) using telephone touchpad - in-band and out-of-band
- Should support for Voice Extensible Markup Language (VoiceXML)
- Should support speech recognition that interprets spoken words as texts (Advanced Speech Recognition).
- Should support playing of pre-recorded sounds
- Should support redirection to human assistance, as per defined rules
- Should be able to generate Data Records – (CDRs) and have exporting capabilities to other systems
- Should provide provision for voice mailbox and voice recognition

There are multiple ways of integration of the solution with other systems is envisaged. These may be through Web Services, Message Queuing, File based or API based. The integration and data sharing mechanism may be either in Batch Mode or Needs basis (synchronous or asynchronous). Some of the key requirements of the interface/integration are mentioned below:

  - o Interface Definition
  - o Interface Owner
  - o Interface Type
  - o Interface Format
  - o Frequency
  - o Source System
  - o API/Service/Store Procedure
  - o Entitlement Service
  - o Consuming System
  - o Interface Layout (or) Schema
- Should have provision for exceptional scenarios
- Should have syntax details such as data type, length, mandatory/option, default values, range values etc.
- Error code should be defined for every validation or business rule
- Inputs and outputs should be defined
- Should be backward compatible to earlier datasets

- Data exchange should provide transactional assurance
- Response time and performance characteristics should be defined for data exchange
- The failover scenarios should be identified
- Data exchange should be auditable

10.8. Security

Data exchange should abide by all laws on privacy and data protection Security Architecture This section recommends the proposed security architecture aligning with the overarching architectural principles. The basic tenets of Smart City security architecture are the design controls that protect confidentiality, integrity and availability of information and services for all the stakeholders.

10.8.1.1. User Security and Monitoring

Authentication & Authorization

A strong authentication mechanism should be considered to protect unauthorized access to the Smart City applications. Consider use of at least two of the following forms of authentication mechanism:

- Something you know, such as a password, PIN etc
- Something you have, such as a smart card, hardware security token etc
- Something you are, such as a fingerprint, a retinal scan, or other biometric methods

Levels of Authentication

Based on the security requirements the following levels of authentication should be evaluated.

- For applications handling sensitive data it is recommended that in the least one factor authentication key in the form of a password is essential. Strong password complexity rules should be enforced to ensure confidentiality and integrity of the data
- For applications handling highly sensitive data it is recommended that two factor authentication mechanisms should be considered. The first line of defence is the password conforming to the password complexity rules'. Along with the password next user has to provide a one-time password which varies for each session. One time passwords are valid for each session and it is not vulnerable to dictionary, phishing, interception and lots of other attacks. A counter synchronized One-Time Password (OTP) solution could be used for this purpose.

Authorization

Authorization of system users should be enforced by access controls. It is recommended to develop access control lists. Consider the following approach for developing access control list -

- Establish groups of users based on similar functions and similar access privilege.
- Identify the owner of each group
- Establish the degree of access to be provided to each group

10.8.1.2. Data Security

Traditional Structured Enterprise Data

VSCDL should protect Integrated Project information against unauthorized access, denial of service, and both intentional and accidental modification. Data security, audit controls and integrity must be ensured across the data life cycle management from creation, accessed, viewed, updated and when deleted (or inactivated). This provides a proactive way to build

defences against possible security vulnerabilities and threats, allowing errors to be corrected and system misuse to be minimized.

The implications for adhering to an effective data security and integrity guideline related to the Project are the following –

- Data security policies and standards to be developed and adopted across VSCDL Smart City applications and stakeholders
- Data security controls to be put in place to restrict access to enterprise data based on roles and access privileges. Data audit logs should be maintained for audit trail purposes. Security controls will be able to be reviewed or audited through some qualitative or quantitative means for traceability and to ensure that risk is being maintained at acceptable levels.
- In order to adequately provide access to secured information, security needs must be identified and developed at the data level, not the application level. Database design must consider and incorporate data integrity requirements.
- Procedures for data sharing need to be established. Data integrity during data synchronization needs to be ensured across the enterprise.
- *Audit Capabilities:* The system provides for a system-wide audit control mechanism that works in conjunction with the RDBMS.
- *Maintaining Date/Time Stamp and User Id:* Every transaction, with a date and time and User ID, is captured. The system allows generating various audit reports for verification.
- *Access Log:* The VSCDL Project should have extensive inbuilt security and access control mechanisms. Based on this, the system keeps track of the various functions accessed by any users.

Audit Trail & Audit Log

Audit trails or audit logs should be maintained. Log information is critical in identifying and tracking threats and compromises to the environment.

There are a number of devices and software that should be logged which include hardware & software based firewalls, web servers, authentication servers, central/domain controllers, database servers, mail servers, file servers, routers, DHCP servers etc.

It is essential to decide what activities and events should be logged. The events which ideally should be captured include

- Create, read, update and delete of confidential information;
- User authentication and authorization activities in the system, granting, modification or revoking of user access rights;
- Network or service configuration changes;
- Application process start up, shutdown or restart, abort, failure or abnormal terminations, failure of network services;
- Detection of suspicious activities such as from Intrusion Detection and Prevention system, anti-virus, anti-spyware systems etc.

10.8.1.3.   Application Security

- Project must comply with the Application Security Plan and security guidelines of Government of India as applicable
- Secure coding guidelines should be followed. Secure coding guidelines should include controls against SQL injection, command injection, input validation, cross site scripting, directory traversal, buffer overflows, resource exhaustion attacks etc. OWASP Top 10

standard should be mapped in the secure coding guidelines to cover all major vulnerabilities.

- Validation checks should be incorporated into the application to detect any corruption of information through processing errors or deliberate acts.
- Data output from an application should be validated to ensure that the processing of stored information is correct and appropriate to the circumstances
- Should implement secure error handling practices in the application
- Project should have Role based access, encryption of user credentials. Application level security should be provided through leading practices and standards including the following:
  o Prevent SQL Injection Vulnerabilities for attack on database
  o Prevent XSS Vulnerabilities to extract user name password (Escape All Untrusted Data in HTML Contexts and Use Positive Input Validation)
  o Secure Authentication and Session Management control functionality shall be provided through a Centralize Authentication and Session Management Controls and Protect Session IDs from XSS
  o Prevent Security Misconfiguration Vulnerabilities (Automated scanners shall be used for detecting missing patches, misconfigurations, use of default accounts, unnecessary services, etc. maintain Audits for updates
  o Prevent Insecure Cryptographic Storage Vulnerabilities (by encrypt off-site backups, ensure proper key storage and management to protect keys and passwords, using a strong algorithm)
  o Prevent Failure to Restrict URL Access Vulnerabilities (By providing authentication and authorization for each sensitive page, use role-based authentication and authorization and make authentication and authorization policies configurable
  o Prevent Insufficient Transport Layer Protection Vulnerabilities (enable SSL for all sensitive pages, set the secure flag on all sensitive cookies and secure backend connections
  o Prevent Id Redirects and Forwards Vulnerabilities
  o For effective prevention of SQL injection vulnerabilities, SI should have monitoring feature of database activity on the network and should have reporting mechanism to restrict or allow the traffic based on defined policies.

10.8.1.4.   Infrastructure Security

The following focused initiatives to discover and remedy security vulnerabilities of the IT systems of VSCDL Smart City should be considered to proactively prevent percolation of any threat vectors -

- Deploy anti-virus software to all workstations and servers to reduce the likelihood of security threats;
- Deploy perimeter security technologies e.g. enterprise firewalls to reduce the likelihood of any security threat;
- Deploy web content filtering solutions to prevent threats from compromised websites to help identify and block potentially risky web pages;
- Install enterprise-level e-mail anti-security software to reduce vulnerability to phishing and other e-mail security spams. This would check both incoming and outgoing messages

to ensure that spam messages are not being transmitted if a system becomes compromised.

- Perform periodic scanning of the network to identify system level vulnerabilities
- Establish processes for viewing logs and alerts which are critical to identify and track threats and compromises to the environment. The granularity and level of logging must be configured to meet the security management requirements.
- Deploy technology to actively monitor and manage perimeter and internal information security.
- Deploy network Intrusion Detection System (IDS) on the perimeter and key points of the network and host IDS to critical systems. Establish process to tune, update, and monitor IDS information.
- In case of cloud deployment, cloud services can be disrupted by DDoS attacks or misconfiguration errors which have the potential to cascade across the cloud and disrupt the network, systems and storage hosting the cloud application.
- Deploy security automation techniques like automatic provisioning of firewall policies, privileged accounts, DNS, application identity etc.

10.9. Software Development Lifecycle

Continuous Build

The Vadodara Project should be highly modular and parallel development should be carried out for faster execution using industry's best Software Development Lifecycle practices. All application modules within the same technology platform should follow a standardized build and deployment process.

A dedicated 'development / customization' environment should be proposed and setup. The SI must provision separate development and testing environment for application development and testing. Any change, modifications in any module must follow industry standard processes like change management, version control and release management in large and complex application development environment.

Application source code could be maintained in source control and could be broken up into a number of projects. Source control projects are created to abstract related set of modules or feature that can be independently included in another application.

It is a mandatory to create, update and maintain all relevant documentation throughout the contract duration. Also it should be ensured that a bug tracking toll is maintained for proper tracking of all bugs fixes as per various tests conducted on the application.

10.10. Quality Assurance

A thorough quality check is proposed for the Vadodara Project and its modules, as per standard Software Development Life Cycle (SDLC). SI is expected to lay down a robust Quality Assurance program for testing of the developed application for its functionality, performance and security before putting in production environment. The program must include an overall plan for testing and acceptance of system, in which specific methods and steps should be clearly indicated and approved by <<URBAN LOCAL BODY>>. SI is required to incorporate all suggestions / feedback provided after the elaborate testing of the system, within a pre-defined, mutually agreed timeline. SI must undertake the following:

- Outline the methodology that will be used for testing the system.
- Define the various levels or types of testing that will be performed for system.
- Provide necessary checklist/documentation that will be required for testing the system.

- Describe any technique that will be used for testing the system.
- Describe how the testing methodology will conform to the requirements of each of the functionalities and expected outcome.
- Indicate / demonstrate to VSCDL that all applications installed in the system have been tested.

10.10.1. Performance and Load Testing

SI is expected to implement performance and load testing with following features:

- Testing workload profiles and test scenarios based on the various functional requirements should be defined. Application as well as system resource utilization parameters that need to be monitored and captured for each run also needs to be defined.
- Should support application testing and API testing including HTTP(s), web services, mobile applications and different web 2.0 frameworks such as Ajax/Flex/HTML5.
- SI should perform the load testing of Vadodara Project for multiple workload profiles, multiple scenarios, and user loads to handle the envisaged users of the system.
- Different activities before load testing i.e. identification of work load profiles, scenarios, information capturing report formats, creation of testing scripts, infrastructure detailing and workload profile should be prepared before the start of actual load testing exercise.
- Solution parameters needs to be tuned based on the analysis of the load testing reports. The tuning process could be iterative until the issues are closed. Multiple load runs needs to be executed for users to simulate different scenarios, such as peak load (year end, quarter end, etc.), load generation within the LAN, Load generation across WAN or mobile network simulator while introducing configurable latency/jitter/packet loss etc.
- Should eliminate manual data manipulation and enable ease of creating data-driven tests.
- Should provide capability to emulate true concurrent transactions.
- Should identify root cause of performance issues at application or code level. Include code performance analysis to quickly pinpoint component-level bottlenecks: Slowest classes and methods, most frequently called methods, most costly (aggregate time spent for each method), response time variance etc.
- Should allow selection of different network bandwidth such as analog modems, ISDN, DSL, or custom bandwidth.
- Should be able to monitor various system components e.g. Server (OS, Web, Application & Database) Monitoring, Network (between Client & Server) Delay Monitoring, Network Devices (Firewall, Switch & Router) Monitoring during the load test without having to install any data capturing agents on the monitored servers/components
- Should correlate response times and system performance metrics to provide quick insights in to root cause of performance issues.
- Reports on following parameters (but not limited to) such as transaction response time, transaction per second (Passed), user interface rendering time, transaction per second (Failed), web transaction breakdown graphs, hits per second, throughput, HTTP responses per Second, pages downloaded per second, system infrastructure performance metrics etc.
- Should provide End-to-End system performance analysis based on defined SLAs. Should monitor resource utilization including memory leakage, CPU overload and

network overload. Should have the ability to split end-to-end response time for Network & Server(s) and provide drill-down capability to identify and isolate bottlenecks.

10.11. Advertising and Marketing Guidelines

The SI is required to obtain approvals from VSCDL/VMC before undertaking any advertisement and marketing opportunities through any of the Smart Elements. The SI shall follow following guidelines while undertaking such advertisements or marketing strategies:

a) SI shall be responsible for safeguarding the aesthetics of the location and shall not compromise on any tangible or intangible assets of VSCDL/VMC while undertaking these advertising or marketing campaigns.

b) VSCDL will approve SI's advertisement strategy and execution plan keeping in mind that users are not inundated with advertisements to an extent that it impacts user experience.

c) SI shall take approval from VSCDL on the content, design, size, duration of such advertisements / marketing strategies.

d) SI will not self-proclaim the ownership for carrying out activities under the project in the form of advertisement or marketing activities.

e) The revenue generated from advertising and marketing activities need to be reported to VSCDL, in the format & periodicity as decided by VSCDL.

f) SI shall take utmost care not to infringe into the privacy of residents / tourists.

11.   Annexure VII- Common guidelines/requirements regarding compliance of systems/ equipment

11.1. OEM Selection Criteria

#	Component	Selection criteria for the OEM
A	**ITMS Software Solution**	
1	**ITMS Software Solution Stack**	• Should have been operational for at least 5 City Wide Intelligent Transit Management projects (globally) of minimum 200 buses/trains/vehicles each in last 3 years
B	**Surveillance/CCTV Components**	
1	**CCTV Cameras**	• Minimum installation base of 50,000 IP based cameras across globe as on 31/03/2017 **and** Should have been operational for at least 2 City/outdoor CCTV Surveillance projects (globally) of minimum 500 IP based city/outdoor cameras each in last 3 years **OR** • From any of Top 10 OEM from Latest IHS World Report for Network Security Cameras, Report for Security Cameras & Report for Intelligent Cameras
2	**ONVIF Compliance**	All CCTV Cameras, Video Management System, Video Analytics Solution/Software and any video/image processing solution within overall project offering should be ONVIF Core Specification '2.X' or 'S' compliant and provide support for ONVIF profiles such as Streaming, Storage, Recording, Playback etc.
B	**IT Infrastructure Components**	
1	**Edge Level (Field) Switches**	• Minimum installation base of 5,000 switches across globe as on 31/03/2017 and Should have been operational for at least 2 City/outdoor CCTV Surveillance projects (globally) for supporting minimum 500 city/outdoor network devices (such as camera, controller etc.) each in last 3 years OR • OEMs who are amongst the top 5 for World-wide Market share in terms of Revenue as per IDC / Similar organisation's latest published quarterly report / presence in the latest Magic Quadrant by Gartner.
2	**Other Switches, and Routers**	• OEMs who are amongst the top 5 for World-wide Market share in terms of Revenue as per. IDC / Similar organisation's latest published quarterly report / presence in the latest Magic Quadrant by Gartner.
3	**Servers and Desktop PC**	• OEMs who are amongst the top 5 for world-wide market share in terms of revenue as per IDC / Similar organisation's latest published quarterly report / presence in the latest Magic Quadrant by Gartner.
4	**Storage Solution**	• OEMs who are amongst the top 5 for world-wide market share in terms of revenue as per IDC / Similar organisation's latest published quarterly report / presence in the latest Magic Quadrant by Gartner.

6	EMS (Enterprise Management System)	• OEMs who are amongst the top 5 for world-wide market share in terms of revenue as per IDC / Similar organisation's latest published quarterly report / presence in the latest Magic Quadrant by Gartner.

Note: The Bidder shall attach relevant latest report(s), that specifies meeting above OEM selection criteria

11.2. Other/General Criteria

1. The specifications mentioned for various IT / Non-IT components are indicative requirements and should be treated for benchmarking purpose only. SIs are required to undertake their own requirement analysis and may propose higher specifications that are better suited to the requirements.

2. Any manufacturer and product name mentioned in the Tender should not be treated as a recommendation of the manufacturer / product, unless specifically mentioned so.

3. None of the IT / Non-IT equipment's proposed by the SI should be End of Life product. It is essential that the technical proposal is accompanied by the OEM certificate in the format given in Volume I of this Tender, where-in the OEM will certify that the product is not end of life product & shall support for at least 6 years from the date of Bid Submission.

4. All IT Components should support IPv4 and IPv6

5. Technical Bid should be accompanied by OEM's product brochure / datasheet. SIs should provide complete Make, model, part numbers and sub-part numbers for all equipment/software quoted, in the Technical Bid, as per section 11.1 (Volume 1)

6. SIs should ensure complete warranty and support for all equipment from OEMs. All the back-to-back service agreements should be submitted along with the Technical Bid.

7. All equipment, parts should be original and new.

8. The user interface of the system should be a user friendly Graphical User Interface (GUI).

9. Critical core components of the system should not have any requirements to have proprietary platforms and should conform to open standards.

10. For custom made modules, industry standards and norms should be adhered to for coding during application development to make debugging and maintenance easier. Object oriented programming methodology must be followed to facilitate sharing, componentizing and multiple-use of standard code. Before hosting the application, it shall be subjected to application security audit (by any of the CERTIN empanelled vendors) to ensure that the application is free from any vulnerability; and approved by the VSCDL.

11. All the Clients Machines / Servers shall support static assigned IP addresses or shall obtain IP addresses from a DNS/DHCP server.

12. The Successful SI should also propose the specifications of any additional servers / other equipment/hardware/software, if required for the system.

13. The indicative architecture of the system is given in this volume. The Successful SI must provide the architecture of the solution it is proposing.

14. The system servers and software applications will be hosted in Data Centres as specified in the Bid. It is important that the entire set of Data Centre equipment are

in safe custody and have access from only the authorized personnel and should be in line with the requirements & SLAs defined in the Tender.

15. The Servers provided should meet industry standard performance parameters (such as CPU Utilisation of 60 percent or less, disk utilisation of 75 percent or less). In case any non-standard computing environment is proposed (such as cloud), detail clarification needs to be provided in form of supporting documents, to confirm (a) how the sizing has been arrived at and (b) how SLAs would be met.

16. SI is required to ensure that there is no choking point / bottleneck anywhere in the system (end-to-end) and enforce performance and adherence to SLAs. SLA reports must be submitted as specified in the Bid without fail.

17. All the hardware and software supplied should be from the reputed Original Equipment Manufacturers (OEMs). VSCDL reserves the right to ask replacement of any hardware / software if it is not from a reputed brand and conforms to all the requirements specified in the tender documents.

18. System Integrator shall place orders on various OEMs directly and not through any sub-contractor / partner. All licenses should be in the name of the VSCDL .

12. *Annexure VIII – Current Bus Routes in Vadodara City*

રૂટનો નંબર	રૂટનું નામ
૧	સ્ટેશન – માંડવી – સ્ટેશન વાયા દવાખાના, ટાવર, ન્યાયમંદિર, માંડવી
૨	સ્ટેશન – પાણીગેટ ટાંકી – સ્ટેશન વાયા દવાખાના, ટાવર, ન્યાયમંદિર, માંડવી
૩	સ્ટેશન – બાપોદ – સ્ટેશન વાયા દવાખાના, ટાવર, માંડવી, પાણીગેટ, ઉમા ચાર રસ્તા, વૃંદાવન
૩ ડી	સ્ટેશન – બાપોદ – સ્ટેશન વાયા ફતેગંજ સર્કલ, અમીતનગર, ખોડીયાર નગર, સરદાર એસ્ટેટ, વૃંદાવન
૪	સ્ટેશન – સયાજીપાર્ક – સ્ટેશન વાયા દવાખાના, ટાવર, માંડવી, પાણીગેટ ટાંકી, મહાવીર હોલ, કમલાનગર
૪ ડી	સ્ટેશન – સયાજીપાર્ક – સ્ટેશન વાયા ફતેગંજ સર્કલ, અમીતનગર, ખોડીયાર નગર, સુપર બેકરી, કમલાનગર
૫	સ્ટેશન થી સ્ટેશન (સરક્યુલર) – વાયા ટાવર, માંડવી, ઉમા ચાર રસ્તા, કિશનવાડી, સંગમ
૬	સ્ટેશન થી સ્ટેશન (સરક્યુલર) – વાયા જીવન ભારતી, સંગમ, કિશનવાડી, ઉમા ચાર રસ્તા, માંડવી, ટાવર
૭	સ્ટેશન – ડભોઈ બાયપાસ – સ્ટેશન વાયા દાંડીયા બજાર, માર્કેટ, માંડવી, ચોખંડી, ગાજરાવાડી
૭ એ	સ્ટેશન – ડભોઈ બાયપાસ – સ્ટેશન વાયા દાંડીયા બજાર, માર્કેટ, જયરત્ન બીલ્ડીંગ, યમુના મીલ, ગણેશનગર
૭ બી	સ્ટેશન – યમુનામીલ – સ્ટેશન વાયા દવાખાના, માંડવી, ચોખંડી, વિહાર ટોકિઝ, ગાજરાવાડી
૮	સ્ટેશન – કલાદર્શન – સ્ટેશન વાયા દવાખાના, કીર્તીસ્તંભ, ન્યાયમંદિર, પાણીગેટ ટાંકી, કલાદર્શન ચાર રસ્તા
૯	સ્ટેશન – સોમાતલાવ – સ્ટેશન વાયા દવાખાના, માંડવી, પાણીગેટ ટાંકી, વૃંદાવન ચાર રસ્તા, પરિવાર ચાર રસ્તા
૯ એ	સ્ટેશન – સોમાતલાવ – સ્ટેશન વાયા દવાખાના, માંડવી, આર્યુબેદિક ત્રણ રસ્તા, કલાદર્શન, પરિવાર
૯ ડી	સ્ટેશન – સોમાતલાવ – સ્ટેશન વાયા ફતેગંજ, અમીત નગર, ખોડીયાર નગર, સુપર બેકરી, વૃંદાવન
૧૦	સ્ટેશન – જી.આઈ.ડી.સી. – સ્ટેશન વાયા દવાખાના, કીર્તીસ્તંભ, લાલબાગ બ્રીજ, માંજલપુર ગામ, સરસ્વતિ કોમ્પલેક્ષ
૧૦ એ	સ્ટેશન – જી.આઈ.ડી.સી. – સ્ટેશન વાયા દવાખાના, કીર્તીસ્તંભ, લાલબાગ બ્રીજ, મંગલેશ્વર, દરબાર ચોકડી
૧૦ ડી	સ્ટેશન – સુબોધનગર – સ્ટેશન વાયા ટાવર, ન્યાયમંદિર, કીર્તીસ્તંભ, મંગલેશ્વર, દરબાર ચોકડી
૧૧	સ્ટેશન – તરસાલી – સ્ટેશન વાયા દવાખાના, કીર્તીસ્તંભ, માંજલપુર નાકા, ડેરી ત્રણ રસ્તા, શાંતિનગર
૧૧ એ	સ્ટેશન – તરસાલી – સ્ટેશન વાયા દવાખાના, કીર્તીસ્તંભ, માંજલપુર નાકા, તુલસીધામ, સુશેન
૧૧ બી	સ્ટેશન – તરસાલી – સ્ટેશન વાયા દવાખાના, કીર્તીસ્તંભ, જયરત્ન બીલ્ડીંગ, ડભોઈ રોડ, ડેરી ત્રણ રસ્તા, શાંતિનગર
૧૧ ડી	સ્ટેશન – તરસાલી – સ્ટેશન વાયા દવાખાના, ન્યાયમંદીર, ચોખંડી, ડેરી ત્રણ રસ્તા, શાંતિનગર

૧૨	સ્ટેશન – માણેજા – સ્ટેશન વાયા દવાખાના, કિર્તીસ્તંભ, માંજલપુર નાકા, તુલસીધામ, સુશેન, મકરપુરા
૧૩	સ્ટેશન – માણેજા – સ્ટેશન વાયા ટાવર, ન્યાયમંદિર, માર્કેટ, માંજલપુર નાકા, સુશેન, મકરપુરા
૧૪	સ્ટેશન – જામ્બુવા – સ્ટેશન વાયા દવાખાના, ન્યાયમંદિર, કિર્તીસ્તંભ, માંજલપુર નાકા, સુશેન, મકરપુરા
૧૪ એ	સ્ટેશન – જામ્બુવા – સ્ટેશન વાયા ટાવર, માંડવી, ગીતામંદિર, ડેરી ત્રણ રસ્તા, સુશેન, મકરપુરા ડેપો
૧૫	સ્ટેશન – હરણી બાયપાસ – સ્ટેશન વાયા દવાખાના, ભૂતડી ઝાંપા, ભાંડવાડા, સંગમ, માણેકપાર્ક
૧૫ એ	સ્ટેશન – હરણી / દરજીપુરા – સ્ટેશન દવાખાના, ભૂતડી ઝાંપા, ભાંડવાડા, સંગમ, માણેકપાર્ક
૧૫ ડી	સ્ટેશન – દરજીપુરા – સ્ટેશન વાયા ટાવર, માંડવી, ફતેપુરા, કિશનવાડી, સુપર બેકરી
૧૬	સ્ટેશન – રાધ રેસીડન્સી – સ્ટેશન વાયા દવાખાના, કિર્તીસ્તંભ, માંજલપુર નાકા, તુલસીધામ, સુશેન, નોવિનો
૧૭	સ્ટેશન – મકરપુરા ગામ – સ્ટેશન વાયા ટાવર, માંડવી, ચોખંડી, ડેરી ત્રણ રસ્તા, મકરપુરા
૧૭ એ	સ્ટેશન – વૈકુંઠધામ – સ્ટેશન વાયા ટાવર, માંડવી, ચોખંડી, ડેરી ત્રણ રસ્તા, મકરપુરા
૧૮	સ્ટેશન – સમા – સ્ટેશન વાયા સેફોન ટાવર, નિઝામપુરા, મહેશાણા સર્કલ, અભિલાષા, ચાણક્યપુરી
૧૮ એ	સ્ટેશન – સમા – સ્ટેશન વાયા સેફોન ટાવર, નિઝામપુરા, મહેશાણા સર્કલ, સંતોષી નગર, કલ્યાણ હોલ
૧૯	સ્ટેશન – છાણી – સ્ટેશન વાયા પંડ્યા હોટેલ, સરદાર નગર, નવાયાર્ડ, રોઝીઝ ગાર્ડન, છાણી જકાત નાકા
૧૯ એ	સ્ટેશન – છાણી – સ્ટેશન વાયા સેફોન ટાવર, નિઝામપુરા, સૈનિક છાત્રાલય, છાણી જકાત નાકા
૧૯ બી	સ્ટેશન – પ્રયાગ ટેનામેન્ટ – સ્ટેશન વાયા પંડ્યા હોટેલ, સરદાર નગર, રોઝીઝ ગાર્ડન, ગણેશ ચોકડી, ડીગ ડીગ ચોકડી
૧૯ સી	સ્ટેશન – અલંકાર ટેનામેન્ટ – સ્ટેશન વાયા પંડ્યા હોટેલ, સરદાર નગર, રોઝીઝ ગાર્ડન, ફુલવાડી, જકાત નાકા
૨૦	સ્ટેશન – દંતેશ્વર – સ્ટેશન વાયા ટાવર, ન્યાયમંદિર, ચોખંડી, પ્રતાપનગર, અમરઅખ્ખા
૨૦ એ	સ્ટેશન – દંતેશ્વર – સ્ટેશન વાયા દવાખાના, કિર્તીસ્તંભ, માંજલપુર નાકા, ડેરી ત્રણ રસ્તા, પ્રતાપનગર
૨૧	સ્ટેશન – રામેશ્વર – સ્ટેશન વાયા ચકલી સર્કલ, હરિનગર, વિષ્ણુકુંજ, રાજેશ ટાવર, સી. એન. વિદ્યાલય
૨૨	સ્ટેશન થી અટલાદરા, બીલ – સ્ટેશન વાયા રેસકોર્ષ, ચકલી સર્કલ, મનીષા ચોકડી, અક્ષર ચોક, બાનકો પ્રોડક્ટ્સ
૨૨ એ	સ્ટેશન – બીલ, અટલાદરા – સ્ટેશન વાયા દિનેશ મીલ, અકોટા ગામ, મુજમહુડા, અક્ષર ચોક, અટલાદરા મંદિર

૨૩	સ્ટેશન – ભાઈલી – સ્ટેશન વાયા રેસકોર્ષ સર્કલ, ચકલી સર્કલ, જે. પી. પોલીસ ચોકી, દિવાળીપુરા, રાણેશ્વર
૨૩ એ	સ્ટેશન – ભાઈલી – સ્ટેશન વાયા રેસકોર્ષ, ચકલી સર્કલ, મનીષા ચોકડી, રાણેશ્વર, બ્રાઈટ ડે સ્કુલ
૨૩ બી	સ્ટેશન – ભાઈલી – સ્ટેશન વાયા રેસકોર્ષ, ચકલી સર્કલ, હરિનગર, દેવ નગર, રાણેશ્વર પેટ્રોલ પંપ
૨૪	સ્ટેશન – અક્ષર એપાર્ટમેન્ટ – સ્ટેશન વાયા રેસકોર્ષ, ઈલોરાપાર્ક, આત્મજ્યોતિ આશ્રમ, હરિઓમ નગર, હાઈ ટેન્શન રોડ
૨૪ એ	સ્ટેશન – અક્ષર એપાર્ટમેન્ટ – સ્ટેશન રેસકોર્ષ, ઈલોરાપાર્ક, જૈન મંદિર, અરુણાચલ, સુરેશ ભજીયા
૨૫	સ્ટેશન – પંચવટી, ઉંડેરા સર્કલ – સ્ટેશન વાયા રેસકોર્ષ, ગેંડા સર્કલ, ગોરવા, સહયોગ, પંચવટી
૨૫ એ	સ્ટેશન – પંચવટી, ઉંડેરા સર્કલ – સ્ટેશન વાયા સેફોન ટાવર, શાસ્ત્રી બ્રીજ, ગેંડા સર્કલ, ગોરવા, સહયોગ
૨૬	સ્ટેશન – તાંદલજા – સ્ટેશન વાયા શ્રેણીકપાર્ક, ગાય સર્કલ, એસ. એન. ડી. ટી. કૉલેજ, મનીષા ચોકડી, ગુલાબવાડી
૨૬ એ	સ્ટેશન – તાંદલજા – સ્ટેશન વાયા રેસકોર્ષ, ચકલી સર્કલ, મનીષા ચોકડી, ગુલાબવાડી, મુક્તિનગર
૨૭	સ્ટેશન – ગોકુલનગર – સ્ટેશન વાયા રેસકોર્ષ, આમ્રકુંજ, હરિનગર, યશ કોમ્પ્લેક્ષ, ગોત્રી, અંબિકા નગર
૨૭ એ	સ્ટેશન – સેવાસી – સ્ટેશન વાયા રેસકોર્ષ, ચકલી સર્કલ, હરિનગર, યશ કોમ્પ્લેક્ષ, ગોત્રી પાણીની ટાંકી, જલારામ નગર
૨૭ બી	સ્ટેશન – રળીયાતબાનગર – સ્ટેશન વાયા રેસકોર્ષ, ચકલી સર્કલ, હરિનગર, યશ કોમ્પ્લેક્ષ, ગંગોત્રી, વુડાના મકાન, રત્નાકર
૨૮	સ્ટેશન – બાલાજીનગર – સ્ટેશન વાયા રેસકોર્ષ, ઈલોરાપાર્ક, જૈન દેરાસર, નિષાપાર્ક, સમતા ચોકડી
૨૯	સ્ટેશન – જલારામ નગર – સ્ટેશન વાયા રેસકોર્ષ, આમ્રકુંજ, હરિનગર, મધર સ્કુલ, જય જલારામ નગર, ગોકુળ પાર્ટી પ્લોટ
૨૯ એ	સ્ટેશન – જલારામ નગર – સ્ટેશન વાયા રેસકોર્ષ, આમ્રકુંજ, હરિનગર, ઈ. એસ. આઈ. હોસ્પીટલ, જલારામ નગર, ઉષા નગર
૩૦	સ્ટેશન – લક્ષ્મીપુરા – સ્ટેશન વાયા રેસકોર્ષ, ઈલોરાપાર્ક, ગંગા જમુના, ગોરવા વર્કશોપ, આનંદવન
૩૧	સ્ટેશન – બાજવા – સ્ટેશન વાયા રેસકોર્ષ, ગેંડા સર્કલ, બાપુની દર્ગા, મધુનગર, બાજવા, કરોડીયા
	નવા રૂટ વાયા નામ
૩૨	સ્ટેશન – રાધે રેસીડન્સી – સ્ટેશન વાયા દવાખાના, મારુતીધામ, નોવીનો
૩૩	સ્ટેશન – વેદાંત રેસીડન્સી – સ્ટેશન વાયા ટાવર, માંડવી, પૂનમ કોમ્પ્લેક્ષ

૩૪	સ્ટેશન – નર્મદેશ્વર – સ્ટેશન વાયા રેસકોર્ષ, ઈલોરા પાર્ક, સહયોગ
૩૫	સ્ટેશન – સેવાસી – સ્ટેશન વાયા રેસકોર્ષ, ચકલી સર્કલ, યશ કોમ્પ્લેક્ષ
૩૬	સ્ટેશન – રણીયાતબા નગર – સ્ટેશન વાયા રેસકોર્ષ, હરિનગર, વુડાના મકાન
૩૭	સ્ટેશન – પ્રયાજ ટેનામેન્ટ – સ્ટેશન વાયા પંડ્યા હોટેલ, છાણી જકાત નાકા, ગજાનંદ ચોકડી
૩૮	સ્ટેશન – અલંકાર ટેનામેન્ટ – સ્ટેશન વાયા પંડ્યા હોટેલ, દિપ ટોકિઝ, ફુલવાડી જકાત નાકા
૩૯	સ્ટેશન – તાંદલજા – સ્ટેશન વાયા રેસકોર્ષ, ચકલી સર્કલ, મનિષા ચોકડી
૪૦	સ્ટેશન – સનફાર્મા – સ્ટેશન વાયા રેસકોર્ષ, રાણેશ્વર, પત્રકાર ચોકડી
૪૧	સ્ટેશન – બાજવા – સ્ટેશન વાયા પંડ્યા બ્રિજ, છાણી ગામ, જી.એસ.એફ.સી. ગેટ
૪૨	સ્ટેશન – ભાયલી – સ્ટેશન વાયા રેસકોર્ષ, ચકલી સર્કલ, મનિષા ચોકડી
૪૩	સ્ટેશન – જલારામ નગર – સ્ટેશન વાયા રેસકોર્ષ, આમ્રકુંજ, મધર સ્કૂલ
૪૪	સ્ટેશન – થી – સ્ટેશન વાયા ફતેગંજ, અમિત નગર, આનંદ નગર, સંગમ
૪૫	સ્ટેશન – થી – સ્ટેશન વાયા ફતેગંજ, અમિત નગર, સુપર બેકરી, કિશનવાડી
૪૬	સ્ટેશન – થી – સ્ટેશન વાયા ટાવર, માંડવી, કિશનવાડી, સુપર બેકરી
૪૭	સ્ટેશન – ડભોઈ બાયપાસ – સ્ટેશન વાયા ડાંડીયા બજાર, માર્કેટ, ચોખંડી
૪૮	સ્ટેશન – સુબોધ નગર – સ્ટેશન વાયા જેલ રોડ, સાંઈ ચોકડી, દરબાર ચોકડી
૪૯	સ્ટેશન – કપુરાઈ ચોકડી – સ્ટેશન વાયા ટાવર, માંડવી, ગાજરા વાડી
૫૦	સ્ટેશન – દંતેશ્વર – સ્ટેશન વાયા જેલ રોડ, લાલ બાગ, હજીરા
૫૧	સ્ટેશન – સોમાતલાવ – સ્ટેશન વાયા માંડવી, વૃંદાવન
૫૨	સ્ટેશન – તરસાલી – સ્ટેશન વાયા ટાવર, માંડવી, ચોખંડી
૫૩	સ્ટેશન – સોમાતલાવ – સ્ટેશન વાયા સંગમ, કિશનવાડી, ઉમા

JAN MAHAL" Multi Modal City Transport Hub:

A magnificent building in the heart of the station area will be open for citizens of Vadodara, who will be able to catch public transport and even shop from it. The Smart City Transport Hub project was given a nod by the Vadodara Smart City Development Ltd (VSCDL)

The hub will integrate the city bus service, railways, state transport depot, taxi services, rickshaws as well as public parking.

Benefits:

- Multi Modal City transport hub will be directly connected to railway station with under-pass and connected to existing GSRTC bus depot. Plot area of the proposed project is 11,514 sq.mt.

- The Design of Multi Modal City transport hub will incorporate the Heritage Nature of the City.

- Multi Modal City transport hub also includes

    - Multi-Level mechanized parking system

    - Auto rickshaw & taxi stand parking.

- Bus terminal facility includes 25 number of bus-bays. Multi Modal City transport hub has public facilities like Cafeteria, Passenger waiting concourse, ticket window counter and administration office.

Approximately it will take 18 Months to complete the construction, after the infrastructure is ready the current bus terminal facility will be moved to Jan Mahal.

13. *Annexure IX- Reference Architecture of the Mobile App*

The reference architecture of the Mobile App adhering to the best practices, envisioned for One Vadodara App, is depicted below.
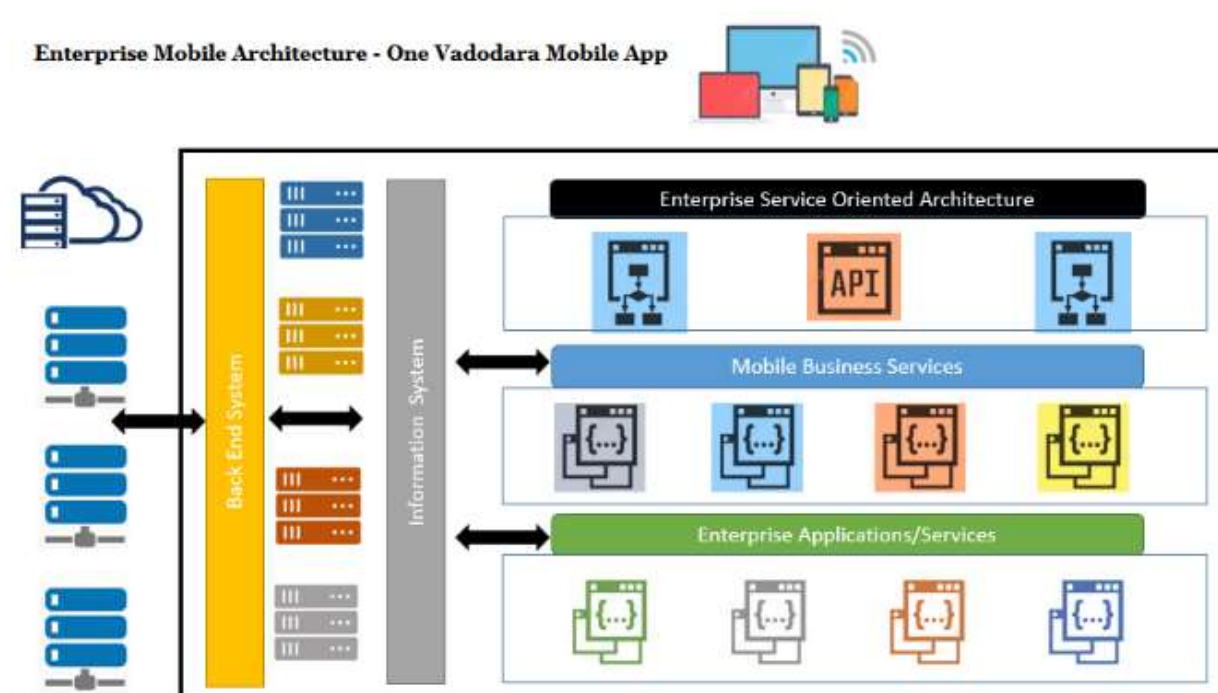

The One Vadodara Mobile App architecture basically covers following major components:

- **Mobile Application**: Enterprise Architecture for One Vadodara Mobile App basically covers mobile applications and service for various stakeholders. It must support custom application, on premise application and application hosted on enterprise Cloud. Also application hosted on others premises could also be extended to stakeholders using mobile applications of VMC/VSCDL through API integration.

- **Mobile Platform**: Mobile Platform should be capable of developing any app to support any device to cater the business requirements of organization. Platform should be scalable, robust and extensible. Also platform must provide support for REST API for integrating various systems and solutions to its stakeholder over mobile. The platform must also support APIs to organization standards and policies, with provision for identity management and application/service management as per other industry standards and protocols.

   One Vadodara Mobile App has embraced open architecture as per Government of India standards and guidelines Leveraging Java and HTML5, which enables developers to easily build and extend enterprise applications for iOS and Android platforms from a single code base.

- **Service Integration**: Mobile Applications and services over apps will enable transaction with core applications and systems using REST API/ standard web services. Integration through REST API/standard web service promotes reuse of existing application services, secure access to enterprise data /services from in premise and external applications/systems. Integration

Architecture is basically rest on Service Oriented Architecture to respond to business requirements of VMC/VSCDL. API Management will also help VMC/VSCDL to support open data and monetize service using REST APIs/ and standard web services.

Mobile application are usually developed around core back end application and information system. Power of any mobile solution depends on the application and information system at the backend. APIs encapsulate back end application and information system and provide the relevant information to end user for various purpose. Seamless and Secure API is the key element of One Vadodara Mobile App Mobility Strategy.
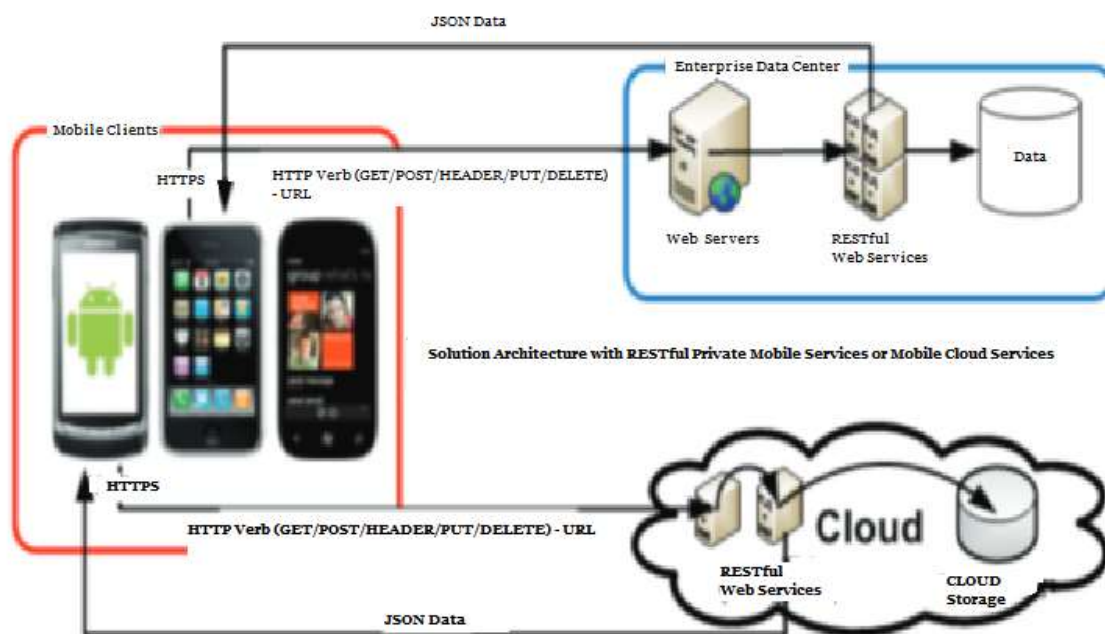
** Source: Servicetagmag

- **Mobile Security**: Mobile Platform must provide security of data and privacy of users. Enterprise Architecture provides secure access to enterprise applications/services securely without interfering other device features and applications. Mobile technologies faces various threats namely user based threats, device based threats and network based threats.

Some of the characteristics of the TO-BE conceptual landscape include:

- Customers have a single profile and single first-time authetication across all web based digital assets
- Content can be managed internally by the VMC/VSCDL digital team and consistently across digital assets, where relevant;
- UX testing can be managed by the VMC/VSCDL digital team and with the capability to rapidly incorporate feedback;
- Integration will be fit for purpose with a preference for real time integration for online services;
- Customers will be able to track their requests and understand the status of their transaction
- Data driven personalization and provision of useful content to customers;

- Consistent look and feel and set of services, where appropriate, delivered across digital channels.

XXXXX