

**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**



**DRAFT SPECIFICATION
OF
REAL-TIME TRAIN INFORMATION SYSTEM**

SPECIFICATION NO. RDSO/SPN/TC/77/2011

VERSION 1.0

ISSUED BY

**TELECOM DIRECTORATE
RESEARCH DESIGNS & STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW-226011**

SECTION-I

GENERAL

1.0 Railway Board vide their letter no. 2003/E&R/3400/20/TMRS dated 25.11.2003 communicated approval to RDSO/Lucknow for taking up 14 Projects under Technology Mission for Railway Safety with IIT/Kanpur. One of the project was “Satellite Imaging for Rail Navigation(SIMRAN)” which covers;

- (i) GPS based Real Time Train Tracking.
- (ii) Wireless Connectivity.

Accordingly, a pilot project on Satellite Imaging for Rail Navigation (SIMRAN) was taken up and executed jointly by IIT/Kanpur and RDSO/Lucknow, which involves Real Time Train Tracking System using Global Positioning System (GPS) and Global System for Mobile (GSM) technologies. The project envisaged dissemination of Real Time Train Running Information through Internet, SMS and Display Boards at the Stations/Trains.

A schematic of System Architecture is given in Figure 1.

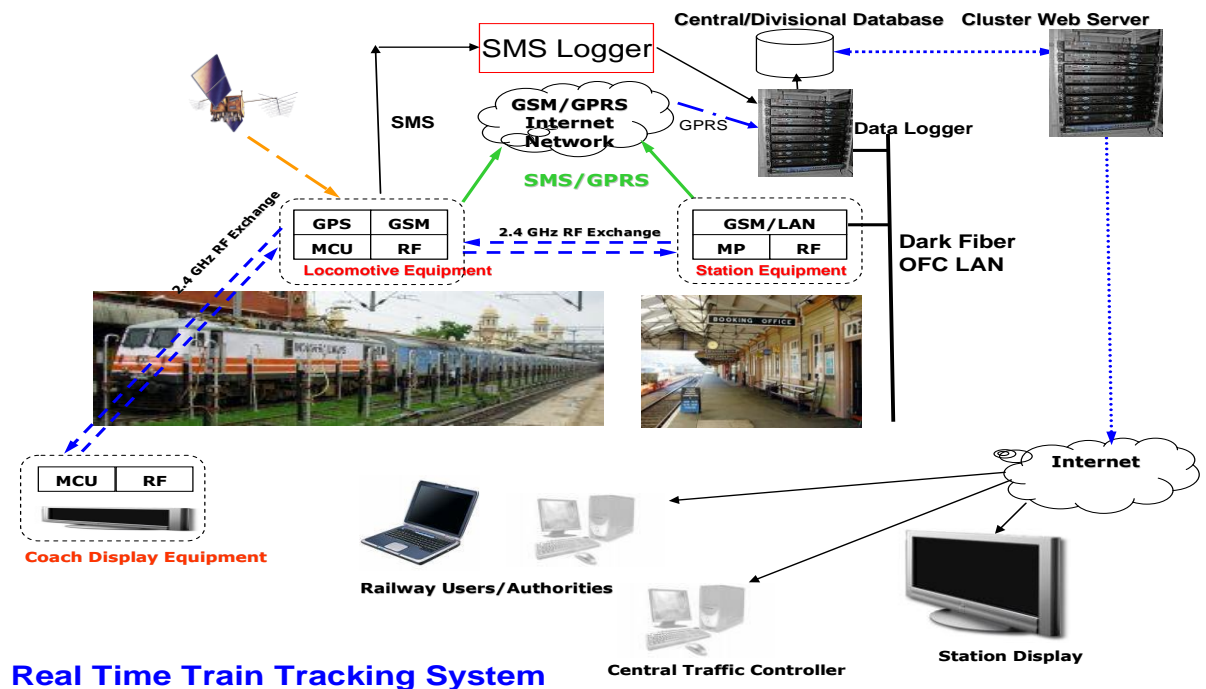


Fig. 1. Real-Time Train Information System

1.1 Railway Board vide letter No.2011/Tele/2(2)1 dated 17.11.2011 directed RDSO to issue Specification of Real Time Train Information System.

1.2 The Specification covers the requirements of Real Time Train Information System(RTIS) and is based upon technology developed under Pilot Project SIMRAN. The RTIS comprises of following major Sub System/Equipment.

- Locomotive Equipment
- Station Equipment
- Central Server

Locomotive Equipment acquires its location through inbuilt GPS Receiver and forward it to Central Server via GPRS. In section where GSM Coverage is not available, Location Information is forwarded from Locomotive Equipment to Station Equipment over RF, from where it is forwarded to Central Server via OFC Network.

1.6 This specification comprises of 4(Four) sections including this section (Section I).

1.6.1 Section II covers Equipment Architecture, Functional, Technical, Electrical and Mechanical Requirement etc. for **Locomotive Equipment**.

1.6.2 Section III covers Equipment Architecture, Functional, Technical, Electrical and Mechanical Requirement etc. for **Station Equipments**.

1.6.3 Section IV covers System Architecture, Functional, Technical and Electrical Requirement for **Servers & Networking Equipments** to be provided at Data Centre of RTIS.

1.7 Security Software such as Antivirus, Anti-Intrusion Prevention and Secured Authentication Process shall be provided.

1.8 System shall provide full Network Monitoring, Performance Logging, Statistics & Management Reporting. Out of band Maintenance Channel between Train and Remote Maintenance Centre shall be provided.

1.9 The System shall comply with all prevailing Cyber Law and/or Internet Security Law and various stipulations in this regard in India.

1.10 All requisite Statutory and Regulatory clearances shall be obtained from DOT, Ministry of Information & Broadcasting, DOS, NOCC, SACFA and WPC by Purchaser/System Provider as applicable.

1.11 System Provider shall demonstrate working of complete system as proposed to be supplied either in a Working Railway System or in Lab Environment before supply to the Purchaser.

SECTION II

LOCOMOTIVE EQUIPMENT

2.0 GENERAL:

This section covers the requirement of Locomotive Equipments of Real Time Train Information System to be installed on the Electric as well as Diesel Locomotives.

2.1 GENERAL REQUIREMENT:

2.1.1 Locomotive Equipment shall mainly consist of Processing Unit Motherboard, Memory, GPS Receiver, GSM Modem, RF Transceiver, Display, Keypad and Power Supply Module including Inbuilt Battery.

2.1.2 'Power On' indication with RED LED shall be available in the Locomotive Equipment, which shall glow when Power is available at the output of Power Supply Module.

2.1.3 The Locomotive Equipment shall support and work on Open Source Linux Operating System. This Linux Operating System shall be sourced from reputed Linux Operating System Provider such as Debian, CentOS, Red Hat, Fedora, SUSE & Ubuntu to enable Service Support in India. Latest available version of Linux OS shall be used. Application Software as approved by Purchaser shall be loaded into Locomotive Equipment.

2.1.4 Locomotive Equipment shall be capable of working upto 200 Kmph. Locomotive Equipment shall be suitable for EMUs, MEMUs, DMUs, Electric Locomotives & Diesel Locomotives including Microprocessor based Locomotives running on Indian Railways.

2.1.5 Locomotive Equipment shall be capable of working in different Railway Electrified Sections(25 KV AC, 1500 V DC & 750 V DC) as well as Non-Electrified sections of Indian Railway.

2.1.6 The Locomotive Equipment and 'its Antenna'/'Any other Fitting' shall not in any way infringe the Schedule of Dimensions(SOD) being followed on Indian Railway.

2.1.7 Equipments, Wires & Cables, Fixing Arrangements etc. to be installed Inside & Outside Locomotives shall be of Fire Retardant Material and shall not cause fire.

2.1.8 Suitable Label Plate (etched/engraved/anodized or any other arrangement) ensuring durability shall be suitably fixed on each rack/module/equipment and contain following information.

- Specification Number
- Manufacturer's name and identification
- Model No.
- Unit Serial No.
- Year of manufacture

2.2 FUNCTIONAL REQUIREMENT:

- 2.2.1 When Powered ON, the Locomotive Equipment shall display Software Version on the LCD Display for a period of 5 Seconds. Subsequently Locomotive Equipment shall acquire GPS Co-ordinates and GPS Clock. The Internal Clock of Locomotive Equipment shall be synchronized to GPS Clock. Current Time(24 Hours Format) shall be displayed on Top Left of LCD Display to be displayed till Locomotive Equipment is Powered Off. Locomotive Equipment shall be capable to display Locomotive Speed(Kmph) acquired through GPS on Top Right of LCD Display, if required in future by Purchaser.
- 2.2.2 Subsequently Locomotive Equipment shall establish Two GPRS Connection with MSP(Mobile Service Provider) via Two GSM Modems using WVDIAL. GPRS Connection once established shall be kept CONNECTED until it is broken either because of Non-availability of GSM Coverage or due to some other reason. The availability of both GPRS Connections shall be continuously checked using PPP Daemon and WVDIAL every 30 seconds.
- 2.2.3 Communication between Locomotive Equipment and Train Operation Server/Data Logger Server shall be using TCP/IP. Further to provide security (Authentication, Confidentiality & Integrity) for transmission over GSM Network/Internet, Public-Private Key Encryption (Asymmetric Key Algorithm) using Secured Socket Layer(SSL) Protocol shall be implemented.
- 2.2.4 After Power ON Process, Locomotive Equipment should start sending every minute at HH:MM:00 Heart Beat(HB) Messages to both Data Logging Servers via one of the GPRS Connection. These HB Messages contain information pertaining to Locomotive Equipment at time HH:MM:00. This information includes Equipment Id, GPS Date & Time Stamp, Longitude, Latitude and Speed of the Vehicle on which Locomotive Equipment is installed.
- 2.2.5 After Power ON Process, Locomotive Equipment should start broadcasting every 3 Seconds, at HH:MM:00/03/...../57 HB Messages via RF Transceiver. These HB Messages contain information pertaining to Locomotive Equipment at time HH:MM:00/03/...../57. This information includes Equipment Id, GPS Date & Time Stamp, Longitude, Latitude and Speed of the Vehicle on which Locomotive Equipment is installed.
- 2.2.6 After Power ON Process, Locomotive Equipment should start sending every 6 Minute at HH:00/06/12.../48/54:00 Control (CTL) Messages to both Train Operation Servers via one of the GPRS Connection. These CTL Messages contain information regarding Locomotive Equipment IP Address (as allotted by MSP) at time HH:00/06/12.../48/54:00. This also includes Equipment Id, GPS Date & Time Stamp.
- 2.2.7 Subsequently, Locomotive Equipment will acquire from Train Operation Servers any update if available w.r.t. IP Address and Port Number of Train Operation Servers and Data Logging Servers. It will also acquire Table w.r.t. to latest Version of Locomotive Equipment Software from Train Operation Server. If Locomotive Equipment Software has been updated, it shall be downloaded from Train Operation Server at 04:00 Hours and installed on Locomotive Equipment.
- 2.2.8 On Pressing Log-In Key, Log-In Page shall be opened, which will prompt User to enter 4-8 Digit Alphanumeric User Id and 4 Digit Alphanumeric Password. While entering User Id, it

shall be displayed at LCD Display. While entering Password it shall be displayed as '*' on LCD Display. After entering above details and pressing Enter Key, User Id and Password will be checked with Train Operation Servers via GPRS Connection.

2.2.9 On Pressing Train Registration Key, Train Registration Page will be displayed on LCD Display which will prompt User to enter Train Category P(Passenger) or G(Goods) or S(Special) Train.

2.2.9.1 On entering P, User will be prompted to enter Train Number and Originating Station Train Date. This Train Number Prefixed with P will be conveyed alongwith Originating Station Train Date, Current Date & Time Stamp, GPS Co-ordinates & Equipment Id to Train Operation Server.

On receipt of Confirmation, Train Category and Train Number shall be Displayed in Top-Right of LCD Display to be continued till Deregistration/Detachment is done.

2.2.9.2 On entering G, Originating Station Train Date will be acquired from GPS Clock and displayed on the screen. This Train Category will be conveyed alongwith Originating Station Train Date, Current Date & Time Stamp, GPS Co-ordinates & Equipment Id to Train Operation Server.

Confirmation for above Registration will be received from Train Operation Server which will include 5 Digit random Train Token Number. On receipt of Confirmation Train Category and Train Token Number shall be Displayed in Top-Right of LCD Display to be continued till Deregistration/Detach is done.

2.2.9.3 Similarly On entering S, Originating Station Train Date will be acquired from GPS Clock and displayed on the screen. This Train Category will be conveyed alongwith Originating Station Train Date, Current Date & Time Stamp, GPS Co-ordinates & Equipment Id to Train Operation Server.

Confirmation for above Registration will be received from Train Operation Server which will include 5 Digit random Train Token Number. On receipt of Confirmation Train Category and Train Token Number shall be Displayed in Top-Right of LCD Display to be continued till Deregistration/Detachment is done.

2.2.10 On Pressing Train Detach Key followed by Confirmation Key, Train Category, Train (Token) Number alongwith Originating Station Train Date, Current Date & Time Stamp, GPS Co-ordinates & Equipment Id to Train Operation Server will be conveyed to Train Operation Server. On receipt of confirmation of Detach from Train Operation Server, Locomotive Equipment will stop displaying Train Category and Train (Token) Number on its LCD Display and will be ready for Registration/Attach.

2.2.11 On Pressing Train Attach Key, Train Registration Page will be displayed which will prompt User to enter Train Category P(Passenger) or G(Goods) or S(Special) Train.

2.2.11.1 On entering P, User will be prompted to enter Train Number and Originating Station Train Date. This Train Number Prefixed with P will be conveyed alongwith Originating Station Train Date, Date & Time Stamp, GPS Co-ordinates & Equipment Id to Train Operation Server.

On receipt of Confirmation, Train Category and Train Number shall be displayed in Top-Right of LCD Display to be continued till Deregistration/Detach is done.

- 2.2.11.2 On entering G, User will be prompted to enter 5-Digit Train Token Number which has been conveyed by previous Locomotive Pilot. This Train Token Number will be conveyed alongwith Train Category, Current Date & Time Stamp, GPS Co-ordinates & Equipment Id to Train Operation Server.

Confirmation for above Attachment will be received from Train Operation Server. On receipt of Confirmation Train Category and Train Token Number shall be Displayed in Top-Right of LCD Display to be continued till Deregistration/Detachment is done.

- 2.2.11.3 Similarly On entering S, User will be prompted to enter 5-Digit Train Token Number which has been conveyed by previous Locomotive Pilot. This Train Token Number will be conveyed alongwith Train Category, Current Date & Time Stamp, GPS Co-ordinates & Equipment Id to Train Operation Server.

Confirmation for above Attachment will be received from Train Operation Server. On receipt of Confirmation Train Category and Train Token Number shall be Displayed in Top-Right of LCD Display to be continued till Deregistration/Detachment is done.

- 2.2.12 If the Train is registered under P Category, Locomotive Equipment shall ask from Train Operation Server, Train Profile and Route Profile from Originating Station to Destination Station. Train Profile is Working Time Table of Train, while Route Profile includes information like, En-route Stations GPS Co-Ordinates, Distance between Adjacent Stations, Stations Divisions and Stations State.

- 2.2.13 If the Train is registered under G or S Category, Locomotive Equipment shall ask for Route Profile from Train Operation Server from Current Station(based upon GPS Co-ordinates) to all the possible routes upto next Junction Stations. On reaching next Junction Stations, Locomotive Equipment shall ask for Route Profile from Train Operation Server from Current Junction Station(based upon GPS Co-ordinates) to all the possible routes upto next Junction Stations , and so on.

Based upon available Route Profiles, and Train Movement Data(GPS Co-Ordinates) of Train, Locomotive Equipment, shall decides the actual route on which it is travelling and accept take corresponding Route Profile as Current Route Profile.

- 2.2.14 Once Locomotive Equipment is registered against a Train (Token) Number, HB messages from GSM Modem as well as RF Transceiver which are being transmitted vide Clause 2.2.4 & Clause 2.2.5 will include Train (Token) Number also.

- 2.2.15 Locomotive Equipment shall have the process of checking availability of both GPRS Connections at every 10 Seconds using WVDIAL and PPPD. If both GPRS Connections are available, one will be flagged as Active and other as Reserve. If only one GPRS Connection is available it will be flagged Active and other will be flagged as Failed. If none of the GPRS Connection is available, both will flagged as Failed.

- 2.2.16 Heat Beat messages will be transmitted every minutes by Active GSM Modem at HH:MM:00. Active GSM Modem will send messages to both Data Logging Servers simultaneously. HB messages which were successfully delivered to both Data Logging Servers shall be kept in Delivered Message Memory in Solid State Disk of Locomotive Equipment, which will keep these data for 3 Days. Messages which were not successfully sent to either of Data Logging Server shall be kept in Pending Message Memory in Solid State Disk of Locomotive Equipment, which will keep these data for 3 Days.
- 2.2.17 Active GSM Modem will check messages from Pending Message Memory and try sending to respective server(s) at every minute at HH:MM:30. Once message is delivered, it will be moved from Pending Message Memory to Delivered Message Memory. These Pending Messages shall be delivered in FIFO Manner.
- 2.2.18 Based upon Route Profile available with Locomotive Equipment, it shall determine Station Passing Message, Station Arrival Message, Station Departure Message and Non-Schedule Stop Message. These messages shall be transmitted as and when events happen by Active GSM Modem as well as by RF Transceiver.
- 2.2.18.1 When Train is approaching a Railway Station and is within Approx. 300 Meter of Railway Station, it will generate and send a message called as Station Passing Message (**PEX**) to Data Logger Server. This information includes Equipment Id, Train Id, GPS Date & Time Stamp, Station Code, Message Type(PEX), Longitude, Latitude and Speed of the Vehicle on which Locomotive Equipment is installed.
- 2.2.18.2 When Train is within Approx. 300 Meter of Railway Station and its speed is close to 0(Zero) Kmph, it will generate and send a message called as Station Arrival Message (**AEX**) to Data Logger Server. This information includes Equipment Id, Train Id, GPS Date & Time Stamp, Station Code, Message Type(AEX), Longitude, Latitude and Speed of the Vehicle on which Locomotive Equipment is installed.
- 2.2.18.3 When Train has generated and send AEX Message and then it acquires a speed of approximately 5 Kmph, it will generate and send a message called as Station Departure Message (**DEX**) to Data Logger Server. This information includes Equipment Id, Train Id, GPS Date & Time Stamp, Station Code, Message Type(DEX), Longitude, Latitude and Speed of the Vehicle on which Locomotive Equipment is installed.
- 2.2.18.4 When a Passenger Train, has stopped at Non-Scheduled Stoppage, it will generate and send a Non-Scheduled Stoppage(**NSS**) Message to Data Logger Server. This information includes Equipment Id, Train Id, GPS Date & Time Stamp, Station Code, Message Type(NSS), Longitude, Latitude and Speed of the Vehicle on which Locomotive Equipment is installed.
- 2.2.19 If a Message(PEX, AEX, DES and NSS) is not delivered by GPRS, it shall be kept in Pending Message Memory till it is delivered by an Active GPRS Modem to both the Data Logger Server.
- 2.2.20 If both the GPRS Connections are not available and flagged as Failed, then Locomotive Equipment will send the last Pending Message which has not been delivered to either of Data Logging Server to RS-232 Port provided for External Connection to MSS Transmitter. Subsequently it will keep sending HB, Station Passing Message, Station Arrival Message and Station Departure Message to RS-232 Port till at least one of the GPRS Connection is Active

and at least one message has been successfully delivered to at least one of the Data Logging Server.

2.2.21 On pressing Diversion, in Emergency Route Change for Passenger Train, Route Change Message will be generated and transmitted to Train Operation Server. The message includes details like Train Id, Originating Station Train Date, Date & Time Stamp, GPS Co-ordinates & Equipment Id.

On receipt of above message all possible Route Profile to Next Junction Station will be transmitted from Train Operation Server to Locomotive Equipment in predefined Format. Locomotive Equipment will decide the Correct Route Profile on which Train is moving using its own Train Movement Data(GPS Co-ordinates). On reaching Next Junction Station this process will be repeated and so on.

2.2.22 Among HB, PEX, AEX & DEX, the highest priority shall be assigned to PEX/AEX/DEX Messages and HB has least priority.

2.2.23 On Pressing Train Deregistration Key followed by Enter Key, Train Category, Train Number alongwith Originating Station Train Date, Date & Time Stamp, GPS Co-ordinates & Equipment Id to Train Operation Server will be conveyed to Train Operation Server. On receipt of confirmation of Deregistration from Train Operation Server, Locomotive Equipment will stop displaying Train Category and Train Number on its LCD Display and will be ready for Registration/Attach.

2.2.24 On pressing Logout Button of Locomotive Equipment, Locomotive Equipment will be locked. For Registration/Attach of Train, Login is required to be done.

2.2.25 This equipment shall continuously track GPS Satellites and accordingly record every second Position(Longitude, Latitude and Altitude), GMT Time and Speed parameters. These parameters shall be saved in memory of Locomotive Equipment.

2.2.26 The Locomotive Equipment, at its commissioning is required to be configuration with Central Server. During Configuration Process it will send following information to Central Server:

- Locomotive ID,
- Locomotive Equipment Physical ID,
- Locomotive Equipment GSM IMEI Nos. & SIM Card Nos.,
- Locomotive Equipment Phone Nos.,
- Hardware Version,
- Embedded Software Version

After receiving these information Central Server will verify these information for suitability of operation. If found suitable Central Server shall send a Configuration Confirmation message to Locomotive Equipment. Only after successful completion of above Configuration Process, Central Server shall starts exchange of messages with the concerned Locomotive Equipment.

Configuration process shall be repeated as and when any information mentioned above is changed in Locomotive Equipment.

2.3 TECHNICAL REQUIREMENTS:

2.3.1 Locomotive Equipment shall have a built-in GPS Receiver for getting GPS Co-ordinates(Longitude, Latitude & Altitude), Speed and Time-Stamp from Satellite System. The GPS Receiver shall comply following specifications.

- L1 Frequency C/A Code with 12 (or higher) independent Tracking Module(Channels).
- It shall support NMEA-0183 Protocol.
- Tracking Sensitivity shall be better than -150 dBm.
- Autonomous Positional Accuracy shall be better than 10 Meter.
- Suitable to work with Maximum Altitude of 18,000 Meter
- Suitable to work with Maximum Speed of 200 Kmph.
- Update Rate shall be 1 Hz
- Reacquisition time < 1 Second
- Cold Start better than 45 Seconds
- Warm Start shall be better than 38 Seconds.
- Hot start better that 5 Seconds
- Antenna Short Circuit Protection
- Built-in Antenna supervisory circuit for determination of active antenna open or short state
- Built-in non volatile RTC with battery backup option

2.3.2 This equipment shall have Two(2) built-in GSM Modules. By inserting SIM Card of Public GSM Service Provider it should be possible to send message through GPRS or SMS. GSM Module shall comply with the following specifications.

- Frequency Band GSM 850, GSM 900, DCS 1800, PCS 1900.
- Transmit Power 2 W at EGSM 900 and GSM 850
1 W at DCS 1800 and PCS 1900
- GPRS Connectivity GPRS multi-slot class 10
- GPRS Data Downlink Data Transfer is 85.6 kbps max.
Uplink Data Transfer is 42.8 kbps max.
- Serial Port Interface can be used for CSD, GPRS and for AT Commands.
- GSM Module should support MT, MO, CB, Text and PDU Mode.
- GSM Module should integrate the TCP/IP Protocol.
- It should have 50 Ohm antenna connector for connecting external antenna.
- GSM Module should support SIM Card of 1.8 V and 3V.
- Built in non volatile RTC with battery backup option

2.3.3 This Locomotive Equipment shall have RS-232 Port for future provision of one-way transmission of short messages from Locomotives to Central Server via external 'INSAT Mobile Satellite Service(MSS) Transmitter'.

MSS Transmitter alongwith INSAT Satellite Transponder and MSS Hub provides one-way transmission of short messages from Locomotives to Central Server with following characteristics.

- Information Rate 300 BPS
- Message Length 40 Characters Maximum
- Error Control Rate ½ FEC and 16 Bit CRC
- Transmission Randomized Transmission of 3 bursts per Message in Maximum 46 Seconds.
- Modulation Differentially encoded BPSK
- Transmission Frequency 2677.56-2678.56 or 2688.56-2689.56 MHz.
- LO Stability + 1 PPM
- Channel Spacing 10 KHz
- Transmit EIRP 8 dBW Minimum over + 45° Off-Axis

NOTE: MSS Transmitter, INSAT Satellite Transponder and MSS Hub are not covered under the Scope of this Specification.

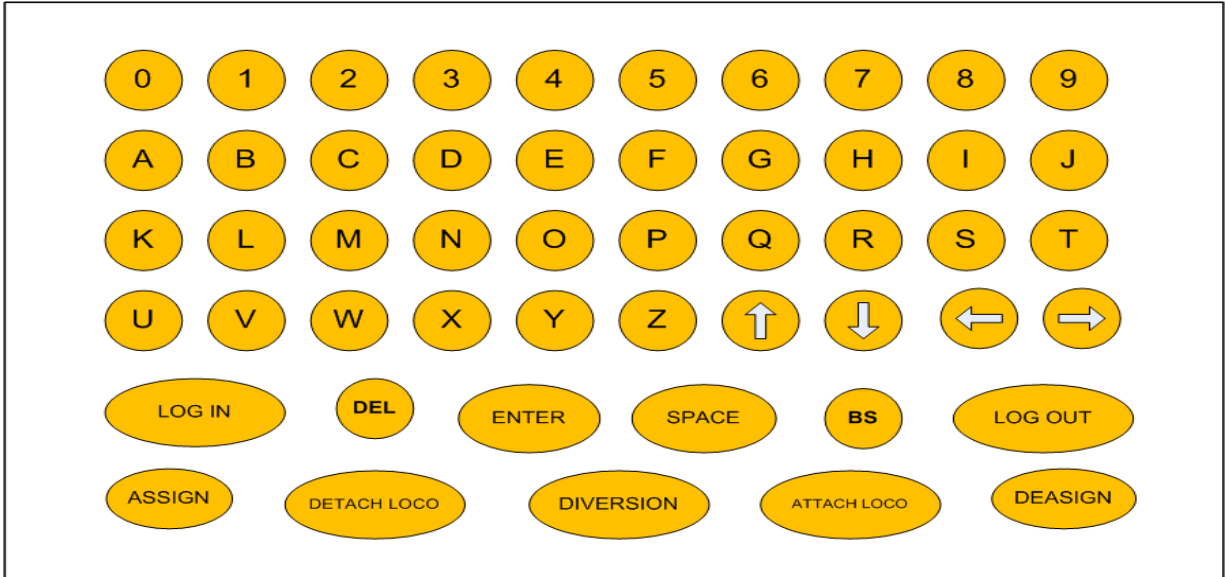
2.3.4 Locomotive Equipment shall have built-in RF Transceivers to communicate with Station Equipment of RTIS. This RF Transceivers shall comply with following specifications.

- Operating Frequency 2.4 GHz
- Protocol IEEE 802.15.4
- Minimum Transmit Power Output 100mW(20dBm).
- Permitted Maximum Power 1 Watt in spread of 10 MHz or Higher.
- Receiver Sensitivity -100 dBm (1% packet error rate)
- RF Data Rate 250,000 bps
- Serial Interface Data Rate 1200-115200 bps
- Supported Network Topologies Point-to-Point, Point-to-Multipoint & Peer-to-Peer.

2.3.5 Locomotive Equipment shall have built in 7”-10” Colour LCD Display for Loco Pilot Interface. This LCD Display shall also be used for Configuration and Fault Diagnosis. The Specification of Colour LCD Displays are as below:

- Resolution 1024 X 768
- Screen Type SVGA
- Typical Contrast Ratio 1000 : 1
- Dynamic contrast Ratio 1000,000 : 1
- Colours 16.2 Millions
- Viewing Angle 160°

2.3.6 Locomotive Equipment shall have built-in Alphanumeric Keypad to enable functions like Login, Train Assignment/Deassignment, Train Attach/Detach, Route Diversion, Train Logout etc. The Schematic Layout of this Alphanumeric Keypad shall be as below:



This Alphanumeric Keypad shall comply with following specifications.

- Membrane Type
- Contact Bounce shall be less than 5 ms.
- It shall have minimum Cyclic Life of 5 Millions Cycles.

2.3.7 This equipment shall have built-in Industry Grade Solid State Drive(SSD) of Minimum 64 GB. The Specification of SSD are as below

- | | |
|--------------------|-------------------------------|
| • Form Factor | 2.5 Inch |
| • Storage Capacity | 64 GB Minimum |
| • Memory Type | Non-Volatile Flash |
| • Connector | SATA 7+15 Pin Combo Connector |
| • Read Speed | Minimum 200 MB/Second |
| • Write Speed | Minimum 100 MB/Second |

Operating System Software and Application Software shall be kept in this SSD Memory. Further, this SSD Memory shall be keeping data received through GPS Receivers for at least 30 Days. This SSD Memory shall also be keeping data related with Onboard Diagnostics System for a duration of 15 Days. This SSD Memory shall also be keeping Delivered Message Data and Pending Message Data of 7 Days.

2.3.8 The Processing Unit Motherboard of Locomotive Equipment shall be based upon Intel Atom Processor with following minimum specifications:

- | | |
|-------------------|---------------------------|
| • Processor | Intel Atom |
| • Clock Speed | Minimum 1 GHz |
| • RAM | 1 GB DDR2/DDR3 |
| • Graphic Display | SVGA |
| • Ethernet | One RJ45 Gigabit Ethernet |
| • SATA Port | One for 64 GB SSD |

- USB 4(Four) USB 2.0 Ports
- Audio Interface Mic in & Line out
- Watchdog Timer Programmable via S/W from 1 Second to 100 Seconds
- Input Supply 12 V DC
- Ventilation Fanless

2.3.9 The Locomotive Equipment at “Incoming Power Supply Input” shall be protected with pluggable Surge Protection Devices (SPDs) which consists of combination of MOV/Suppressor Diode and GD tube. This protection shall be in compliance to IEC 61643-1. Protection against Short Circuit shall also be provided through Circuit Breaker.

2.3.10 Locomotive Equipment shall have in-built Power Supply Module. This Power Supply Module will address the Power Requirement of Locomotive Equipment including future provision of external MSS Transmitter. This Power Supply Module shall be SMPS based with following minimum specifications.

- Input Supply Range 50-150 Volt, DC Supply or 70-300 Volt, 50/60 Hz, AC Supply
- Output Supply 12 Volt, 6 Amp., DC Supply
- In-built Battery Minimum 4000 mAH NiMH or Li-Ion Battery
- Battery Charger It should be capable of charging fully discharged above NiMH or Li-Ion Battery in 4 Hours
- Output Supply Ripple 50 mV Peak to Peak

2.3.11 In addition, Locomotive Equipment shall have 12 V DC, 5 Amp DC Power Supply Port for ‘INSAT Mobile Satellite Service(MSS) Transmitter’. As such Power Supply requirement of MSS Transmitter will be addressed by Power Supply Module of Locomotive Equipment.

2.3.12 The Locomotive Equipment shall work as transmission platform through which data generated by Onboard Diagnostics System or any other Data Generated Onboard which shall be transmitted to a designated server. The Locomotive Equipment shall have One Ethernet Port and One USB 2.0 Interfaces.

2.3.13 In addition, One USB 2.0 Interface shall be available, via which Software Loading/Deletion, Configuration, Diagnostics shall be carried out.

2.3.14 The Antenna for GPS, GSM and RF Transceiver of Locomotive Equipment shall be Screw Mounting Type and shall be Waterproof and Weather proof. The height of these antenna along with mounting arrangement shall not be more than 200 mm above Train Roof Level. These antenna shall have following specifications:

- GPS Antenna
 - Centre Frequency: 1575.42 MHz
 - VSWR : less than 1.5:1
 - Peak Gain : 3dBi
- 2 GSM Antennae

- Frequency: 824-960 Mhz; & 1800 MHz
 - Impedance: 50 Ohm
 - VSWR: less than 2.0:1
 - Typical Gain: 2 dBi +/- 1dB at 850 Hz
- RF Antenna
 - Frequency Range: 2400-2500 MHz
 - VSWR: less than 1.5:1
 - Impedance: 50 Ohm
 - Polarization Type: Vertical
 - Antenna Type: Omni

In electric locomotives, these Antennae would be mounted on the roof of the Locomotives and would be working in the close vicinity of 25KV/50Hz conductor, which is high EMI Zone. As such Antennae and RF Transceiver shall be suitable for working in this harsh environment.

- 2.3.15 The design of the Locomotive Equipment shall be robust and with State-of-the-Art Technology. The design shall be modular for ease of maintenance, replacement and fault troubleshooting.
- 2.3.16 The size of Locomotive Equipment shall not exceed 300 mm X 300 mm X 150mm(H x W x D). The housing of this Locomotive Equipment shall be constructed out of minimum 0.8 mm thick CRCA Sheet to IS:513 Grade-O. This housing shall meet the requirement of IP 65 as specified in IS-13947. This housing shall be Powder coated in black color shade.
- 2.3.17 Locomotive Equipment shall have provision to facilitate its mounting which is rugged enough on all types of Locomotives so that Locomotive Equipment does not get detached during the run of train. Further, this provision shall also meet the requirements as defined in Clause 2.5. This provision to facilitate mounting shall be as approved by Purchaser.
- 2.3.18 All individual modules i.e. Processing Unit Motherboard, Memory, GPS Receiver, GSM Modem, RF Transceiver, Display, Keypad, Power Supply Module and I/O Interface Module etc. shall be accommodated inside single housing.
- 2.3.19 All type of connectors used in Locomotive Equipment shall be lockable and sturdy enough to bear the harsh environment of Locomotives.
- 2.3.20 All insulated conductors except those within the confines of a printed circuit board assembly shall be of the rating enough to withstand the maximum current voltage during fault and overload.
- 2.3.21 All wiring shall be neatly secured in position and adequately supported. Where wires pass through any part of metal panel or cover, the hole through which they pass shall be suitably bushed with rubber grommet.
- 2.3.22 All non-current carrying metal parts shall be bonded together and earthed. An earth terminal suitable for taking minimum 4 mm dia wire and with suitable marking shall be provided.

- 2.3.23 All materials and workmanship shall be of professional quality to ensure high reliability.
- 2.3.24 The equipment and components shall not use any material which support combustion.
- 2.3.25 The Locomotive Equipment shall be designed and manufactured so as to withstand Burn-In Test, Applied High Voltage Test, Climatic Test, Vibration Test, Bump Test & Mechanical Shock Test as stipulated in Section V of this specification.
- 2.3.26 Each electrical component should be possible to be located on the PCB by the layout/circuit drawings. Switch Mode diodes may be marked as a block in the layout/circuit diagram. The wiring shall be clearly and permanently identified with a designation of a colour code which corresponds to the equipment circuit diagram. Where non standard colours are used, cable function shall be clearly and permanently labeled at both ends.
- 2.3.27 Fuse holder identification shall include details of the fuse rating and type. In case of fuses on PCBs, the rating shall be either on the fuse or PCB.
- 2.3.28 The mean time to replace a faulty Locomotive Equipment shall be less than 20 minutes.
- 2.3.29 The MTBF of the system shall not be less than 70,000 hours.

2.4 CLIMATIC REQUIREMENTS:

- 2.4.1 The Locomotive Equipment will be required to work inside Locomotive where Metallic Surface temperature under Sun goes upto : 75°. and inside shade upto : 55°C max. Minimum Temperature can go upto -10°C. Humidity during Rainy Weather can go upto 100%.
- 2.4.2 The Locomotive Equipment shall withstand following Environment Testing Requirements:
- i) Dry Heat Test(Operation) at 55 deg C as per IS: 9000 (Pt. III) Section V for 16 hours duration with Equipment in Operating Condition.
 - ii) Dry Heat Test(Storage) at 75 deg C as per IS: 9000 (Pt. III) Section V for 16 hours duration with Equipment in Non-Operating Condition.
 - iii) Cold Test(Operation) at -10 deg C as per IS: 9000 (Pt. II) for 2 hours duration with Equipment in Operating Condition.
 - iv) Rapid Variation Temperature Test from -10 deg C to +55 deg C with Temperature Rate Change of 1 deg C per minute for 3 Hours. The No. of Cycle for this Test shall be 3. This Test shall be as per IS: 9000 (Pt. XIV) Section II.
 - v) Damp Heat Test(Cyclic) at 40 deg C and 95% RH as per IS: 9000 (Pt. V) Section II for 12+12 hours cyclic duration with Equipment in Operating Condition. The No. of Cycle for this Test shall be 6.
 - vi) Damp Heat Test(Storage) at 40 deg C and 95% RH as per IS: 9000 (Pt. IV) for 4 Days with Equipment in Non-Operating Condition.

During the Environment Testing which requires Equipment to be kept in Operating condition, functioning of all the major modules GPS Module, GSM Modem, LCD Display, Power Supply Module, Battery Solid State Disk and RF Transceiver shall be observed.

- 2.4.3 Atmosphere in India during hot weather is extremely dusty with desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6mg/m^3 . In many iron ore and coal mine areas, the dust concentration is very high affecting the filter and air ventilation system. Locomotive Equipment shall be suitable for working in above atmospheric conditions.
- 2.4.4 In Coastal Area, atmosphere is humid and salt laden with maximum pH value of 8.5, Sulphate of 7 mg/litre, max. concentration of Chlorine 6 mg/liter and maximum conductivity of 130 micro Siemens/CM. Locomotive Equipment shall be suitable for working in above atmospheric conditions.
- 2.4.5 High wind speed in certain areas, with wind pressure reaching 150kg/m^2 . Locomotive Equipment shall be suitable for working in above atmospheric conditions.

2.5 VIBRATION & SHOCK REQUIREMENT

- 2.5.1 The Locomotive Equipment and its mounting arrangement shall be designed to withstand satisfactorily the vibration and shocks encountered in service as specified. Accelerations over 500 m/s^2 have been recorded at axle box levels for long periods during run. Vibrations during wheel slips are of even higher magnitude. The Locomotive Equipment shall meet the Vibration & Shock Testing Requirements as defined in IEC 61373.

2.6 EMC & EMI REQUIREMENT:

- 2.6.1 The Locomotive Equipment shall be suitable for installation on the Trains running in AC/DC Electrified sections as well as Non-Electrified sections. It shall be suitable for all Trains including where locomotives having Thyristor Controlled Single Phase or 3-Phase Induction Motors and where Chopper Controlled EMU Stocks are attached.
- 2.6.2 The system operation and its safety should not be affected by EMI encountered in 25 KV AC Electrified areas. Properly screened RF Cables should only be used to prevent Electromagnetic interference.
- 2.6.3 Radio Interference Test: The equipment shall be meet Radio-frequency Interference susceptibility Testing requirement as per Clause 10.2.8.1 of IEC 60571.
- 2.6.4 Supply Over-voltage, Surges and Electrostatic Discharge Test : The equipment shall meet Supply Over-voltage, Surges and Electrostatic Discharge Testing requirement as per Clause 10.2.6 of IEC 60571.
- 2.6.5 Transient Burst Susceptibility Test : The equipment shall meet Transient Burst Susceptibility Testing requirement as per Clause 10.2.7 of IEC 60571.

2.7 INSTRUCTION AND MAINTENANCE MANUAL:

- 2.7.1 Two copies of the Instruction Manual shall be supplied along with each Locomotive Unit. The manual has to include dimensioned layout drawings, detailed circuit and schematic diagrams. PC card layouts and detailed interconnecting drawings of modules. Details of testing and adjustment procedure, initial checks on receipt at site, detail installation & commissioning procedures, maintenance procedure, proposed routine maintenance tests, actual test results obtained for the particular and at the factory and a detailed trouble shooting chart shall be

outlined in the manual. A copy of the Installation and Maintenance Manual shall also be provided on a CD.

- 2.7.2 Instruction Manual is to be prepared using good quality paper with clear and crisp printing. All the drawings in clear printing shall be attached to the handbook binding. One set of flow chart drawings necessary for troubleshooting shall be provided with lamination with each manual. The handbook shall have a thick polythene sheet cover with plastic spiral binding or comb-binding.

SECTION-III

STATION EQUIPMENT

3.0 General:

This section covers the requirement of Station Equipments of Real Time Train Information System to be installed & commissioned on the selected Stations.

3.1 GENERAL REQUIREMENT:

- 3.1.1 Station Equipment shall mainly consist of Processing Unit Motherboard, Memory, GPS Receiver, GSM Modem, RF Transceiver, Display, Keypad and Power Supply Module including In-Built Battery.
- 3.1.2 'Power On' indication with RED LED shall be available in the Station Equipment, which shall glow when Power is available at the output of Power Supply Module.
- 3.1.3 The Station Equipment shall support and work on Open Source Linux Operating System. This Linux Operating System shall be sourced from reputed Linux Operating System Provider such as Debian, CentOS, Red Hat, Fedora, SUSE & Ubuntu to enable Service Support in India. Latest available version of Linux OS shall be used. Application Software as approved by Purchaser shall be loaded into Locomotive Equipment.
- 3.1.4 Station Equipment shall be capable of working in all Electrified(25 KV AC, 1500 V DC & 750 V DC) as well as Non-Electrified sections of Indian Railway.
- 3.1.5 Station Equipment shall receive PEX/AEX/DEX/NSS Messages from being broadcasted by Locomotive Equipment via RF Transceiver from nearby Locomotive Equipment and communicate them to Data Logger Servers via Station IP Network(provided using OFC Network of Indian Railway) or GPRS Connection.
- 3.1.6 Equipments, Wires & Cables, Fixing Arrangements etc. to be installed alongwith Station Equipment shall be of Fire Retardant Material and shall not cause fire.
- 3.1.7 Suitable Label Plate (etched/engraved/anodized or any other arrangement) ensuring durability shall be suitably fixed on each rack/module/equipment and contain following information.
- Specification Number
 - Manufacturer's name and identification
 - Model No.
 - Unit Serial No.
 - Year of manufacture

3.2 Functional Requirement

- 3.2.1 When Powered ON, the Station Equipment shall display Software Version on the LCD Display for a period of 5 Seconds. Subsequently Station Equipment shall acquire GPS Co-ordinates and GPS Clock. The Internal Clock of Station Equipment shall be synchronized to GPS Clock. Station Name, Current Date & Time shall be displayed on LCD Display.

- 3.2.2 Station Equipment shall check the availability of Station IP Network between Station Equipment and Data Logger Server using PING Command. Status of availability of this Station IP Network shall be displayed on LCD Display.
- 3.2.3 Station Equipment shall establish GPRS Connection with MSP(Mobile Service Provider) via GSM Modem using WVDIAL. GPRS Connection once established shall be kept CONNECTED until it is broken either because of Non-availability of GSM Coverage or due to some other reason. The availability of GPRS Connections shall be continuously checked using PPP Daemon and WVDIAL every 30 seconds. Status of availability of this GPRS Connection shall be displayed on LCD Display.
- 3.2.4 Communication between Station Equipment and Data Logger Server shall be using TCP/IP. Further to provide security (Authentication, Confidentiality & Integrity) for transmission over GSM Network/Internet, Public-Private Key Encryption (Asymmetric Key Algorithm) using Secured Socket Layer(SSL) Protocol shall be implemented.
- 3.2.5 Subsequently, Station Equipment will acquire from Train Operation Servers any update if available w.r.t. IP Address and Port Number of Train Operation Servers and Data Logging Servers. It will also acquire Table w.r.t. to latest Version of Station Equipment Software from Train Operation Server. If Station Equipment Software has been updated, it shall be downloaded from Train Operation Server at a 04:00 Hours and installed.
- 3.2.6 After Power ON Process, Station Equipment should start sending every 10 Minute at HH:00/10/20.../40/50:00 Heart Beat(HB) Messages to both Data Logging Servers via Station IP Network or GPRS Connection. This information includes Equipment Id, Station Name/Code and GPS Date & Time Stamp.
- 3.2.7 After Power ON Process, Station Equipment should start receiving Broadcast Message being transmitted by Nearby Locomotive Equipment. If these received Broadcast Message contain PEX/AEX/DEX/NSS Messages then these received Message shall be delivered by Station Equipment to Data Logger Servers via Station IP Network or GPRS Connection.
- 3.2.8 Heart Beat Messages and PEX/AEX/DEX/NSS Messages which are being received from Nearby Locomotive Equipments shall be kept in Solid State Disk, which will keep these data for 30 Days.
- 3.2.9 The Station Equipment, at its commissioning is required to be configured with Data Logger Server. During its registration process it will send following information to Static DB Cluster Server:
- Station Name,
 - Station Code,
 - Station Equipment Physical ID,
 - Station Equipment SIM Card No.,
 - Station Equipment Phone No,
 - Hardware Version,
 - Embedded Software Version

After receiving these information Data Logger Server will verify these information for suitability of operation. If found suitable Data Logger Server shall send a Configuration Confirmation message to Station Equipment. Only after successful completion of above Configuration Process, Data Logger Server shall starts exchange of messages with the concerned Station Equipment.

Configuration process shall be repeated as and when any information mentioned above is changed in Station Equipment.

3.3 TECHNICAL REQUIREMENTS

3.3.1 Station Equipment shall have a built-in GPS Receiver for getting GPS Co-ordinates(Longitude, Latitude & Altitude), Speed and Time-Stamp from Satellite System. The GPS Receiver shall comply following specifications.

- L1 Frequency C/A Code with 12 (or higher) independent Tracking Module(Channels).
- It shall support NMEA-0183 Protocol.
- Tracking Sensitivity shall be better than -150 dBm.
- Autonomous Positional Accuracy shall be better than 10 Meter.
- Suitable to work with Maximum Altitude of 18,000 Meter
- Suitable to work with Maximum Speed of 200 Kmph.
- Update Rate shall be 1 Hz
- Reacquisition time < 1 Second
- Cold Start better than 45 Seconds
- Warm Start shall be better than 38 Seconds.
- Hot start better that 5 Seconds
- Antenna Short Circuit Protection
- Built-in Antenna supervisory circuit for determination of active antenna open or short state
- Built-in non volatile RTC with battery backup option

3.3.2 Station Equipment shall have One(1) built-in GSM Modules. By inserting SIM Card of Public GSM Service Provider it should be possible to send message through GPRS or SMS. GSM Module shall comply with the following specifications.

- Frequency Band GSM 850, GSM 900, DCS 1800, PCS 1900.
- Transmit Power 2 W at EGSM 900 and GSM 850
1 W at DCS 1800 and PCS 1900
- GPRS Connectivity GPRS multi-slot class 10
- GPRS Data Downlink Data Transfer is 85.6 kbps max.
Uplink Data Transfer is 42.8 kbps max.
- Serial Port Interface can be used for CSD, GPRS and for AT Commands.
- GSM Module should support MT, MO, CB, Text and PDU Mode.
- GSM Module should integrate the TCP/IP Protocol.
- It should have 50 Ohm antenna connector for connecting external antenna.

- GSM Module should support SIM Card of 1.8 V and 3V.
- Built in non volatile RTC with battery backup option

3.3.3 Station Equipment shall have built-in RF Transceivers to communicate with Locomotive Equipment of RTTIS. This RF Transceivers shall comply with following specifications.

- Operating Frequency 2.4 GHz
- Protocol IEEE 802.15.4
- Minimum Transmit Power Output 100mW(20dBm).
- Permitted Maximum Power 1 Watt in spread of 10 MHz or Higher.
- Receiver Sensitivity -100 dBm (1% packet error rate)
- RF Data Rate 250,000 bps
- Serial Interface Data Rate 1200-115200 bps
- Supported Network Topologies Point-to-Point, Point-to-Multipoint & Peer-to-Peer.

3.3.4 Station Equipment shall have built in 7"-10" Colour LCD Display for Loco Pilot Interface. This LCD Display shall also be used for Configuration and Fault Diagnosis. The Specification of Colour LCD Displays are as below:

- Resolution 1024 X 768
- Screen Type SVGA
- Typical Contrast Ratio 1000 : 1
- Dynamic contrast Ratio 1000,000 : 1
- Colours 16.2 Millions
- Viewing Angle 160°

3.3.5 This equipment shall have built-in Solid State Drive(SSD) of Industry Grade Minimum 64 GB. The Specification of SSD are as below

- Form Factor 2.5 Inch
- Storage Capacity 64 GB Minimum
- Memory Type Non-Volatile Flash
- Connector SATA 7+15 Pin Combo Connector
- Read Speed Minimum 200 MB/Second
- Write Speed Minimum 100 MB/Second

Operating System Software and Application Software shall be kept in this SSD Memory. Further, this SSD Memory shall be keeping data received through RF Transceiver from various Locomotive Equipments passing through the Station for 30 Days. This SSD Memory shall also be keeping data received through GPS Receiver for a duration of 30 Days. This SSD Memory shall also be keeping Delivered Message Data, which has been delivered to Data Logger Server for 30 Days.

3.3.6 The Processing Unit Motherboard of Station Equipment shall be based upon Intel Atom Processor with following minimum specifications:

- Processor Intel Atom
- Clock Speed Minimum 1 GHz
- RAM 1 GB DDR2/DDR3
- Graphic Display SVGA
- Ethernet One RJ45 Gigabit Ethernet
- SATA Port One for 64 GB SSD
- USB 4(Four) USB 2.0 Ports
- Audio Interface Mic in & Line out
- Watchdog Timer Programmable via S/W from 1 Second to 100 Seconds
- Input Supply 12 V DC
- Ventilation Fanless

3.3.7 The Station Equipment at “Incoming Power Supply Input” shall be protected with pluggable Surge Protection Devices (SPDs) which consists of combination of MOV/Suppressor Diode and GD tube. This protection shall be in compliance to IEC 61643-1. Protection against Short Circuit shall also be provided through Circuit Breaker.

3.3.8 Station Equipment shall have in-built Power Supply Module. This Power Supply Module shall be SMPS based with following minimum specifications.

- Input Supply Range 50-150 Volt, DC Supply
70-300 Volt, 50/60 Hz, AC Supply
- Output Supply 12 Volt, 6 Amp., DC Supply
- In-built Battery Minimum 4000 mAH NiMH or Li-Ion Battery
- Battery Charger It should be capable of charging fully discharged above NiMH or Li-Ion Battery in 4 Hours
- Output Supply Ripple 50 mV Peak to Peak

3.3.9 One USB Interface shall be available, via which Software Loading/Deletion, Configuration, Diagnostics shall be carried out.

3.3.10 Ethernet Interface via RJ45 Connector shall be provided to connect the Station Equipment to Station IP Network(Over OFC) for communication with Data Logger Server/Train Operation Server/Static DB Cluster Server.

3.3.11 The Antenna for GPS, GSM and RF Transceiver of Station Equipment shall be Screw Mounting Type and shall be Waterproof and Weather proof. Besides these antenna shall have following specifications:

- GPS Antenna
 - Centre Frequency: 1575.42 MHz
 - VSWR: less than 1.5:1
 - Peak Gain: 3dBi
- 1 GSM Antenna
 - Frequency: 824-960 Mhz; & 1800 MHz
 - Impedance: 50 Ohm

- VSWR: less than 2.0:1
 - Typical Gain: 2 dBi +/- 1dB at 850 Hz
 - RF Antenna
 - Frequency Range: 2400-2500 MHz
 - VSWR: less than 1.5:1
 - Impedance: 50 Ohm
 - Polarization Type: Vertical
 - Antenna Type: Omni
- 3.3.12 The design of the Station Equipment shall be robust and with State-of-the-Art Technology. The design shall be modular for ease of maintenance and fault troubleshooting.
- 3.3.13 The size of Station Equipment shall not exceed 300 mm X 300 mm X 150mm(H x W x D). The housing of this Locomotive Equipment shall be constructed out of minimum 0.8 mm thick CRCA Sheet to IS:513 Grade-O. This housing shall meet the requirement of IP 65 as specified in IS-13947. This housing shall be Powder coated in black color shade.
- 3.3.14 All individual modules i.e. Processing Unit Motherboard, Memory, GPS Receiver, GSM Modem, RF Transceiver, Display, Keypad, Power Supply Module and I/O Interface Module etc. shall be accommodated inside single housing.
- 3.3.15 All type of connectors used in Station Equipment shall be lockable and sturdy enough to bear the harsh environment of Indian Railway.
- 3.3.16 All insulated conductors except those within the confines of a printed circuit board assembly shall be of the rating enough to withstand the maximum current voltage during fault and overload.
- 3.3.17 All wiring shall be neatly secured in position and adequately supported. Where wires pass through any part of metal panel or cover, the hole through which they pass shall be suitably bushed with rubber grommet.
- 3.3.18 All non-current carrying metal parts shall be bonded together and earthed. An earth terminal suitable for taking minimum 4 mm dia wire and with suitable marking shall be provided.
- 3.3.19 All materials and workmanship shall be of professional quality to ensure high reliability.
- 3.3.20 The equipment and components shall not use any material which support combustion.
- 3.3.21 The Station Equipment shall be designed and manufactured so as to withstand Climatic Test, Vibration Test, Bump Test & Mechanical Shock Test as stipulated in this specification.
- 3.3.22 Each electrical component should be possible to be located on the PCB by the layout/circuit drawings. Switch Mode diodes may be marked as a block in the layout/circuit diagram. The wiring shall be clearly and permanently identified with a designation of a colour code which corresponds to the equipment circuit diagram. Where non standard colours are used, cable function shall be clearly and permanently labeled at both ends.

3.3.23 Fuse holder identification shall include details of the fuse rating and type. In case of fuses on PCBs, the rating shall be either on the fuse or PCB.

3.3.24 The mean time to replace a faulty Locomotive Equipment shall be less than 20 minutes.

3.3.25 The MTBF of the Station Equipment shall not be less than 70,000 hours.

3.4 CLIMATIC REQUIREMENTS:

3.4.1 The Station Equipment will be required to work inside Locomotive where temperature can go upto : 55°C max. Minimum Temperature can go upto -10°C. Humidity during Rainy Weather can go upto 100%.

3.4.2 The Station Equipment shall withstand following Environment Testing Requirements:

- i) Dry Heat Test(Operation) at 55 deg C as per IS: 9000 (Pt. III) Section V for 16 hours duration with Equipment in Operating Condition.
- iii) Cold Test(Operation) at -10 deg C as per IS: 9000 (Pt. II) for 2 hours duration with Equipment in Operating Condition.
- iv) Rapid Variation Temperature Test from -10 deg C to +55 deg C with Temperature Rate Change of 1 deg C per minute for 3 Hours. The No. of Cycle for this Test shall be 3. This Test shall be as per IS: 9000 (Pt. XIV) Section II.
- vii) Damp Heat Test(Cyclic) at 40 deg C and 95% RH as per IS: 9000 (Pt. V) Section II for 12+12 hours cyclic duration with Equipment in Operating Condition. The No. of Cycle for this Test shall be 6.
- viii) Damp Heat Test(Storage) at 40 deg C and 95% RH as per IS: 9000 (Pt. IV) for 4 Days with Equipment in Non-Operating Condition.

During the Environment Testing which requires Equipment to be kept in Operating condition, functioning of all the major modules GPS Module, GSM Modem, LCD Display, Power Supply Module, Battery Solid State Disk and RF Transceiver shall be observed.

3.4.3 Atmosphere in India during hot weather is extremely dusty with desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6mg/m³. In many iron ore and coal mine areas, the dust concentration is very high affecting the filter and air ventilation system. Station Equipment shall be suitable for working in above atmospheric conditions.

3.4.4 In Coastal Area, atmosphere is humid and salt laden with maximum pH value of 8.5, Sulphate of 7 mg/litre, max. concentration of Chlorine 6 mg/liter and maximum conductivity of 130 micro Siemens/CM. Station Equipment shall be suitable for working in above atmospheric conditions.

3.4.5 High wind speed in certain areas, with wind pressure reaching 150kg/m². Station Equipment shall be suitable for working in above atmospheric conditions.

3.5 VIBRATION & SHOCK REQUIREMENT

3.5.1 The Station Equipment and its mounting arrangement shall be designed to withstand satisfactorily the vibration and shocks encountered in service as specified. Accelerations over

500 m/s² have been recorded at axle box levels for long periods during run. Vibrations during wheel slips are of even higher magnitude. The Station Equipment shall meet the Vibration & Shock Testing Requirements as defined in IEC 61373.

3.6 EMC & EMI REQUIREMENT:

- 3.6.1 The Station Equipment shall be suitable for installation in AC/DC Electrified sections as well as Non-Electrified sections.
- 3.6.2 The system operation and its safety should not be affected by EMI encountered in 25 KV AC Electrified areas. Properly screened RF Cables should only be used to prevent Electromagnetic interference.
- 3.6.3 Radio Interference Test: The equipment shall be meet Radio-frequency Interference susceptibility Testing requirement as per Clause 10.2.8.1 of IEC 60571.
- 3.6.4 Supply Over-voltage, Surges and Electrostatic Discharge Test : The equipment shall meet Supply Over-voltage, Surges and Electrostatic Discharge Testing requirement as per Clause 10.2.6 of IEC 60571.
- 3.6.5 Transient Burst Susceptibility Test : The equipment shall meet Transient Burst Susceptibility Testing requirement as per Clause 10.2.7 of IEC 60571.

3.7 INSTRUCTION AND MAINTENANCE MANUAL:

- 3.7.1 Two copies of the Instruction Manual shall be supplied along with each Station Equipment. The manual has to include dimensioned layout drawings, detailed circuit and schematic diagrams. PC card layouts and detailed interconnecting drawings of modules. Details of testing and adjustment procedure, initial checks on receipt at site, detail installation & commissioning procedures, maintenance procedure, proposed routine maintenance tests, actual test results obtained for the particular and at the factory and a detailed trouble shooting chart shall be outlined in the manual. Feedback format is also to be included in the Instruction Manual. A copy of the Installation and Maintenance Manual shall also be provided on a CD.
- 3.7.2 Instruction Manual is to be prepared using good quality paper with clear and crisp printing. All the drawings in clear printing shall be attached to the handbook binding. One set of flow chart drawings necessary for troubleshooting shall be provided with lamination with each manual. The handbook shall have a thick polythene sheet cover with plastic spiral binding or comb-binding.

SECTION –IV

DATA CENTRE

4.0 General:

This section covers the requirement of Data Centre for Real-Time Train Information System. It is a redundant, scalable and 24x7 Central Service Provider. In any case of disaster this system must be able to provide “Quality of Service (QoS).

Data Centre in Hot Standby configuration shall be provided at two different geographically distant locations, as decided by Railways. Connectivity between Two Data Centres shall be provided through Layer-3 MPLS Virtual Private Network(VPN).

4.1 Central Servers at each Data Centre shall consists of following Logical Servers;

(i)	Data Logger Server	:	3 Physical Server Nodes
(ii)	Static DB Cluster Server	:	9 Physical Server Nodes
(iii)	Dynamic DB Server	:	3 Physical Server Nodes
(iv)	Archival Server	:	2 Physical Server Nodes
(v)	Train Operation Server	:	3 Physical Server Nodes
(vi)	Web Server	:	8 Physical Server Nodes
(vii)	Data Provider Server	:	2 Physical Server Nodes
(viii)	DNS/DHCP/LDAP/NTP Server	:	2 Physical Server Nodes
(ix)	Certification Server	:	1 Physical Server Node
(x)	AAA Server	:	1 Physical Server Node
(xi)	Gateway Server	:	2 Physical Server Nodes
(xii)	Repository Server	:	1 Physical Server Node
(xiii)	NFS Cluster Archival Servers	:	2 Physical Server Nodes
(xiv)	Management Server	:	2 Physical Server Nodes

Technical Specification of Physical Server Nodes is given in Clause 4.2. Functional Description of these Logical Servers are given in Clause 4.3.1 to 4.3.18

4.2 Technical Specification of Physical Server Nodes :

4.2.1 Technical Specification of Blade Server Nodes shall be as below:

•	Processor Type	:	Intel Xeon 5600 Series
•	Processor Core	:	Six
•	Processor Cache	:	Minimum 8 MB shared L3 Cache per Processor
•	Minimum Processor speed	:	2.2 GHz
•	Multi Processor	:	2
•	Main Memory	:	Minimum 16 GB at 1066 MHz, DDR3 Registered, Upgradable upto 144

- Storage Type : GB(equally distributed to all memory channels)
600 GB, 6 Gbps, 10 KRPM, Hot Plug SFF SAS
- Maximum Number of Drives : Two Serial Attached Small form Factor Hot Plug SFF SAS
- Form Factor : Blade
- Network : Two Gigabit Ethernet Interface
- System Management : Blade Server Nodes shall support System Management Capabilities as mentioned in Clause 4.2.2.

4.2.2 Blade Server Chassis & Rack : Blade Servers shall supplied along with suitable Chassis which can house minimum 14 Blade Servers or more. These Blade Server Chassis shall be mounted in 19” Rack.

Blade Server Chassis should include common resources essential for the Blade Server System like Power Management, Ethernet Management, Cabling, System Management etc. Specification of Blade Server Chassis shall be as follows:

- Form Factor : Upto 10U, 19” Rack Mountable. It shall include all accessories so that it can be mounted on an Industry Standard 42 U Rack.
- Midplane : High-Availability Midplane for providing communication paths for Ethernet, Power Supply & Management.
- Interconnect Module : It shall be fully populated with Interconnect Module.
- Blade Bays : Blade Chassis to accommodate minimum 14 Hot Pluggable Blade Servers.
- Blade Switch Module : Blade Server Chassis should be configured with Redundant Ethernet Managed Blade Switch Module.
- Fan Module : Blade Server Chassis should be configured with Redundant Fan Modules.
- Power Module : Blade Server Chassis should be configured with Redundant Power Supply to cater for the Blade Servers.
- DVR Reader : One
- Management Module : Blade Server Chassis should be configured with Management Module
- System Management : Blade Server Chassis shall have System Management Capabilities to monitor Power Module, Fan Module, Chassis Environment and Server Resources. It should also facilitate optimization of Power Usage & Computer Resources.

4.2.3 Gigabit Ethernet Switch : 24 Port Gigabit Switch as per requirement(Minimum 4 Number) shall be supplied and implemented in Central System of RTIS. The Specification of these Gigabit Switch are given below:

- Network Protocol : IEEE 802.3/3u/3ab/3z/3x

- Interface : 24 10/100/1000 Mbps Switching Port
4-built-in SFP Gigabit Ethernet Fibre Port
- Switching Fabric : Minimum 32 Gbps
- Port Indicators : Status LED for Link Integrity, Disabled, Activity, Speed and Full Duplex Mode
- System Status Indicators : System, RPS, Bandwidth Utilization
- Redundancy : 1:N Master Redundancy
- Power Supply: 100-240 Volt AC, 50/60 Hz Universal Input.
- Routing : Provides full IPv6 Dynamic Routing

4.2.4 Router: All the external traffic to Central System of RTIS shall be routed through Router, which also serves as a firewall.

- 2 Slots which supports Standard Network Module/Enhanced Network Module/Enhanced extended Network Module.
- 4 WAN Interface Card
- 2 Gigabit Ethernet (10/100/1000) LAN Ports.
- 1 fixed Small Form-Factor Pluggable Port for SFP Gigabit Ethernet Connectivity.
- Hardware based VPN Encryption Acceleration
- 1 Console Port
- Router must support the bandwidth requirement for multiple Fast Ethernet Interface at every Network Slots.
- Redundant Power Supply configuration
- IP Security(IPSec)
- VPN (AES, 3DES, DES, MPLS)
- Statefull Firewall Protection
- Dynamic Intrusion Prevention(IPS),

4.2.5 User Terminal/Workstations : User Terminal/Workstations (Minimum 10 Nos.) shall be provided with following Specification:

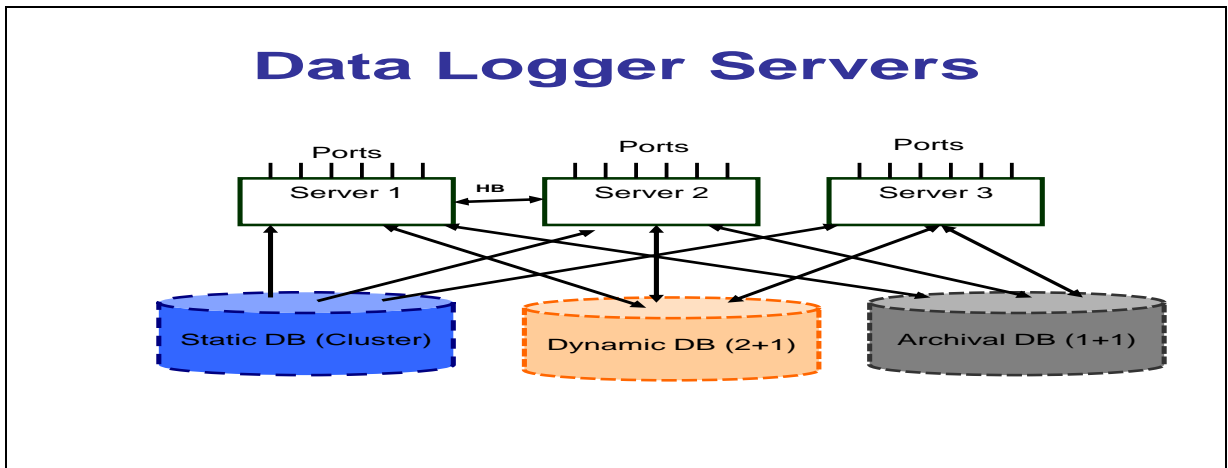
- Processor Type : Intel Core i7-2640M
- Processor Cache : Minimum 4 MB L3 Cache
- Minimum Processor speed : 2.8 GHz
- Main Memory : Minimum 6 GB DDR3 SDRAM, Upgradable upto 16 GB
- Storage Type : 600 GB, 5 KRPM, SATA
- Graphics : Intel HD Graphics 3000
- Dedicated Video Memory : 1 GB DDR3
- Display : 13.3 Inch LED Backlight
- Interface : 2 Highspeed USB(USB 2.0) Type A Connector
10/100/1000 Base-T Network(RJ-45) Interface

- Wireless LAN : SD Memory Card Slot
- Battery : IEEE 802.11a/b/g/n
- : Lithium Ion with minimum 4000 mAH

4.3 Functional Specification of Logical Servers to be implemented in Data Centre are given below:

4.3.1 **Data Logger Servers:** Data Logger Servers comprises of 3(Three) Nodes. Two Nodes shall be implemented in Master-Slave Configuration with common Logical IP Address with Channel Bonding Mode. Master & Slave Nodes shall be synchronized with each other in Heartbeat Mode.

Third Node will be Standby Node and have separate Logical IP Address, and will start receiving Data only if Locomotive/Station are not able to deliver Data to Server 1/2. Data Logger Servers shall be loaded with Linux Operating System with MYSQL Client. A schematic of Data Logger Servers is given below:



4.3.1.1 The Data Logger Servers shall be responsible for receiving Heart Beat Message and Train Movement Data(Station Passing Message, Station Arrival Message, Station Departure Message and Non-Schedule Stoppage Message) from Locomotive Equipment and keeping them in Dynamic DB Server. It shall also keep a copy of Heartbeat Message in Archival DB Server. Heart Beat Message and Train Movement Data shall be received on separate Port of Data Logger Server.

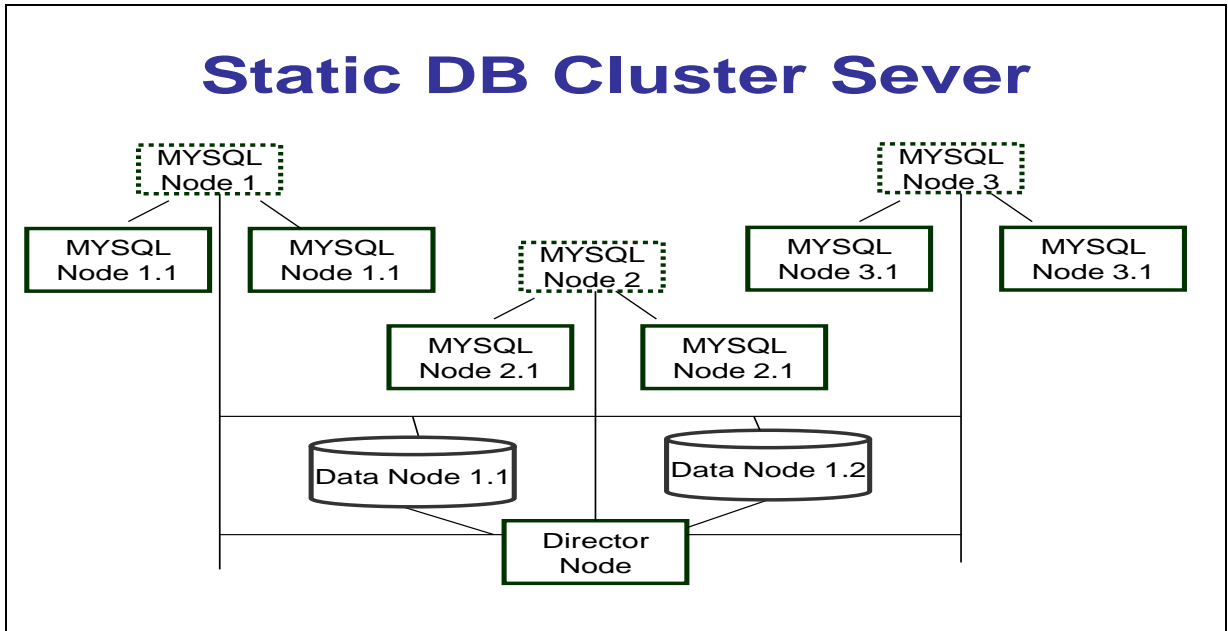
Data Logger Servers will be required to access Static DB Cluster Server for determining relation between Locomotive Equipment Id and Train Id. Train Movement Data stored in Dynamic DB Server, also includes Train Id.

4.3.1.2 Data Logger Server shall be responsible for receiving Train Movement Data (Station Passing Message, Station Arrival Message, Station Departure Message and Non-Schedule Stoppage Message) generated by Locomotive Equipment and routed through Station Equipment and keeping them in Dynamic DB Server.

4.3.1.3 To provide security (Authentication, Confidentiality & Integrity) for transmission over GSM Network/Internet, Public-Private Key Encryption (Asymmetric Key Algorithm) using Secured

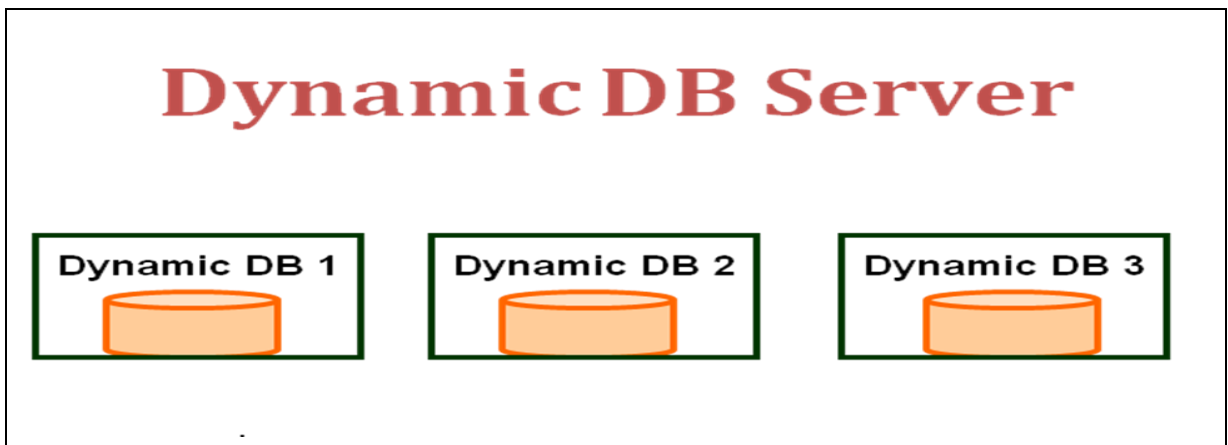
Socket Layer(SSL) Protocol shall be implemented between Locomotive/Station Equipment and Data Logger Servers.

4.3.2 Static DB Cluster Server : Static DB Cluster Server comprises of 9(Nine) Nodes, and shall be implemented in Cluster Configuration as shown below. Static DB Cluster Server shall be loaded with Linux Operating System with MYSQL. The schematic of Static DB Cluster Server is given below:



4.3.2.1 This Static DB Cluster Server shall be responsible for keeping Static Data of RTIS. These Static Data includes, Station Details(Name, Code, GPS Co-ordinates, Km., Division, Zone, Category, Platform), Locomotive Details (Number, Loco Shed, Type), Train Details(Name, Train Number, Starting Station, Destination Station, Enroute Stations, Arrival/Departure/Passing Time, etc.), SVG Maps, Section Details, Route Details, Division Details, Zone Details, Train at a Glance Time Table, etc.

4.3.3 Dynamic DB Server : The Dynamic DB Servers comprises of 3(Three) Nodes with separate Logical IP Address. Dynamic DB Servers shall be loaded with Linux Operating System with MYSQL Server. The schematic of Dynamic DB Servers is given below:



4.3.3.1 This Dynamic DB Server shall be responsible for keeping Train Movement Data of Train which are running. These Train Movement Data includes Heart Beat Messages(Current) received from Locomotive Equipments and Train Movement Data(Station Passing Message, Station Arrival Message, Station Departure Message and Non-Scheduled Stoppage Message) received from Locomotive/Station Equipments.

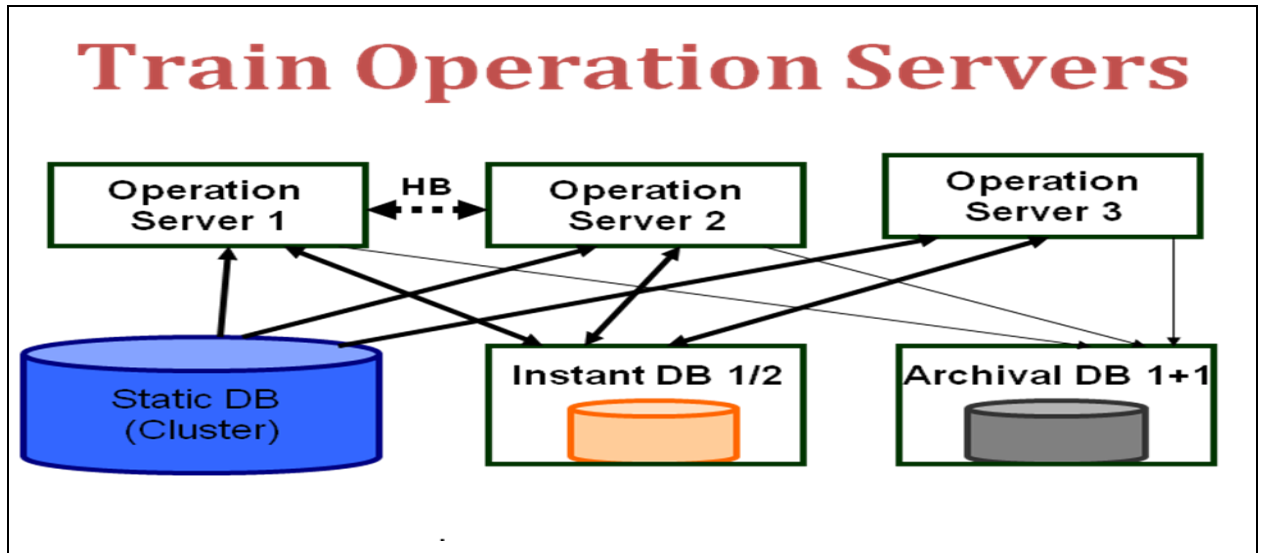
4.3.4 Archival DB Server : The Archival DB Servers comprises of 2(Two) Nodes, and shall be implemented with common Logical IP Address with Channel Bonding Mode. Archival DB Servers shall be loaded with Linux Operating System with MYSQL Server. The schematic of Dynamic DB Servers is given below:



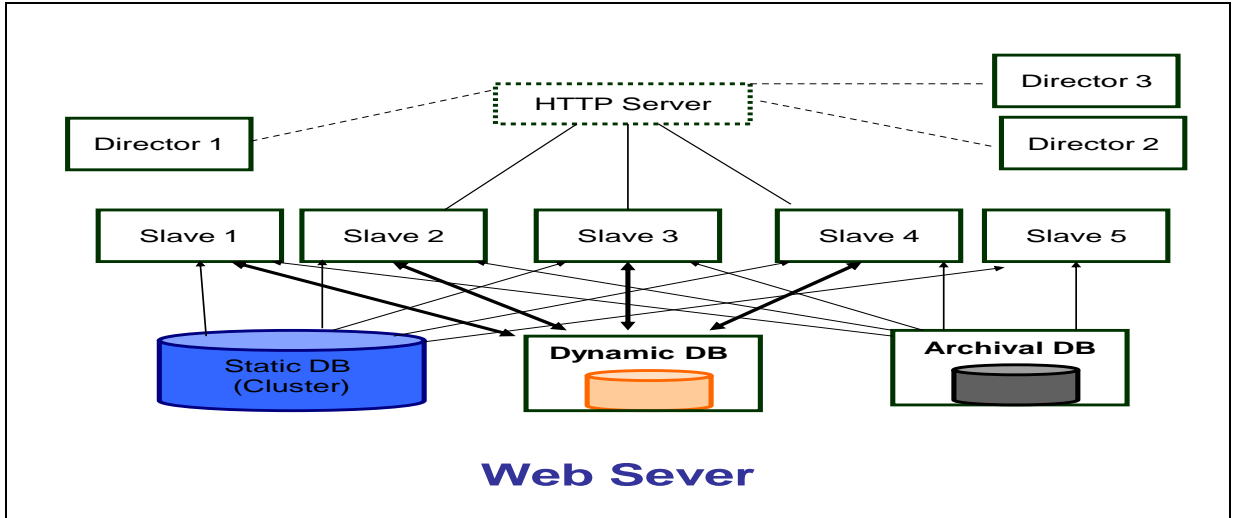
4.3.4.1 This Archival DB Server shall be responsible for keeping Heart Beat Message of Train which are running. This Archival DB Server shall also keep Train Movement Data(Station Passing Message, Station Arrival Message and Station Departure Message) of Trains which has completed its journey and has reached Destination.

4.3.5 Train Operation Server : The Train Operation Servers comprises of 3(Three) Nodes, and shall be implemented in Master-Slave Configuration with common Logical IP Address with Channel Bonding Mode. Mater & Slave Nodes shall be synchronized with each other in Heartbeat Mode.

Train Operation Servers shall be loaded with Linux Operating System and MySQL Client. The schematic of Train Operation Servers is given below:



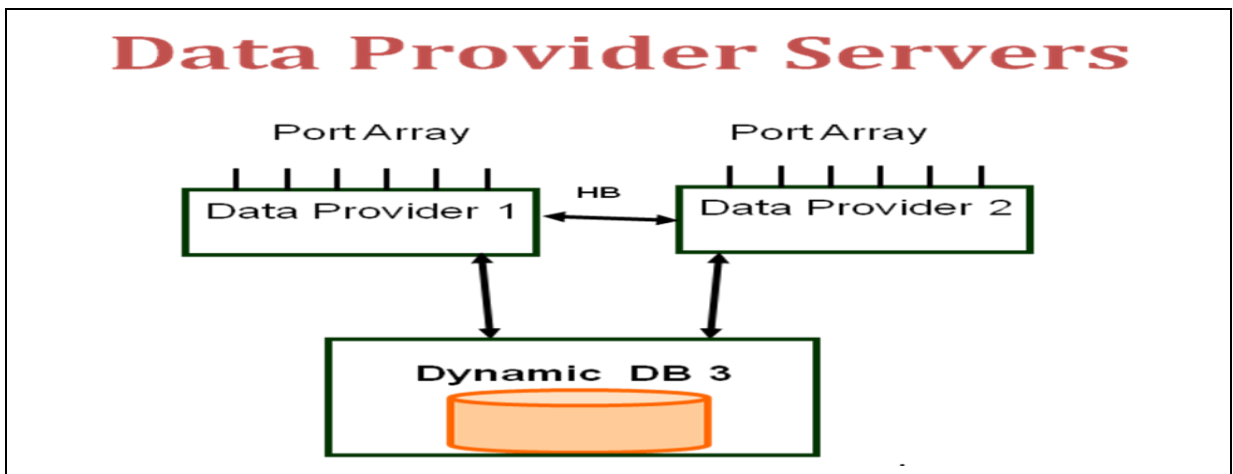
- 4.3.5.1 The Train Operation Servers shall be responsible for communicating with Locomotive Equipment for Login, Logout, Registration, Deregistration, Attach, Detach activities.
- 4.3.5.2 After Train Registration, Train Operation Servers will get the Train Route from Static DB Cluster Server and keep the Train Route Profile at Dynamic DB Server to log Train Movement Data(Station Passing Message, Station Arrival Message, Station Departure Message and Non-Scheduled Stoppage Message) against this Train Route Profile.
- 4.3.5.3 Train Operation Servers shall be responsible for maintaining Train Id w.r.t. to Locomotive Equipment Id. Train Operation Servers shall also be responsible for generating Train Id for Goods and Special Trains from Temporary Train Id Registry. Train Operation Server shall also be responsible for resolving conflict in Train Id.
- 4.3.5.4 To provide security (Authentication, Confidentiality & Integrity) for transmission over GSM Network/Internet, Public-Private Key Encryption (Asymmetric Key Algorithm) using Secured Socket Layer(SSL) Protocol shall be implemented between Locomotive Equipment and Train Operation Servers.
- 4.3.5.5 Train Operation Servers shall be responsible for transferring Train Movement Data(Station Passing Message, Station Arrival Message, Station Departure Message and Non-Scheduled Stoppage Message) of Trains which has reached Destination and has completed its journey, from Dynamic DB Servers to Archival DB Servers.
- 4.3.5.6 Train Operation Server shall be responsible for keeping latest version of Locomotive/Station Equipment Software and providing it to Locomotive/Station Equipments whenever requested.
- 4.3.6 Web Server :** The Web Server comprises of 8(Eight) Nodes, and shall be implemented in 5+3 Configuration, with 3 Director's Node and 5 Slave Nodes. Web Server shall be loaded with Linux Operating System. The schematic of Train Operation Servers is given below:



4.3.6.1 Web Server shall be responsible for hosting Website for Administration, Management & Operation. Management Information System of RTIS shall be implemented by Web Server.

4.3.6.2 Further Data Mining of Trains for Administrative/Managerial purpose after completion of Train Run, shall be possible through Web Server.

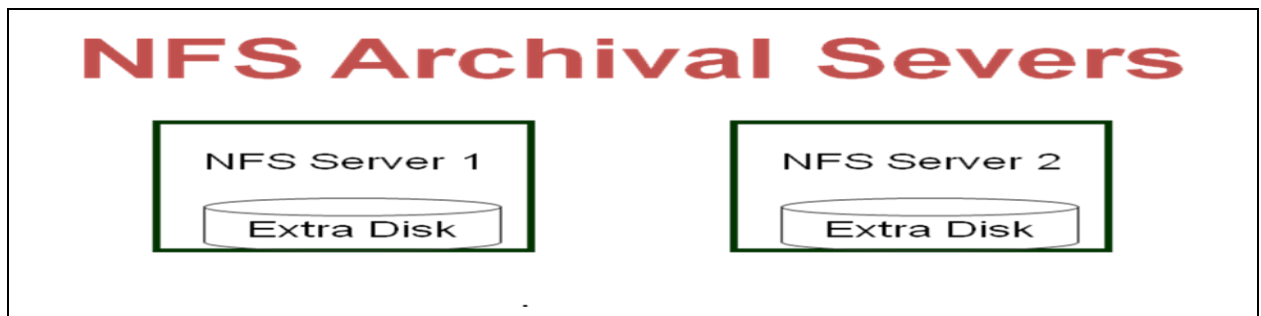
4.3.7 Data Provider Server : The Data Provider Server comprises of 2(Nodes) Nodes and implemented in Master-Slave Configuration with common Logical IP Address with Channel Bonding Mode. Mater & Slave Nodes shall be synchronized with each other in Heartbeat Mode. Data Logger Servers shall be loaded with Linux Operating System with MYSQL.



4.3.7.1 Data Provider Server shall be responsible for providing Train Running Data to various Department/Sections/Agencies which are closely associated with the working of IR for other applications external to RTIS.

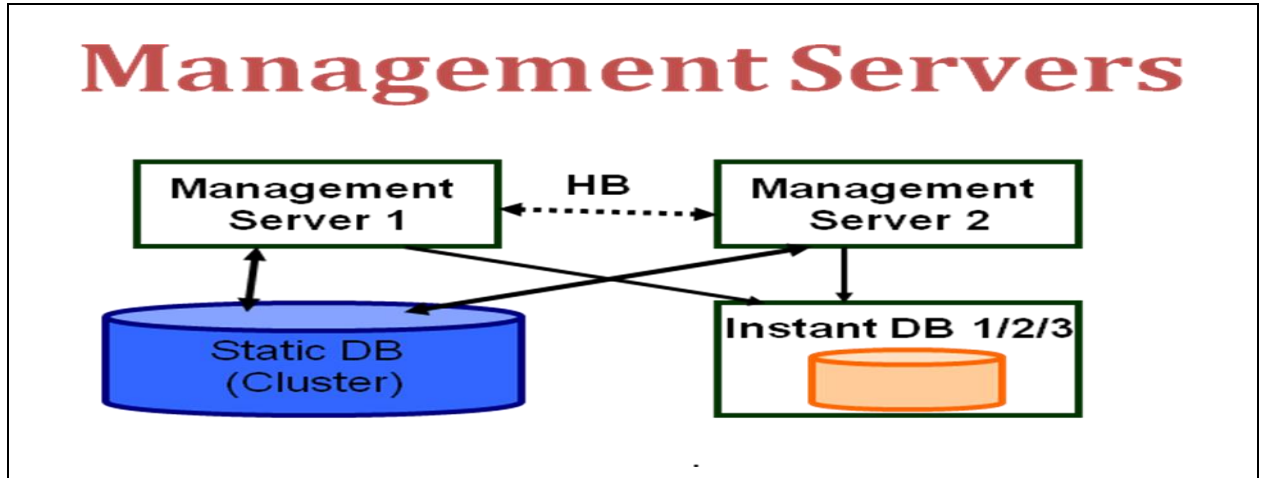
4.3.8 DNS Server : Linux based DNS Server shall be responsible for providing Domain Name System Service for RTIS Network.

- 4.3.9 DHCP Server :** Linux based DHCP Server shall be responsible for providing DHCP Service for RTIS Network. This shall facilitate smooth centralized Network Management of host IP Address.
- 4.3.10 LDAP Server :** Linux based LDAP Server shall be responsible for providing Lightweight Directory Access Protocol Service for RTIS Network.
- 4.3.11 NTP Server :** Linux based NTP Server shall be responsible for providing NTP Service for RTIS Network.
- 4.3.12 DNS Server, DHCP Server, LDAP Server and NTP Server** shall be implemented on 1 (One) Physical Server Nodes with one Physical Server Node as Standby.
- 4.3.13 Certification Server:** Certification Server shall be responsible for certification of Public-Private Key. It shall be implemented on one Physical Server Node.
- 4.3.14 AAA Server :** RADIUS based Authentication, Authorization and Accounting Service shall be provided by AAA Server. It shall be implemented on one Physical Server Node.
- 4.3.15 Gateway Server:** Firewall shall be implemented on Gateway Server, which shall be connected to the external world through Router. Gateway Server shall be implemented on 1 (One) Physical Server Nodes with one Physical Server Node as Standby.
- 4.3.16 Repository Server :** It shall be responsible for keeping a copy of all the version of Software used in the System.
- 4.3.17 NFS Cluster Archival Server :** NFS Cluster Archival Servers shall be Two(2) independent Nodes. It shall be responsible for taking backup of Static Database, Software Versions of all Servers, Configuration Files of all Servers. If any Server or parts of Server gets corrupted, this will help in recovery of the affected Server. A new Server may be created using this data in case of hardware failure. The schematic of NFS Cluster Archival Servers is given below:



- 4.3.18 Management Server :** The Management Server comprises of 2(Nodes) Nodes and implemented in Master-Slave Configuration with common Logical IP Address with Channel Bonding Mode. Mater & Slave Nodes shall be synchronized with each other in Heartbeat Mode.
- 4.3.18.1** It shall be responsible for downloading Software Updates and providing it to all the Servers/Equipments.

4.3.18.2 It shall work as Internal Website for updating Static Database in Static DB (Cluster) Server.



4.3.19 Network Management : Open Source Network Monitoring Application (such as Nagios) to run under Linux shall be implemented for watching host and services. It shall provide following features

- Monitoring of Network Services(SMTP, POP3, HTTP, NNTP, PING, etc.)
- Monitoring of Host Resources (Processor Load, Disk Usage, etc.)

4.3.20 Software for achieving above requirements shall be carefully developed and implemented. Software Design including Flow Chart shall be submitted to Purchaser for its approval. Software shall be developed in PHP.

4.3.21 Database Structure Design to be developed in MySQL shall be submitted to Purchaser for its approval.

4.3.22 Website Design & Structure to be developed in PHP shall be submitted to Purchaser for its approval.

4.4 CLIMATIC REQUIREMENTS:

4.4.1 Server Nodes and Networking Equipments(Router & Switches) shall have Operating Temperature Range of 5°C to 40°C.

4.4.2 Server Nodes and Networking Equipments(Router & Switches) shall be required to work in Relative Humidity(Non-Condensing) Range of 5-85%.
