

Vehicle Tracking and Monitoring System (VTMS) & Passenger Information System (PIS) Part 1: Functional & Technical Specifications



Karnataka State Road Transport Corporation

ಕರ್ನಾಟಕ ರಾಜ್ಯ ರಸ್ತೆ ಸಾರಿಗೆ ನಿಗಮ

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The document is Part 1 of the set of specifications covering three parts as under:

Part – 1: Functional & Technical requirements specifications (This Document)

Part – 2: General Instructions and Commercial Specifications

Part – 3: Operational requirements and Legal specifications

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Project Overview: Vehicle Tracking & Monitoring System

Vehicle Tracking & Monitoring System (VTMS) project is planned to offer benefits to provide on time information to the stakeholders that include amongst others - KSRTC operating staff, Control Center Staff, Bus Stand Staff, Commuters. The system is expected to provide quality real time information on arrival and departure status, handling of incidents and accidents, increase safety of commuters and staff, reduce operational costs, improve traffic efficiency etc.

The proposed VTMS project implementation will include core components such as: Vehicle Tracking System, Real Time Trip Information System, establishing a Central Control Station at Bangalore and Divisional Control stations at various locations. In addition to the VTMS project, data from other existing or new systems that will be developed and interfaced to the VTMS so as to provide complete picture of operations, enhanced level of services the commuters and utilization of the existing infrastructure for running advertisement campaigns

Core technologies include Geographical Positioning System (GPS) at the core and supporting Information & Communication Technology infrastructure in terms of Hardware Software and Monitoring equipment.

KSRTC plans to source funds from the Ministry of Road Transport & Highways, (MoRTH) GoI to implement VTMS project, in consistent with the GoI objectives. The 50% capital cost of the project is expected to be borne by the Government of India

About KSRTC

Karnataka State Road Transport Corporation (KSRTC) was established in August 1961 under the provisions of the Road Transport Corporation Act 1950 with the objective of providing “adequate, efficient, economic and properly coordinated road transport services”. Three Corporations viz., BMTC, Bangalore from 15-08-1997, NWKRTC, Hubli from 01-11-1997 and NEKRTC, Gulbarga from 01-10-2000 were formed out, on a regional basis, with KSRTC doing operations covering Southern Karnataka and interstate areas.

KSRTC operates its services to all villages in the State, which have motorable roads. KSRTC provides transport facilities to 92% of the villages in monopoly area (6,743 out of 7,298) and 44% in non-monopoly area (5,158 out of 11,789). At present it has a corporate office, 13 divisional offices, 71 depots, 110 bus stations, 2 bus bodybuilding workshops, a printing press, 3 training Institutes, and a hospital. On an average KSRTC operates 23.30 Lakh Kms/day and carries 24.5 Lakh passengers daily. About 30,318 employees are working in the Corporation.

The organization structure of KSRTC includes Divisions and Depots. Depots are Operational Hubs and control the operations of Bus and Bus stands under them. For the purpose of tracking and managing KSRTC operations, KSRTC defines Sectors which are logical units. A sector may consist of multiple division jurisdiction areas and a Division may have multiple sectors.

The proposed VTMS Project will initially cover 2,000 Buses of KSRTC, reaching out to geographical area across Karnataka and major places in neighbouring states of Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra, Goa, and Pondicherry. The longest routes operated are Bangalore-Shirdi, Bangalore-Mumbai, Bangalore-Vijayawada, and Bangalore-Trivandrum. Major places covered in the neighboring states are Chennai, Hyderabad, Madurai, Coimbatore, Neyveli, Tiruvannamalai, Tirukoilur, Trichur, Ernakulam, Trichy, Pondicherry, Panjim, Shirdi, Mantralaya, Tirupathi, etc.

Operational Characteristics of KSRTC

In the financial year 2009-10, KSRTC operated 6,458 schedules with a fleet strength of 6,967. The services are operated with a load factor of 69.50 % and 23.09 lakh effective kilometres per day.

The table below illustrates the operational performance of KSRTC during the period 2006 to 2010.

Table 1: Operational performance of KSRTC during 2006 to 2010

Sl No	Factors	2006-07	2007-08	2008-09	2009-10
1	Schedules	5,478	5,737	6,206	6,458
2	Fleet held	5,902	6,709	6,873	6,967



Sl No	Factors	2006-07	2007-08	2008-09	2009-10
3	Effective Kilometers/Day	18.92	20.82	22.20	23.09
4	Load Factor (%)	70.8	72	70.8	69.5

The table below illustrates the data as of 2010-11 and the likely demand in 2011-12:

Table 2: User demand forecast - 2011

User Demand Particulars	Existing 2010-11	Future 2011-12	Assumptions/Comments
Bus Schedules	6,458	6,842	Based on trend observed during 2010-11 data
Distance Operated per Day (In Km)	2,330,986	2,487,000	Assuming similar vehicle utilization observed in 2010-11
Total Trips Per Day	40,048	50,391	
No. of passengers carried per day (in lakhs)	24.00	25.00	
Average Load Factor (%)	69	71	
Number of Bus Depots	69	80	

Vision of KSRTC

KSRTC proposes to improve its capability in managing the entire public transport system more efficiently, safely with a Commuter-friendly approach. This is planned to be achieved by introducing real time monitoring and tracking of the fleet, information to passengers at bus terminus and bus-stands.

The current project aims to improve the reliability of KSRTC services through effective Operations, Travel Demand Management measures and Emergency Incident Management System and reduction in the waiting time of its passengers and those who arrive at bus stands to receive passengers. One of the interesting insights realized by transportation planners in recent years is to provide greater reliability and predictability in transport, and monitor the operations real time and not just to move people to their destinations faster. An unfortunate aspect of most current transportation systems is to deal with travel time variations. This can be due to weather, congestion, traffic incidents, or a large number of other external factors. This uncertainty means that travelers must allow extra time for their travel. VTMS can provide improved real-time and predictive information travel uncertainty by smoothing traffic and informing exact arrival departure, number of seats available in vehicles and the like that allows commuters to plan their trips better.

Broad Scope of VTMS Project

- Vehicle Tracking and Monitoring of identified 2000 bus fleet
- Integrate of existing Reservation System to the VTMS to obtain a single view
- Implement a Crew Roster system for allocation of personnel to trips
- Implement a Trip Schedule system for planning and dispatch of buses
- Implement a IT infrastructure Monitoring system for VTMS IT infrastructure

Stakeholders and Broad Overview of Requirements

Briefly, the overview of the VTMS requirements include the following from the system perspective

- Ability to locate a specific bus in real time to know the position and status
- Ability to highlight exceptions through Alerts by monitoring of, deviations such as route, arrival and departure times etc,
- Ability for Effective Planning & Management through a Decision Support System by collecting, collating and storing information on real time basis about the transport system and its effectiveness



- Provide access to real time information related to bus schedules, Expected Time of Arrival (ETA), Estimated Time of Departure (ETD), etc., through Display at Bus stands, Self service Short Messaging Service (SMS) as well as the Internet.
- Facilitate timely management of Incidents / Accidents, effectively monitoring break downs and the related information, route diversion in the event of any incidents on the highways – State and National
- Establish meaningful instant two-way voice facility between Driver – and control stations or pre-specified numbers
- Integrate to the existing AWATAR reservation system for common trip numbers and bus schedules, and number of vacant seats in the bus, and provide for a trip allocation system for those schedules not present in AWATAR
- Ability to allocate crew to trips as per operating schedules
- Ability to manage advertising campaigns through display of advertisements at Bus Stands.
- Ability to Monitor and manage the Distributed IT infrastructure of entire VTMS & PIS

Stakeholder Analysis

Vehicle Tracking & Monitoring System must meet the different needs of stakeholders. The system must meet the essential criteria such as: (a) Availability; (b) Accessibility; (c) Assessment; and (d) Acceptance to assure KSRTC the acceptance of VTMS system by different stakeholders.

Travelers

- Information availability on Bus routes such as Bus Numbers, Starting – Destination Point – enroute stops, hotels, Schedule nos, trip-codes, ETA / ETD, approximate travel time in at least two languages – English and Kannada, types of buses – AC / Non-AC / Non-stop routes, class, platform, etc. This information is to be provided on SMS and Internet

In Vehicle Crew

- Two-way communication between the driver and control room/specified officials for Emergency /incident management through use of preconfigured call buttons and numbers
- Establishing an audio conference with the bus driver and other stakeholders
- Ability to track the driver behavior through Harsh Acceleration/ braking, over speeding and provide alerts real time audio alerts where needed

Operational Managers

- Facilitate managers to manage the entire fleet operations efficiently through on-line remote access to vehicle positions, speed, breakdown, accident/ incident, and two way communication to in Vehicle Crew etc
- Provide standard reports and charts to support all level of management in decision-making that include missed trips, late trips on different routes, break downs and its duration, vehicles offline, accidents – types, impact, losses etc, route-wise stop times for different trips at bus stops, average speed point to point, travel time analysis, improper stops at bus stops, driver behavior, deviation in routes, speed violations at different locations and at different points of time

KSRTC Management

- Analytical data for the top management to support effective management towards meeting their commitments in providing services of KSRTC
- Cater to requirements of dynamic and context based specific reports graphs and charts and other standard Management Information System reports to give a snapshot view to the KSRTC management on daily, monthly, quarterly, half-yearly and yearly performance.

Customers of KSRTC (Advertisement Campaigns)

- The infrastructure deployed for VTMS would also be used for conducting advertisement campaigns for KSRTC customers

**Eco-system partners**

- Access to history data and information on various incidents and accidents to process insurance claims on buses / passengers; encouragement of two wheelers and car users to start using the public transport system to bring down traffic congestion and to keep the environment green and healthy.

Expected Outcomes of the project

With the introduction of Vehicle Tracking & Monitoring System, the following clear factors would get established:

Effective Crew/Fleet Planning, Tracking & Monitoring

With VTMS, the staff at various levels at KSRTC shall be able to Plan the schedules, Allocate personnel, track the compliance through a monitoring system and then initiate corrective action where desired. This information is not available readily in the present system.

Increase in productivity

With intelligent display units at bus-stands providing information on bus trips, schedules and estimated time of arrival, commuters enhance their productive time with no idle waiting time at bus stands.

Reduction in travel time

With well established communication lines between the vehicle, control stations, control rooms and the bus stands, ability to manage operations will be enhanced in the event of any emergencies enroute saving the property of KSRTC (in such events such as riots en-route) and help to reach the destination in pre-determined time.

Patronage of Public Transport System

The introduction of VTMS will result in more efficient transport management, real-time dissemination of information to passengers regarding bus services at bus stands. This will enhance reliability of public transport services and encourage people using personal transport to use public transport system.

Reduction in accidents

With VTMS improving the monitoring, tracking and increased efficiency and management of fleet, it is expected to reduce incidents. In the unfortunate event, use of incident management facility in VTMS, will ensure quick relief in incidents such as hold ups, breakdowns diversions etc.

The outcome of VTMS implementation could be translated into measurable parameters such as:

Table 3: Measurable outcomes for project evaluation

#	Key Outcomes	Evaluation plan
1	Real-time punctuality monitoring of bus arrivals and departures –thereby reliability of services.	Reports generated at data center in control room, operational command centers at the divisions.
2	Effective Planning for Fleet Management & deployment of Buses.	Reports generated at data center in control room. Number of Changes to extant Schedules based on VTMS Reports and feedback.
3.	Adherence to planned Schedules	Number of Trips Missed
4	Effective management of Incidents	Time to Communicate to right stakeholders to address the adversity
5.	Increase in Commuter/Passenger Satisfaction level.	Conducting surveys with different segment of population
6.	Real Time Information Dissemination to Passengers on status of Buses	Number of SMS/Internet access/ Call Center queries for Arrival and Departure information

Based on the above theme, VTMS needs to provide a facility to put in place thresholds on various parameters and the targets set with the participation of different stakeholders of KSRTC. The system will provide KSRTC management that scope for continuous improvement of the services of KSRTC.



VEHICLE TRACKING & MONITORING SYSTEM

Overall Scope of Service

The overall scope of the implementation will consist of design, development, testing, installation, commissioning, training, handholding operations, and management of facilities for a period of three years by the winning bidder.

This project is planned to cover 2000 Buses, 52 Information display units at identified Bus stands and one control room. VTMS is divided into the following main components:

This project envisages the following closely inter-related systems:

- **Vehicle Tracking & Monitoring system (VTMS)** that incorporates at its core a Global Positioning system (GPS) as part of the vehicle mounted unit (VMU) to locate the actual coordinates of the vehicle while in transit, including incident and emergency management system and
- **Passenger Information System (PIS)** to provide the estimated time of arrival and departure and arrival of buses at various destination and intermediate points calculated based on the vehicle position at any point in time, and
- **Data center and Operational Control room** that will act as a hub to coordinate and integrate Vehicle Locating and Passenger Information systems.
- Implementation of Crew Allocation system to the trips and schedules
- Implementation of Advertisement system for display at bus stations
- Implementation of Monitoring system for ascertaining the health of the VTMS IT infrastructure

New scenario with the induction of technology

Figure 1: Bus stand



The Functional and Technical Requirements for each of the modules are detailed below:

Functional Requirements – a set of functions which the module must meet in realizing the objectives of the stakeholders. In other words, this part meets the “What” is required of the solution. These requirements are bulleted with F-REQ

Technical Requirements - a minimum set of technical features that will help in realizing the functionality of the system. In other words, this part meets the guidelines of “How” the solution is conceptualized.

The bidder is required to provide a compliance statement to the requirements as provided in Annexure B



General Technical Requirements

- T-Req 1.** Language Support: All display technologies and software must support the Unicode 5.0 (<http://www.unicode.org/>) character set. Specifically the systems must support English and Kannada
- T-Req 2.** Accessibility: The entire set of applications for VTMS needs to be web based. The VTMS application must be accessible through the internet to a KSRTC user / commuter as per the industry standard User Authentication System and User Roles framework. Further the access should be possible through popular browser interfaces such as Internet Explorer, Firefox, and Google Chrome. The users are located across the various locations in the state. The Graphical user interface shall be browser based and intuitive
- T-Req 3.** RDBMS & SQL Support: All databases used in VTMS are to be standard RDBMS and all SQL related queries & data types must conform to ISO SQL. The bidder /Implementing vendor shall if required, provide to the Purchaser the relational database layout including related fields, key fields and definitions for all fields in all tables in the database
- T-Req 4.** DATES: All information technologies MUST properly display, calculate, and transmit date data, including, but not restricted to 21st-Century date data. All dates must be displayed & printed in 'dd/mm/yyyy' format
- T-Req 5.** Web Services: Wherever web services are used in VTMS, the interchange must conform to industry standards such as W3C SOAP 1.2 standard (<http://www.w3.org/2000/xp/Group/>).
- T-Req 6.** Forms: All forms used in VTMS MUST conform to either HTML 4.01 (<http://www.w3.org/TR/html4/>) forms or XForms 1.0 (<http://www.w3.org/MarkUp/Forms/>)
- T-Req 7.** The system should interface to a standard SMS and email gateways using standard protocols with encryption
- T-Req 8.** Digital Signatures on XML Documents: All digital signatures implemented on XML documents MUST conform to standards such as W3C XML Signature Specifications (<http://www.w3.org/Signature/http://www.w3.org/Signature/>)
- T-Req 9.** The system shall support 3000 concurrent user queries/transactions with 2000 vehicles and 52 PIS display units. However, software system should be scalable to support 5000 concurrent user queries/transactions with 7000 buses and 500 PIS display units without affecting performance the system shall be scalable with additional hardware included as required at a later point.

Access, Roles and Users

- T-Req 10.** Entire set of applications their features shall provide for various levels of secure access based on defined roles and responsibilities within KSRTC based on units (Bus stand/Depot/Division/Corporation) with attached roles and privileges. For e.g. Certain information shall be created / modified by users attached to specific units only but the information can be seen by all such as information related to a division can be created/modified only by users attached to the division and others can only see the information and copy if applicable unless otherwise specified
- T-Req 11.** Application Access shall support multiple roles for a single user and also support delegation as per operational norms of KSRTC
- T-Req 12.** Application Access for certain features shall be provided to general public with no login feature and other advanced features would be provided only on login.
- T-Req 13.** An Audit trail of changes to all access privileges shall be maintained and should not be possible for deletion

Vehicle Tracking & Monitoring system (VTMS): Requirements

Functional and Technical Requirements: (VTMS)

An overview of the functional architecture of the VTMS overall solution is illustrated in the following diagram:

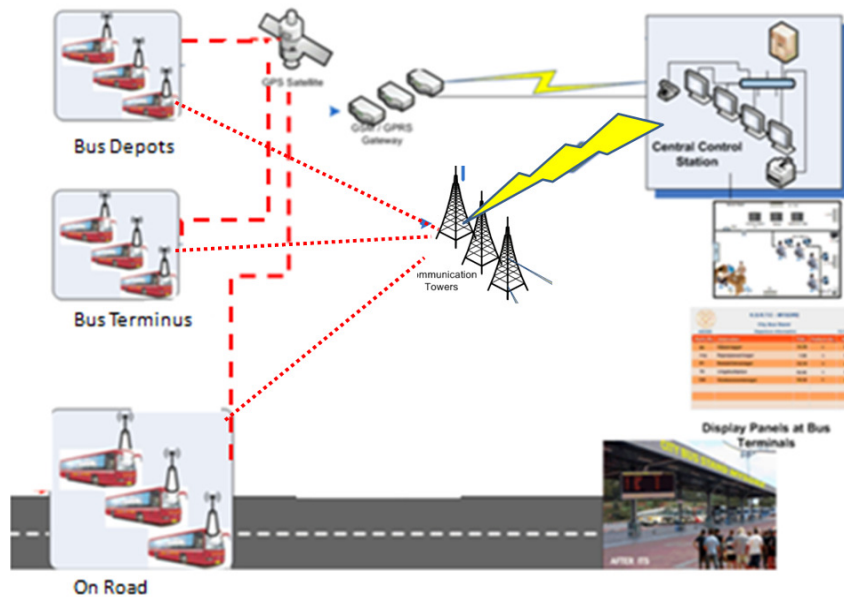


Figure 2 VTMS Solution Overview

Operational Features

Configuration of Roads, Routes, Schedules

- F-Req 1.** Configuration module shall have Facility to create / Modify Road, Routes, Schedules and other standard GIS parameters. Road master/detail will have different roads with unique road ID containing all the places along the path used by KSRTC with other relevant information about road. Map based creation of road is preferred. Routes will have operation starting and ending places required for schedules. A route will have unique route ID and a route may be prepared using multiple roads/part of roads attached containing stops. Schedule will have unique schedule number and multiple trips operated in the schedule with unique trip code and relevant trip operational detail like schedule Kms trip-wise.
- F-Req 2.** There shall be provision to export/import the Road, Route and Schedule data to/from MS Excel file in a format required by KSRTC.
- F-Req 3.** Configuration module shall support creation of the following master data as per KSRTC requirement
- Precise geographical position (Longitude/latitude coordinates) of each item in the route
 - En-route boarding points, stops/pickup points, authorized stops, hotels, etc.
 - Details of Depots, Divisions, Bus stands, platforms, places and other units of KSRTC with details of contact telephone numbers and contact names of KSRTC officials
 - Precise distances between places
 - State, District, KSRTC Jurisdiction of the points on the route
 - Nature or type of road and its status (closed / open / partially open, deviation details where a road is temporarily not motorable, etc
 - Any other item that is required for VTMS



- F-Req 4.** The Services for configuration of all GIS parameters as per KSRTC requirements be provided for a period of three years by the bidder i.e., vendor has to survey and configure. These include items such as defining Geo Coding (Address Geo Coding, Reverse Geo Coding), Geo-fencing required point etc.
- F-Req 5.** Configuration module shall support multiple names (alias max of 3) for single place and shall have an intuitive user interface to enable operational managers easily create locations, pickup points, roads, routes, schedules.
- F-Req 6.** The module shall support for cancelling a service (full/partial) dynamically for present/future/previous date of journey, for a day or period and record any operational information, Re-introduce the cancelled service for a day or period.
- F-Req 7.** The schedule creation module will be web based and shall incorporate the following features
- Schedules will be based on routes defined in the VTMS route configuration.
 - Schedules can be created in advance with 'effective from' and 'effective to' dates and will be automatically available on the day/s
 - Schedule will have all relevant operational details like class of service, type of schedule, etc.
- F-Req 8.** Roster Configuration module should enable the following
- Allocation/re-allocation of vehicles and crew to schedules/schedule trips as per vehicle allocation and duty-roster system followed by KSRTC.
 - Allocation of crew and vehicle will be current for a week which will continue automatically for indefinite time unless otherwise modified. The application is intelligent enough to dynamically change vehicle and crew for schedules on week and date basis using rolling option or any other logic which suits KSRTC requirement. Manual intervention/allocation shall not be required unless otherwise there are changes in roster.
 - Allocation can be done in advance and will be automatically triggered on a particular day and date, i.e., allocation shall be possible with effective date.
 - Facility to allocate a bus on unscheduled route on real time basis.
 - The list of Crew will be obtained from the master list of employees along with the details such as Designation, License number (Driving or Conductor license or both), expiry date of license, KSRTC Token Number (unique for the division), PF number (unique number), Depot, Division, Location, Emergency contact number, etc.
 - While the VTMS module is to be rolled out to all divisions, the Roster module needs to be rolled out at later in consultation with KSRTC.
- F-Req 9.** Note that, one vehicle may be allocated to multiple schedules/crew and single schedule may have multiple vehicles/crew. One vehicle/crew may carry out partial schedule duty and the alternate/relief vehicle/crew completes the remaining schedule duty. The schedule or crew may change after trip/trips or after reaching a place. The module shall support the requirement.
- F-Req 10.** VTMS configuration module shall support dynamic trip configuration, enabling the control rooms to deactivate/activate individual trips, re-allocation of crew/vehicle for full schedule or partial schedule, modification of schedule related information as per KSRTC requirement
- F-Req 11.** This module shall support re-allocation of vehicle/crew in bulk at Depot level (interface with multiple grids using which vehicle/crew can be allocated/reallocated for all the schedules of a depot and save once) on either day/weekly/date basis.



VTMS System

An illustration of VTMS is indicated below:

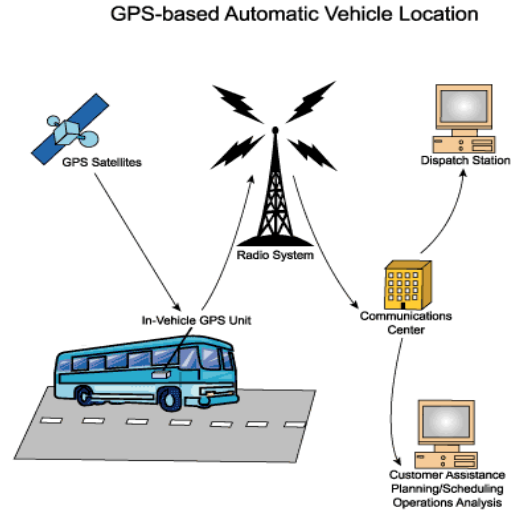


Figure 3: GPS based Automatic Vehicle Tracking & Monitoring (VTMS)

- F-Req 12.** The system will be web based and the bidder shall manage the VTMS portal on a day to day basis for a period of three years. The typical activities cover standard portal visitor analysis, popular pages, page loading times, other maintenance activities such as changing website content, modification, restructure, initiating customer opinion polls etc as required by KSRTC. This portal will be accessed by Commuters, Monitoring Stations, Control Stations, other KSRTC staff and will be the single point entry for authentication and role based access.
- F-Req 13.** Appropriate features for KSRTC to categorize complete operational area geographically into different division jurisdiction/sector for better management and establish control rooms.
- F-Req 14.** Users will be classified based on roles with access levels across the application. For e.g. depot-wise access, with users of one depot will not have access to other depots. The control room staff has access to the data of all depots. The divisions Control room shall have access to all details pertaining to buses of their division and those that pass through the division. The important access levels required are Corporation/Division/Depot/Bus Stand. The bus stand staff can have edit access to limited data of all services passing through his bus stand. Some data can be accessed by all for read only purpose.
- F-Req 15.** Vehicle Fleet Summary Dashboard – A configurable dashboard on fleet performance for each user role (division, depot, Central office) from VTMS with critical information for the console operators and monitoring staff such as but not limited to Number of Schedules on Time, Deviation of schedules that are configurable and parameterized based on time (say +/- 10 minutes) etc.
- F-Req 16.** The GIS system shall provide for color coded display (preferably with service class bus image) based on arrival times of buses at various bus stations. The following table illustrates the color codes based on arrival times efficiency, all of them to be easily configurable:

Table 4: Color Coded Information Display

Green	On time (defined as not more than 5 minutes early or 10 minutes late)
Orange	Early (more than 5 minutes early)
Yellow	Late (more than 10 minutes late)
Pink	Off-route
Blue	Not logged in
Arrow ►	Point the direction of travel



- F-Req 17.** The data structure and format will conform to standard practices adopted internationally and will have to be based on the Data Standards Definition framework widely accepted. The data elements may include vehicle description, identification, VTMS details and other data elements as identified essential by the implementing vendor and KSRTC and its Project Management Agency
- F-Req 18.** The database shall always be up-to-date on the movement of vehicles along with their defined schedules and destinations and details of the drivers/ conductors of the vehicles.
- F-Req 19.** VTMS application shall provide a graphical interface to make quick position related assessments. Application shall support dynamic monitoring of vehicles moving out of their defined routes and be able to raise alerts to be sent across to the driver of such vehicles.
- F-Req 20.** VTMS application software shall support facilities to zoom-in to enable close-up view of the vehicle of interest or to zoom-out to view all the vehicles on the screen.
- F-Req 21.** VTMS application software shall support both time mode (periodic update based on time interval) and distance mode (periodic update based on distance interval) configurable intervals.
- F-Req 22.** VTMS application software shall support calculation of distance travelled by a vehicle on a schedule/ trip and average distance traveled and time taken in a schedule for a period. Calculation of Travel time estimation between two places class-wise.
- F-Req 23.** The interface of the application shall support multiple window views for an overview with capabilities to close up and enlarge a screen of interest.
- F-Req 24.** VTMS application software shall support for playing back the recorded details of the bus movement along the authorized route for a period of 3 months online and 3 years archive data.
- F-Req 25.** VTMS application software shall have provision for creating different roles and privileges for controlling accessibility (read only/Add/Modify) based on units (Bus stand/Depot/Division/Corporation) attached and roles and privileges.

Precise Location of different vehicles in KSRTC fleet

- F-Req 26.** The tracking and locating the vehicle(s) will cover all those buses that are equipped with monitoring units and shall include those in movement those stationed in the bus depots/Bus stands/workshops/Pickup points ,stops, etc. This features shall be available to the users on demand
- F-Req 27.** Information elements that needs to be captured at the minimum include longitude, latitude, physical location with date and time stamps, bus number, schedule number, trip code, contact number and crew ID and overlay this on a map
- F-Req 28.** VTMS shall provide the above data on demand with an overlay on the geographic map or as a text table on real time basis at pre-determined and configurable intervals
- F-Req 29.** Display of real-time dynamic movement of buses plying on a selected route in both Text and on map, with relevant ETA (to the destination point of the route) displayed alongside
- F-Req 30.** Facility to track real time and generate reports based on Defined vs. Actual movement of vehicles. The variance will include a set of preconfigured parameters such as defined routes, stoppages, etc.
- F-Req 31.** The VTMS receives the current position of all the buses from the Tracking Unit, will disseminate the data received and transfer the relevant information like the schedule No, Destination of the bus and the Expected Time of Arrival at that bus stop, to the bus stand display, which has requested for the data.

Interface with AWATAR (Passenger Information System of KSRTC)

- F-Req 32.** AWATAR to VTMS request: The VTMS application shall be interfaced with AWATAR to receive Trip code from AWATAR and send VTMS related information to the AWATAR passenger/user.
- F-Req 33.** VTMS to AWATAR request: The VTMS application shall be interfaced with AWATAR to accept PNR number or Ticket number from VTMS user and obtain corresponding trip code from AWATAR and provide the VTMS application user VTMS related information.



VTMS System Enquiry and Response

- F-Req 34.** System shall support generalized enquiry for a jurisdiction based on run time parameters indicatively such as
- Real time / history of all trips that are more than a “X” minutes late (x input runtime by the user)
 - Real time- history / Record of a particular jurisdiction in maintaining ETA
 - Real time / history of All Trips or specific trips between two points with a feature to playback
- F-Req 35.** VTMS Support real time enquiry from KSRTC Staff (or Commuter) between two points and for all the trips that are scheduled with pickup point/stop/bus stand/place/sector and ETA of destinations as well as the present position of the bus. The enquiry broadly supports response in terms of details of Time table, type of services with reservation and non-reservation AC/ Non AC facilities, ETA, ETD of the buses all or sector wise.
- F-Req 36.** System shall support real time enquiry of a bus location based on bus number/trip code and to know ETA at next or required place.
- F-Req 37.** System shall support real time enquiry based on Bus Stops/Pickup point, Bus Stand, schedule no, trip id, bus no etc., to find out whether the bus passed a pickup point/stop/bus stand/place, to find out the nearby vehicle/s to a given place/location/pickup point bound to specified destination (which have not passed), to find out the nearby vehicle/s to a given vehicle which have not passed/just passed/on the same route or on different route. The output shall be possible both on map and text based display.
- F-Req 38.** Response to the query shall be appropriate to the channel from which the enquiry was received such as SMS/ Web. SMS response will be perhaps a limited text message while that from the web shall have relevant text output / Table and if relevant vehicle locations of the current trips on a web page with an overlay on the map.
- F-Req 39.** The system shall provision controlling display of vehicle/schedules based on user role for a query. Some vehicles may not be visible to public and visible only to certain roles with in KSRTC.
- F-Req 40.** The display of vehicles on the map shall be color coded based on parameters such as regular schedules, special services, services with reservation and non-reservation facilities etc as per operational requirement of KSRTC.
- F-Req 41.** As regards the Information (a specific type of enquiry) to be displayed on the PIS at each Bus stand/ Bus Terminus will contain details of Trips codes with an ETA of the next 2 hours(configurable) platform wise/all. The details for display shall contain Estimated ETA, ETD (If relevant), Type of Service (AC/Non AC, Reserved/Non Reserved), etc.
- F-Req 42.** VTMS should enable KSRTC staff to query and visualize graphically patterns of poor on-time performance in order to take corrective actions
- F-Req 43.** The consolidated and individual queries are possible based on organization of Sectors and Divisions within KSRTC. (Refer note on Sectors and Divisions in the section on “About KSRTC”)
- F-Req 44.** System shall provide actual distance between two places or points.

Alerts from the VTMS system

The VTMS system shall have the ability to raise alerts associated with simple Business rules in the context of the operations and Vehicle Tracking and Monitoring. Following are some of the specific cases

- F-Req 45.** Alerts will be displayed on the monitoring console and an extract of the same will be available on the users dashboard for the user with their jurisdiction of operation
- F-Req 46.** The Control Room 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.



- F-Req 47.** Alerts from Moving / stranded buses enroute through the operation of a panic button provided in the VTMS Unit.
- F-Req 48.** Alerts will need to be generated in case of deviations from the authorized route and recorded in all cases for reporting and review
- F-Req 49.** Alerts on exceptions for all other pre configured parameters such as driver behavior, harsh acceleration/braking, non stoppage at designated points, not meeting the ETA and ETD schedules etc and logged into journey details of the bus for each trip
- F-Req 50.** In case of vehicles that are moving Alerts shall be flashed at the control room as well as the nearest two Bus stands i.e., through one that is passed and the one approaching Bus stand
- F-Req 51.** Preconfigured alerts with respect to vehicles and crew shall be sent to the Mobile number/ email id via the SMS/ email as maintained in the system – for ex, Expiry of Mandatory items such as Crew Licenses, FC renewal, Vehicle Insurance Renewal, Road Permits for vehicles, breakdowns, accidents etc. These alerts are to be sent a configurable number of days (typically 1 month) before the expiry occurs
- F-Req 52.** Vehicle Service Alerts for service and maintenance based on business rules of operation from the records, Maintenance-plans, division wise along with vehicle number, etc.
- F-Req 53.** SMS notification to concerned officials for specified schedules/vehicles regarding certain parameters like regularity, skipping stops, speed violations, etc.
- F-Req 54.** Provision to capture information pertaining to incidents like riots, natural calamities, etc and sending alerts to required bus stand.

SMS Management for the VTMS System

- F-Req 55.** The system shall cater to the following
- Arrangement with a SMS service provider for providing the SMS service with a standard number
 - System will automatically reply (send SMS) to all SMS enquiries
 - The rate at which the SMS shall be charged to the end user is to be indicated and should comply to the guidelines from telecom authorities
 - Provide reports regarding number of SMS's received (category wise) and sent (category wise), cost of the SMS's and revenue generated for this service.
 - The system shall have provision to send SMS to concerned mobile numbers (KSRTC officials) by KSRTC users, on selected criteria, with customized message.
- F-Req 56.** The revenue generated by this service shall accrue to KSRTC and the commercial arrangement proposed for handling SMS shall be clearly provided by the bidder

Vehicle Mounted Units

Functional Requirements Vehicle Mounted Units (VMU)

- F-Req 57.** The VMU unit shall not only operate outdoors but also be able transmit stored signals in an environment which may not have a very clear view of the sky
- F-Req 58.** VMU should support 2-way voice communication between the driver of the vehicle and the various Control room (Central and Divisional) for sending alerts from vehicle with preconfigured buttons for activating the voice communication with the central control station, call centre, and divisional control room. The configuration shall allow communication only to the numbers maintained. The voice communication will be simple and activated through the press of a button.
- F-Req 59.** The vehicle mounted communication hardware i.e., Audio Speaker and Microphone of the VMU needs to be located at appropriate place speaking listening and should be able to pick up audio from the driver

**Technical Requirements of Vehicle Mounted Units**

- T-Req 14.** VMU shall consist of a GPS receiver with GPS Antenna, GSM/ GPRS receiver, Speaker and Microphone for hands-free voice communication to enable services such as vehicle tracking, communication and control in connection with a backend control centre system. The antenna shall be suitably located so as to provide reliable coverage
- T-Req 15.** VMU will update the location information like Latitude and Longitude to the central server through GPRS.
- T-Req 16.** The location of VMU within the bus shall be easily accessible for maintenance and servicing but located to prevent tampering or unauthorized removal and shall be vibration & shock resistant, heat resistant, dust resistant and water / rain splash resistant and shall be tamper proof.
- T-Req 17.** VMU should have at least IP65 or higher protection classification according to IEC 60529.
- T-Req 18.** VMU shall conform to relevant Indian or international standards with corresponding Indian or International certification.
- T-Req 19.** The tracking system /VMU fitted in the buses will calculate the positions from the GPS receiver and transfer the data to the Central Control Station server through GPRS interface for processing /prediction of arrival time of buses at different bus stops. The accuracy of the prediction time (Expected Time of Arrival-ETA) and ETD (Expected Time of Departure) should not vary more than +/- 10 minutes.
- T-Req 20.** The accuracy of the prediction of vehicle location should not vary more than +/- 3 meters.
- T-Req 21.** VMU software should be upgradeable/ configurable over the air (OTA).
- T-Req 22.** VMU should have at least 4 programmable buttons (SOS button – 1 no. plus 3 buttons – configurable for different messages/hotline communication to preconfigured numbers).
- T-Req 23.** In case of loss of communication link, the VMU shall have memory storage for at least 5000 way points to keep the data till the communication link is re-established. System memory should save data and not be reset when unit is switched off or during power failure.
- T-Req 24.** VMU should support the configuration of standard parameters such as r Over-Speeding, Harsh Braking, Harsh Acceleration etc as well as other general in-vehicle parameters and generate alerts as necessary.
- T-Req 25.** VMU shall work on 12V DC or 24 DC Battery and the device should be powered by vehicle battery and not ignition.
- T-Req 26.** VMU application should generate alerts on tampering of the VMU or its components
- T-Req 27.** The VMU shall be scalable/upgradeable to support feature like capturing number of available seats if KSRTC decides to implement in future.
- T-Req 28.** GSM/GPRS specifications

Table 5: GSM / GPRS specifications

1	GSM	Normal MS-SMS data
2	Frequency	As per allowed bandwidth and frequency for operations in India
3	GPRS	Type B class 10
4	SIM	1.8V/3V
5	Antenna	Suitable Antenna for efficient operation with provisions for stable mounting
6	Certification	Equipment needs to be certified as per Indian or international standards CE or FCC



T-Req 29. GPS specifications

Table 6: GPS Specifications

1	Frequency	As per allowed bandwidth and frequency for operations in India
2	C/A code	Standard Positioning Service
3	Channels	Minimum 16-Channels
4	Sensitivity	Minimum -158 dBm Acquisition without external assistance
5	Accuracy	Horizontal: <6 meters (50%) Altitude: <11 meters (50%) Velocity: 0.06 m/sec
6	Antenna	Suitable antenna for mounting on target vehicles (buses)

T-Req 30. Environmental specifications

Table 7: Environmental Specifications

1	Temperature	Operating -20°C to +70°C
2	Humidity	5% to 95% RH non-condensing at +40°C
3	Enclosure	Certified IP 65 or equivalent
4	Vibration	to meet SAE standards
5	Shock	to meet SAE standards

Physical Specifications

T-Req 31. Assembly: Enclosed box as per standards with suitable mounting Integrated with chargeable battery pack

Electrical Characteristics

T-Req 32. Primary Power: Vehicle Battery 12/24 volts

T-Req 33. Battery Life : Mandatory 8 Hours normal operation

Firmware:

T-Req 34. Over the Air Download of firmware as well as configuration parameters

T-Req 35. Store and Forward features for network dark zone

Driver-support and Behavior Information System

F-Req 60. Driver will be given an interface for the voice communication. Communication Headset will be provided to the driver to interact with Control Room. The driver will use the two-way communication facility made available to communicate with the Control Room. The Control Room can also contact any of bus drivers instantly to communicate messages. Conference facility at the control room for conferencing any other member with the driver

F-Req 61. The system should support hands-free voice communication and alerts for preconfigured parameters to the driver for items such as speed limits, harsh acceleration, through appropriate beeps to prevent the driver from having to look at the display panels that could be a source of distraction

F-Req 62. Audio alerts (typically, few beeps) for the driver to warn in cases such as exceeding Speed limits, non stoppage, etc, at bus stops will be provided.

F-Req 63. A Score Card based mechanism is to be provided on driver's driving habits and adherence to the business rules set in the system for tracking driver behavior such as performance on ETA, ETD, authorized / Unauthorized stoppages, Non-Stoppage at Bus stops/stands/pickup points, unauthorized Deviations from route, Over-Speeding, Harsh Acceleration, Harsh Braking and the like. These details are to be recorded for generating reports

F-Req 64. Summary and Detailed Reports are to be generated on demand as per configured parameters based on specific driver, all drivers for a jurisdiction between specified dates.



Passenger Information System (PIS): Requirements

Functional and Technical Requirement (PIS)

The PIS shall include all the components that are directed towards passengers. “Passengers” & “commuters” in this context would also mean the commuters, prospective commuters who enquire about the KSRTC services, persons who arrive at the bus stands to receive passengers. The terms passenger and commuter is used interchangeably.

VTMS is from the passenger perspective is directed to improving Service Reliability. Reliability will be viewed as consistency of “on-time-performance” across days. Over time, arriving customers adapt to the historic bus arrival pattern. Service that wildly fluctuates over time (including early stop departures) causes commuters to adapt by arriving sufficiently early at stops to ensure that the bus is not missed. A facility to enquire about a trip/schedule by commuters is addressed in the section on enquiry and response.

The display of PIS information in a display unit at bus stand shall be configurable based on bus stand and platform. Single unit may display services of more than one platform.

The PIS information shall be displayed both in Kannada and English alternatively (single or two language is configurable).

The following set of requirements augment those already provided are towards providing the information to commuters.

Display system functional requirements

- F-Req 65.** At major bus stands, 52 Information Display units will be supplied and mounted appropriately, configured and commissioned. Out of these 52 units, 38 are under KSRTC jurisdiction, 4 under Interstate, and 4 each under NEKRTC & NWKRTC. The list of these bus stands are indicated in appendix -1.
- F-Req 66.** There are locations with multiple displays at a bus stand and are to be managed from the same server at the bus stand
- F-Req 67.** At all these bus stands, display units will receive and display the transmitted contents from the central system through a gateway or other suitable means as provided in the technical Architecture. The facility at each of these bus stands will need to have connectivity through a wired cable to the display systems for displaying the messages and information content.
- F-Req 68.** Display systems needs to support Digital display of text, images and video on appropriate screens such as LCD, Plasma Panels, LED, etc both in English and Kannada.
- F-Req 69.** Displayed messages must be readable in high bright, day light.
- F-Req 70.** Display system in addition to the display of information from VTMS shall be capable of displaying advertisements and multimedia content at the bus stops and may need to alternate between Passenger information and Advertisements.
- F-Req 71.** The frequency and period of information display on PIS display shall be configurable from central location for advertisements and other transit information.
- F-Req 72.** Display shall provide for modular configurable layout enabling parallel display of content on different areas of the screen – Real time Transit information (Routes, ETA, Type of service, Fare, Seats available etc), Time/Date, Public announcements, Safety information, Commercial advertising, a ticker tape at the bottom for text announcements/advertisements, other local Tourist information.
- F-Req 73.** Information display requirements similar to what is provided in the bus stands to be provided in Control Room at location specified by KSRTC. Two PIS Display units will be mounted appropriately, configured and commissioned at Control Room.
- F-Req 74.** The control room display shall be capable of switching over to display the transit information of any of the 50 displays for viewing the content in real time.
- F-Req 75.** All displays for PIS will have a with configurable refresh rate, ideally 1 minute or less.
- F-Req 76.** The bus Stand display, which receives will display continuously until the next set of data is received



Display System Technical Requirement (PIS)

- T-Req 36.** The management of display will be carried out by an exclusive server located at each bus stand that will be remotely managed from the central location. The information is to be pushed/pulled from the central server. Passenger information will be pushed/pulled in real time while all other information shall be scheduled during non-peak hours (see section on advertisement campaigns for more details).
- T-Req 37.** Display units shall be mounted on a rugged enclosure to withstand harsh environmental conditions with reasonable physical security. Fitment provision will have to be provided in the Bus stands along with necessary power supply made available. Display will be located at a convenient height to have a clear view of the message of next arrival bus.

K.S.R.T.C - MYSORE				
City Bus Stand				
4/5/208	Departure Information			12:15:00
Route No.	Destination	Time	Platform No.	Bay
95	Vijayanagar	12.30	1	3
71A	Rajarajeswarinagar	1.05	1	4
61	Ramakrishnanagar	13.10	1	4
76	Lingabudipalya	18.45	1	3
135	Vivekanandanagar	19.10	1	3

Figure 4: Example of Transit Information Display on panel

Display Hardware Specification

- T-Req 38.** Passenger Information System for important Bus Stands will have a Minimum 52" Industrial flat panel display from a recognized company.
- T-Req 39.** One Integrated tamper proof casing for complete PIS Unit and should address physical security considerations
- T-Req 40.** UPS with display for 15 to 20 minutes back-up (to ensure smooth transition from main power supply to generator in case of power outages) desirable.
- T-Req 41.** Aesthetic requirements such as fonts, colors, rows per page, display time to be remotely configurable and displayed for at least 10 sec before
- T-Req 42.** Minimum Specifications for LCD Display Units

Table 8 Minimum specifications for Display units

#	Parameter	Minimum requirement
1	Type of Display	52 Inch, Color, from a recognized brand with rugged construction. (Where higher sizes are required, KSRTC will provide the specific requirements at additional cost)
2	Minimum and maximum viewing distance and angle of viewing (where the display screen looks DOT-FREE!)	Viewing distance 3- 30 meters Minimum 150°V – 60°H
3	Size of the display characters	Approx 3-4"(in Bus Stand platforms)



#	Parameter	Minimum requirement
4	Environmental specifications	Temperature: 0 to +55 deg C Thermal cycling: 5 Deg C/mt Vibration: 2 g Sealing: IP 65 Humidity: 90% RH Drop: 1 mt on all faces
5	Minimum life of the display system	100,000 hours
6	Power supply	90 V to 250 V AC; 50 VA
7	Display format	Multimedia content, Text in Kannada and English with presentation in tables, Fixed Text and scrolling Text



Monitoring & Operational Station (Control room) and Data center- Requirements

Functional and Technical Requirements

The system will be routinely accessed by on the basis of their jurisdiction of operations viz. Central (meaning entire KSRTC) or Division (respective KSRTC Divisions). VTMS will initially be rolled out as a central system and will be delegated to divisions/Depots at an appropriate time considering readiness, Training etc.

The routine 24 x 7 x 365 access to the VTMS system will be from the hubs of operations broadly classified as Monitoring Stations and Operations Stations. Monitoring stations are those that monitor alerts, conduct general queries and queries based on alerts, inform the operations control personnel about exceptions. The personnel at the monitoring stations are of lower in the KSRTC hierarchy and are charged with the responsibility of Monitoring and Tracking the fleet based on their jurisdiction. Operational Stations are the nerve centre of the KSRTC operations for decision making and are used by decision makers. The Operational stations control the operations based on the inputs from the VTMS either independently or based on inputs and alerts from the monitoring personnel. Monitoring and Operations stations in smaller jurisdiction are normally manned by a single person. The application shall be able to support these features.

It follows from the above that there will be provision for the following types of stations for VTMS systems

- Central Monitoring Station- Role & Dashboard required
- Divisional Monitoring Station- Role & Dashboard required
- Central Operations Station- Role & Dashboard required
- Divisional Operations Station-Role & Dashboard required
- Central Monitoring Station and Central Operations station - Role & Dashboard (this is required if both are to be managed by single person)
- Divisional Monitoring Station and Divisional Operations station - Role & Dashboard (this is required if both are to be managed by single person)
- Depot Monitoring Station and Operating Station - Roles & Dashboards

F-Req 77. Data center shall be housed in a premises identified by KSRTC. A room approximately 20x15 is will be provided for the purpose. All servers will be housed at this place in racks that are to be supplied by the Vendor

F-Req 78. The DATA CENTER shall have adequate power back up through UPS that shall support minimum of 8 hours backup and shall be provided by the vendor.

F-Req 79. DATA CENTER – Precision AC estimated to be approximately 3 x 4 tonnes, is to be supplied by the vendor along with minimum fire detection and fire suppression system.

F-Req 80. The operations and monitoring stations (control room) shall be housed in a premises identified by KSRTC. All applications that are part of VTMS should be accessible from this location. Connectivity shall be provided as given under connectivity requirements

F-Req 81. The geographical information system (GIS) applications shall enable display of the position of vehicles on a detailed digitized road map of the routes and linked with the communication control and reporting applications.

F-Req 82. The stations will be web-enabled, shall provide for appropriate user access (role based, read only/read-write) and other security controls

F-Req 83. All monitoring stations shall be able to receive alerts from the vehicles and display on screen to attract the operator's attention.

F-Req 84. Response to Alerts and Messages are to be configurable. If there is no configuration maintained, the alert is logged and can be retrieved later for reporting. An indicative list for typical configuration for alerts are listed below

- Type of message (for ex. Emergency, Driver behavior etc),
- Message Priority (for ex. Very High, High, Normal etc)
- On screen alert (alert required, Color, Time to lapse if not acknowledged etc)
- Audio alert (required, Not required, Type of Audio – Beep etc)



- Message acknowledgement and action (Click, speak to the Driver, Enter action taken in a form etc)
 - Second level Acknowledgement (required, not required etc)
- F-Req 85.** All messages configured as “Emergency Messages: shall have an audio alert till it is acknowledged by the operator with a second supervisory level acknowledgement is needed to remove the alert from the screen.
- F-Req 86.** The following equipment shall be provided at the control room (Central Operations and Monitoring Station)
- Supply of two PIS display units similar to bus stand display units (52 inch). One of these shall be used as monitoring and tracking console and the other may be available to use as display hook up for monitoring the bus stand display as required that is initiated by choosing the display from the list of bus stand display units
 - Supply of 8 Workstations/Computers: Latest processor machines with TFT monitors, Windows OS.
 - Supply of 7 Printers: Two printers with color Print/Scan/Copy/Fax option. Two numbers LaserJet printers. Two Dot matrix printers (132 columns). And One A3 Size printer to print maps
 - Networking and network devices for the LAN connected with Data center for sharing Data center band width.

Advertisement & Campaign Management Services – an overlay on VTMS

- F-Req 87.** KSRTC proposes to use the displays at bus stands for conducting advertisement campaigns for its customers. These advertisements will be run as campaigns that are targeted at the personnel visiting the bus stands. The technology infrastructure for the system would be an incremental overlay on the existing VTMS system with addition of software and hardware systems as needed. The broad elements of the advertisement system are provided below.
- F-Req 88.** Schematic of the Campaign Management System

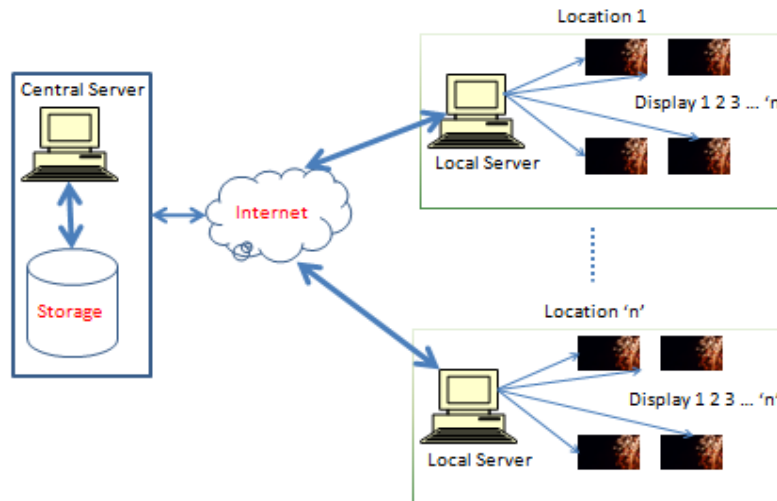


Figure 5 Schematic of the Advertisement Campaign System

- F-Req 89.** The Campaign System is conceptualized as a distributed system with a Central server in Bangalore and Local servers at locations where the campaigns are run. The central server hosts the Campaign Master System (CpMS) that controls all local servers that host the Campaign Slave System (CpSS) at various locations (Bus Stands). The CpMS and CpSS are interconnected through VPN as in the case of VTMS and use the same data channels, standby configurations etc.



F-Req 90. CpMS will have three sub systems viz., System Management Utilities, Customer Management Utilities and Campaign Management utilities. These utilities / software tools will aid in Planning, Execution, and Reporting functions of campaigns. The CpMS functions of the system are to be implemented monitored / controlled centrally.

Operational Flow

F-Req 91. The system is conceptualized with three logical stakeholders apart from the customer viz., System Admin, Campaign Planner, Campaign System manager. System Admin is responsible for the health of the system and its availability including software operations as needed. The Campaign planner is responsible for interacting with the customer, planning the campaign and providing reports to the customer and is typically from the marketing department of KSRTC. Campaign System Manager is the owner of the entire campaign system is responsible for its operations, addition of new locations, operations and interacting with the other stakeholders. He is the central one point contact for the system.

F-Req 92. The operations are conceptualized as follows

- Campaign Planner defines and initiates a campaign for a customer based on the system
- Campaign assets are received and uploaded to the system from central location
- Campaign System Manager verifies and approves the campaign based on the campaign details maintained including the schedule
- Confirmation to customer that the campaign is scheduled with the start date and end date, details of asset etc
- Before the campaign gets initiated, the campaign-Media-Assets are transferred to the CpSS as daily nightly transfers. The CpSS logs into the CpMS and downloads the Media-Assets This would be later converted to a real time download
- Daily nightly download of Performance data from CpSS to CpMS for review by Campaign Planner, Campaign System Manager and Customer> This would be later converted to a real time download
- Campaign System Manager periodically provides the Billing data handoff to the accounting system for invoicing to the customer

Timeline for Advertisement & Campaign Management Services

F-Req 93. The priority of KSRTC is the Vehicle Tracking and Monitoring System. Therefore the implementation of Advertisement system will be second priority. However the implementation is to be completed by the end of 180 days from the start of the project. Appropriate timelines are to be factored into the VTMS program plan for the purpose.

Features of the Campaign Management System

F-Req 94. The following requirements summarize the main functions that are needed for the CpMS and CpSS. The functionality is provided more as a requirements guideline rather than an exhaustive list. The vendor may either develop or use an existing product to address the general functionality for each of the subsystems.

System Management Utilities

F-Req 95. System Management Utilities facilitate to centrally manage the following functions

- ADD MOD DEL users, their privileges features of administrators for both Central and Remote users
- Configuration utilities for system functions and operations both central and remote users that includes storage, Display type, delivery methods etc
- Review system performance of both Central and Remote systems with reference to Audit log, system health, storage space, advertisement delivery and the like
- Any other function that is routinely required to ensure system functioning



Customer Management Utilities

F-Req 96. Campaign Management utilities facilitate to centrally manage the following functions

- ADD MOD DEL of customers and their details
- Associate Customers with Campaign types and specific campaigns
- Provide on screen query and reports on Campaign planning, Slot availability, Campaign estimates of Costs, performance of campaigns etc.
- Provide billing and accounting hand off data for preparing invoices from KSRTC to customers
- eMail alerts based on simple business rules to campaign managers for any campaign that was not run, campaign that is ending over the next few days (parameterized number of days) etc.

Campaign Management Utilities

F-Req 97. Campaign management utilities to manage the campaigns that include the following

- Define different types of Campaigns based on time (time of the day, day of the week etc), type of asset (multimedia, scrolling ticker etc)
- Configure campaigns for customers based on the configured types
- Plan, schedule, modify, delete a campaign with details of Campaign assets, their currency based on start date and end date or the number of exposures required
- Campaign Execution including scheduling of Data Transfers, readiness report and start of the campaign with utilities to alter the campaign mid way
- Campaign Reporting for effectiveness of campaigns, based on simple campaign metrics such as planned versus actual exposures as needed
- Campaign Media-Asset Management utility that provides version control based storage, distribution, transfer, use and archival of media assets

F-Req 98. The bidder is expected to clearly mention the following in the response to the RFP

- Cost of the Advertisement System with all details
- Specific Campaign Management software
- List of Features and functionality that the software supports and provision for developing additional features if needed
- Few use cases to demonstrate the capability of the software that include – Configuration Data transfer, Campaign execution, Reporting

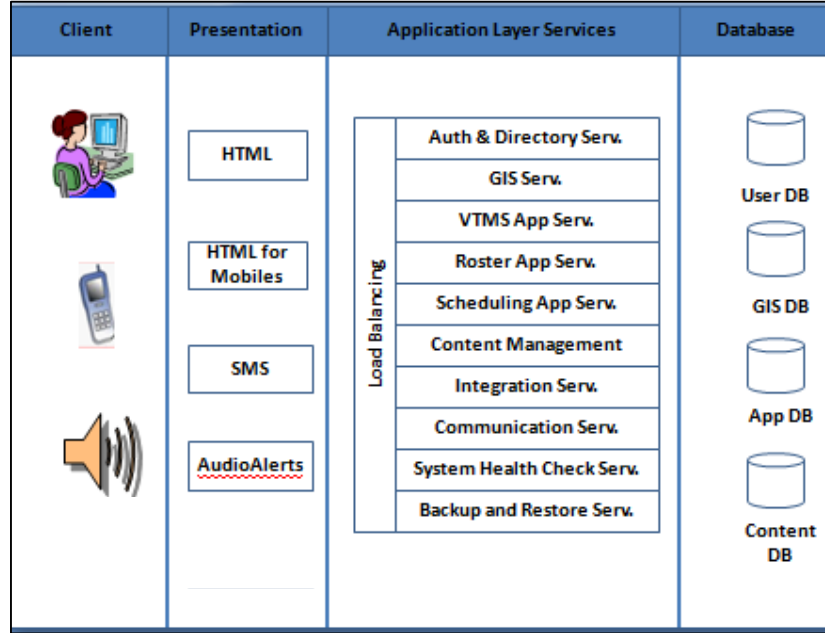
Technical Architectural Requirements

T-Req 43. The high-level logical architecture of the conceptualized solution is described below. Some of the key services that have been included are – Directory and Authentication, GPS/GSM Services, GIS Services, VTMS Application Services, (Tracking and Monitoring), Scheduling Application Services, Roster Services, Content Management Services, Integration Services, Communication (Data Voice and SMS), System Health Check Services, Backup and restore Services



T-Req 44. The conceptualized schematic is provided below.

Figure 6 Logical Components of VTMS



The conceptualized architecture comprises of following broad technology components.

- T-Req 45.** It is acknowledged that each vendor will have their architecture and arrangement of components to meet the requirements. However, based on the above conceptual view of the VTMS system, response to the RFP shall elaborate on the vendor's proposed architecture and the manner in which it meets the requirements provided below.
- T-Req 46.** Features of Proposed Solution – the solution must be standards-based that can be installed on standard operating systems, databases, communication technologies, based on accepted industry standards, on a unified portal framework and built on an architecture that will provide secure access to applications.
- T-Req 47.** The design shall provide for componentized solutions assuring scalability, reliability, availability, and security. A brief write up on the architecture is to be provided. This is typically a Browser on a computer, or a cell phone (browser & SMS).
- T-Req 48.** In case of bus stands the client is a server that feeds the displays with information from PIS and advertisement management system

Presentation layer

- T-Req 49.** The presentation layer components need to format the content to fit the end client device. Typical client is a traditional Internet browser and the applications should be compatible with many of the popular browsers such as IE, Chrome, Mozilla, etc (covered earlier).
- T-Req 50.** Presentation layer should have provision for formatting output to the target channel



Application layer components

- T-Req 51.** Load Balancer – This is a hardware/software load balancer to ensure that load is distributed evenly across all of the web server instances. The detailed specifications of the load balancer if proposed is to be provided
- T-Req 52.** Auth & Directory Services –Directory services components provide user credentials for all users including the internal authors & content publishers. The authentication and authorization is done for all services, like Website access, content publishing, content management access, database access etc. Central Security System (CSS) holds the user credentials for all users. The details of the proposed software, authentication methods for various access modes and specification of the same is to be provided
- T-Req 53.** GIS services – These components provide the map and overlay of data on to the related systems. The detailed specifications of the software proposed is to be provided
- T-Req 54.** VTMS App Services – These services are core to the entire application for tracking and monitoring of the KSRTC fleet including the reporting services. The details of the proposed software custom built/customized product is to be provided
- T-Req 55.** Roster Application Services – These components provide a feature to create modify and allocate crew to a trip and is interfaced to the VTMS application. The details of the proposed software custom built/customized product is to be provided
- T-Req 56.** Schedule Application Services – These components provide features to create modify and delete schedules and are interfaced to the VTMS application. The details of the proposed software custom built/customized product is to be provided
- T-Req 57.** Content Management – These components manage all types of digitized content including HTML and XML Web content, document images, and multimedia content of advertisements and all the content that is needed for VTMS The details of the proposed software custom built/customized product is to be provided
- T-Req 58.** Integration Services - These components provide integration services and helps the VTMS to form a composite platform optimized for building service-oriented applications that extend and integrate the various applications like GPS, GIS, VTMS, Scheduling, Roster, PIS etc. The technical architecture of the proposed solution should clearly mention the proposed way to integrate these applications
- T-Req 59.** Communication Services – These components form the back bone for communication and shall integrate GPS, GPRS, Monitoring, etc. The details of proposed software custom built/customized product is to be provided
- T-Req 60.** System Health Checkup Services – These components provide data on the IT infrastructure of VTMS systems thereby ensure services are always running 24 x 7. The system will need to monitor Servers (both local and distributed), Storage, Network components, and network links as needed to ensure that the services are available and resilient. The details of the software proposed for the solution is to be provided
- T-Req 61.** Backup and Restore services – These components ensure that timely back up on an external storage is available and in cases of contingencies restoration is possible. The details of proposed software custom built/customized product is to be provided

Database layer components

- T-Req 62.** The specification of the databases used for the VTMS system is to be provided including instances, licensing and support for the period of contract
- T-Req 63.** Hardware / Software Firewalls are to be provided for Security of the entire system at the data center as needed.



Connectivity to Various Locations

The diagram below provides the connectivity as conceptualized and is only an indicative. The actual connectivity solution to be provided is detailed below.

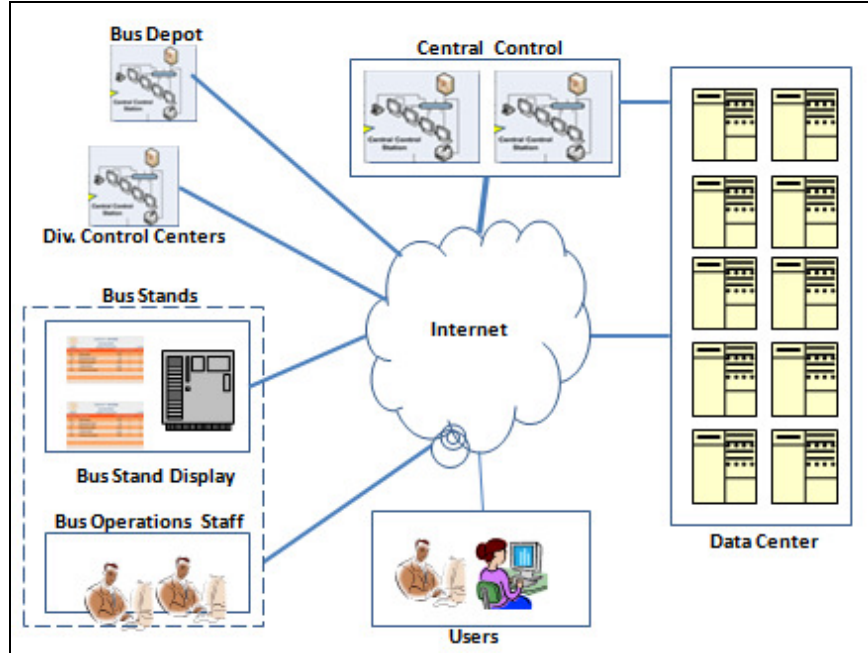


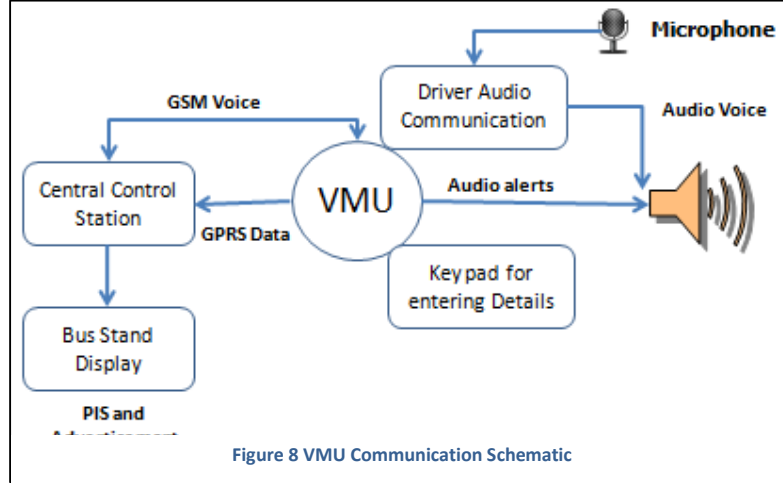
Figure 7 Physical Connectivity across components

- T-Req 64.** The provisioning connectivity for VTMS project are the following and shall be the responsibility of the vendor
- Data Center to the Internet – Leased Line /Internet
 - Central Monitoring and Operations Control Stations (control room) Located in the same building as Data Center will share the data center bandwidth.
 - Connectivity to Bus Stand Displays – Leased Line / Internet
 - Connectivity between Bus and Data center (Data)
 - Two way voice communication between Bus and Control room /specified numbers.
- T-Req 65.** In addition, based on the requirement at a later date, the vendor may have to provide connectivity to the following at additional cost during the project period of 3 years
- Broad band/Leased Line to Divisional /Depots level control rooms.
- T-Req 66.** All required communication equipment, network equipment; interface with the telcos shall be the responsibility of the selected bidder.
- T-Req 67.** Data Center – The vendor shall locate the centralized data center to house all the hardware and software required for VTMS at a location specified by KSRTC. Physical security to the location is the responsibility of KSRTC.
- T-Req 68.** The networking & clustering of servers shall be provided at the data center
- T-Req 69.** Connectivity to Central stations - The Central Monitoring and Operations control stations with adequate space will be located in Bangalore close to the data center. All central control functions are managed from this location.
- T-Req 70.** At least two alternate paths are to be provided with direct connectivity to the data center. The vendor shall provide all network related hardware and software required for central stations.



T-Req 71. Connectivity to Bus stands – A separate communication and advertisement system server will have to be provided at each location in Appendix 1 (list of bus stand) to manage PIS display(s) and requirements of Advertisement system. Connectivity to this server is to be provided over VPN so that management of the server from the central control station is possible

T-Req 72. Connectivity to the Display – The PIS display(s) are connected to the server at the bus stand.



Connectivity through local area network/Video cable is to be provided to the display(s)

T-Req 73. The communication when on internet will be on Virtual Private Network

The diagram illustrates the schematic of the communication from the VMU to the CCS.

T-Req 74. Communication between KSRTC Central Stations and the bus fleet - The data communication channel requires exchanging data between the Central Stations and the bus fleet. This data shall be encrypted with a minimum of 128 bit encryption

T-Req 75. The GPRS/GSM data connectivity would be seamless while moving from one cell site to other cell site.

T-Req 76. Voice communication between vehicle and control room/specified numbers

T-Req 77. Connectivity to the VMUs shall be an arrangement worked out by the bidder with respective service providers. The entire set of VMUs communication will be an arrangement as a Closed User Group for data and voice communication. The response to the RFP shall clearly mention the commercial and technical arrangement with service providers

Computing Hardware Specifications

T-Req 78. The hardware required for the VTMS application is to be provided component wise with specifications. Below is an indicative list of servers that are required. However, the exact requirement is dependent on the solution proposed and vendor is free to arrive at the suitable deployment architecture and components.

T-Req 79. Servers required (this is an Indicative list and not mandatory. Bidder shall provide hardware as per system requirements to support desired load)

Table 9: Servers & Accessories Requirements

Item	Quantity (Nos.)	
Web Server	2	System Scalable to 4 Dual core processors, 16 Gb RAM, 2x 146 GB HDD
Database Servers	2	System Scalable to 4 Dual core processors, 48 Gb RAM, 2x 146 GB HDD



Application Server	2	System having 2 processor, 16 GB RAM, 2x 146 Gb HDD
Directory Server	1	System having 2 processor, 16 GB RAM, 2x 146 Gb HDD
GSM/GPRS Server	1	System having 2 processor, 16 GB RAM, 2x 146 Gb HDD
Reporting Server	1	System Scalable to 4 Dual core processors, 16 Gb RAM, 2x 146 GB HDD
Integration Server	1	System having 2 processor, 16 GB RAM, 2x 146 Gb HDD
GIS Server	1	System having 2 processor, 16 GB RAM, 2x 146 Gb HDD
Storage Manager Server	2	System having 2 processor, 16 GB RAM, 2x 146 Gb HDD
SAN Array – 5 Tb	1 + 1	System is FC Storage, Array should support clustering , SAN switch and power supply, controllers in redundancy, with near online storage on SATA

- T-Req 80. Processor expandability:** Minimum acceptable number of processors is 2; and the servers must be expandable to support 4 processors
- T-Req 81. Processing unit fault tolerance:** The servers must support hot-swappable hard disk modules
- T-Req 82.** Fire extinguisher system: The vendor shall provide industry standard fire extinguishing system for the Data Center.
- T-Req 83.** Precision air conditioning for Data Centre shall be provided to designed load of the IT infrastructure hosted and provide for additional capacity of 20% to ensure that the parameters such as temperature and airflow are within operational ranges in case of expansion.
- T-Req 84.** Based on the estimated load of the Central command Station , power back up solution must be planned to support 8 hours battery backup of the CCS Servers for running the core services such as vehicle tracking and Passenger Information system
- T-Req 85.** UPS for Data Centre is to be provided to support the servers, storage and networking load with Parallel redundant based advanced digital technology. UPS system with 0.9 leading power factor loads with 8 hours backup.

System Health Check Management

- T-Req 86. General Requirements:** In addition to the management, administration, and security requirements specified in earlier sections covering the various hardware and software components of the System, the System must also provide for the following management, administration, and security features at the overall system level.
- T-Req 87.** Monitoring of the system health needs to be through a separate monitoring application and shall be manned by the bidder on 24 x 7 x 365 basis at the Central Monitoring Centre. This service shall be provided for a period of 3 years
- T-Req 88.** The monitoring software needs to provide configuration of alerts on critical parameters. Indicative list of parameters are
- Servers - Server status, memory, disk space, processor load, status of critical processes etc. Covers servers at the distributed locations as in appendix 1
 - Storage – Status of Storage system and alerts for system functioning
 - Network – Network equipment status
 - Network links status Up / Down
 - Other routine features that are normally included in Monitoring applications
- T-Req 89. Technical management and troubleshooting:** Remote management is to be built in for the servers at bus stands provided in Appendix 1 through a well defined interface
- T-Req 90.** Periodic and on demand reports on the status of critical IT infrastructure elements should be provided to KSRTC.



Integration of VTMS Components

Integration Features

T-Req 91. KSRTC will facilitate the successful bidder is expected to interact and arrive at appropriate technical solutions through discussions with the existing solution providers. VTMS will integrate with the following systems

- Passenger Reservation system (AWATAR)
- Scheduling module for Vehicle Fleet Scheduling
- Crew Roster module for allocation of Crew
- Integration will be through a service request-response/ Web Service mechanism for online integration without direct access to any of the existing systems. Alternatively, hand off files are to be provided that will be applied from the source system to the destination systems with no / minimal manual intervention
- Provision to upload data from MS Excel files, text Flat-files with delimiters, or equivalent as input to the VTMS from all allied systems.

Reports

Reporting Features

F-Req 99. VTMS will assist transit managers in establishing scheduled running times. These times are essential for proper transit management and operation. The requirement is directed towards the goal of appropriate time management by using **actual** running time data derived from the VTMS system and balancing the operations for efficiency and effectiveness.

F-Req 100. All reports are to be prepared as per user requirements. The Implementing vendor shall provide all the reports that KSRTC requires, as and when required, in the agreement period. In general, reporting tool will also provide for easy generation of graphics such as histograms, pie chart, etc in 2/3-dimensional and in multi-colour as selected by the end-user. Modification in Report generation utility will not be construed as customization or code modification.

F-Req 101. The solution shall provide analytic reporting tool for dynamic report generation based on user requirements, easily configurable from drop down menu items for selecting the columns for the reports, fonts including time periods and route-wise or other elements of choice.

F-Req 102. Facility shall be provided for reports to be generated on demand / scheduled as nightly runs and emailed to a set of ids maintained. Identified summary reports should be available as trend graphs, pie charts, bar graphs etc as needed.

F-Req 103. Facility for generating a report of the recorded details of the bus movement along the authorized route for a period of 6 months online with 3 years near online archives of data.

F-Req 104. VTMS should support simple statistical analysis of the frequency distribution of actual transit travel times produced by the VTMS system and provide guidance on establishing running times for use in preparing passenger, vehicle and crew schedules. These are between two specified dates in a period or for a specific route/schedule/jurisdiction

F-Req 105. Enable the measurement between arrival time of trips at specific time points / schedules to determine the reliability of service from a customer perspective to enable-effective operational management, VTMS will measure deviations from published schedule for a particular time point to permit at least the identification of problematic route segments and time periods so strategies to fix the problems can be developed

F-Req 106. Perform an analysis of end of line layovers to determine their role in on-time terminal departures – a key determinant of on-time performance along a route.



- F-Req 107.** VTMS will support **simple** statistical analyses; transit analysts would also be able to trade off efficiency with reliability by developing a curve showing the probability of subsequent on-time terminal departures as a function of the scheduled running time
- F-Req 108.** Provision for users to generate Adhoc reports based on pre configured set of parameters with provision to include additional parameters within a reasonable time frame.
- F-Req 109.** Operational performance information shall be available online / near online for a period of at least two financial years for comparison purpose archiving old data up to three years.
- F-Req 110.** Product improvement: This involves modification of application to improve performance, to ease usage, to make application more user-friendly. A semi annual review of the existing system and the enhancements required shall be discussed and taken up separately for implementation

Sample Reports

Some of the sample reports are listed below.

Table 10: Sample report

1	Jurisdiction wise Scheduled trips for the day
2	Speed violation
3	Driver duty performance daily/weekly/monthly
4	Daily out shedding deviation report
5	Driver wise improper stopping
6	Details of Missed trips
7	Reports by Area name (Trip history in area names) –Area traveled by a vehicle on any selected date and time, sector wise.
8	Reports by Location (Trip history in Map Location) - Selected date and time. This gives status of motion, location at that instance and speed of the vehicle
9	Vehicle Traveled Path Report
10	Actual Trip Report
11	Extra Trip Report
12	Consolidated GPS Analysis Report – Operator wise
13	Vehicle Trip revenue details
14	Daily Consolidated GPS Analysis Report – Vehicle wise, Vehicle type wise
15	Vehicle Distance Traveled
16	Average Speed Report - Depot wise/ Operator wise/ Vehicle wise
17	Speed Limit Violation Report- Depot wise & Depot / vehicle wise
18	Periodic Consolidated GPS Analysis Report – Depot wise, Division-wise, vehicle-wise.
19	Consolidated GPS Analysis Report – Depot wise, Division-wise, all.
20	GPS Daily/Monthly Billing Report for Casual/Chartered contract vehicles (if included in future)–Depot wise/Operator wise/vehicle wise
21	Monthly Consolidated GPS Analysis Report- Depot wise



22	Accident analysis Report
23	Location data availability and non-availability report
24	Vehicle Mountable Unit and PIS unit failure report
25	Daily/monthly/weekly distance travel report
26	Stoppage violation reports
27	Schedule adherence report
28	Missed Pickup point/bus stand Detail Report

Daily Bus Stops Skipped Report

Table 11: Sample Bus stops skipped report

Date						Bus Stop Type :		
Sr. No.	Time	Bus No	Route No.	Bus Stop No.	Stage Name	Depot Code	Driver ID.	Conductor ID
Total stops skipped								

Daily Speed Violation Report

Table 12: Daily speed violation report

Date :		Duration more than seconds			
Duty No:		Bus registration No			
Sr. No	Time	Route No	Location Driver No	Duration (Sec)	Speed (Km/h)
1					
2					

Daily Driver Duty Performance

Table 13: Daily Driver Duty Performance report

Date:					
Sr. No	Driver Name:	Driver ID:	MOR/EV	Out-shedded (Y/N)	DUTY STATUS
1					
2					

Daily Out shedding deviation report

Table 14: Daily out-shedding deviation report

Daily Out shedding deviation report						
Date:				Shift:		
Sr. No.	Duty No.	Bus Reg. No.	Scheduled Out-shed Time	Actual Out-shed Time	Deviation time(min)	Reason

**Daily Improper Stopping Report**

Table 15: Daily improper stopping report

Date:							
Sr. No.	Time	Route No	Driver No	Driver Name	Bus Reg. No	Conductor No	Stage Name
1							
2							

Daily Missed Trips Report

Table 16: Daily Missed Trips report

Date :	Missed Trips	Break Down	Bus No	Staff No	Late Out Shedding	Late Running	Route Deviation	Total Missed Trips
Terminal								
Terminal Total								
Grand Total								

Pilot Implementation

- F-Req 111.** The System Integrator will develop a pilot for testing and acceptance before rolling out to ensure that the system meets the purpose effectively. The scope of the pilot implementation will include the following:
- F-Req 112.** The pilot will be run for four weeks to study any issues arising out of the implementation. This will include a systematic survey of the stakeholders through structured questionnaire and analyzing their feedback for incorporating changes as required and appropriate.
- F-Req 113.** Successful completion of pilot project is to be measured as implementation in 20 buses in 2 routes covering 6 bus stands – one starting bus stand, one destination bus stand, and one intermediate bus stand as indicated by KSRTC.
- F-Req 114.** The pilot will be evaluated on the following evaluation factors:
- ETA at bus stands to be accurate by +/- five minutes (displayed 30 minutes (configurable) before arrival of the bus at the bus stand)
 - Availability of Display Sign boards > 98% , Screen refresh at control panels with updated data on bus locations to be within less than 5 seconds
 - Screen should display the location of all buses and must dynamically be able to update the data within 60 seconds (parameterized)
 - 99.9% Availability of application, network and agreed services over the Internet
 - Creating MIS reports on the identified route
 - Average VTMS portal Loading over 64 Kb bandwidth < 10 Secs - Application Portal web pages loading time, page refresh time over
 - Support response for voice queries - through surveys collected every quarter < 5 rings - Calls to be picked within 5 rings
 - Availability of GSM communication network device in-vehicle > 98% - At any point of time minimum 99% of GPS units shall be functional
- F-Req 115.** Implementation of signboards at two bus stands, Implementation of signboards at bus stands in one identified route. This route will be indicated t by KSRTC
- F-Req 116.** Deployment of the minimum infrastructure at the Central Control Station as required to demonstrate the functionality of the stipulated services of the VTMS



- F-Req 117.** The Pilot implementation and acceptance will be signed off by the Head of the Project Implementation Committee based on the report submitted by the third party Project manager selected by KSRTC as part of the Project Management Consultancy.
- F-Req 118.** If for any reason the pilot is found to be deficient, these will be communicated to the vendor in writing on the lapses that need to be made good. A one-time extension will be provided to the vendor for making good the lapses pointed out and offering the system to PIC for review.
- F-Req 119.** Based on the test results and feedback from the pilot implementation, the Project Manager in shall draw up a schedule for implementing the changes which shall be reviewed / modified / approved by the PIC. The changes approved will be implemented and tested again before the final acceptance by the PIC. On approval by the PIC, the system Integrator will plan the rollout across all the routes in coordination with the Project Management Consultancy (PMC)

Training

- F-Req 120.** The supplier shall be responsible for effectively providing training to the bus drivers/ Conductors, Control room Staff, Depot Managers / operators, in various operations and shall also train KSRTC identified IT systems staff in the maintenance of the Vehicle Tracking and Monitoring System including the data center and control room equipment and services.
- F-Req 121.** The number of personnel trained is indicated in the table below:

Table 17: Strength of personnel required to be trained

#	Category	# to be trained	Details of Training
1	Drivers		VTMS- VMU operations and quick trouble shooting skills
2	Conductors		VTMS- VMU operations and quick trouble shooting skills;
3	data center and control room		VTMS application operations Quick trouble shooting techniques
4	Depot Operators / Managers		MIS and data analyses for improving operational efficiency
5	Traffic dept /IT Systems Staff		VTMS application operations data center and control room infrastructure configuration, maintenance and trouble shooting

- F-Req 122.** The supplier shall provide world class printed documented training manual on all areas of training as listed in the table below. The Project Manager / PIC will have the rights to review the documents for the supplier to make the changes both in its content and form.

Implementation Schedule (Entire System)

- F-Req 123.** The planned implementation schedule for the complete procurement, installation, and commissioning is detailed below. The SI may however, submit a detailed project plan for implementation for review, consideration and acceptance by the PIC. Once approved, the schedule needs to be adhered to which otherwise could invoke liquidated damages. A sample Project plan is attached, a summary of which is given below: Expected date to start the implementation is 10-10-2011; the project should go live on 25-03-2012; in **5½ months**. Detailed project plan for VTMS implementation is attached.



Table 18: VTMS Implementation Schedule

#	Activity / Milestone	Days	Liquidated Damages
A	Data center and control room	30	yes
1	"Preparation for provisioning power, cabling, UPS at Data center in KSRTC HQs"	3	
2	Structured cabling connecting Data center facility with back end systems & testing connectivity	3	
3	"Deployment & configuration of Hardware systems, operating systems, databases, networks (LAN/WAN) etc in Data center & control room"	8	
4	"Deploying Application subsystems - VTMS, PIS, configuration and customization"	10	
5	Configuring and integration testing	3	
6	Training	3	
B	VTMS Pilot implementation (one month)	30	Yes
1	Determining geo position of each bus stand/bus stop/pickup point and other points of interest through Survey in the pilot routes (Geo coding and geo fencing)	10	
2	Setting up connectivity with the ISP for Broadband / GSM/GPRS in the pilot routes / bus stands	7	
3	"Installing VMU - GPS Navigation System, 2-way voice communication in 20 buses in 2 routes"	3	
4	"Installing, Testing & Commissioning Display boards in 6 Bus stands in identified routes"	7	
5	Monitoring & feedback from the pilot	3	
C	VTMS Full implementation	95	Yes
1	Determining geo position of remaining bus stand/bus stop/pickup point and other points of interest through Survey in the pilot routes (Geo coding and geo fencing)	25	
2	"Site preparation - power supply, civil works for mounting the display units at Bus Stands and the control room"	15	
3	"Installing VMU - GPS Navigation System, 2-way voice communication in remaining buses"	25	
4	Setting up connectivity with the ISP for Broadband / GSM/GPRS in all routes / bus stands	10	
5	Configuring the applications at Data center with the survey data	8	
6	Integration Testing	5	
7	Training	7	
D	Go Live	10	Yes
1	Preparation for the Launch Date	3	
2	Operational testing and help services after "go-live"	7	
3	Ongoing Operation & support (3 years)		



Appendix – 1: Proposed Bus stands for installation of Information Display units:

Table 19: List of bus stands for display units

Sl. No	Place	Bus stand	Number of Information Display units
1	Bangalore	Kempegowda Bus stand	6
2	Bangalore	Satellite Bus Stand	3
3	Bangalore	Shantinagar	1
4	Bangalore	Byappanahalli	1
5	Mysore	Moffusil Bus Stand	4
6	Mangalore	Bus stand	2
7	Hassan	New Bus Stand	3
8	Tumkur	Bus stand	1
9	Mandya	Bus stand	1
10	Davanagere	Bus stand	1
11	Shimoga	Bus stand	1
12	Chitradurga	Bus stand	1
13	Harihara	Bus stand	1
14	Dharmasthala	Bus stands	2
15	Kukkesubramanya	Bus stand	1
16	Chikkamangalore	Bus stand	1
17	Chikkaballapura	Bus stand	1
18	Madikeri	Bus stand	1
19	Ramanagar	Bus stand	1
20	Kolar	Bus stand	1
21	Maddur	Bus stand	1
22	Chamarajanagara	Bus stand	1
23	Chennapatna	Bus stand	1
24	Puttur	Bus stand	1
25	Hubli	Bus stands	2
26	Belgaum	Bus stand	1
27	Gulbarga	Bus stand	1
28	Bellary	Bus stand	1
29	Bidar	Bus stand	1
30	Raichur	Bus stand	1
31	Dharwad	Bus stand	1
32	Chennai	Koyambedu Bus stand	1
33	Coimbatore	Central Bus stand	1
34	Tirupathi	Central Bus stand	1
35	Hyderabad	Central Bus stand	1
		Total	50

Note: KSRTC jurisdiction-38, Interstate-4, NEKRTC-4 & NWKRTC -4

- F-Req 124.** Implementing Vendor may provide an alternative deployment plan. KSRTC shall review the same and may agree to such plan submitted by Implementing Vendor.
- F-Req 125.** The implementation of the entire system should be completed in all respects within 5½ (Five & half) months of signing of Agreement.