

Request for Proposal
for Selection of
System Integrator for
Implementation of
Intelligent Transit
System (ITS)
Solutions in Jabalpur

**Volume 2 – Scope of
Work and Requirement
Specifications**

RFP Ref. No – JSCL/2018/299/ADM/113

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List Abbreviations

Abbreviations	Definitions/Description
AFCS	Automatic Fare Collection System
AMC	Annual Maintenance Contract
BOM	Bill of Materials
CCC	Command Control Centre
CCTV	Closed-Circuit Television
EMV	Europay, MasterCard and Visa
ETM	Electronic Ticketing Machine
FY	Financial Year
GPRS	General Packet Radio Service
GPS	Global Positioning System
ICT	Information & Communication Technology
ITB	Instructions to Bidders
ITS	Intelligent Transit System
ISBT	Inter State Bus Terminus
JCTSL	Jabalpur City Transport Services Limited
JMC	Jabalpur Municipal Corporation
JSCL	Jabalpur Smart City Limited
KPI	Key Performance Indicator
LOA	Letter of Award
MIS	Management Information System
MoHUA	Ministry of Housing & Urban Affairs

Abbreviations	Definitions/Description
NCCMC	National Common Mobility Card
O&M	Operations & Maintenance
OCC	Operations Control Centre
PA system	Public Address system
PCI-PTS	Payment Card Industry – Pin Transaction Security
PIS	Passenger Information System
PPI	Prepaid Payment Instruments
RFP	Request for Proposal
SAM	Secure Access Module
SDK	Software Development Kit
SI	System Integrator
SLA	Service Level Agreement
UAT	User Acceptance Testing
UPS	Uninterruptible Power Supply
VPN	Virtual Private Network

1. INTRODUCTION

1.1. Project Background

Jabalpur is among the first 20 cities selected in first round of smart cities challenge under Smart City Mission by Ministry of Housing and Urban Affairs, Government of India (formerly, Ministry of Urban Development).

In alignment to objectives, Jabalpur Smart City Limited (JSCL) aims to have an ICT based transit management and traffic management system which shall add value to citizens, city authorities and society in general by bringing down travel time, reducing travel related energy consumptions, increasing comfort and safety of travel, establishing efficient and effective management procedures and working towards both environmental and financial sustainability.

Jabalpur desires to foster the development of a robust and intelligent Transit and system infrastructure that is reliable and IT enabled. The proposed ITS solutions shall use emerging technologies to improve the efficiency, effectiveness, accessibility and sustainability of the transportation network in Jabalpur and also help to reduce environmental impacts.

The proposed ITS solution shall enable the collection of data or intelligence which provides relevant and timely information to make key decisions. The aim of the ITS solutions is to utilise the various technologies to solve the many transport challenges faced by various user groups, such as JCTSL, bus operators, commuters etc.

1.2. Key Stakeholders

The proposed ITS solution envisages to meet desired requirements of various transit authorities/agencies, transit operators and vendors and commuters in Jabalpur. In the process of conducting the current assessment of ITS implementation in Jabalpur the following stakeholders have been identified:

- Jabalpur Municipal Corporation
- Jabalpur Smart City Limited
- Jabalpur City Transport Services Limited
- Public Transit operators
- Commuters

1.3. Existing System and Infrastructure

1.3.1. Bus Services in Jabalpur

JCTSL is running a fleet of 104 city buses which are popularly called the Metro buses, consisting following types of buses:

- 50 standard semi-low floor buses (44 seaters)
- 54 midi buses (28 seaters)

The details of buses and bus operators are as shown in the table:

Table 1-1: JCTSL- Bus Operator Details

Name of Operators	Concession start date	No. of Buses operated	Average no. of buses operated in a day
Maa Narmada Transport Service	Oct 2015	Total Buses - 48 • Standard Buses – 35 • Midi Buses – 13	32
Shri Sadguru Transport Service	Oct 2012	Total Buses - 49 • Standard Buses – 15 • Midi Buses - 34	31
Jay Hanuman Transport	Oct 2015	Total Buses - 7 • Midi Buses - 7	7

The complete bus operations are managed through 2 bus depots located at Aga Chowk and Teen Patti Chowk in Jabalpur. The details of Bus Depots are:

Table 1-2: JCTSL- Bus Depot

Sl #	Name of Depot	Fleet size	Operation managed
1.	Aga Chowk depot	56 buses	Shri Sadguru Transport Service (49 buses) Jay Hanuman Transport (7 buses)
2.	Teen Patti Chowk depot	48 buses	Maa Narmada Transport Service

JCTSL has also commenced Airport shuttle services with 2 buses for the convenience of the commuters.

There are around 134 bus stops/stands in Jabalpur. A total of 38 bus shelters are planned to be implemented in PPP mode, out of which 20 new bus shelters have been completed as on date. Additionally, 23 new bus shelters have also been constructed under Smart City Mission.

1.3.2. Overview of ITS initiatives by JCTSL

Since its inception in 2006, JCTSL has undertaken notable ITS initiatives such as tracking of city buses through GPS, installation of PIS system, introduction of ETMs, ICT interventions in ISBT, installation of CCTV camera in buses and ISBT, introduction of common mobility card etc. The various ITS initiatives undertaken by JCTSL are as below:

a) J-Card Project (Automatic Fare Collection Project)

J-Card is an initiative undertaken by JCTSL with an objective to offer the citizens of Jabalpur the ability to use new generation cashless means to make daily payments, especially in public transport, small retail where bulk of household income is spent, person to person payments and for all kinds of municipal payments. J-Card also envisages the use of smart phone apps to augment and enhance the capability of offline payment card.

Currently, the card is being issued as passes for travel in JCTSL buses and recharged at the sole Issuing center situated at the Nagar Nigam office.

b) GPS based Vehicle Tracking and PIS

GPS devices have been installed in all the city buses. The Operation and Maintenance of these GPS devices and tracking of the city buses work has been contracted to a vendor by JCTSL. A Central Command and Control Centre has also been established in the JCTSL premises. All the buses can be tracked and monitored from the Central Command and Control Centre. Currently, the JCTSL city buses can also be monitored online by visiting portal <http://locate.trackinggenie.com>. Various reports can be generated through this portal such as Fleet Status reports, Alert (Over Speed, Low Battery and SOS Alarm) reports, Halt Summary reports etc. JCTSL has engaged a separate vendor for website integration and mobile App development for PIS.

c) Camera based Bus Surveillance System in JCTSL City Buses

Under this project, two CCTV cameras, one Mobile Video Recording Device and other peripheral items are being installed in 104 city buses of JCTSL. The system covers the design of Bus Surveillance system, supply, delivery, testing & commissioning followed by a 2 years onsite warranty period, followed by a 3 years comprehensive annual maintenance period (CAMC).

d) ICT initiatives in ISBT

An integrated system comprising Parking Management System, E-Ticketing System, Public Information System and Security & Surveillance System has been implemented in ISBT Jabalpur. The O& M phase of this project started on 26 April 2017.

e) Electronics Ticket Machine

Electronic Ticketing Machines (ETMs) are being used in all JCTSL city buses for issuance of tickets to passengers commuting in city buses. The ETMs have been implemented by the bus operators. The ETMs currently being used are offline devices thus necessitating manual download of data at the end of the day.

f) JCTSL-RT Mobile App

JCTSL-RT is an Android-based real time ticket booking application introduced by JCTSL for hassle free travel and ticket verification in its city buses. It is expected that with the JCTSL-RT app, the commuters shall be able to book ticket and passes for various routes of JCTSL buses. Currently, the App is operational for Airport shuttle buses only.

1.3.3. ITS initiatives by JSCL

Under Smart City Initiatives, JSCL is implementing an Integrated Solid Waste Management project as part of which a Command Control Centre has been constructed at Manas Bhawan, Jabalpur for tracking of solid waste collection in the city. Under this project, around 2.26 lakhs households have been tagged with RFID and approximately 230 hand-held RFID readers have been provided as on date. At the Command Control Centre, the overall status of solid waste collection can be easily monitored through various colour indicators.

1.4. Project Objectives

As part of this Project, JSCL aims to augment the Intelligent Transit System in JCTSL by implementing a new smart card based automatic fare collection system, vehicle tracking system, Passenger Information System (PIS), Public Address system (PA system), Bus Operation Management System, Depot Management System and Enterprise Management System in Jabalpur.

The proposed ITS solutions have been described in subsequent sections of this RFP.

2. SCOPE OF WORK

2.1. Overview

The ITS System Integrator shall Design, Develop, Implement, Integrate Intelligent Transit System (ITS) solutions in Jabalpur and provide Operation & Maintenance support for the ITS solutions for a minimum period of Five (5) years from the day of Go-Live of the project as per the scope of services described in this RFP Document. The ITS System Integrator should also provide requisite capacity building support to city authorities/agencies as per the scope of services described in this RFP Document.

Any functionality not expressly stated in this document but required to meet the needs of the JSCL/JCTSL to ensure successful operations of the ITS solutions shall essentially be under the scope of the ITS System Integrator and no extra charges shall be admissible to carry out the same.

The overall scope of work ITS System Integrator shall comprise procurement, supply, design, testing, installation, commissioning, training, handholding, management of operation and maintenance for a period of 5 years for the following ITS solutions:

- Automatic Fare Collection System (AFCS)
- Vehicle Tracking System for JCTSL buses (VTS)
- Passenger Information System (PIS system)
- Public Address System (PA system)
- Bus Operation Management System (BOMS)
- Depot Management System (DMS)
- Enterprise Management System (EMS)

The schematic figure below shows the ITS systems envisaged under this project.

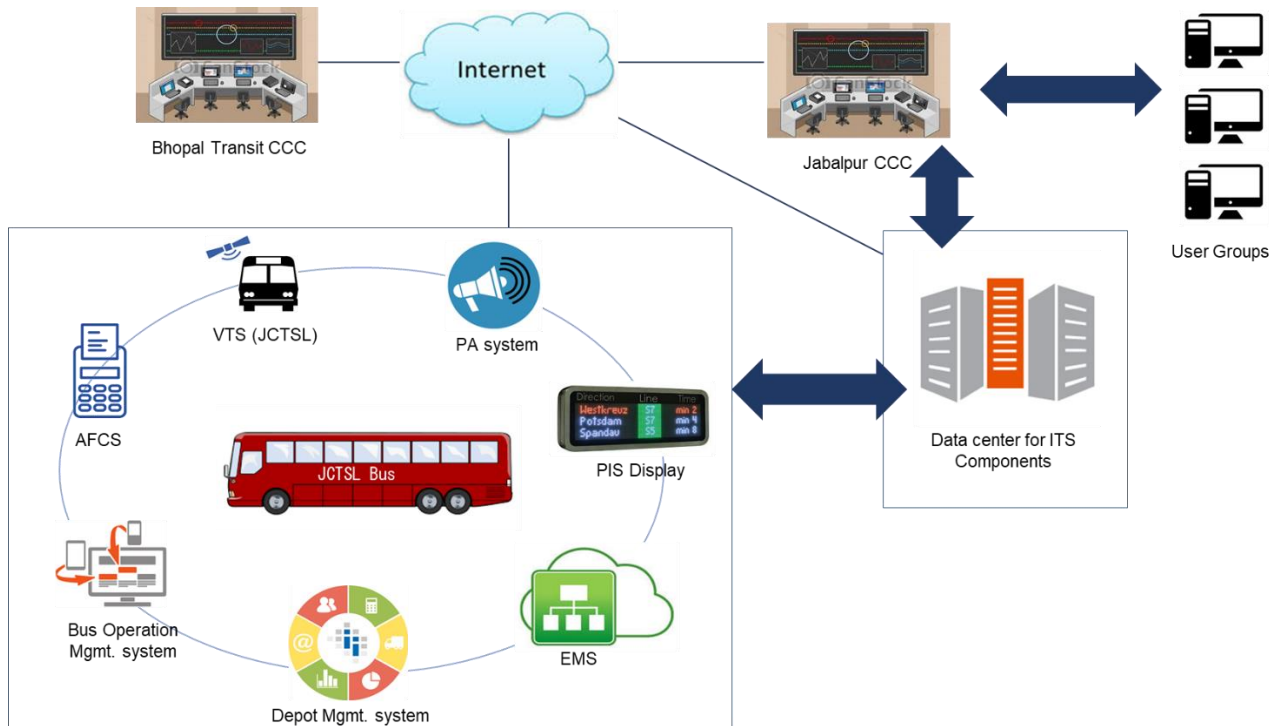


Figure 2-1: ITS Solution Architecture

2.2. Geographical Coverage of the Project

The proposed ITS project shall cover buses, stops, site locations and offices/depots regarding the bus operations of JCTSL. The current number of buses, bus stops, site locations and offices/depots to be covered are as below:

Sl. #	ITS Solutions	Details
1.	Automatic Fare Collection System (AFCS)	In 106 city buses <ul style="list-style-type: none"> • 50 standard semi-low floor buses • 54 midi buses • 2 Airport Shuttle buses
2.	Vehicle Tracking System (VTS)	For 106 buses
3.	PIS Display Boards at Bus Stops and On-board PIS	<ul style="list-style-type: none"> • At 5 bus stops/locations, 10 PIS display units • Operationalisation of on-board PIS display units installed in all existing JCTSL buses, replacement of any defective (beyond repair) display boards in the existing JCTSL buses and integration with proposed VTS • Integration with on-board PIS display units in new buses to be procured in future

Sl. #	ITS Solutions	Details
4.	Public Address System	At 61 bus stops
5.	Bus Operations Management System	<ul style="list-style-type: none"> For 106 city buses For 3 bus operators
6.	Depot Management System	<ul style="list-style-type: none"> At 2 depots (Aga Chowk depot & Teen Patti Chowk depot)
7.	Enterprise Management System	<ul style="list-style-type: none"> For monitoring of all ITS solutions as envisaged in this project.

2.3. Detailed Scope of Work

The detailed scope of work for ITS System Integrator (ITS System Integrator) shall be as under:

1) Assessment and Site Survey for finalization of detailed technical architecture and project plan

The ITS System Integrator shall be responsible to carry out the detailed field survey for each of the ITS solution component requirement in order to finalize infrastructure requirement, network bandwidth requirement, operational & administrative challenges etc. and shall submit detailed Site Survey Report and Project Implementation Plan to JSCL/JCTSL. This survey shall finalize the exact position/co-ordinates of all field equipment, as required, in consultation with JSCL/JCTSL.

2) System Requirements Gathering Study, Design & UAT

The ITS System Integrator shall carry out the detailed assessment of the functional requirements for the ITS solutions and prepare the System Requirements Specifications (SRS), in consultation with JSCL/JCTSL and project management consultant. The SRS prepared by the ITS System Integrator shall be submitted to JSCL/JCTSL for its review and approval. UAT shall be carried out for all ITS solution software proposed by ITS System Integrator. It is necessary to obtain a formal sign-off from JSCL/JCTSL for the SRS, before proceeding with the design/development of the ITS Application software.

3) Procurement, Supply, Installation and Commissioning of ITS components

The ITS System Integrator shall procure, supply, install and commission all ITS Components, hardware, software etc. as per quality, standard and technical and functional specifications as mentioned in this RFP Document. The proposed indicative Bills of Materials (BOM) of each ITS components of the Project is specified in Section 0 of this RFP volume 2.

The ITS System Integrator shall also be responsible for replenishment/restoration of project site or any of the components of project site to its original conditions at its own cost if such project site or component so damaged during the installation and maintenance by ITS System representative/staff.

All wiring shall be done by the ITS System Integrator at its own cost. JSCL/JCTSL shall provide required power supply at one point at site locations.

4) Integration with other ITS systems

The ITS System Integrator shall carry out integration of the proposed ITS solution with existing ITS systems as per requirement of JSCL/JCTSL, to enable information exchange between the systems, including by way of developing tools/ APIs. The ITS System Integrator shall also assist in integration of ITS solutions with any future ITS solutions being undertaken at State-level/City-level as per requirement of JCTSL, including by way of developing tools/ APIs and/or integration with APIs of external systems.

5) Managed Services

The ITS System Integrator shall provide hosting infrastructure (including but not limited to servers, storage, operating systems, database, security, networking, connectivity, rack, etc.) at JCTSL Control Centre on a managed service basis. JCTSL shall provide one rack space at its Control Centre for ITS hosting infrastructure.

The ITS System Integrator shall migrate the ITS solutions to the State-Level cloud-based Data Centre, as and when it is ready and as per requirement of JSCL/JCTSL.

6) Operationalisation of on-board PIS

On-board PIS display units are installed in JCTSL buses. The ITS System Integrator shall operationalise the existing on-board PIS display units installed in all existing buses of JCTSL and integrate the same with the vehicle tracking device installed by the ITS System Integrator. The outer destination boards shall display the route number, destination name and intermediate bus stop names, and the inner display boards shall display the name of the next approaching bus stop, route and bus-stop details and other messages, as decided by JSCL. The ITS System Integrator shall replace those display boards (if any) in the existing buses, which are defective and beyond repair. The ITS System Integrator shall also provide O&M for the PIS display units in the existing buses during the contract period.

The ITS System Integrator shall integrate the vehicle tracking device and on-board PIS in new buses to be procured by JCTSL in future during the contract period in the ITS.

7) Capacity Building and Training

The ITS System Integrator shall conduct proper need-based training for all the concerned staff of JSCL, JCTSL, bus operators and other stakeholders and draw up a systematic training plan. ITS System Integrator shall provide hard copy & soft copy of the training materials to all the trainees. The training shall held at various office/department locations as finalised by JSCL/JCTSL.

8) Connectivity

The ITS System Integrator shall provide the following connectivity during the Contract Period:

- Leased line connectivity for CCC
- Broadband connectivity for POS terminal

9) **Operations & Maintenance of ITS components**

The ITS System Integrator shall be responsible for Operations & Maintenance of Software Applications/Modules, IT Infrastructure for the period of 5 years post successful Go-live and operational acceptance of the system, which shall include but not limited to the following activities:

- **Help Desk Management**

The ITS System Integrator shall provide helpdesk support for lodging complaints with respect to the defects/issues in Automatic Fare Collection System and other ITS components.

The ITS System Integrator shall be responsible to provide and operate a Helpdesk for lodging complaints with respect to the defects/issues in Automatic Fare Collection System and other ITS components. Citizens/commuters and other end-users of ITS components shall be able to call and report problems/issues with ITS components.

- **System Administration/Management support**

- Offer technical support for ITS project
- Upkeep, configuration and operation of ITS application
- Install or upgrade software
- Maintain security policies, troubleshoot, train/supervise staff etc.
- Generation of various reports including revenue clearing and settlement reports for AFCS

- **Smart Card initialisation**

- Initialisation, Configuration and Key Management of Smart Cards
- Inventory Management of Smart Cards (New, refunded/returned, damaged/defective etc.)

- **Operation of pass issuance (one shift on working days)**

- Issuance of personalised and anonymous Smart Cards and allied activities

- **Annual Maintenance Contract (AMC)**

- All the ITS components (including hardware, system software and application software) supplied by the ITS System Integrator shall carry one year comprehensive on-site warranty.

The O&M support shall have to provide during the working/operational hours of JCTSL (6 am to 10 pm, 7 days a week).

The ITS System Integrator is required to provide suitable manpower operational support during O&M phase as below:

- Operators for Pass Issuance - 1 operator

- Manpower services for Operation Management - 4 resources

The working hours of operation team shall be as per the office hours of JSCL/JCSTL. System Integrator shall be required to provide such manpower meeting following requirements:

- All such manpower shall be minimum graduate pass
- All such manpower shall be without any criminal background / record.
- JSCL/JCTSL 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.
- System Integrator shall have to replace any person, if not found suitable for the job.

10) Insurance

The ITS System Integrator shall get comprehensive insurance from reputed insurance company for the project duration for all ITS equipment / components installed under this project.

11) Others

The ITS System Integrator shall also be responsible for the following activities:

- a) Obtain relevant certifications for application security and functionality.
- b) Adherence to latest Industry Standards, guidelines as specified by government authorities.
- c) Standard Operating Procedures (Manuals, Forms, Process documents) to standardize the processes during O&M phase.
- d) The ITS System Integrator shall ensure that the end of support for any of the component/equipment is not reached during the concurrency of the contract.
- e) The ITS System Integrator shall ensure compliance to all mandatory government regulations as amended from time to time.
- f) The System Integrator shall ensure that all the peripherals, accessories, sub-components required for the functionality and completeness of the solution, including but not limited to devices, equipment, accessories, cables, software, licenses, tools, etc. are provided according to the requirements of the solution.
- g) JSCL/JCTSL shall not be responsible if the ITS System Integrator has not provisioned some components, sub-components, assemblies, sub-assemblies as part of Bill of Materials in the RFP. The ITS System Integrator shall have to provision these & other similar things to meet the solution requirements at no additional cost and time implications to purchaser.
- h) All the software licenses that the ITS System Integrator proposes shall be perpetual software licenses in the name of JSCL along with maintenance and updates for the currency of the contract. The software licenses shall not be

restricted based on location and purchaser shall have the flexibility to use the software licenses for other requirements if required.

- i) The ITS System Integrator shall ensure there is a comprehensive onsite support arrangement for duration of the contract with all the OEMs for respective components.
- j) Considering the criticality of the infrastructure, System Integrator is expected to design the solution considering the RFP requirement of no single point of failure with high level of redundancy and resilience to meet the network uptime requirements.
- k) ITS System Integrator shall be responsible for periodic updates & upgrades of all equipment, cabling and connectivity provided at all locations during the contract period.
- l) ITS System Integrator shall be responsible for setting up / building / renovating the necessary physical infrastructure including provisioning for network, power, rack, etc. at all the locations.

12) Project Hand-over

The ITS System Integrator will provide JSCL/JCTSL the following six months before the expiry of the Contract Period:

- a) Information relating to the current services rendered and data relating to the performance of the services; Entire documentation relating to various Project Milestones, any other data and confidential information related to the Project;
- b) All other information (including but not limited to documents, records and agreements) relating to the products & services related to the project to enable JSCL/JCTSL, or it's replacing successful System Integrator (as the case may be).
- c) The System Integrator shall provide the JSCL/JCTSL with a recommended exit management plan.
- d) Promptly during exit on reasonable request by JSCL/JCTSL, the System Integrator 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 System Integrator). JSCL/JCTSL shall be entitled to copy of all such information. Such information shall include details pertaining to the services rendered and other performance data. The System Integrator shall permit JSCL/JCTSL to have reasonable access to its employees and facilities, to understand the methods of delivery of the services employed by the System Integrator and to assist appropriate knowledge transfer.

2.4. Project Components

2.4.1. Automatic Fare Collection System (AFCS)

The ITS System Integrator shall carry out design, development, testing, supply, installation, integration, commissioning, operation and maintenance of Automatic Fare Collection System (AFCS). The AFCS solution shall be a new Contactless Smart Card based solution for ticketing services for buses. The Automatic Fare Collection System shall manage the fare payment transactions and allied activities for the bus operators.

The components of AFCS as envisaged in this project are:

- ETM devices
- Contactless Smart Card (CSC)
- Driver Control Units (DCU) & On-board Card Validators (OCV)
- Charging Infrastructure for ETMs
- Smart Card Issuance Point of Sales (POS) Terminal
- Backend Application including Central Clearing House

In lieu of separate Driver Control Units device, the ITS System Integrator may also propose On-board Card Validators having in-built functionalities of Driver Control Unit (DCU) in their AFCS solution.

It is envisaged that the AFCS shall use DESfire EV1 cards initially, however, the entire system shall be compatible to the use of open loop bank cards so that the open loop bank cards can be introduced without requiring any changes in the hardware and software. Alternatively, the Bidder may also propose open loop bank cards from Day 1 in lieu of DESfire EV1 cards.

The ITS System Integrator shall also be responsible for the following:

- Design, Printing, Supply/Distribution of newly branded J-Card for Jabalpur
- Design, develop and maintain Interoperable SMART Card Application and Card Data format & L2 Kernel for Fare Management Devices
- Maintenance of Central Clearance house management in Jabalpur as per requirements of Smart card based ticketing
- Provide complete Software Development Kit (SDK) of the all AFCS components device to JSCL/JCTSL.
- JSCL/JCTSL, in its sole discretion, may decide to procure ETM devices from a third party. In such case, the ITS System Integrator shall integrate such ETM devices with proposed ACFS as per requirement.
- Provide & install required power sockets/extension boards & necessary racks for charging of ETMs/batteries. For charging infrastructure for ETMs, electric connection at single point will be provided at each depot by JSCL/JCSTL.
- Support JSCL/JCTSL in extending the use of Smart Card for other payments such as parking, utilities, retail payments etc.
- Support different channels for recharge of Smart Card including online top-up, mobile wallets, auto-credit instructions etc.

- Assist JSCL/JCTSL to obtain RBI approval for issuance of semi- closed PPI.

2.4.2. Vehicle Tracking System (VTS)

The ITS System Integrator shall be required to provide Vehicle Tracking System to track all the city buses under JCTSL.

The VTS system shall be a web based application which utilizes GIS map to show real time positions of the buses. The system shall have enterprise capabilities which enables multiple user type to be enabled to carry out various functions like Vehicle Schedule Tracking, Speed Management, Stoppage Management, Route replays, bus tracking dashboard etc. as a standard functionality. The system shall have screen based tracking capability, so as to enable tracking staff to quickly analyse activities and have a better insight into operational data of all activities within the system. The system shall be seamlessly integrated with bus GPS system, fleet management system, passenger information system, public address system and mobile application.

2.4.3. Passenger Information System

The ITS System Integrator shall be required to provide PIS which will comprise the following:

- **LED display boards at specified bus stops**

PIS LED displays shall be used to provide real-time information to passengers waiting at the bus stops. The ITS System Integrator shall install PIS displays at select major bus stops as per the list provided at **Appendix 1: List of Locations for PIS Led Display**.

- **Web-portal**

The ITS System Integrator shall develop a web –portal for JCTSL which shall provide the following information-

- Bus route and schedule
- ETA
- Journey planner
- Fare related information
- Details of Cards issuance and recharge channels
- Contact details

The web-portal shall be bi-lingual – in English and Hindi.

- **Mobile App**

The ITS System Integrator shall develop a mobile app for Android and IOS platforms for JCTSL which shall provide the following information-

- Bus route and schedule
- ETA
- Journey planner
- Fare related information
- Details of Cards issuance and recharge channels

- Contact details

- **Operationalisation of on-board PIS**

The ITS System Integrator shall operationalise the existing on-board PIS display units installed in all existing buses of JCTSL. The ITS System Integrator shall carry out repair of on-board PIS display units as per requirements. In case some of the display boards are defective and beyond repair, the ITS System Integrator shall replace the same with new display boards, as per UBS-II specifications. The ITS System Integrator shall also provide O&M for the existing and replaced PIS display units during the contract period. The ITS System Integrator shall integrate the vehicle tracking device and on-board PIS displays in the new buses to be procured by JCTSL in future, during the contract period.

The ITS System Integrator shall also integrate the on-board PIS display units with proposed VTS solution.

2.4.4. Public Address System

The PA system shall receive the information from other ITS systems (Vehicle Tracking System, Passenger Information System) and disseminate the same in synchronized way to the passengers at bus stops. The PA system shall have the capability for making announcements of emergency messages, social messages and ad-hoc messages from the Control Centre.

The ITS System Integrator shall be required to install the PA system at 61 new bus stops in Jabalpur. The list of bus stops is provided at **Appendix 2: List of Locations for PA system.**

2.4.5. Bus Operation Management System

The Bus Operation Management System shall enable JCTSL management team to extract various reports from operations data and carry out analysis enabling JCTSL to have better insight into control parameters and enable officials to take effective business decisions leading to higher operational efficiency. The proposed system is expected to help JCTSL in effective monitoring of bus operations and initiate actions to improve bus services in the city for better commuters' satisfaction.

The Bus Operation Management System shall bring in comprehensive reports and dashboards for JCTSL/JSCL management for monitoring of key performance indicators for the bus operations and passenger travel patterns to plan, analyze and appraise bus services to commuters.

The various reports to be generated by the system will include:

- Revenue Management reports (revenue per km, pass revenue per day, average ticket revenue etc.)

- Analytics reports for Service Planning (Route profiling, peak-off peak passengers, O/D metrics)
- Fleet Operations reports (Operated Kms, Fleet in operations, Fleet Outshed performance)
- Incident reports (Breakdowns, Accidents)
- Services Delivery (performance of different operators, fleet operated, Schedule performance, stops skipping)

The key functionalities and reports envisaged under Bus Operations Management System shall be:

a) Management Dashboard

- Single view operational statistics in charts and graphs.
- Real-time view of schedules and operational aspects
- Comparative operational snapshot on various parameters like fleet utilization, trips operated, revenue collection etc.
- Fleet Operations (Operated kms, Fleet in operations, Fleet Out-shed performance)
- Incidents (Breakdowns, Accidents)
- Forecasting of revenue, commuter density on routes

b) Revenue/Operations Snapshots

- Financial and revenue collection statistics in a single view (revenue per km, pass revenue per day, average ticket revenue etc.)
- Live ticketing status on various routes
- Number of buses operated vis-à-vis schedules, trips operated, kms operated, missed trips, etc.
- Route deviations, speed violations, stops skipped, etc.
- Passenger count on various routes/ trips, trips with high/low passenger volumes

c) SLA monitoring

- Managing the service levels, service standards, service deviations by bus operator
- Provides reporting on Service Level Agreements (SLAs)
- Bus Operators' Contracts Management
- Compliances to various statutory requirements – drivers' license, conductors' license, bus insurance, bus fitness, pollution under control certificate, etc.
- Buses maintenance schedule compliance reports

d) MIS Reports

- MIS reports for various parameters, alerts, etc.
- Analytics reports for Service Planning (Route profiling, peak-off peak passengers, O/D metrics)
- Comprehensive MIS report for JCTSL/JSCL Management

2.4.6. Depot Management System

The ITS System Integrator shall provide Depot Management System (DMS) which shall primarily collect and maintain a database having information on staff (drivers and conductors), buses, their maintenance, daily revenue collection and other daily reports. Essentially, DMS shall be used by the bus operators for managing their operations. DMS shall 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 key features of bus Depot Management System shall include the following:

- Vehicle Scheduling and Dispatch System
- Crew Scheduling and Allocation
- Operation parameters
 - Actual trip performance versus scheduled
 - Actual km operated versus scheduled
- Revenue parameters
 - Route-wise, trip-wise, bus-wise, conductor-wise, etc.
- Incident Management System
 - Breakdown
 - Accidents
- Vehicle Log System
 - Maintenance – scheduled versus actual
- Drivers & Conductors Master details including license validity, etc.
- Bus Master details such as fitness validity & due dates

DMS shall be implemented for complete bus operations in both the depots at Aga Chowk and Teen Patti Chowk in Jabalpur.

2.4.7. Enterprise Management System

The IT infrastructure provided in this project will be required to be managed from various aspects in order to maximize the availability of IT services and SLA performance. THE ITS System Integrator shall provide an EMS solution which shall consist of the following core modules:

- Network Fault Management System
- Integrated Performance Management System
- Application Performance Management System
- Integrated Helpdesk Solution
- Asset Management

2.5. System Design Principles

The proposed ITS solutions are planned to improve public transit operations in Jabalpur. Accordingly, the ITS solutions shall be designed considering the following guiding principles:

1. **Scalable:** The system shall be scalable to future growth in number of buses, depots, passengers etc. and to integrate with other smart city initiatives and support sustainable development to meet the growing demand of the Jabalpur. The IT infrastructure proposed shall support these scalability requirements. The system shall also support vertical and horizontal scalability so that depending on changing requirements from time to time, the system may be scaled upwards. There shall not be any system imposed restrictions on the upward scalability in number of field devices/number of passengers/transactions/bus stops/users, etc. The ITS will be scalable to 200 buses without requiring any change in hardware or application. Beyond that, the ITS shall be scalable with upgradation/addition of hardware, without requiring any change in applications.
2. **High Performance:** The system shall be up and running without any single point of failure as per the demands of various mission critical applications running on the network. Components of the architecture shall provide redundancy and ensure that there are no single points of failure in the key project components. Considering the high sensitivity of the system, design shall be in such a way as to be resilient to technological sabotage. To take care of remote failure, the systems shall be configured to mask and recover with minimum outage. The ITS System Integrator shall be required to make the provision for high availability for all the services of the system.
3. **Secure:** The network shall have built-in security features as per good industry practices in line with the requirement for ITS including fare payment system. Access control shall be implemented at all levels. The ITS System Integrator shall make provisions for security of field equipment as well as protection of the software system from hackers and other threats. The virus and worms attacks shall be well defended with gateway level Anti-virus system. Furthermore, all the system logs shall be properly stored & archived for future analysis and forensics whenever desired. The following guidelines shall 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 shall be provided to ensure that the system is not tampered or modified by the unauthorized persons or system operators.
 - c) Implement data security to allow for changes in technology and business needs.
 - d) The security of the field devices shall be ensured with system architecture designed in a way to secure the field devices in terms of physical damage & unauthorized access.
4. **Manageable:** The system shall be seamlessly managed with centralised enterprise management software. All the network components shall be manageable using open standard management protocols such as SNMP. 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. **Interoperable:** The system shall have capability to take inputs from other third party systems as per situational requirements. All products shall be open standards based and should be interoperable with different vendors' products following industry standards.
6. **Fault Tolerance and Resilient:** The system shall have inbuilt redundancy features to provide high availability. Redundancy shall be proposed at various levels to ensure that single link failure does not affect the critical functionality.

3. Implementation Plan & Timeliness

3.1. Implementation Plan

The ITS Project shall comprise two phases, viz. Implementation phase and Operation & Maintenance (O&M) Phase.

The implementation phase will be further divided into two phases – Pilot phase and Roll-out phase.

In the Pilot phase, development, testing and pilot implementation of ITS solutions shall be undertaken by the ITS System Integrator. Post successful pilot implementation of ITS solutions and their Sign-Off by JSCL/JCTSL, the ITS System Integrator shall roll-out the implementation of ITS solutions.

3.2. Implementation Phase

3.2.1. Pilot Implementation phase

The ITS solutions shall initially be supplied, deployed, installed and commissioned at identified locations/routes as described in the table below:

Milestones for Pilot Implementation	Coverage
Supply, Deployment, Installation & Commissioning of the following ITS solutions:	
<ul style="list-style-type: none"> • Automatic Fare Collection System 	<ul style="list-style-type: none"> • One route, Minimum 10 buses
<ul style="list-style-type: none"> • Vehicle Tracking System 	<ul style="list-style-type: none"> • Minimum 10 buses
<ul style="list-style-type: none"> • PIS, PIS Web-Portal & Mobile App and PA System 	<ul style="list-style-type: none"> • PIS and PA system - One bus stop
<ul style="list-style-type: none"> • Bus Operation Management System 	<ul style="list-style-type: none"> • One bus operator
<ul style="list-style-type: none"> • Depot Management System 	<ul style="list-style-type: none"> • One depot (Teen Patti Chowk)

Gaps identified during the pilot implementation will be addressed by making necessary changes to the ITS applications, before embarking on the rollout of Implementation.

3.2.2. Roll-out of Implementation Phase

Once the Pilot Implementation is successfully completed and accepted (Sign-off) by JSCL/JCTSL, the ITS System Integrator shall progressively implement the ITS Solutions for the remaining scope as described in the table below:

Milestones for Roll-out of Implementation	Coverage
Supply, Deployment, Installation & Commissioning of the following ITS solutions:	
<ul style="list-style-type: none"> Automatic Fare Collection System (AFCS) 	<ul style="list-style-type: none"> For all remaining routes and buses
<ul style="list-style-type: none"> Vehicle Tracking System 	<ul style="list-style-type: none"> For all remaining buses
<ul style="list-style-type: none"> PIS, PIS Web-Portal & Mobile App and PA System 	<ul style="list-style-type: none"> For all remaining bus stops as per the project scope
<ul style="list-style-type: none"> Bus Operation Management System (BOMS) 	<ul style="list-style-type: none"> For remaining two bus operators
<ul style="list-style-type: none"> Depot Management System (DPS) 	<ul style="list-style-type: none"> For remaining one depot (Aga Chowk)
<ul style="list-style-type: none"> Enterprise Management System (EMS) 	<ul style="list-style-type: none"> As per project scope

3.3. Operation & Maintenance (O&M) Phase

The O&M phase will commence from the date of “Go-Live” of ITS solutions. The O&M phase shall be for a period of 5 years.

The ITS System Integrator shall operate and maintain the ITS solutions for contract period of five years from the date of “Go-Live”.

3.4. Project Timelines

The ITS System Integrator shall be responsible for the implementation of the project within the timelines as indicated in the table below. The detailed project timelines are as provided in the Table below:

Project Milestones	Timelines
Implementation Phase	
Signing of Contract	T*
Submission of System Requirement Specifications (SRS) document	T1 = T + 6 weeks
Approval of SRS by JSCL/JCTSL	T2 = T1 + 2 weeks

Project Milestones	Timelines
Conducting pilot implementation of ITS including: <ul style="list-style-type: none"> Automatic Fare Collection System on one route (minimum 10 buses) Vehicle Tracking System for 10 buses PIS, PIS Web-Portal & Mobile App and PA System - one bus stop Bus Operation Management System and Depot Management System in one depot for one bus operator 	T3 = T2 + 10 weeks
Acceptance /Sign-Off of pilot implementation by JSCL/JCTSL	T4 = T3 + 2 weeks
Roll out of ITS solutions for all buses, depots, bus operators and bus stops (“Go-Live”)	T5 = T4 + 12 weeks
Operation & Maintenance (O&M) Phase	
Operation and Maintenance of ITS solutions	T5 + 5 years

* where “T” is the date of Signing of Contract between JSCL/JCTSL and ITS System Integrator.

3.5. Overview of Roles and Responsibilities of Key Stakeholders

The broad roles & responsibilities of key stakeholders are as described in the Table below:

Stakeholder	Role Description
Jabalpur Smart City Limited (JSCL)	<ul style="list-style-type: none"> Co-ordination with JMC & other agencies/departments for implementation of ITS project Signing the Contract Agreement for executing the project with successful vendor (ITS System Integrator) Release payments to ITS System Integrator as recommended by JCTSL Provide overall guidance, review and steer the project Bear the electricity charges for all sites (depots/bus stops) as per project scope during Contract Period
Jabalpur City Transport Services Ltd.(JCTSL)	<ul style="list-style-type: none"> Appoint a dedicated Nodal Officer for ITS Project from smooth implementation of the Project. Unless otherwise approved, CEO (JCTSL) will be the Nodal Officer for the ITS Project. Provide necessary information/documents to ITS System Integrator for carrying out survey and other field related works Co-ordination with ITS System Integrator for implementation of the project Monitor and review the project progress in association with JSCL Facilitate interaction between bus operators and ITS System

Stakeholder	Role Description
	Integrator. <ul style="list-style-type: none"> • Forwarding the certification of up time, down time of ITS components JSCL for release of the payments to ITS System Integrator • Prioritisation of Sites, if required for implementation of PIS and PA system in consultation with JSCL.
ITS System Integrator (ITS System Integrator)	<ul style="list-style-type: none"> • Field survey to understand the detailed requirements • Prepare the Project Plan in consultation with the JSCL/ JCTSL • Enter into contract with JSCL • Mobilization of the team and take up the work • Deliver the Project Milestones as defined in the Contract Agreement • Conduct training for officials and staff from JSCL, JCTSL, bus operators and other as required • Payment of the communication (connectivity) charges during commissioning period and entire operation and maintenance period of 5 years. • Payment of the Communication bills for all sites during project period • Transfer of all the assets created within 30 days from the date of completion of the Acceptance Test through proper sale Invoice. • Undertake testing/3rd party certification of solution components as required. • Customize, Configure, Maintain and update the ITS Application software during the contract period. • Train the identified personnel of Traffic Department on operating and maintaining the complete system. • Prepare quarterly and annual reports
Project Management Unit (PMU)	<ul style="list-style-type: none"> • Provide project management services for entire duration of the Project • Develop the project plan and project charter • Coordinate workshops and discussion meetings between project stakeholders • Review the deliverable submitted by ITS System Integrator and Provide Technical review/inputs for ITS solutions such as ACFS, VTS, Depot Management System, Bus Operation Management System, PIS, PA system. • Highlight deviations/issues in the deliverables of ITS System Integrator to JSCL/JCTSL in resolution of issues. • Monitor and maintain issue tracker and keep on updating the status of all risks and issues from time to time. • SLA monitoring • Defining the escalation mechanism for timely resolution of issues & risks.

4. Payment Milestones

4.1. Payment during Implementation Phase

The payment milestone for ITS System Integrator during Implementation phase shall be as under:

Sl. #	Payment Components	Payment Terms
1.	ITS Software solutions, licenses etc. as per Bill of Materials, including <ul style="list-style-type: none"> • Backend Application Software for Automatic Fare Collection System • VTS software • Mapping Platform –Map Licenses • PIS Management System • PA system Software solution • Bus Operation Management System Software • Depot Management System Software • COTS (OS, DB, Firewall, Antivirus, etc.) • Enterprise Management Software 	The payment for ITS Software solutions will be made as below: <ul style="list-style-type: none"> • 60% of the solution CAPEX price on acceptance of pilot implementation of all solutions • 30% of the solution CAPEX price on 'Go-Live' implementation of all solutions • 10% of the solution CAPEX price upon completion of 3 months from 'Go-Live' date.
2.	Hardware Components, as per Bill of Materials, including <ul style="list-style-type: none"> • ETM Devices including device application software, AC charger, Memory card, shoulder carry case, one extra battery and other accessories • Charging Infrastructure including accessories in terms of batteries charging capacity • Contactless Smart Card (with printing on both sides) • Vehicle Tracking Devices • Driver Control Unit & On-board Card Validators (as proposed) • PIS LED Board for Bus stop • IP-based Public Address System with speakers, amplifier, horn, master 	The payment for hardware components will be made as below: <ul style="list-style-type: none"> • 60% of the CAPEX price of corresponding hardware items on acceptance of delivery & commissioning* of the respective item • 30% of the CAPEX price of corresponding hardware items on 'Go-Live' implementation of all ITS solutions • 10% of the CAPEX price of corresponding hardware items upon completion of 3 months from 'Go-Live' date.

Sl. #	Payment Components	Payment Terms
	control desk <ul style="list-style-type: none"> Desktops for depot and bus operation management teams/officials/CCC including UPS, OS and MS Office Printers/MFP for depot and bus operation management teams/officials/CCC Server Infra (including Servers, Rack, Storage, Networking) POS Terminal (Computer, Multi-function Printer, Receipt Printer, Card Printer, Card Reader, UPS, User Display) 	
3.	Common Infrastructure and Other cost as below: <ul style="list-style-type: none"> Installation charges for AFCS equipment, PIS equipment and PA system Common infrastructure for PIS and PA system at Bus stops - Junction box, Rugged enclosure and UPS Data digitization, training etc. Furniture for Desktop & Printer 	The payment for Common infrastructure and other costs will be made as below: <ul style="list-style-type: none"> 100% of the CAPEX price of corresponding items on 'Go-Live' implementation of all ITS solutions

* Commissioning would mean that the item has been put to its desired functional use and has been accepted by JSCL/JCTSL.

4.2. Payment during O&M Phase

The payment milestone for ITS System Integrator during O & M phase shall be as under:

Sl. #	Payment Heads	Payment Terms
1.	Payments during O& M Phase	<ul style="list-style-type: none"> On quarterly basis post completion of the quarter

All payments shall be made by JSCL after obtaining a no-objection certification from JCTSL regarding the deliverables carried out by the ITS System Integrator, subject to any applicable deductions.

5. Functional and Technical Requirements

5.1. Functional Requirements of Automatic Fare Collection System

5.1.1. General Functional Requirements

The ITS System Integrator shall be responsible to design, develop, test, integrate, install and provide the Automatic Fare Collection System Application Software for the Project, which shall comprise various functional modules including but not limited to the following:

i. Clearing and Settlement

The Clearing and Settlement module will be a main module of the AFCS. The Clearing and Settlement module will meet the following functional requirements:

- It shall process all Smart Card usage transactions and generate settlement files on daily basis.
- It shall process all transactions received till a cut-off time. The cut-off time will be a configurable parameter. The transactions received after cut-off time will be processed next day.
- At the end of each day, all transactions will be settled on various accounts configured in the System. The System will generate settlement files for each Transit Operator within the specified time frame.
- It shall generate a report of rejected transactions and it will be possible for authorised users to perform manual settlements, under strict audit trail. It shall provide a centralised view and thus provide alerts to the users of potential cash shortfalls in the fund.
- The main account will be reconciled daily based on the settled amounts and the balance available on all Smart Cards. The daily reconciliation shall take into account all transactions with a financial impact including Smart Card usage transactions, recharge transactions, any cancelled transactions, refunds, Smart Card replacements, adjustments and write-offs, if any.

ii. Transactions Management

- This module shall process all transactions received from valid sources including DCUs, OCVs, ETMs and third party systems.
- It shall ensure that no duplicate transactions are recorded in the System. It shall also manage missing transactions, by identifying them on the basis of transaction sequence number, last balance, etc. and will incorporate a suitable mechanism to handle them.

iii. Security Management

The AFCS shall be designed in a way so as to ensure maximum security of all sub-systems/ components of the System. The AFCS shall be suitably protected from internal as well as external threats.

The main features of Security Management will include the following:

- The System will be fully protected from the attacks of viruses, malware, etc.
- Suitable security policies, processes and monitoring will be built-in and enforced to the fullest extent to ensure unauthorised access, hacking, denial of service attack or other security breaches are prevented.

iv. Operator Management

There will be multiple bus operators using the AFCS. This module shall be used to manage the accounts of various bus operators. It shall be possible to add new bus operators without any modification in software/ hardware. It shall be possible to configure the parameters specific to different bus operators attributes such as name, address and bank account details.

v. Smart Card Management

The Smart Card Management module shall meet the following functional requirements

- This module shall contain the master database of all Smart Cards present in the System. Each Smart Card will have unique identity.
- The module shall facilitate tracking of Smart Cards throughout their lifecycle including procured, initialized, issued, active, refunded, defective/ damaged, dormant (removed from active list), hot-listed, disposed off, etc.
- The security deposit and e-purse balance on each Smart Card will be stored and managed. In case of passes, the pass details, date of validity, remaining trips, etc. will be stored.
- It shall manage the collection, tracking and refund of Smart Card deposits.
- Based on the transactions received by the AFCS, the e-purse balance for all Smart Cards shall be updated.
- The AFCS will be able to manage refund and replacement of Smart Cards. It shall allow refunded Smart Cards to be reused.
- The System shall be able to detect and report anomalies in use of Smart Cards.

vi. Reporting Module

It is possible to generate reports daily, weekly, monthly, or on ad-hoc basis. It is possible to generate consolidated reports as well as separate reports for different bus operators and non-transit applications.

The AFCS shall provide standard reports, exception reports and Management Information System reports, including but not limited to the following:

- Financial Reports
- Operation Reports
- Reconciliation Reports
- Sales/ recharge Reports
- Card Usage Reports
- Parameter Reports
- Log Reports

- Exception Reports (Fraudulent Card Usage Report etc)
- Version Update Reports

vii. Clock Synchronisation

The AFCS Application will maintain a master clock, from which all the sub-systems/ components/ equipment will synchronise their clocks. The frequency of synchronisation will be a configurable parameter. All devices and sub-systems within the System (on and off line) shall be time-synchronized.

viii. Hot-list/ White-list Management

During the operations of AFCS, certain Smart Cards may have to be blocked from further use due to reasons like requests from passengers who have lost their Smart Cards or a Smart Card having suspect transactions. The details of such Smart Cards required to be blocked will be maintained in a hot-list.

Similarly, certain Smart Cards will need to be recharged automatically, based on standing instructions by passengers. In case of a recharge through internet/ mobile phone, the e-purse value on Smart Cards will have to be updated. For such Smart Cards, a white-list will be maintained in the system.

The Hot-list/ White-list Management module will meet the following functional requirements:

- It shall facilitate manual entering of IDs of Smart Cards to be blocked, in the system by authorised staff (such as customer service staff)
- The hot-list will be propagated to all devices/ systems where the Smart Cards may be used. On encountering a Smart Card, whose ID is present in the hot-list, a device will block the Smart Card in a manner that it cannot be used again, without manual intervention from authorised staff.
- A white-list will be prepared at regular intervals, which will include details of the Smart Cards to be recharged. The white-list may include details of:
 - Smart Cards for which the passengers have given standing instructions to recharge the Smart Cards by a specific amount, whenever the balance falls below a specific value.
 - Smart Cards which have been recharged through alternative recharge methods like internet and mobile phones.
- The details of Smart Cards, which have been blocked / recharged through one device/equipment, will be removed from hot-list/white-list in all the devices/ equipment.

ix. Key Management System

The ITS System Integrator shall design and provide a Key Management System (KMS) for the AFCS.

The main features of the KMS will include the following:

- The KMS shall manage generation, storage, transmission, distribution and phasing out of all cryptographic keys, system key materials, security

variables and certificates. It shall manage all keys and other security elements from their birth till phase-out.

- The KMS shall manage all system keys through their life-cycle and shall support key diversification, key roll-over, key versioning and key phase-out.
- There will be different keys for different functions. The keys will include debit key, credit key, signature key, issuer key, SAM authentication key, read only key, etc. The critical keys like debit keys, credit keys and signature keys shall be used through SAM so that the application does not have direct access to the keys.

Other General requirements

- It shall be possible to issue/recharge Smart Card through handheld ETM by conductors and in future through retail operators. It shall also be possible to recharge Smart Card through online top-up, mobile wallets, auto-credit instructions etc.

5.1.2. ETM Device

The ETM shall meet the functional requirements of JSCL/JCTSL including, but not limited to the following:

- 1) The ETM application shall support existing and future fare rules of JCTSL/operators including but not limited to various fare types and categories (Adult, Child, and Luggage etc.)
- 2) The ETM shall have the route and stoppage data in the ETM application for all routes operated by JCTSL/operators and all bus stops.
- 3) The ETM shall support secured Login using ID and PIN.
- 4) The login into the device shall also support using Contactless Smart Cards
- 5) The ETM shall be able to send the transaction details to the server using encrypted protocols.
- 6) The System shall be an online system. The ticket data shall be communicated on-line from ETMs to Backend over GPRS.
- 7) There shall be a provision to download transaction data from ETMs through USB cable, in case the data is not communicated to server due to problem in communication or ETM device.
- 8) The ETM application shall be easy to use for the conductors. The conductors shall be able to issue tickets using minimum key-strokes.
- 9) The ETM shall support using the contactless Smart Cards (with stored value as well as e-Pass) including ISO 14443 Type A & B cards, Mifare family cards and SCOSTA contactless cards and contactless EMV based bank cards (including Master cards, VISA and NCMC's Rupay)

- 10) The ETM shall display the valid passengers' count in the bus, at any point of time, based on the ticket issued/passes validated.
- 11) The ETM device shall be able to display the real-time status of the battery health.
- 12) The ETM device shall be able to conserve battery during idle time by invoking sleep mode.
- 13) It shall be possible to charge ETM Device as well as its battery separately.
- 14) The ETM shall support over-the-air update of fare and table, routes, bus-stops, configuration parameters/ETM application.
- 15) The ETM device shall have a module to allow its use by the ticket inspector to inspect customers' Smart Cards to ascertain payment of fare and to issue penalty receipts.

5.1.3. Driver Control Unit (DCU)

The Driver Control Unit (DCU) is a key on-board device and shall have the functionalities including, but not limited to, the following:

- To provide interface between bus drivers and the AFCS.
- To configure, control and monitor all the On-board Card Validators, present on the bus.
- To ascertain bus-stops based on GPS inputs, as well as manual inputs
- To provide communication interfaces including 3G/GPRS, Wi-Fi, USB and RS232/ RS485.
- To be capable of interfacing with other on-board devices including a printer, for issuance of single-journey and other paper tickets.
- To be capable of reading the transactions history and balance available on CSCs and to recharge CSCs, on its own or in conjunction with one of the OCVs.

The DCU shall meet, at least, the following functional requirements:

- 1) To allow drivers to interact with the AFC System to perform various activities including, but not limited to, log-on, log-off, shift start, shift end, trip start, trip end, route select, etc.
- 2) To store complete master data required for operation and calculation of fares including, but not limited to, details of bus stops, routes, crew details, passenger types, fare policy, business rules, route and trip etc.
- 3) To detect bus-stops based on the coordinates obtained from inbuilt GPS. The geo-fence radius for different bus-stops shall be configurable. The ITS System Integrator shall provide alternative solutions to update the bus-stop automatically, through concepts like triangulation based on GSM signal strength or cell ID identification. In case, bus-stop is not automatically updated, Driver shall be able to manually update the bus-stop through DCU or Conductor shall be able to update the bus stop through ETM, which shall get updated on DCU/OCVs through Bluetooth/Wi-Fi.

- 4) To configure, control and monitor OCVs. It shall be possible to configure OCVs, including their brightness and contrast through DCU. The status of all OCVs/ non-functional OCV shall be displayed on the DCU.
- 5) The DCU shall be capable of reading balance, pass status and transaction history from CSCs and recharging CSCs.
- 6) The DCU shall store complete fare policies/ business rules and encryption keys for secure communication. The ITS System Integrator shall provide one SAM per DCU. The SAM shall be an industry standard SAM, capable of storing multiple keys; supporting different encryption including TDEA, AES and RSA; and interacting with various types of Smart Cards.
- 7) The DCU shall have sufficient memory to store, at least the details of:
 - (a) Up to 1,000 bus stop details including stop ID, stop name, latitude, longitude, etc.;
 - (b) Up to 500 routes;
 - (c) Up to 20,000 transaction records;
 - (d) 100 log-in and log-off records;
 - (e) 500 alerts/ events records;
 - (f) 1,00,000 card details (including hot-list and white-list information);
 - (g) Minimum two sets of fare tables (one current and one future dated)
 - (h) Any other data as required
- 8) The DCU memory shall be easily expandable to cater to double the above requirements, to meet future needs.
- 9) It shall also have the ability to receive software upgrades over the air through 3G/ GPRS and Wi-Fi as well as directly through interfaces like USB/ RS232.
- 10) The DCU and its memory shall be protected from damage to prevent data loss in all events including device tampering, vandalism, power failure, power fluctuations, power spikes, etc.
- 11) The DCU shall generate, store and transmit the transactions data, events and alerts data, maintenance data, operational logs and any other type of data as may be required. The primary mode of data communication between DCU and Central System shall be 3G/GPRS. The frequency of data transfer shall be a configurable parameter. The DCU shall communicate with the Depot Computer through Wi-Fi, in case 3G/GPRS is not functional or available.
- 12) All relevant details like route number, route direction, current bus-stop name, date, time, GSM signal strength, etc. shall be displayed on the DCU screen. The display messages and keypad configuration for DCU shall be programmable, as per the requirement.
- 13) The DCU and its mounting shall be vandal and tamper resistant. The mounting shall be such that the display is easily readable by driver, the keypad is in easy access of driver and the DCU does not block driver's field of vision. The mounting arrangement of DCU may vary for different types of buses.

5.1.4. On-board Card Validators (OCV)

The OCVs shall be able to meet, at least, the following functional requirements:

- 1) To allow cardholders to transact using Contactless Smart Cards (CSC). The Cardholders shall be able to present their CSCs on the OCVs for transactions. The OCVs shall be able to read, authenticate, validate and transact on the CSCs.
- 2) There shall be 2 OCVs on each bus. Each OCV shall be able to do only entry, only exit or both entry and exit transactions, as configured.
- 3) The OCVs shall also be able to check the validity of all types of passes. OCVs shall store complete fare policy, business rules, any other data required for operation and calculation of fares.
- 4) The OCVs shall be capable of reading balance, pass status and transaction history from CSCs and recharging CSCs.
- 5) The OCVs shall be able to block CSCs, based on the hot-list present in their memory. The OCVs shall also be able to update balance on CSCs, based on white-list present in their memory.
- 6) The OCVs shall store complete fare policies/ business rules and encryption keys for secure communication. The ITS System Integrator shall provide one SAM per OCV. The SAM shall be an industry standard SAM, capable of storing multiple keys; supporting different encryption including TDEA, AES and RSA; and interacting with various types of Smart Cards.
- 7) The OCVs shall have sufficient memory to store, at least, the details of:
 - a. Up to 10,000 transaction records
 - b. 100 log-in and log-off records
 - c. 500 alerts/ events records
 - d. 100,000 card details (including card hot list and card auto load information)
 - e. Minimum two sets of fare tables (one current and one future dated)
 - f. Any other data as required
- 8) The OCVs memory shall be easily expandable to cater to double the above requirements, to meet future needs. The OCV and its memory shall be protected from damage to prevent data loss in all events including device tampering/ vandalism, power failure, power fluctuations, power spikes, etc.
- 9) The OCVs shall have the ability to receive software upgrades through interfaces like USB/ RS232.
- 10) The OCVs shall generate, store and transmit the transactions data, events and alerts data, maintenance data, operational logs and any other type of data as may be required. It would be possible to extract data from OCVs through external physical connectivity through USB/ RS232 port as a backup.
- 11) The OCVs shall display relevant messages like 'Not in operation', 'Please touch your card', 'Invalid card', 'Insufficient balance', 'Try again', exception messages for other exceptions, money debited, balance available, pass validity, current bus-stop name, etc. The display messages shall be programmable, as specified by JSCL/JCTSL. The messages and formats shall be decided in consultation with

- JSCL/JCTSL. There can be different message sets for different OCVs due to operational requirements/ fare policy. The messages shall be easily configurable.
- 12) The OCV display shall be easily readable under all ambient light conditions including direct sunlight, night time, etc. and angle of up to 15 degrees in any direction.
 - 13) The LEDs and audio beeps on OCVs shall be configured for different conditions (like successful transaction, unsuccessful transaction due to insufficient balance, invalid card, low balance, etc.). It would be possible to easily change the configuration of LEDs and audio beeps.
 - 14) The OCVs card interface shall fully comply with ISO 14443 (all relevant parts). The OCVs shall be capable of transacting on all types of ISO 14443 Type A and Type B cards including MIFARE Ultra light, MIFARE Ultra light C, MIFARE Classic, MIFARE Plus, DESFire, DESFire EV1 and other MIFARE family cards, micro-processor based cards, NFC devices SCOSTA CL, NCMC's Rupay and contactless EMV cards.
 - 15) The OCV card antenna shall be designed to provide easy access to Cardholders for presenting their CSCs. The area for tapping CSCs shall be clearly distinguished. The operating range for cards shall be a configurable parameter.
 - 16) The OCVs and their mounting shall be vandal and tamper resistant. The mounting shall be such that the display is easily readable by all categories of Cardholders.
 - 17) The mounting arrangement of OCVs may vary for different types of buses. The OCVs and mounting arrangement shall be positioned such that it does not cause any hindrance in passenger flow and does not obstruct the driver's, conductor's or customers' field of vision. The mounting arrangement shall be flexible to allow the mounting location to be optimised in order to maximise passenger throughput.
 - 18) The OCV design shall be modular, so that various modules can be added/ removed and memory and other components can be upgraded, without requiring any major design change.

The ITS System Integrator may also propose alternative solutions such as OCVs/ETMs having in-built functionalities of Driver Control Unit (DCU) in their solution architecture.

5.1.5. AFCS Backend Software Application Software

The AFCS Backend Application software shall meet the functional requirements of JSCL/JCTSL including, but not limited to the following:

- 1) The Backend Application software shall be able to configure fare rules as per the requirements of JCTSL and update the same on all Card validators and ETMs (existing ETMs as well as new ETMs) over-the-air as well as through physical download using data cable.
- 2) The Backend Application software shall be able to display real time display of revenue collection information.
- 3) The Backend Application software shall be able to send email of revenue collection details to designated officials on periodic intervals.

- 4) The AFCS Application software shall be able to display real time dashboard of health of the ETM devices/validators.
- 5) The AFCS Application software shall be able to block any prohibited or debarred ETM Device from backend through over-the-air command.
- 6) The backend system should be robust enough to handle online communication of at least 1,000 ETM Devices/validators.

5.1.6. Contactless Smart Card (CSC)

The entire AFC System shall be designed in a way that it supports multiple types of Contactless Smart Cards (CSCs). The AFC System shall be compatible with ISO 14443 Type A and Type B standards, NCMC and contactless EMV (Europay, MasterCard Visa) and Rupay.

Smart Cards shall be able to carry all products as per fare rules and shall be used in transit and non-transit applications. The Smart Card operating system shall support a multi-application structure and allow post-issuance management of Smart Card content.

1) Type of CSCs

It shall be possible to use any type of CSCs in the system, without requiring any significant change in hardware/ software. The major types of CSCs supported on the system shall include:

- i. Complete MIFARE family cards including MIFARE Ultra light, MIFARE Ultra light C, MIFARE Classic, MIFARE Plus, DESFire, DESFire EV1, SCOSTA CL;
- ii. Micro-processor based Contactless Smart Cards and NFC devices;
- iii. NCMC/Contactless EMV, and Rupay

2) Smart Card Integrated Circuit Card (ICC) Minimum Capability

The following minimum requirements shall be met for all Smart Cards:

- i. The Smart Cards shall support a published and freely available method for ICC Identification.
- ii. The Smart Cards shall guarantee the response to the ISO 14443 ATQ command requesting the Card Serial Number (CSN). The CSN shall be globally unique per ICC.
- iii. The Smart Cards shall support an e-purse mechanism capable of credit and debit of value based on authentication through keys.
- iv. The Smart Cards shall support e-purse for purchasing non-transit products e.g. merchandise from participating merchant network.
- v. Shall support a method of algorithmically securing data files on the card with Credit, Debit, Read and Write access permissions via unique and separate Keys per data block.

- 3) In the beginning, DESFire EV1 4 KB Smart Cards shall be used. There shall be two major categories of Smart Cards issued as part of the AFC System:

- Anonymous stored value Smart Cards
- Personalized pass/ concessional fare/ free travel Smart Cards

The Bidder can also propose open loop bank issued NCMC card in lieu of DESfire EV1 card.

4) **Specifications of Card Application**

- i. The Card Application shall conform to the requirements set by ISO 14443 standards.
- ii. The Card Application shall meet the transaction speed requirements specific to transit operations and shall not be more than 300 milliseconds for most complex tap-in and tap-out transactions.
- iii. The Card Application shall be designed to secure and safeguard the integrity and security of the data stored on the Smart Card. The ITS System Integrator shall specify the method of security and safeguarding the integrity of transaction data.
- iv. The Card Application shall conform to the following requirements:
 - a. The Smart Card applications shall meet requirements of all types of business rules for transit operation, including fare payment from e-purse, passes, different types of concessions, etc.
 - b. The CSCs shall be able to accommodate/ incorporate any new business rules that may be required for transit operations.
 - c. The CSCs shall handle all conditions like insufficient balance, negative balance, failure to tap-out after tap-in, etc.
 - d. The CSCs shall support a multi-application structure to enable creation and addition of new applications, including non-transit applications, without interfering with the existing ones. It would be possible for different applications to have their own security keys. The multiple applications would be able to access common areas on the Smart Card including the electronic purse, subject to security conditions.
 - e. The CSCs shall allow adding new applications and updating and/ or removal of existing applications, without having to recall Smart Cards.
 - f. The CSCs shall be designed to secure and safeguard the integrity of data including electronic purse value, transaction data, etc. stored on the card.
 - g. The transaction speed requirements specified herein shall not be impacted by the security features design, specifically through the Smart Card's contactless interface.
 - h. The Smart Card Application shall be secured, to prevent any frauds. In case, there is more than one application on Smart Cards, each application shall be secured independently, so that an application can be accessed, without exposing the data/ files of other applications.
- v. The Card Application shall be designed to make the most optimum use of Smart Card memory.

5) **General Requirements**

- i. The ITS System Integrator shall design Card graphics in consultation and approval of JSCL/JCTSL.
- ii. The system shall allow for recycling of returned anonymous cards.
- iii. Operators/ Employees Smart Cards: Certain categories of employees/operators shall be given Smart Cards, for operation/ maintenance of the AFC System components. Such categories shall include:
 - a. Operator employees – drivers/ conductors
 - b. Revenue Protection Officers
 - c. Maintenance Personnel
 - d. Test Smart Card
 - e. Any other category of users as decided by JSCL/JCTSL
- iv. ITS System Integrator shall develop Card Application, suiting the roles of the above categories.

5.1.7. **Point of Sale Terminal Specifications**

- 1) The Point of Sale Terminals shall be used to issue and recharge Smart Cards and to make refund against Smart Cards. The POS will be a handheld device, having inbuilt Contactless Smart Card module, thermal printer and 3G modem.
- 2) The Point of Sale Terminals shall have, at least, the following modules:
 - Computer
 - Multi-function Printer
 - Receipt Printer
 - Card Printer
 - Card Reader
 - UPS
 - User Display
- 3) **Functional Requirements:** The POS shall be able to meet, at least, the following functional requirements:
 - The POS shall allow the device operators to log-in, log-off using their Smart Cards or User-ID/ Password.
 - The POS shall be used to issue anonymous as well as personalised Smart Cards. For personalised Smart Cards, the details of the cardholder shall be captured in the system. The name and other details and photographs of the cardholder shall be printed on the card.
 - The POS shall be used to recharge Smart Cards and renew passes.
- 4) The POS shall generate, store and transmit the transactions data, events and alerts data, maintenance data, operational logs and any other type of data as may be required.

5.2. **Technical Requirements of Automatic Fare Collection System**

5.2.1. **ETM Device**

The technical specifications of ETM Devices shall be as set out in the table below:

Sl. #	Parameter	Minimum Requirements
1.	Processor	Minimum 400 MHz ARM11 32-bit RISC processor
2.	OS	The OS shall have strong functionalities having at least the following features: <ul style="list-style-type: none"> a) Capability of multi-tasking i.e. forking a child process from main process b) Capability of multithreading application c) Seizing of a single resource by more than one competing process d) Locking of resource (GPRS modem, file) to prevent seizing by another process in case one process is using it. e) Unlocking of resource to allow another process the usage of the resource f) Scheduling to allow the usage of single resource by competing processes. g) Forced unlocking of resource if a process seized it and crashed without freeing it. h) Capability of upgrading application and configuration data over the air, directly from the Backend server. i) In case, any specific software/application is required to programme /configure/manage the devices, the same shall be provides free-of-cost.
3.	SDRAM	Minimum of 64 MB
4.	FLASH	Minimum of 128 MB
5.	Extendable Memory	SD/Micro SD card interface (minimum 16 GB)
6.	Display	Graphic display minimum 128 x 64 pixels, minimum 2.5" screen, Monochrome or colour, backlight, capable of displaying Graphical images / icons
7.	Keypad	Minimum of 15 keys on the keypad
8.	Thermal Printer	57 mm, (minimum of 18 lines/sec), Easy paper roll loading Should support minimum 15 meter length thermal paper roll (55 GSM); Paper out sensor
9.	SAM slots	Minimum 2 SAM slots
10.	GPRS/3G	Wireless Wide Area GSM/GPRS/ 3G
11.	Battery	Li-ion/Li-polymer, minimum 1800 mAH (Print 800 ticket per shift with a minimum of 12 hours of operations with real time data transfer and smart card read & write facility); Over-charge/ over-voltage/ over-current protection; Quick recharge; Easily removable and separately chargeable; Extra battery pack per ETM
12.	Weight	Max. 500 g
13.	Communication Ports	LAN 10/100 Base-T (10/1000 Mbps) USB 2.0 – 1 no.

Sl. #	Parameter	Minimum Requirements
14.	Security	Shall support encryption standards including 3DES and AES for smart card reading/writing as well as communication with Central System
15.	Operating temp.	5 – 50 degree C
16.	Contactless Smart Card Reader	Inbuilt Contactless Smart Card reader – ISO 14443 Type A & B, including support for complete Mifare family cards, Desfire, SCOSTA CL, contactless EMV, NCMC, qSparc etc.
17.	Indications on display	Battery charge status GSM Signal strength
18.	Audio	Beeps on key-press and transactions
19.	Others	Remote Administration; Over the air upgrade of firmware, application, configuration parameters, master data, etc. should be possible
20.	Accessories	Shoulder carry bag AC charger (working from 160 V to 250 V) Memory Card – minimum 2 GB USB data cable
21.	Certifications	<ul style="list-style-type: none"> • Minimum EMV Certification Level 1 & 2, MasterCard, Visa, Rupay, NCPI's qSparc • PCI PTS Certification

5.2.2. Charging Infrastructure

The technical specifications of Charging Infrastructure shall be as set out in the table below:

Sl. #	Parameter	Minimum Requirement
1.	Gang Charger with Battery Charging Slots	Minimum 4 battery charging slots i.e. should be capable of charging at least 4 batteries simultaneously.
2.	LED Indications	Battery under charging status Battery charge complete status The Battery Charger shall have LEDs to show the status of power and charging status of each battery individually.
3.	Accessories	AC charger (working from 160 V to 250 V)
4.	General	The Battery Charger shall have adequate protection for batteries from dust, etc. The Battery Charger shall have over-charge protection.

5.2.3. Contactless Smart Card

The Contactless Smart Cards (CSC) to be supplied by the ITS System Integrator shall meet the following specifications:

Item	Description
Physical Characteristics	Shape and Physical dimensions (including thickness) to be compliant to ISO 14443-1 standard The complete base material including inlay, card body and transparent outer layer shall be high grade PET-G. Card surface shall have low sensitivity to dust and moisture adherence. Card antenna should be made of copper wire only.
Card Lifetime	Card life shall be greater than 5 years. During this period, the card must not develop cracks, holes or other surface imperfections due to ageing.
General Characteristics	Card shall adhere to specifications covered in ISO IEC 10373-1 – General Characteristics for following parameters: <ul style="list-style-type: none"> • Resistance to dynamic bending stress • Torsion stress • Bending stiffness • Resistance to break • Flammability, Peel strength • Card warpage • Resistance to chemicals • Adhesion • Card stability, etc.
Electrical Characteristics	Card shall work up to a distance of 10 cm between antenna and card.

Item	Description
	<p>For DESFire Smart Cards, the ITS system Integrator shall submit Arsenal certificate, which shall include certification for essential electrical parameters, protocols and characteristics of DESFire contactless card.</p> <p>The Cards shall fully comply with ISO 14443 Type A standards.</p>
Security Features	<p>Cards shall be encoded with transportation keys prior to delivery.</p> <p>Each Card shall have a 7 byte unique internal ID (UID)</p> <p>Each Card shall have a unique serial number laser engraved on it, as per the number scheme to be provided.</p> <p>ITS System Integrator shall provide the mapping of UID and unique serial number, in soft copy.</p> <p>Card shall be tamper-proof i.e., on an attempt to open the Card, it should become unusable.</p>
Environmental conditions	<p>Temperature: 0 to + 60°C</p> <p>Relative Humidity: 5 to 95%</p>
Card Graphics	<p>The Cards shall be printed on both sides, with four colour print process, as per the Card graphics designs specified by JSCL/JCTSL. The Cards may have different graphics (maximum four) as may be decided by JSCL/JCTSL.</p> <p>The Smart Card graphics shall not deteriorate for at least five years under normal use conditions.</p>

5.2.4. Driver Control Unit (DCU)

Technical Specifications: The DCU shall meet the following specifications/ requirements:

Sl. #	Description	Minimum specification/ requirement
1.	Processor	Minimum 400 MHz, 32 bit processor
2.	Operating System	Windows or Linux or any other standard OS
3.	Display	<ul style="list-style-type: none"> Minimum 4.5" Colour LCD, 320 x 240 pixels Good visibility in all lighting conditions including direct sunlight and night time
4.	Memory	<ul style="list-style-type: none"> Flash and RAM Expandable memory – minimum 8 GB
5.	Keypad	<ul style="list-style-type: none"> Keypad including number keys, Enter key, back/ cancel key and programmable function keys Minimum life of 1 million key depressions
6.	GPS receiver	<ul style="list-style-type: none"> Minimum 20 channel Better than 10 meter positional accuracy External or internal GPS antenna Suitable to operate accurately and reliably in a built-up urban environment having high rise buildings.
7.	GSM modem	<ul style="list-style-type: none"> Support GPRS for data, SMS and voice Minimum Tri band, GPRS class 10 or above Internal antenna
8.	Communication Interfaces	<ul style="list-style-type: none"> Wi-Fi – 802.11 b/ g DCU should have following free ports/ interfaces for future use: <ul style="list-style-type: none"> USB port RS 232 – 2 nos. RS 485 – 1 no.
9.	Power	<ul style="list-style-type: none"> Input Voltage range 9 – 30 Volts DC
10.	Internal Battery	<ul style="list-style-type: none"> Minimum 6 hours operating backup
11.	SAM Slots	<ul style="list-style-type: none"> Minimum 4
12.	Smart Card interface	<ul style="list-style-type: none"> Fully compatible with ISO 14443 Type A and Type B smart cards, including but not limited to MIFARE Ultralight C, MIFARE Classic, MIFARE Plus, DESFire EV1 and other MIFARE family cards and Microprocessor based cards, SCOSTA CL, NFC devices and EMV based Bank cards, Rupay etc.
13.	Environmental	<ul style="list-style-type: none"> Operating temperature – 0°C to 55°C Relative Humidity – 5% to 95% non-condensing Ingress Protection – IP65 or better The device may be exposed to direct sun, through windows for long periods, thus it must be suitable to withstand the same. The device must be able to withstand such shocks and

Sl. #	Description	Minimum specification/ requirement
		vibrations, as are expected to be encountered in the operation onboard a mobile bus, in Indian conditions.
14.	Other requirements	<ul style="list-style-type: none"> • Inbuilt RTC with Battery Backup • Inbuilt speaker for audio beeps/ indications • Dual colour LED indication – 3 numbers (for power, GPS and GSM)

As an alternative solution, one of the OCVs, directly or with ETM or with a separate device, may meet functionalities of DCU.

5.2.5. On-board Card Validator

- 1) The On-board Card Validators (OCVs) are the primary interface devices for Cardholders. The OCVs shall be installed on buses to provide Smart Card interface for Cardholders for doing Smart Card based transactions.
- 2) The OCVs shall have the functionalities including, but not limited to, the following:
 - To provide interface between Cardholders using CSCs and the AFC System.
 - To be able to calculate fares based on business rules and bus-stops information
 - To read, authenticate, validate and transact on the CSCs, based on the business rules, in a secure manner.
- 3) The OCV shall have, at least, the following modules:
 - Processor
 - Display
 - Memory
 - Contactless Smart Card Interface and Antenna
 - SAM slots
 - Battery
 - Communication Interfaces
 - Any other module to meet operational requirements
- 4) Technical Specifications: The OCVs shall meet the following specifications/ requirements:

Sl.#	Description	Minimum specification/ requirement
1.	Processor	Minimum 400 MHz, 32 bit processor
2.	Operating System	Windows, Linux or any other standard OS
3.	Display	<ul style="list-style-type: none"> • Minimum 3.5" Colour LCD, 320 x 240 pixels • Good visibility in all lighting conditions including direct sun and night time
4.	Memory	<ul style="list-style-type: none"> • Flash and RAM • Expandable memory – minimum 8 GB
5.	Interfaces	OCV shall have following free ports/ interfaces for future use:

Sl.#	Description	Minimum specification/ requirement
		<ul style="list-style-type: none"> • USB – 1 no. • RS232 – 1 no
6.	Power	Input Voltage range 9 – 30 Volts DC
7.	Battery	Minimum 6 hours operating backup
8.	Environmental	<ul style="list-style-type: none"> • Operating temperature – 0°C to 55°C • Relative Humidity – 5% to 95% non-condensing • Ingress Protection – IP65 or better • The device may be exposed to direct sun, through windows for long periods, thus it must be suitable to withstand the same. • The device must be able to withstand such shocks and vibrations, as are expected to be encountered in the operation onboard a mobile bus, in Indian conditions.
9.	Smart Card interface	Fully compatible with ISO 14443 Type A and Type B smart cards, including but not limited to MIFARE Ultralight C, MIFARE Classic, MIFARE Plus, DESFire EV1 and other MIFARE family cards and Microprocessor based cards, NFC devices, contactless EMV cards, NCMC's Rupay card
10.	SAM slots	Minimum 4
11.	LEDs	3 (Red, Green and Amber)
12.	Other requirements	<ul style="list-style-type: none"> • Inbuilt RTC • Inbuilt speaker for audio beeps/ indications

5.3. Requirement Specifications for Vehicle Tracking System

5.3.1. Specifications for Vehicle Tracking Device

In line with the notification by the Ministry of Road Transport and Highways (MoRTH), Notification, dated 28 November, 2016, each bus shall be fitted with the Vehicle Tracking Device and panic buttons in accordance with AIS – 140:2016, including any amendment as on the date of release of RFP.

The requirement/specifications of AIS-140:2016 with amendment thereof may be downloaded from the link below:

<https://araiindia.com/hmr/Control/AIS/1302018121129PMAIS-140withAmd1.pdf>

5.3.2. Requirement Specifications for VTS Application

A. General Requirements

- 1) Each vehicle/bus, using the vehicle tracking device, shall determine its precise location through GIS based GPS System and transmit the same to the Operation Control Centre (OCC) at 10 seconds or any other defined intervals of time. The location shall be displayed on GIS based route maps at OCC.

- 2) The system shall provide map based tracking and transit route based tracking of vehicles by the OCC. 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, vehicle tracking dashboard etc. as a standard functionality.
- 3) The system shall enable control centre management staff/other senior officials to take quick decision, which shall be achieved by providing graphical tools for visualization. The software shall enable JCTSL and JSCL to drill and analyse information and online data in a multidimensional manner. Comprehensive analysis and reporting capabilities are expected to be part of the application delivery which matches the world standard capabilities of VTS.
- 4) The VTS shall be able to give ETA at next bus stops in real time based on speed and distance measurement. The system shall update ETA at bus stop on all PIS and PA system accordingly.
- 5) The system shall be able to compare the actual location of the vehicle / bus, at any given time, with its scheduled location
- 6) The system at the control rooms shall be able to calculate the time for the vehicle / bus to reach all subsequent stops along the route, factoring in the current vehicle / bus and any deviations from the schedule and reported traffic congestion en-route
- 7) Shall provide inputs/feeds to Passenger Information System (PIS) and PA system with the real-time data to be displayed at various display units and announcement systems
- 8) The system deployed should be scalable to support at least 1,000 vehicles and upto 300 Bus Stops. In addition, unlimited number of geo-tagged locations should be supported by the solution.
- 9) The solution proposed should also assist in integration with other smart city initiatives, for instance, Solid Waste Management, Traffic management, City Surveillance etc.
- 10) Information elements that need to be captured and transmitted to OCC at the minimum include longitude, latitude, and physical location en-route with date and time stamps, vehicle / bus number, route number, and Driver ID, etc.
- 11) Shall provide these data on real time basis at pre-determined and configurable intervals (10 seconds) over GPRS/GSM network
- 12) Tracking of vehicles / buses that deviate from the scheduled route based on definition of permitted geographic regions of operation
- 13) Vehicle Fleet Summary Dashboard – Quick view on vehicle fleet performance
- 14) Register a vehicle / bus on unscheduled route from backend on real time basis

- 15) Exception Recording/ Actions (Over-Speeding, Harsh Acceleration, Harsh Braking, Off-route Detection, unscheduled stoppage, Non-Stoppage at Bus stops, Trip Cancellation, Trip curtailment).
- 16) Real-time Running Trip Line diagram of vehicle / buses on a particular route, for headway detection.
- 17) Auto headway detection and notification.
- 18) Applications Software shall have a facility to define the Masters.
- 19) New routes shall be created in the application.
- 20) Business rules engine for fare stages, fare structures, various routes etc. shall be configurable.
- 21) The facility shall be provided to collate the transactional data received from Depots and Bus Stations.
- 22) Officials shall be able to access the application as per the pre-defined roles and responsibilities
- 23) The application shall provide facility to query the data and generate the customized reports as per the requirements.
- 24) The system shall display the contact details of the bus driver / conductor so that the operation center staff can communicate with them directly.
- 25) The OCC operator shall be able to drill down to the exact location of the event by clicking on the alert and see the position of event drawn over the map along with driver, vehicle and standard description of event details related to the business rule.
- 26) The system be able to integrate with the City OCC/ State OCC with all the available data like Location , route information, Vehicle telemetry information, speed etc.

B. Web-Page & Maps Requirements

- 1) Web based application compatible with all major browsers and accessible from internet enabled device accessible through an easy to use portal that shows easy to read maps. The user will be able to enter the route, direction, station/stop ID or select these from a sequence of drop down lists and from a map.
- 2) The software will incorporate maps to support the functionality, comprised of a selection of individually selectable theme layers
- 3) The ITS System Integrator will provide a GIS based base map for the purpose of the project at a scale of 1:2000 which would be acceptable to JCTSL operationally.
- 4) SI need to develop additional overlay map layers to the external source map that can include polygons, lines (e.g., route traces) and points (e.g., landmarks,

transfer locations, time-points, stops), with the colour, shape and thickness being selectable.

- 5) The software will allow users to view the map, including a selectable combination of the source map layers and new layers, at various user-defined zoom levels.
- 6) The map display icon for each vehicle location to display as the label the vehicle, block or route.
- 7) The display icon of the bus on the map will provide an indication if the latest reported location being displayed is older than the reporting interval or not, to identify packet losses and delay in communication transfer.
- 8) The system will provide a real-time output of the current location and schedule adherence for all fleet vehicles, for use by the next stop prediction software.

5.4. Functional Requirements of Public Address system (PA system)

The PA system shall meet the functional requirements of JSCL/JCTSL including, but not limited to the following:

- 1) The Public Address system (PA system) shall make the audio announcement of the route number, destination and Estimated Time of Arrival (ETA) for buses approaching the bus stops.
- 2) The PA system shall be capable of addressing pre-recorded announcements at all identified bus stops.
- 3) The PA system shall be capable of addressing ad-hoc announcements at selected/all bus stops from Operations Control Center (OCC).
- 4) The PA system shall be capable of addressing citizen at identified bus stops/locations from Operations Control Center (OCC).
- 5) The proposed system shall contain an IP based announcing control connected to the OCC.
- 6) The announcement which is made from the OCC using the IP based announcing console shall be routed via the established network to the various PA system end devices deployed of various bus stops.
- 7) PA system's master controller should have function keys for selecting the single bus stop, group of bus stops locations or all bus stops.
- 8) PA system's master controller should facilitate multiple MIC inputs and audio inputs.
- 9) PA system shall support two languages – English and Hindi.

5.5. Functional Requirements of Passenger Information System (PIS) Display Boards

The PIS LED Display Boards shall meet the functional requirements of JSCL/JCTSL including, but not limited to the following:

- 1) The PIS system shall display real-time information of the route and estimated time of arrival using data connections with the Vehicle Tracking System of JCTSL.
- 2) The display system shall indicate route no. & ETA of the bus on the display to assist passengers.
- 3) PIS shall communicate with PIS backend in real time using communication medium.
- 4) PIS information shall be displayed in English & Hindi alternatively (single or multiple language shall be configurable)
- 5) Displayed messages shall be readable in high bright, day light. The LED based display screens shall provide sufficient visibility in broad daylight condition.
- 6) The frequency and period of information display on PIS display shall be configurable from central location for transit information as required by JSCL/JCTSL.
- 7) All displays for PIS shall have a configurable refresh rate, ideally 1 minute or less
- 8) Display of PIS in a display unit at bus stop shall be configurable based on bus stop.
- 9) The PIS Display may also be used to display public service information, and/or advertisements.
- 10) The frequency and period of information display on PIS display shall be configurable from central location for advertisements and other transit information
- 11)

5.6. Technical Requirements of Passenger Information System (PIS) Display Boards

5.6.1. Minimum Technical Specifications of PIS

Passenger Information System hardware shall consist of LED based display system for bus stops. The minimum technical specifications of PIS display system shall be as set out in the table below:

SI #	Parameters	Minimum Requirement or better
1.	Enclosure	The LED Display units shall be mounted on a rugged enclosure to withstand harsh environmental conditions with reasonable physical security
2.	Height	The LED Display units shall be located at a convenient height to have a clear view of the message displayed.
3.	Power Supply	Fitment provision shall have to be provided in the Bus Stop. The power supply shall be provided by JSCL/JCTSL

SI #	Parameters	Minimum Requirement or better
		at one point in the bus stop.
4.	General	Provision of any hardware like GPRS Communication system, networking, etc. required to run the PIS on LED Display Units
5.	General	Aesthetic requirements such as fonts, colors, rows per page, display time to be remotely configurable and displayed based on requirements.
6.	Minimum and Maximum viewing distance and angle of viewing	Viewing distance 3- 30 meters Minimum 150°V – 60°H
7.	Size of Display characters	12 cm
8.	Resolution in terms of number of pixels (X by Y) and the pitch between pixels for the display character	LED pitch of 10 mm to 12 mm per character
9.	Length of the message for a particular route; information that needs to be displayed in English & Hindi	Route No.(4 characters) : The vehicle Route identity Time (2 characters): Estimated Time of Arrival of the bus at the given bus Stop Destination (20 characters): End point of the trip
10.	Number of lines of display	2 lines
11.	Maximum width & length available at the bus stop	Approx. 150 cm X 60 cm
12.	Storage capacity inside the display	Minimum of 10 route information for 30 minutes (bus shelters), automatic update of the firmware
13.	Display colour	Amber
14.	Update of display	Real time
15.	Communication protocol between the display unit and the central server	GPRS / 3 G
16.	Controller & antenna	Built-in
17.	Power supply	90 V to 250 V AC; 50 VA
18.	Environmental specifications	Temperature: 0 to +60 deg C Sealing: IP 65 Humidity: 5% to 95% RH
19.	Minimum life of the display system	100,000 hours
20.	Data format	Bit map or unicode
21.	Display format	Text in hindi & english with presentation in tables, fixed and scrolling text

SI #	Parameters	Minimum Requirement or better		
22.	Sample format	Route	ETA	Destination
		256A	12:30	Hindi/English Scrolling
		297N	12:35	Hindi/English Scrolling

5.7. Technical Requirements of Public Address system (PA system)

The minimum technical specifications of PA system shall be as set out in the table below:

SI #	Parameters	Minimum Requirement or better
1.	PA system	Should have the capability to control individual PAS i.e. to make an announcement at select location (1:1) and multiple/all locations (1: many) simultaneously. The PAS should also support both, Live and Recorded inputs
2.	Speaker	Minimum 2 speakers, To be used for Public Address System Speakers shall be especially designed for broadcasting high quality voice communications.
3.	Amplifier	The power amplifiers shall have adequate continuous (RMS) power output to meet the requirement of the configuration. The output voltage and impedance shall meet with the system requirements. Amplifiers shall be protected against over loads and output shorts and a special thermal overload on the heat sink.
4.	Connectivity	IP Based
5.	Integration	With PIS system and Operations Control Center
6.	Construction	Sturdy enclosure body for equipment
7.	Battery	Internal Battery with different charging options (Mains)
8.	Power	Automatic ON/OFF operation, configurable time
9.	Casing	IP-65 rated for housing
10.	Operating conditions	0° C to 55°C

5.8. Functional Requirements of Bus Operations Management System

A. Management Dashboard

- 1) Display information shall be in a simple and lucid format and shall use intuitive and interactive visualization to enable users to quickly navigate, understand, and investigate data elements to make informed decisions.
- 2) The system shall 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, MS-Word and Web formats.

- 3) The system have a default configuration and landing page for each user or user-group that are editable.
- 4) The system shall allow multiple visual elements to be laid out on the same display.
- 5) The system shall 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:
- 6) All visual elements shall have editable titles, labels, legends, axes, icons, and colors, where applicable.
- 7) Interactive visualization component shall display the overall aggregate status of a Bus Operator's KPI with proper color coding (green, yellow, red, or as defined JSCL or its designated authority). It shall allow the user to drill own and switch between different KPIs (e.g. KPI for average vehicle utilization, average vehicle duration, etc.)

B. MIS Reports

The proposed MIS solution shall provide a facility for generating and viewing online, project and various reports for transactions handled during a specified period, transaction density trends for any specified periodicity and any bottleneck situation creating dependency at any stage. The system and Dynamic Dashboard shall be an integrated system which shall provide user-friendly reporting functionalities such as graphical display for the staff, officials of JCTSL and other relevant project stakeholders. The MIS details shall be worked out during the SRS stage.

The following type of reports, but not limited to, are required to be generated from this sub module. The report should be generated in standard formats like pdf, xls, doc, etc.

- 1) **Fixed Format Reports:** Application should provide robust reporting capabilities. Application should publish reports using tools such as Microsoft Word or Adobe Acrobat and it should be possible to generate output in multiple formats including PDF, HTML, and Excel etc. The output can also be delivered through email or can be printed.
- 2) **Ad-hoc Reports:** Application should provide the users with ad hoc query & analysis capability. Application should create new analyses from scratch or modify existing analyses in dashboard pages. Business users do not need to understand physical data storage to combine data from multiple enterprise information sources intuitively, quickly, & easily. Tools and utilities should be provided to facilitate design layout using MS Excel, Adobe Acrobat etc. An indicative list of reports is mentioned below:
 - Daily Operation Summary
 - Bus Operated vis-à-vis schedule report
 - Trips Performed Report
 - Total km Travelled daily
 - Vehicle Utilization Report
 - Travel Time Analysis Report

- Missed Trip Report
- Driver Performance Report
- Over speed Report
- Route Deviation Report
- Passenger density report- Route wise, Day wise, Trip wise
- Operator-wise for single operator for combined reports for all operations
- 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 shall be useful.

C. Revenue Snapshots

- 1) The System shall provide financial and revenue collection statistics in a single view (revenue per km, pass revenue per day, average ticket revenue etc.)
- 2) The System shall provide ticketing status on various station / routes
- 3) Live data should be populated with specific periods as configured from the system.
- 4) The System shall generate per trip kilometres, passenger count per trip, revenue collection reports, weekly revenue summary etc. in order to assist in monitoring performance of agencies and making payment for the services.

D. SLA monitoring system

List of Daily Reports needed for the service performance monitoring of bus operation:

1) Category 1: Bus Maintenance and Availability:

- Bus Availability
 - How many buses are available for operations in the depot at the beginning of the shift daily?
- Bus Breakdowns
 - How many buses are in the workshop for repairs, how many buses breakdown during while in service?
 - Bus with repeated breakdowns
- Bus Maintenance
 - Individual Bus report consists of preventive maintenance and all other work done on that bus with kilometres
 - Deviation of maintenance vis-à-vis schedule

2) Category 2: On Time Performance

Definition of On Time Performance (OTP) shall be finalized in consultation with JCTSL. Time Points within individual routes shall be introduced for OTP. For all OTP, need % early, % On-time and % late.

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

The report shall have scheduled kilometres against actual kilometre by trip and by day. When multiple routes are operational, this information shall be needed per individual route as well.

The report should generate missed trips or missed kilometres per individual routes.

- On Time Performance (OTP) for Individual Trips – Starting bus stops, last bus stop, immediate bus stops
- Speed violation
- Route Deviation, Non-stoppage

E. Passenger & Revenue Reports

- Revenue summary – one day, last 2 days, monthly etc.
- Passenger travelled – one day, last 2 days, monthly etc.
- Route-wise revenue
- Route-wise passengers
- Passengers with passes & cash tickets
- O-D analysis of passengers

F. Other Reports

- Bus
 - Fitness overdue
 - Insurance overdue/expiry
- Drivers
 - Driving License expiry/suspension
 - PS vehicle badge expiry/non-availability
 - Driver involved in multiple accidents
 - Drivers involved in multiple speed violations etc.
- Conductors
 - Conductor license expiry/non-availability, as applicable

5.9. Functional Requirements of Depot Management System

The depot management process shall be primarily responsible to capture and maintain the following details:

- Bus master details
 - Log book
 - Maintenance schedule
 - Fitness validity
 - Road tax validity
 - PUC validity
 - Fuel filling details

- Crew master details
 - Master details – Name, Father’s name, Address, Date of Birth/Age
 - Driving License details, including validity
 - Conductor license details, if applicable, including validity
- Daily crew & bus scheduling
 - Duty schedule
 - Actual operations details from VTS and manual entry
 - Integration with FCS, manual entry of paper tickets
- Reports
 - Daily operations vis-à-vis scheduled
 - Trips operated vs scheduled
 - Kms operated vs scheduled
 - Mileage of buses/buses with high fuel consumption
 - Revenue reports – Bus-wise, Route-wise
 - Revenue comparison vis-à-vis last month, last week etc.

A. Vehicle Scheduling and Dispatch System Module

- 1) The Vehicle Scheduling and Dispatch module 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 VTS (JCTSL) to coordinate different transit functions.
- 2) Combined technologies such as, computer-aided dispatching and VTS shall increase the efficiency of transit operations, enhance safety, improve service. For example, systems integrating automated scheduling and dispatching and VTS 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 VTS allows the coordination of services among many separate transportation agencies.
- 3) The module should be capable of dynamic planning and capable of optimizing 1000s of vehicle movements. The module should be capable of automatic dispatch distribution and transport operations, dynamically rescheduling vehicle and driver assignments based on real-time events.
- 4) The module should 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.
- 5) This module is expected to lend its functionality not only to transit vehicles but also to other municipal vehicles functioning under solid waste, engineering and emergency services.

B. Crew Scheduling and Allocation Module

- 1) The module 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.

- 2) The module shall be able to create group of users based on set of defined parameter(s) by JSCL/JCTSL. The module shall plan, optimize and generate the rostering automatically for month to one year. It shall also allow the Admin or authorized user to create and view the planning for a defined period of time.
- 3) The module 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 module shall interface with HR module 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. The Rostering module shall have optimization technique to minimize and identify the under-performing crew. The module shall provide individual or group wise performance in graphical user interface, including working, non-working hours, holiday, leave, over time, etc.

C. Reports

The system shall provide at least the minimum 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
- Operation parameters
- Actual trip performance versus scheduled
- Actual km operated versus scheduled
- Revenue parameters
- Route-wise, trip-wise, bus-wise
- Incident Management System
- Breakdown
- Accidents
- Vehicle Log System
- Maintenance – scheduled versus actual
- Drivers & Conductors Master details
- Bus Master details such as fitness validity & due dates

5.10. Specifications for Enterprise Management System (EMS)

Enterprise Management Solution should provide end-to-end, comprehensive, modular and integrated management of IT infrastructure components to maximize the availability of IT services and SLA performance. The management system needs to aggregate events and performance information from the domain managers and tie them to service definitions.

The proposed tools should automatically document problems and interruptions for various IT services offered and integrate with the service level management system for reporting on service level agreements (SLAs). The proposed solution must be unified and also generate a comprehensive view of a service with real-time visibility into service status and identify the root cause of various infrastructure problems as well as prioritize resources based on impact. The proposed EMS solution must consist of the following core modules:

- A. Network Fault Management System
- B. SLA Management
- C. Integrated Performance Management System:
- D. Application Performance Management System
- E. Integrated Helpdesk Solution
- F. IT Asset Management
- G. Configuration Management

A. Network Fault Management System

The system shall provide fault and performance management of the network infrastructure that various services operate in. The proposed solution shall provide the following features:

- 1) The Network Fault Management consoles must provide the topology map view from a single central console.
- 2) The proposed Network Fault Management console must also provide network asset inventory reports and SLA reporting for the managed network infrastructure.
- 3) The proposed solution must automatically discover manageable elements connected to the network and map the connectivity between them.
- 4) The system must be able to support mapping and modelling of the infrastructure grouped by network connectivity, physical location of equipment and user groups or departments.
- 5) The modelling of network connectivity must be performed using standard or vendor-specific discovery protocols to ensure speed and accuracy of the network discovery.
- 6) The proposed solution should provide root-cause analysis with multiple root cause algorithms inbuilt for root cause analysis. It should also have a strong event correlation engine which can correlate the events on the basis of event pairing, event sequencing etc.

B. Service Level Management

- 1) The proposed service management system should provide a detailed service dashboard view indicating the health of each of the ITS components/solutions as well as the SLAs.
- 2) The proposed Service Dashboard should provide a high level view for executives and other users of the system. The system should provide an outage summary that gives a high level health indication for each service as well as the details and root cause of any outage.
- 3) The system must breakdown SLA by the hour and should allow to drill down on each hour to report violations.
- 4) The Service Level Agreements (SLAs) definition facility must support defining a set of one or more service Guarantees that specify the Service obligations stipulated in an SLA contract for a particular time period (weekly, monthly, and so on). Guarantees supported must include one that monitors service availability (including Mean Time to Repair (MTTR), Mean Time between Failure (MTBF), and Maximum Outage Time thresholds) and the other that monitors service transaction response time.
- 5) The system must provide the capability to designate planned maintenance periods for services and take into consideration maintenance periods defined at the IT resources level. In addition the capability to exempt any service outage from impacting an SLA must be available.

C. Integrated Performance Management System

This provides a comprehensive end-to-end performance management across key parts of the network infrastructure. It should allow identifying trends in performance in order to avert possible service problems.

- 1) The proposed performance management system shall integrate network, server and database performance information and alarms in a single console and provide a unified reporting interface for network components. The current performance state of the entire network & system infrastructure shall be visible in an integrated console.
- 2) Provide flow-based reporting for network troubleshooting and capacity management.
- 3) Provide Database Performance Monitoring.

Network Performance Management System

- 1) The Network Performance Management consoles must provide a consistent report generation interface from a single central console.
- 2) This central console shall also provide all required network performance reports (including latency, threshold violations, packet errors, availability, bandwidth utilization etc.) for the network infrastructure.
- 3) It shall provide comprehensive health reporting to identify infrastructure in need of upgrades and immediate attention.

Server Performance Monitoring

- 1) The proposed server performance management system shall integrate network performance management systems and provide the unified performance state view in a single console.

Database Performance Monitoring

- 1) The proposed database performance management system shall integrate network and server performance management systems and provide the unified view of the performance state in a single console.
- 2) It should be able to automate monitoring, data collection and analysis of performance from single point.
- 3) It should also provide the ability to set thresholds and send notifications when an event occurs, enabling database administrators (DBAs) to quickly trace and resolve performance-related bottlenecks.

D. Application Performance Monitoring

- 1) The proposed solution must provide a real-time application topology map to triage and quickly pinpoint the component causing a performance bottleneck in the end-to-end transaction flow.
- 2) The proposed solution must determine if the root cause of performance issues is inside the monitored application, in connected back-end systems or at the network layer from a single console view.
- 3) The proposed solution must proactively monitor 100% of real user transactions, detect failed transactions, gather evidence necessary for triage and diagnosis of problems that affect user experiences and prevent completion of critical business processes.
- 4) The proposed solution must gather available performance indicator metrics from all within real-time production environments and real user transactions 24x7 with minimal overhead on monitored applications without sampling.

E. Helpdesk Management

- 1) The proposed Helpdesk Management System must provide support for various defined ITIL processes.
- 2) It must provide flexibility of logging, viewing, updating and closing incident manually via web interface. The web interface console would also offer power-users tips.
- 3) It must provide seamless integration to log incident automatically via system and network management.
- 4) It must provide classification to differentiate the incident via multiple levels/tiers of categorization, priority levels, severity levels and impact levels.
- 5) It must be able to provide flexibility of incident assignment based on the workload, category, location etc.

- 6) Each escalation policy must allow easy definition on multiple escalation levels and notification to different personnel via window GUI/console with no programming.

F. IT Asset Management

- 1) The proposed solution shall maintain complete inventory of all hardware and software applications which are part of ITS.
- 2) Shall allow addition and modification of hardware/software components

G. Configuration Management

The Configuration Management module shall meet the following functional requirements:

- 1) It shall maintain a centralised view of all versions of various sub-systems including but not limited to the AFCS application, device application, device configurations, Smart Card applications, master data sets, devices and smart cards in accordance with the business rules.
- 2) It shall maintain and manage a record of device configuration based on various parameters including device location, type, device serial number, electronic serial number and sub-component serial numbers, asset ID, etc, referable to device history, including maintenance and location history.
- 3) It shall manage the version control for any updates to the central system application, device application and card application and also be capable of rolling back configuration changes, if required.

6. Service Level Agreements

The ITS System Integrator shall have to meet the Service Levels, as defined herein. The Service Levels have been segregated into:

- Implementation Service Levels
- Post-Implementation Service Levels

6.1. Implementation Phase Service Level

6.1.1. Timely completion of Project Milestones

Definition	Timely Completion of Project Milestones would comprise all milestones and deliveries including supply, installation and commissioning of ITS Solutions that are to be completed as part of the project deliverables as per the defined timeframe, as per the Agreement. Week is defined a seven-day calendar period, e.g. one starting with Sunday and continuing through Saturday.
Service Level Requirement	All the milestones/ deliverables defined in the agreement have to be completed within the timelines mentioned in the Agreement without any delay.
Measurement of Service Level Parameter	To be measured in number of weeks of delay from the date of completion as defined in the Agreement.
Default Charge for non-achievement of Service Level Requirement	Default Charge of 0.25% of the corresponding value of line item(s) per week delay.

6.2. Post Implementation Service Level

6.2.1. Availability Measurement Calculation for a Month

Availability of Project components for a month shall be measured using following formula.

$$\{[(\text{Actual Uptime} + \text{Scheduled Downtime}) / \text{Total No. of Working Hours in a Month}] \times 100\}$$

Wherein,

"Actual Uptime" shall mean, of the Total Hours, the aggregate number of hours in any month during which each equipment/Hardware/application is actually available for use.

"Scheduled Downtime" shall mean the aggregate number of hours in any month during which each equipment, is down during total Hours, due to preventive maintenance, scheduled maintenance, infrastructure problems or any other situation which is not attributable to Service Provider's (or Service provider's) failure to exercise due care in performing Service Provider's responsibilities. The Authority would provide a maximum of 04 hours of planned downtime for the preventive maintenance (as part of scheduled downtime) per month per equipment/service.

"Total Working Hours" shall mean the total hours over the measurement period i.e. one month (18 * number of days in the month).

Downtime Calculation

The recording of downtime shall commence at the time of registering the call with Helpdesk/Service Provider for any downtime situation for the equipment. Downtime shall end when the problem is rectified and the Hardware/equipment is available to the user.

Down time shall not be considered for following:

- 1) Pre-scheduled preventive maintenance and health checks (Scheduled Downtime).
- 2) Downtime arising out of the incidents not attributable to ITS System Integrator.

6.2.2. General Terms

The SLA shall be monitored and Default Charges computed on monthly basis.

- 1) Default Charges for a month shall be capped at ten percent (10%) of the total Service Charge for the given month.
- 2) The number and format of reports shall be as per requirements provided by JSCL/JCTSL.
- 3) In case, JSCL/JCTSL so desires, the SLAs may be reviewed on yearly basis and may be amended based on mutual agreement. Till such time, any revision is mutually agreed, the existing SLAs shall continue to be in force.
- 4) SLA shall be excluded in case of incidents/instances not attributable to the ITS System Integrator

6.2.3. Availability of Field Equipment

Definition	<p>Availability of Field equipment will mean that the equipment is able to perform its intended functions.</p> <p>Field equipment shall mean ETM /validators/Point of Sale Terminal/ Vehicle Tracking Devices and other ITS devices used in the field.</p>
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Service Level Requirement	The average availability of the Field equipment should be at least 99% in a month.			
Measurement of Service Level Parameter	$\frac{\{(Actual\ Uptime + Scheduled\ Downtime)\}}{Total\ No.\ of\ Working\ Hours\ in\ a\ Month} \times 100$ Each Device must meet the minimum Availability Standard of Performance on monthly basis			
SLA Exclusion	Excludes: <ul style="list-style-type: none"> • Scheduled downtime, subject to agreed schedule • Vandalism damage 			
Default Charge for non-achievement of Service Level Requirement	If the ITS System Integrator is not able to meet the above defined service level requirement, then any deviation from the same would attract a default charge as per the following:			
	Availability (Monthly average)	>= 98 % to <99%	>= 97% to <98%	<97%
	Default Charge per month	Rs. 50 per percentage Point drop below Service Level for field equipment, except Point of Sale Device	Rs. 75 per percentage Point drop below Service Level for field equipment, except Point of Sale Device	Rs. 100 per percentage Point drop below Service Level for field equipment, except Point of Sale Device
		Rs. 200 per percentage Point drop below Service Level for Point of Sale Terminal	Rs. 300 per percentage Point drop below Service Level for Point of Sale Terminal	Rs. 500 per percentage Point drop below Service Level for Point of Sale Terminal

6.2.4. Failure rate of Contactless Smart Card

Definition	Failure rate of Contactless Smart Card is defined as instances when smart issued fails to perform the intended functions.
Service Level Requirement	Failure rate for cards after issue should not exceed 1 in 10,000 (0.01%) The above shall be in addition to free replacement of any card failed within 4 years
Measurement of Service Level Parameter	The service level would be defined in terms of the number of Incidents/Instances logged with ITS System Integrator
SLA Exclusion	Excludes: Where it is evident from visual inspection that the Card has been physically damaged/ mis-handled on account of Cardholder

Default Charge for non-achievement of Service Level Requirement	Failure Rate (Monthly average)	> 0.01 %
	Default Charge per month	Rs. 10,000 per incident/instance of failure rate

6.2.5. Availability of ITS Applications

Definition	Application availability refers to the total time when the ITS Applications & Hosting Infrastructure are available to the users for performing all activities and tasks.			
Service Level Requirement	The average availability of the ITS Applications & Hosting Infrastructure should be at least 99.5 % in a month			
Measurement of Service Level Parameter	$\left\{ \frac{\text{Actual Uptime} + \text{Scheduled Downtime}}{\text{Total No. of Working Hours in a Month}} \times 100 \right\}$			
SLA Exclusion	Any scheduled and approved preventive maintenance activity by the ITS System Integrator should be carried out with prior approval JSCL/JCTSL. Such scheduled and approved preventive maintenance activities shall preferably be carried out during night time (11 PM to 5 AM) and shall not exceed two instances in a quarter and each instance shall not exceed 4 hours.			
Default Charge for non-achievement of Service Level Requirement	If the ITS System Integrator is not able to meet the above defined service level requirement, then any deviation from the same would attract a default charge as per the following:			
	Application Availability (Monthly average)	>= 99.25 % to <99.5%	>= 99.0% to <99.25%	< 99.00%
	Default Charge per month	Rs. 25,000	Rs. 50,000	Rs. 1,00,000 (per 0.20 % drop or part thereof subject to minimum of Rs. 1 lakh)

6.2.6. Application Response Time

Definition	Application response time refers to the page load time, i.e. the time for loading a webpage of the ITS Applications.
Service Level Requirement	The average application response time for users (time taken for loading of a web page) should not exceed 10 seconds in a month.
Measurement of Service Level	Application response time shall be measured on the basis of automated reports. The data should be captured through

Parameter	automated tools every 30 minutes during the working hours.			
Default Charge for non-achievement of Service Level Requirement	If the ITS System Integrator is not able to meet the above defined service level requirement, then any deviation from the same would attract a default charge as per the following:			
	Response Time (Monthly average)	> 10 secs to <12 secs	>=12 secs to < 16 secs	>= 16 secs
	Default Charge per month	Rs. 20,000	Rs. 30,000	Rs. 50,000

6.2.7. Availability of Hosting Infrastructure

Definition	Hosting Infrastructure availability refers to the total time when the service is available			
Service Level Requirement	The average availability of the Hosting Infrastructure should be at least 99 % in a month			
Measurement of Service Level Parameter	$\{[(\text{Actual Uptime} + \text{Scheduled Downtime}) / \text{Total No. of Working Hours in a Month}] \times 100\}$			
SLA Exclusion	Any scheduled and approved preventive maintenance activity by the ITS System Integrator should be carried out with prior approval JSCL/JCTSL. Such scheduled and approved preventive maintenance activities shall preferably be carried out during night time (11 PM to 5 AM) and shall not exceed two instances in a quarter and each instance shall not exceed 4 hours.			
Default Charge for non-achievement of SLA	Availability (Monthly average)	>= 98 % to <99%	>= 97% to <98%	<97%
	Default Charge per incident (per month)	Rs. 15,000	Rs. 20,000	Rs. 25,000 (per percentage drop or part thereof)

7. Indicative Bill of Materials

The Indicative Bill of Materials for the Project is as given in the Table below:

Sl. #	Line Item/Description	Unit	Quantity
A	Hardware Components		
1.	ETM Devices including device application software, AC charger, Memory card, shoulder carry case, one extra battery and other accessories (incl. one year warranty)	No.	159
2.	Charging Infrastructure including accessories in terms of batteries charging capacity (incl. one year warranty)	No.	318
3.	Contactless Smart Card (CSC) (includes printing on both sides)	No.	5,000
4.	Vehicle Tracking Devices	No.	106
5.	Driver Control Unit (DCU)	No.	106
6.	On-board Card Validators (OCV)	No.	212
7.	PIS LED Board for Bus stop	No.	10
8.	Operationalisation of on-board PIS Display units installed in existing buses and new buses to be procured and integration with proposed VTS (per bus)	No.	106
9.	Repair of on-board PIS Display units	No.	20
10.	Supply, installation of on-board PIS Display units as per requirement (as per UBS –II specifications) and integration with proposed VTS.	No.	30
11.	IP-based Public Address System with speakers, amplifier, horn, master control desk	No.	61
12.	Desktops for depot and bus operation management teams/officials/CCC incl UPS, OS and MS Office	No.	8
13.	Printers/MFP for depot and bus operation management teams/officials/CCC	No.	5
14.	Server Infrastructure (sizing as per proposed solution)		
11.1	Servers	No.	As per proposed solution
11.2	Rack	No.	As per proposed solution
11.3	Storage	Tb	As per proposed solution
11.4	Networking	No.	As per proposed solution

Sl. #	Line Item/Description	Unit	Quantity
15.	Point of Sales Terminal (POS)		
12.1	Computer	No.	1
12.2	MFP	No.	1
12.3	Receipt Printer	No.	1
12.4	Card Printer	No.	1
12.5	Card Reader	No.	1
12.6	UPS	No.	1
12.7	User Display	No.	1
B	Software Components		
1.	Backend Application Software for Automatic Fare Collection System	No.	1
2.	VTS Software	No.	1
3.	Mapping Platform - Map Licenses	No.	106
4.	PIS Management System	No.	1
5.	PIS Web-Portal & Mobile App	No.	1
6.	PA system Software solution	No.	1
7.	Bus Operation Management System Software	No.	1
8.	Depot Management System Software	No.	1
9.	Enterprise Management Software	No.	1
10.	COTS items (sizing as per proposed solution)		
10.1	OS	No.	As per proposed solution
10.2	DB	No.	As per proposed solution
10.3	Firewall	No.	As per proposed solution
10.4	Antivirus	No.	As per proposed solution
C	Common Infrastructure & Other Cost		

Sl. #	Line Item/Description	Unit	Quantity
1.	GPRS/GSM Connectivity- SIM Card & Service Plan for AFCS - Annual	No.	265
2.	GPRS/GSM Connectivity- SIM Card & Service Plan for VTS - Annual	No.	106
3.	GPRS/GSM Connectivity- SIM Card & Service Plan for PIS Display - Annual	No.	10
4.	GPRS/GSM Connectivity- SIM Card & Service Plan for PA system - Annual	No.	61
5.	Leased line internet connectivity for DC/Control Centre - Annual	No.	1
6.	Broadband connectivity for POS Terminal - Annual	No.	1
7.	Common infrastructure for PIS and PA system at Bus stops - Junction box, Rugged enclosure and UPS (1 KVA)	No.	61
8.	Data digitization, training etc	LS	1
9.	Furniture for Desktop & Printer at Depot/JSCL/CCC etc.	No.	8
10.	One time Migration cost to Cloud-based DC	LS	1
11.	Operators for Pass Issuance (For 1 operator) – Annual	No.	1
12.	Manpower services for Operation Management (For 4 persons) - Annual	No.	4

8. Appendix 1: List of Locations for PIS Led Display

SI #	Name of Bus Stop	Quantity
1.	Nagar Nigam	2 PIS displays
2.	ISBT	2 PIS displays
3.	Naudra Bridge	2 PIS displays
4.	Railway Station	2 PIS displays
5.	Teen Patti Chowk	2 PIS displays

9. Appendix 2: List of Locations for PA system

(a) List of locations/ bus stops under PPP model (Completed)

Name of Bus Stop	No.
Teen Patti Bus Stop	2
Naudra Bridge	1
Chhotti Line	1
Medical	1
Collectorate	1
Ghanta Ghar	1
Chanchla Bai	1
Rampur Chowk	2
SAM	1
PSM	1
Civil Line	2
Railway 6	1
Ekta Chowk	1
Damohnaka	1
Empire Talkies	1
Mahila Market	1
Ranitaal(sports complex)	1

Total 38 Bus Stops are to be constructed under PPP mode. The names of bus stops/location shall be intimated to ITS System Integrator as and when completed during the Implementation Phase.

(b) Under Smart City Initiatives – 23 locations/ bus stops

Name of Bus Stop	No.
Motor Mitra	1
Medical	1
Dhanvantari nagar	2
Gwarighat	1
Ploipathar	1
Ranitaal	1
Chunginaka	1
Central Bank	1
Satpula	1
Vehicle turning 1	1
Panera petrol pump	1
Gokulpura Community Hall	1
Hitkarani School	1
Panchvati	1
Dhuadhar	1
Andhmukh Bypass	1
Suhagi	1
TeenPatti	1
University	1
Science College	1
Navyug College	1
Ekta Market Tiraha	1