

पूर्व मध्य रेल

कार्यालय

महाप्रबंधक(सिग.एवं दूरसंचार)

पूर्व मध्य रेल हाजीपुर

दिनांक:-25.06.2025

फाइल संख्या-ECR-HQ0SnT(RBCT)/1/2024
(कम्प्यूटर संख्या-279747)

Sr.DSTEs-DDU/DHN/DNR/SEE & SPJ,
East Central Railway

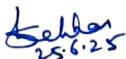
विषय- FUNCTIONAL REQUIREMENT SPECIFICATION FOR Remote Diagnostic and Predictive Maintenance System (RDPMS)(Version 1.0).

संदर्भ:-आरडीएसओकापत्रसंख्या- RDSO/RDPMS/FRS /2025 दिनांक-00.00.2025

उपरोक्त संदर्भित पत्रानुसार FUNCTIONAL REQUIREMENT SPECIFICATION FOR Remote Diagnostic and Predictive Maintenance System (RDPMS)(Version 1.0) इस कार्यालय को प्राप्त हुआ है। जिसे आपको भेजा जा रहा है।

यह आपके सूचनार्थ प्रेषित है।

संलग्न:-संदर्भित पत्र की प्रति।


25.6.25
(राजीव शेखर)

संसिद्धि/ सिग्नल
कृते महाप्रबंधक(सिग. एवं दूरसं.)पूर्मरे हाजीपुर

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**RESEARCH DESIGNS & STANDARDS ORGANISATION
MANAK NAGER, LUCKNOW - 226011**



**FUNCTIONAL REQUIREMENT SPECIFICATION
FOR
Remote Diagnostic
and
Predictive Maintenance System (RDPMS)**

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FOREWORD:

This FRS requires reference to the latest version of following specifications/ Documents: –

1.	IRS: S-24	Electric Point Machine
2.	RDSO SPN 153	Subsidiary LED Signal
3.	RDSO SPN 199	Main LED Signal
4.	RDSO SPN 146	Audio Frequency Track Circuit
5.	IRS S 105	Block Proving by Axle Counter using UFSBI
6.	RDSO SPN 175	Solid State Block Proving by Digital Axle Counter
7.	RDSO SPN 176	Multi-section Digital Axle Counter
8.	RDSO/SPN/177	Single section Digital Axle Counter
9.	IRS: S-99	Data Logger System.
10.	RDSO/SPN/165/2023	Integrated Power Supply
11.	IRS: S 63	PVC insulated underground unscreened cable for Railway signaling
12.	IRS: S 76	PVC insulated indoor cables for Railway signaling
13.	RDSO/SPN/144	Safety and reliability requirement of electronic signalling equipment.
14.	RDSO/SPN/197	Code of Practice for Earthing and Bonding System for Signalling Equipments.
15.	IRS:S 89/2013	Track Feed battery charger
16.	BRS:938-A for QT2 & BRS:939-A for QTA2	Track Relay
17.	IRS:S 88 2004	Lead Acid Battery
18.	RDSO/SPN/208/2012	Electric Lifting Barrier(ELB)
19.	RDSO/SPN/TL/23/99, SMPS Power Plant	Telecom Charger of OFC
20.	EN 50121*	Railway Applications - Characteristics of Railway Systems that affect EMC behaviour
21.	ISO 9001	Quality Systems- model for quality assurance in design, development, production, installation and serving.
22.	IEC 60688	Electrical measuring transducers for converting a.c. and d.c. electrical quantities to analogue or digital signals.
23.	IEC61326	Electrical equipment for measurement, control and laboratory use –EMC requirements
24.	TEC 31318:2021 or latest	Telecommunication Engineering Center Code of practice for securing Consumer Internet of Things (IoT)
25.	IEC 60603	Connectors for electronic equipment - Part 7: Detail specification for 8-way, unshielded, free and fixed connectors.
26.	IEC 61754-20	Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 20: Type LC connector family.

Note:

- * Equivalent Recognized International standards may also be agreed subject to their acceptability in a foreign Railway for same application. The supplier shall submit a copy of the same for verification.
- Whenever, reference to any specification appears in this document, it shall be taken as a reference to the latest version of that specification.

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ABBREVIATIONS :

SNO.	Abbreviation	Expanded Form
1.	IoT	Internet of Things
2.	AI	Artificial Intelligence
3.	ML	Machine Learning
4.	ABS	Automatic Block Signalling
5.	IBS	Intermediate Block Signalling
6.	I/O	Input/output
7.	CCIP	Control Cum Indication Panel
8.	MTBF	Mean Time Between Failure
9.	MTBWSF	Mean Time Between Wrong Side Failure
10.	MTTR	Mean Time to Repair
11.	PCB	Printed Circuit Board
12.	RDSO	Research Designs and Standards Organisation
13.	OFC	Optical Fiber Cable
14.	IPS	Integrated Power Supply
15.	AFTC	Audio Frequency Track Circuit
16.	DAC	Digital Axle Counter
17.	SEM	Signal Engineering Manual
18.	MSDAC	Muti Section Digital Axle Counter
19.	UFSBI	Universal Failsafe Block Interface
20.	LED	Light Emitting Diode
21.	SM	Station Master
22.	RTC	Real Time Clock
23.	BOM	Bill of Material
24.	FOM	Fiber Optic Modem
25.	OS	Operating System
26.	ROM	Read Only Memory
27.	STR	Schedule of Technical Requirements
28.	LCD	Liquid Crystal Display
29.	RE	Railway Electrification
30.	QA	Quality Assurance
31.	QAP	Quality Assurance Program
32.	MTTR	Mean Time To Repair
33.	PF contact	Potential Free contact
34.	OPC-UA	Open Platform Communications – Unified Architecture
35.	LoRa	Long Range communication (a wireless Technology)
36.	IRNSS	Indian Regional Navigation Satellite System
37.	CCSP Layer	C-DOT Common Service Platform
38.	OneM2M	Machine to Machine IoT Standards
39.	MQTT	Message Queuing Telemetry Transport
40.	AE	Application Entity
41.	Intermediate Service Palteform	It is intermediate software which handles to and fro transmission of data packets between Application Software & Station Gateway

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1. SCOPE:

This document explains the requirements for a Remote Diagnostic and Predictive Maintenance System for Indian Railway Signalling equipment. The system will use IoT to collect data, standard logics & AI/ML to monitor, diagnose, and predict equipment performance.

The purpose of this FRS is to standardize and set clear requirements to ensure that data collected from any platform or IoT device is consistent and compatible. This data will be used for machine learning (ML) and AI-based data analytics for predictive maintenance.

2. SYSTEM REQUIREMENT:

- 2.1 The objective of providing Remote Diagnostic and Preventive Maintenance system is to assist maintenance team in taking appropriate maintenance action in advance to prevent the failure of signalling assets. At functional level the system is broadly divided into two categories:
- 2.2 **Remote Diagnostic:** The purpose of the Remote Diagnostic System for Signalling Assets is to minimize MTTR (Mean Time to Restore) and provide real-time insights to maintenance teams for efficient resolution of signal failures. This is accomplished through the automated analysis of telemetry data and operational parameters collected from signalling assets via IoT enabled sensors. The system leverages edge computing for on-site processing and cloud-based analytics for advanced diagnostics. The system delivers fault alerts to mobile devices or PCs, along with possible root cause analysis (RCA). This enables faster fault resolution, streamlined troubleshooting, and improved operational uptime.
- 2.3 **Predictive Maintenance:**-The system facilitates predictive maintenance by delivering predictive alerts to mobile devices or PCs, identifying probable causes through data analysis and AI/ML models. It continuously analyzes data from all stations to develop supervised and unsupervised machine learning models. Based on these models, the system can send automated alerts for signalling assets at risk of failure, enabling maintenance staff to take proactive measures to prevent failures before they occur.
- 2.4 IoT devices , station gateways, and networks shall be continuously monitored to ensure their reliability and uptime. The system shall provide alerts in case of any failure or malfunction in IoT devices, gateways, or network infrastructure, enabling timely intervention and maintenance . Sensor failures may be identified through logical monitoring of sensor values and correlation with other relevant parameters, probable inconsistencies in either the sensors or the signaling assets.

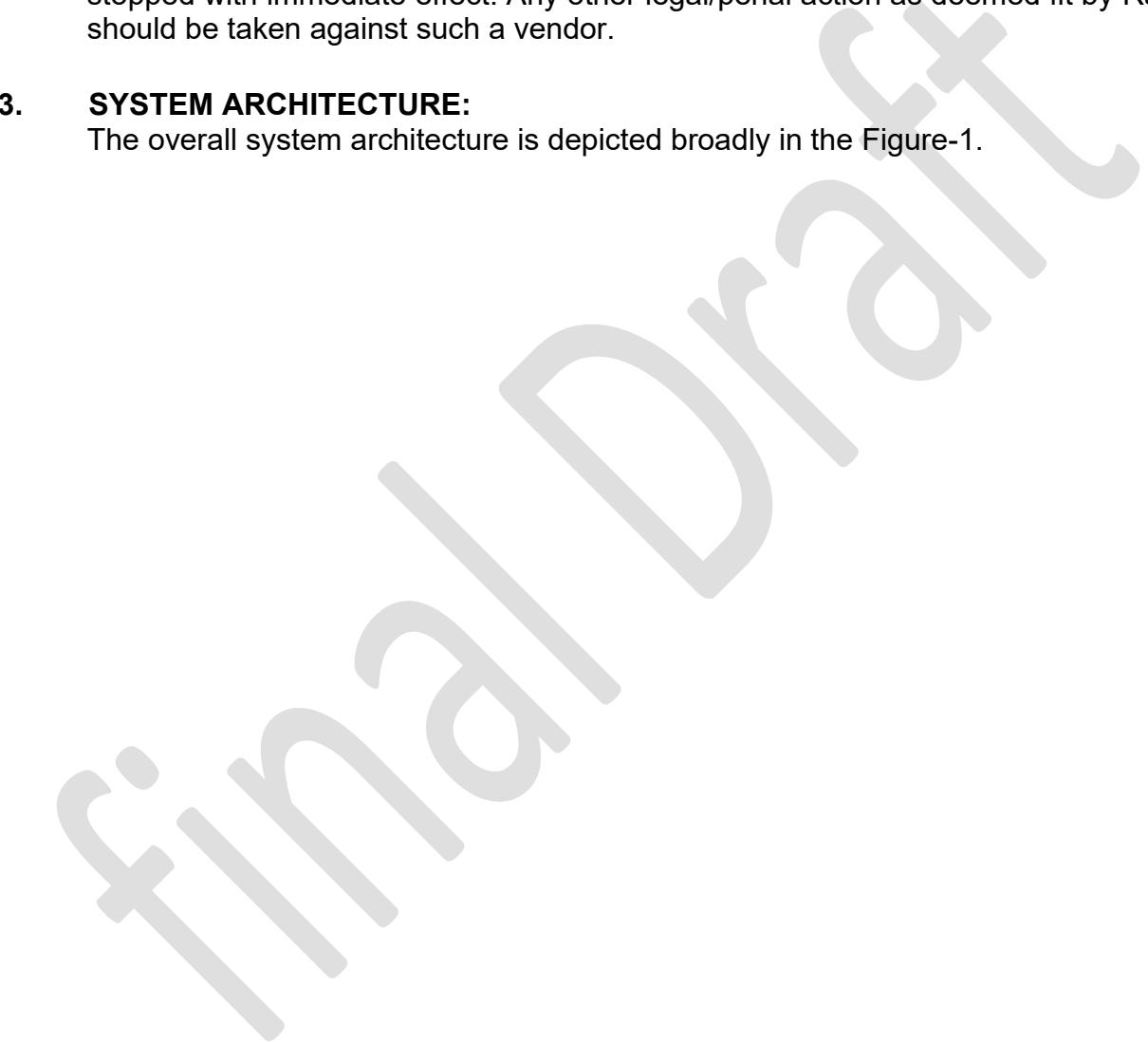
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- 2.5 The system shall be capable of detecting unauthorized access, such as login attempts by unknown users and any suspicious activity/data theft and promptly notifying the relevant stakeholders to ensure system integrity.
- 2.6 If any vendor is found in any malpractice or misuse of data/information, all its contracts should be immediately rescinded under intimation to Railway Board and RDSO. Communication from any device of such a vendor at all locations in any Railway will be stopped with immediate effect. Any other legal/penal action as deemed fit by Railways should be taken against such a vendor.

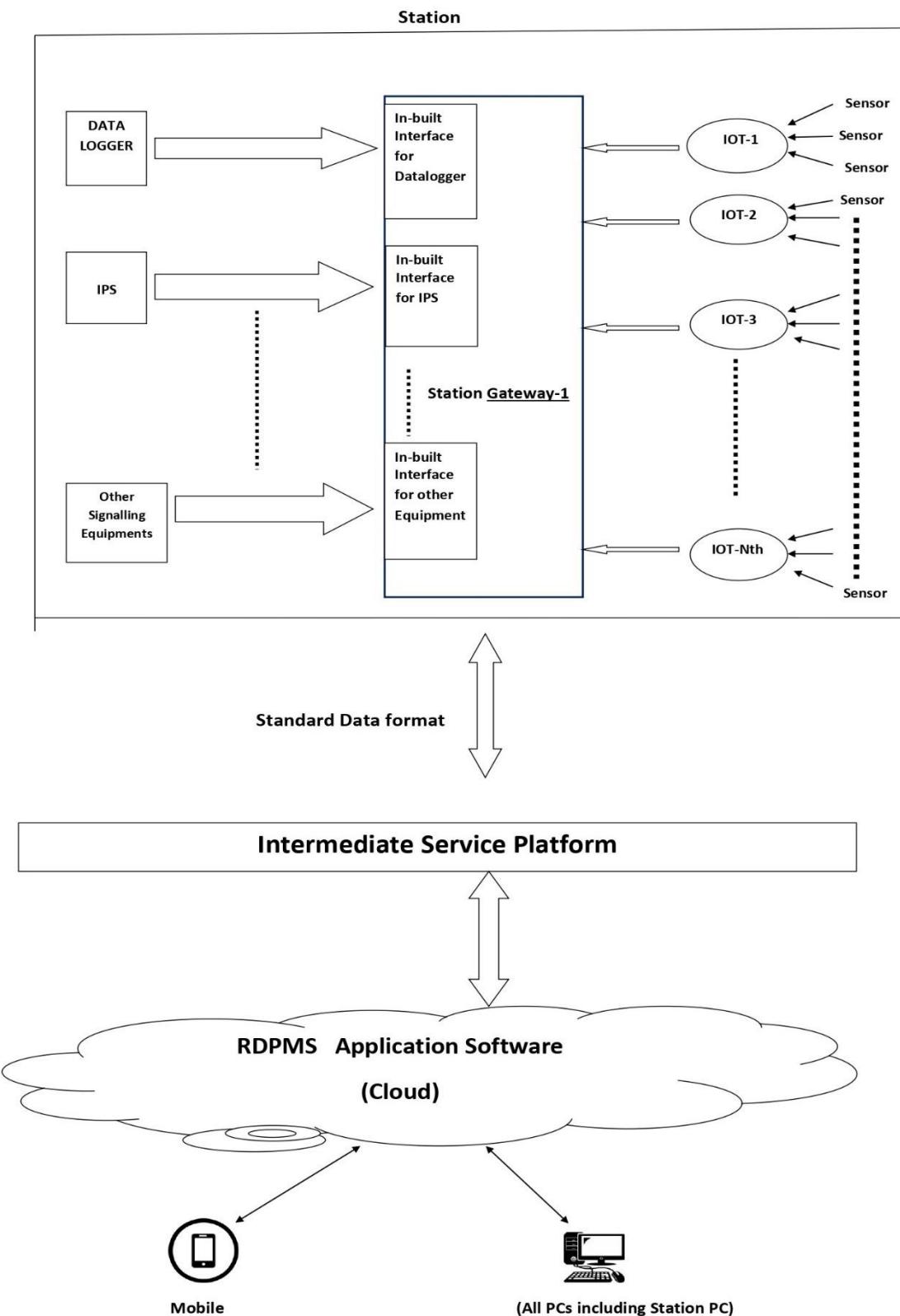
3. SYSTEM ARCHITECTURE:

The overall system architecture is depicted broadly in the Figure-1.



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Figure-1

The schematic diagram shown in Figure-1 is indicative. Vendors are required to prepare a detailed station schematic diagram that clearly defines the architecture, incorporating signalling assets, sensors, IoT devices, communication media, station gateways, station computers, and other components.

The brief description of each sub system is as following:

3.1 Sensors: They shall be installed on the signalling assets or in nearby location boxes to capture the required parameters, such as voltage, current (non-intrusive), temperature, relay status, and other critical data points Details are in section no 4.

3.2 IoT devices: An embedded electronic unit designed to collect data or parameter values from signalling assets through connected sensors/Digital input/PF contacts. These devices transmit the collected data to the station gateway located at the station using wired or wireless data transmission methods. Details are in section no 5.

3.3 Station Gateway: An embedded electronic unit which shall receive raw data/parameters value from Sensors through IoT devices and from diagnostic ports of various equipments for Signalling assets. It shall receive data mandatorily from Data-logger and IPS interface port. Details are provided in Section No. 6.

3.4 Network: Real-time field data, such as voltage, current, temperature, humidity, relay status, vibration, shall be captured by various sensors through IoT devices and processed locally. The processed data will then be transmitted from the IoT devices to the station gateway. For above data transmission, wired/wireless communication technologies shall be used as detailed in Section No. 7.

For communication between the Station Gateway to/from Intermediate service platform (including RDPMS Application) shall be used as detailed in section-7.

3.5 Standard Data format: Station Gateway at every station will send/receive Data to/from RDPMS Application software through Intermediate service Platform (to be planned by Vendors) as per prescribed standard Data Format (Annexure B) using MQTT protocol. These standard Data format with other details are given in Annexure B (Annexure A also to be referred for Standard Nomenclature).The standard data format will ensure interoperability of Station Gateway (including Sensors/IOT) of various vendors with Application Software of other vendors. Additional information is detailed in section no 10.

3.6 RDPMS Application Software: Details are in section no 11.

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3.6.1 RDPMS Application software of vendors shall be designed to receive/send data from/to Station Gateway through Intermediate service Platform (to be planned by Vendors) as per standard Data Format (Annexure B) using MQTT protocol.

3.6.2 The Application Software shall process data using advanced computing techniques, including standard logics, data analysis, and various models of Machine Learning (ML) and Artificial Intelligence (AI). It shall be capable of generating alerts for the occurrence of failures and prediction of failures, along with their probable causes, which will be sent to the Mobile/PC of Railway personnel or the Divisional Control.

3.6.3 Mobile application shall also be developed by Vendors for using the Application through mobile also.

4. DATA ACQUISITION:

4.1 The data from signalling assets at the station shall be collected in real-time using either the inbuilt diagnostic ports of the signalling assets or through external sensors, ensuring accurate and continuous monitoring of the equipment.

4.2 General requirements for external sensors:

4.2.1 For measuring currents, non-intrusive sensors shall be used. Voltage sensors should also preferably be non-intrusive. In cases where intrusive voltage sensors are used for measuring voltage, voltage sensor with high impedance and galvanic isolation shall be considered, provided they have a minimum withstand voltage of 2.5kV for 60 seconds. The loading on the signalling circuit shall be minimal and must not exceed 1 mA per channel (sensor).

4.2.2 The accuracy of sensors must ensure that no noise is introduced into the data used for machine learning. Proper accuracy and stability of sensors are critical for achieving the end goal of predictive maintenance.

4.2.3 Most sensors will function as transducers, converting parameters such as current, voltage, and vibration into very weak electrical signals. Therefore, proper safeguards must be implemented to protect against the effects of Electromagnetic Interference (EMI) to ensure the stability and accuracy of the readings. Additionally, sensors must be equipped with protection arrangements against surges originating from lightning, power lines, or Overhead Equipment (OHE). To maintain data integrity, appropriate signal processing techniques and filtering mechanisms shall be employed to remove unwanted signals and noise.

For example, in the RE (Railway Electrification) area, the induced voltage is dynamic and varies due to changes in OHE current caused by the presence or absence of a train. Therefore, the length of cables/wires connecting the transducer/sensor to the IoT device

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should be optimized to keep the induced voltage within permissible limits, ensuring accurate and stable readings. Additionally, the transducer/sensor wires should not run parallel to dynamic current-carrying conductors, as this may alter the sensor readings and compromise accuracy.

4.2.4 Properly rated sensors shall be selected based on the parameter monitoring range of the specific gear type to be monitored. Since machine learning relies on variations in data to identify health signatures, the least count of the sensor for each category of equipment must be appropriate to ensure accurate and meaningful data collection for analysis. Number of sensors for assets has been detailed in Annexure A & C.

4.2.5 Sensors shall comply with IEC 60688 standards, with an accuracy rating of Class 1, as specified in Table 1 of IEC 60688, and shall meet the environmental conditions of Usage Group II (K70), as outlined in Table 6 of IEC 60688. Additionally, sensors must adhere to the immunity requirements specified in Table 2 of IEC 61326 for equipment intended to operate in an industrial electromagnetic environment. A test certificate confirming compliance with these standards shall be submitted from Govt. Lab. If test facility is not available in Govt. Lab, test shall be carried out from NABL accredited Lab.

4.2.6 Provision shall be made for on-site calibration of sensors every year using suitable measuring equipment that has been duly calibrated by a Government Laboratory or a NABL accredited Laboratory to ensure accuracy and reliability of measurements. Before due date of calibration, parameters value should not drift. However out of turn calibration can be done by Zonal Railways if any alteration, maintenance work etc for better accuracy.

4.2.7 The parameters of IPS, Signals, Points, DC Track circuits, LC gates, ELD, SPDs, Temperature and humidity etc have been defined in Annexure- A.

4.3 Outdoor Assets And Their Tentative Parameters for effective monitoring of Signaling gears.

4.3.1 External sensors are required to be provided for monitoring the health of Points, Signals, DC Track circuits, LC Gate, etc. The details of nominal voltage/current range is given in Annexure- C for ready reference.

- i) Note*: Voltage and current signature of motor shall be recorded by capturing data at the rate of 20ms during operation of Point Machine/ELB. The rate of capturing data should be configurable from Application software.

4.3.2 Axle Counters (SSDAC, MSDAC etc) and AFTC (Optional):

Input Voltage and current shall be captured by using sensor. Potential free contacts of vital relays shall be captured through IoT/Datalogger. For using sensors in these equipment, clearance from Zonal Railways/AXLE Counter OEM/AFTC OEMs shall be taken to avoid any interference in AXLE COUNTER working or breach of Safety.

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For using diagnostic port of MSDAC/SSDAC/AFTC for monitoring the health of these equipment, Zonal Railway shall facilitate the sharing of protocol of these equipment from respective OEMs to RDPMS vendors. However, it shall be responsibility of RDPMS vendor to integrate the interface port, if made available.

4.4 Indoor Assets And Their Tentative Parameters To Be Monitored:

4.4.1 Data-logger:

Data such as the status of relays, IPS's PF contacts, and similar parameters are already available in the existing Data Loggers installed in the relay room. To avoid redundant wiring to each relay, the same data shall be utilized. The protocol information for Data Loggers is provided in Annexure A of the Specification IRS: S-99/2006 or its latest version. The Station Gateway shall include provisions for interface compatible with the Data-logger.

4.4.2 Integrated Power Supply (IPS) / Battery Charger:

The following parameters shall be monitored (detailed list provided in Annexure A & C):

- i. All voltage outputs through sensor/diagnostic port.
- ii. Battery: Overall Voltage and current of 110V battery bank through sensor. (Individual Battery monitoring is optional)
- iii. Parameters using Diagnostic port.
- iv. Status of potential free contact through Data logger.

The Station Gateway shall include an inbuilt protocol converter to interface with the IPS diagnostic port as per RDSO/SPN/165/2023 ver 4.0 amdt 1.0 and Annexure-I (Modbus register mapping of IPS for RDPMS uploaded in RDSO website under policy letter section

Use of diagnostic port of IPS (old version) for monitoring purpose is optional. If required, Zonal Railway shall facilitate the sharing of protocol of these IPS from respective OEMs to RDPMS vendors. However, it shall be responsibility of RDPMS vendor to integrate the interface port, if made available.

4.4.3 Surge Protection Devices:

The potential-free contacts of SPD devices, where available, shall be monitored through Data logger.

If the potential-free contacts of SPD devices are not logged in Data logger, same can be captured by using IoT. Care must be taken to ensure that the wiring from the SPD is routed in a manner that prevents it from running parallel to electrically "dirty" cables within the SPD box, thereby minimizing interference and ensuring accurate data capture.

4.4.4 Earth Leakage Detector (ELD) and Cable:

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Status of earth leakage from the ELD shall be monitored through Potential-Free contacts/diagnostic port.

The potential-free contacts of ELD shall be monitored through Data logger. If the potential-free contacts of ELD are not logged in Data logger, same can be captured by using IoT.

Use of diagnostic port of ELD for monitoring of cable health is optional. If required, Zonal Railway shall facilitate the sharing of protocol of ELD from respective OEMs to RDPMS vendors. However, it shall be responsibility of RDPMS vendor to integrate the interface port, if made available.

Coordinated data shall be utilized by machine learning to perform voltage drop analysis, enabling the monitoring of the health of signalling and power cables. Data already being collected, such as voltage readings in the IPS room, voltage in the field, and ELD (Earth Leakage Detector) data, will be leveraged to assess the health and reliability of the cables.

4.4.5 Block Instruments (Optional):

Relay status (potential-free contacts) of the Block Instrument shall be monitored through Datalogger. Line current and selective data for various types of Block Instruments shall be monitored using non-intrusive sensors. These sensors will ensure accurate data collection without interfering with the operation of the block instruments, maintaining system integrity and reliability.

4.4.6 UFSBI(Optional):

Relay status (potential-free contacts) of the UFSBI ~~modem~~ shall be monitored through Datalogger. If the potential-free contacts of UFSBI are not logged in Data logger, same can be captured by using IoT.

Use of diagnostic port of UFSBI for monitoring of it's health is optional. If required, Zonal Railway shall facilitate the sharing of protocol of UFSBI from respective OEMs to RDPMS vendors. However, it shall be responsibility of RDPMS vendor to integrate the interface port, if made available.

4.4.7 The ambient temperature and humidity of the battery room, relay room, power room, and Outdoor shall be recorded. This temperature data can be utilized in machine learning algorithms to model and analyze the impact of changes in these parameters on system performance and asset health.

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4.4.8 Different color-coded cables shall be used for sensor wiring in the CT rack to facilitate easy identification. The color scheme shall be determined by the respective Zonal Railways.

- Note:
1. Assets indicated as optional in this FRS are to be specified clearly in the schedule of work, if Zonal Railways want to monitor. If it is not specified by Zonal Railways, it will be assumed that the scope of work does not cover these items.
 2. For assets where logics have not been defined in FRS in Annexure C, the logics for them should be prepared by Zonal Railways and get approved by RDSO.

5 IOT DEVICE:

- 5.1 The IoT device shall be a software-embedded system preferably COTS (commercially off the shelf), designed to meet the required performance standards of the RDPMS system. Its primary function will be to capture parameters from signalling devices using sensors/Digital input/PF contacts and diagnostic ports and transmit this data to the Station Gateway located at the station.
- 5.2 IoTs should have inbuilt memory of minimum 10 days. Events shall be recorded on a first-in, first-out (FIFO) basis, ensuring that the latest data remains available in the system. Additionally, the IoT device must prevent event loss in case of power failure or communication failure, ensuring data integrity and reliability.
- 5.3 For monitoring at IBS (Intermediate Block Signaling), LC (Level Crossing), and Auto Signaling Assets, the IoT device shall be linked to the nearest station and its Station Gateway through communication technologies (such as quad/PIJF cables, wireless communication technologies (such as 4G/5G/LTE) shall be used to ensure reliable and fast data transfer.
- 5.4 The IoT device shall operate on the available 24V DC power supply from the IPS at the site. Additionally, a provision to operate on 110V AC shall be included as a secondary option. If an IPS power supply is not available at the location, Railways shall provide either a 24V DC or 110V AC power supply.

If 110VAC is used for power supply, the vendor shall supply DIN Rail Mounting type AC-DC adopter of required rating. Universal type adopter preferably commercial-off-the-shelf (COTS) type adopter shall be supplied OR 110 V AC internal converter should be used.

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- 5.5 The IoT device shall communicate with the Station Gateway using either wired or wireless technologies, depending on local site conditions and feasibility as detailed in Section-7.
- 5.6 The IoT device shall periodically send its own health status to the Station Gateway for continuous monitoring. This health status data, along with any detected anomalies, shall be transmitted to the Application Software, as described in Annexures A and B.
- 5.7 The IoT device shall continuously monitor sensors for parameters based on a configurable scanning interval. The scanning interval shall be determined by considering the type of gear/parameter, the requirements for Machine Learning and AI, and the capabilities of the IoT devices. The device must support a scanning interval of 20ms or less and should be configurable by RDPMS Application/Station Gateway.
- 5.8 The data captured by the IoT device will be sent to the Station Gateway, but sending data after every cycle can lead to high bandwidth usage and generate excessive data, making it difficult to manage and process effectively. To address this, a selective data transfer method should be implemented, as per guidelines as given in 5.8.1 below:

5.8.1 Some examples for ready reference are as below:

- i) Track circuits and Signal Lamp or indication voltages of Point Machine and ELBs, which are available continuously the operational parameters may be sent conditionally whenever change of reading is more/less than specific percentage (say $\pm 2\%$) of standard operating value. The % should be configurable from Application software. For transition from one level to other like 110 V to 0 V, intermediate voltages during transition may be skipped till the value is settled.
- ii) However, for Point machine & ELB motor which operates only for few seconds, the operating voltage and current for every operation will be important to capture its current signature. The current signature may help in deciding machine learning to predict cases of less lubrication, friction clutch issue, stone obstruction and gap, Health of motor etc. For such application data will be captured & stored at an interval of 20ms along with tolerance which shall be configurable.
- iii) Digital status should be sampled for every change from UP to DN or vice versa.

Note: Sampling details have been given in Annexure A.

- 5.9 The IoT device shall be rugged and of industrial grade, designed to operate reliably under 24x7 working conditions.
- 5.10 The IoT devices shall be tested in accordance with RDSO/SPN/144 as per RDSO approved test format.

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The IoT devices must also comply with the immunity requirements specified in Table-2 of IEC 61326 (Immunity test requirements for equipment intended to be used in an industrial electromagnetic environment).

Test certificate confirming compliance with above standards shall be submitted from Govt. Lab. If test facility is not available in Govt. Lab, test shall be carried out from NABL accredited Lab.

- 5.11 It must be ensured that IoT devices are secure, including protection against firmware and software vulnerabilities, and are tamper-proof to prevent unauthorized access. Vendor should ensure compliance with the TEC (Telecommunication Engineering Center) Code of practice for securing Consumer Internet of Things (IoT) (TEC 31318:2021 or latest).
- 5.12 The system should have a modular and scalable design. Preferably, it should be rack mountable and compact enough to fit within existing location boxes.
- 5.13 The cybersecurity of IoT devices shall be ensured, with third-party cybersecurity audits conducted on a sample basis as deemed necessary by Railways, in accordance with applicable regulatory requirements. These audits must be carried out by cybersecurity organizations empaneled by CERT-In i.e SQTC (Ministry of Electronics & Information Technology).
- 5.14 The IoT device should support connectivity with external devices such as laptops and mobile phones to enable reading and downloading of real-time microcontroller logs and saved data.
- 5.15 IOT devices deployed in each location shall have at least 10% spare Channels which can be used in future for any augmentation/modification.

6. STATION GATEWAY AND EDGE COMPUTING:

- 6.1 At each station, there shall be an embedded electronic unit called the Station Gateway. It will receive raw data and parameter values from sensors via IoT devices and diagnostic ports of various signaling assets. It shall send/receive the data to/from RDPMS Application software through Intermediate service Platform (to be planned by Vendors) as per standard Data Format using MQTT protocol (Annexure A & B). it shall also send Sensor/IOT health status to Application Software as per Annexure A & B. It will function as an edge computing device at the station and include built-in interface (protocol converters) for connectivity with dataloggers and IPS as detailed in Section-4.

Station Gateway shall also be capable to receive data from diagnostic port of SSDAC, MSDAC, BPAC, UFSBI, AFTC, and ELD etc. Interfacing with diagnostic port of these equipment is optional. If required, Zonal Railway shall facilitate the sharing of protocol of

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these equipment from respective OEMs to RDPMS vendors. However, it shall be responsibility of RDPMS vendor to integrate the interface port, if made available.

It shall also have diagnostic features and configuration capabilities. Details of Data Format are given in Annexure B. (Annexure A also to be referred for Standard Nomenclature).

- 6.2 IoT devices, sensors, and the Station Gateway from a single vendor shall be installed according to the specific requirements of each station. To ensure interoperability, Station Gateways (along with IoT devices and sensors) from different vendors shall be seamlessly integrated with application software from other vendors utilizing the standardized data format.
- 6.3 During future station augmentations, an additional Gateway, along with its IoT devices and sensors, may be deployed by the same or a different vendors. Integration with the existing application software will be facilitated through standard data format ensuring seamless interoperability. The standard nomenclature and data format supports the definition of multiple Gateways at a single station. For further details, refer to Annexure B, with Annexure A providing the standard nomenclature.
- 6.4 The Station Gateway shall have an event logging capacity of minimum 10 days. Events shall be recorded on a first-in, first-out (FIFO) basis, ensuring that the latest data remains available in the system. Additionally, the Station Gateway must prevent event loss in case of power failure or communication failure, ensuring data integrity and reliability.
- 6.5 The system's hardware architecture shall adopt a modular design, enabling scalability, flexibility, and ease of maintenance.
- 6.6 The system shall be easily reconfigurable to accommodate user-required changes, ensuring seamless adaptation to modifications made in the yard.
- 6.7 The implementation of version control and software modifications shall comply with RDSO/SPN/144 standards.
- 6.8 The user interface for configuring the Station Gateway shall be designed in a structured manner, ensuring that the Purchaser can reconfigure the station gateway, if required.
- 6.9 Station Gateway consists of:
 - (i) Suitable Interface for electronic signalling equipment like Data logger, IPS, ELD, SSDAC/MSDAC/BPAC, AFTEC etc as detailed in clause no.6.1.

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(ii) Edge Computing Hardware, Edge Application Software, and Communication Interfaces, including Ethernet, LTE/4G, RS485/RS232 (Serial Interface), wifi, LoRA, Zigbee , etc and additional interfaces as required.

6.10 The communication interface ports of the Station Gateway shall be configurable, ensuring flexibility for integration with various signalling equipments. Unused ports shall be blocked/disabled and shall only be enabled when required.

6.11 The Station Gateway shall be capable of operating with various transmission media, including quad/PIJF cable/optical fiber cable (dark fiber), IP network and wireless networks (4G/5G/LTE) including Ethernet and E1. Provision of other Short-range wireless technologies (LoRa, Zigbee or any licence free band technology etc. may also be made based on requirement.

Provision of suitable accessories as per requirement of consignee shall be made available.

6.12 Power Supply:

The system shall operate on 24V DC with a tolerance of ±30%. The 24V DC IPS channel shall be utilized for power supply.

6.13 The Station Gateway device shall be rugged and industrial-grade, designed for 24x7 continuous operation, ensuring high reliability and durability in demanding environments.

The Station Gateway shall be tested in accordance with RDSO/SPN/144 as per RDSO approved format.

A test certificate confirming compliance with these standards shall be submitted from Govt. Lab. If test facility is not available in Govt. Lab, test shall be carried out from NABL accredited Lab.

6.14 The cabinet shall be modular and ergonomically designed, ensuring ease of maintenance. It shall be powder-coated for durability and corrosion resistance. There shall be locking arrangement for the whole equipment to avoid unauthorized access.

6.15 It shall be ensured that Station Gateways are secure, incorporating protection against firmware and software vulnerabilities. The devices shall be tamper-proof to prevent unauthorized access and ensure the integrity of the system. Vendor should ensure compliance with the TEC (Telecommunication Engineering Center) Code of practice for securing Consumer Internet of Things (IoT) (TEC 31318:2021 or latest).

6.16 Cybersecurity of station gateway shall be ensured, with third-party cybersecurity audits conducted on a sample basis as deemed necessary by Railways, in accordance with applicable regulatory requirements. These audits must be carried out by cybersecurity

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organizations empaneled by CERT-In i.e SQTC (Ministry of Electronics & Information Technology) and compliance with audit observations shall be ensured .

- 6.17 The station gateway should support connectivity with external devices such as laptops and mobile phones to enable reading and downloading of real-time microcontroller logs and saved data.
- 6.18 The Station Gateway shall have remote access from for configurations from RDPMS Application as described in Annexure A ensuring seamless operation and adaptability. It should also be possible to configure it locally at station.

7. NETWORK :

- 7.1 Time synchronization is a critical requirement for ensuring accurate data interpretation between various IoT devices and the Station Gateway, particularly for machine learning applications. This requirement is addressed through time sync standard data packet specified in Annexure-B. Time sync is to be done by a time sync command sent by RDPMS Application. For the master clock, the IRNSS (Indian Regional Navigation Satellite System) clock shall be used as the reference.
- 7.2 The following may be the media between various devices.
 - 7.2.1 The real-time field data (such as voltage, current, temperature, humidity, relay status, vibration, etc.) shall be captured by various sensors and processed before being transmitted to the Station Gateway through IoT devices. For above data transmission, wired communication technologies (such as quad/PIJF cables, dark fiber) and /or wireless communication technologies (such as 4G/5G/LTE) shall be used to ensure reliable and fast data transfer. Short-range wireless technologies (LoRa, Zigbee, any licence free band technology etc.) may also be used for data transmission between IoT devices and station Gateway. Data from IoT devices deployed in location boxes on the same side of the tracks shall be aggregated into networked clusters (or any suitable means) before being sent to the Station Gateway.
 - 7.2.2 It is preferable to choose One wired and one wireless interface, however based on site requirement. Zonal Railway can decide types of communication media to be used for sending IoT data to Station Gateway.

A tentative station architecture is illustrated in Figure-2.

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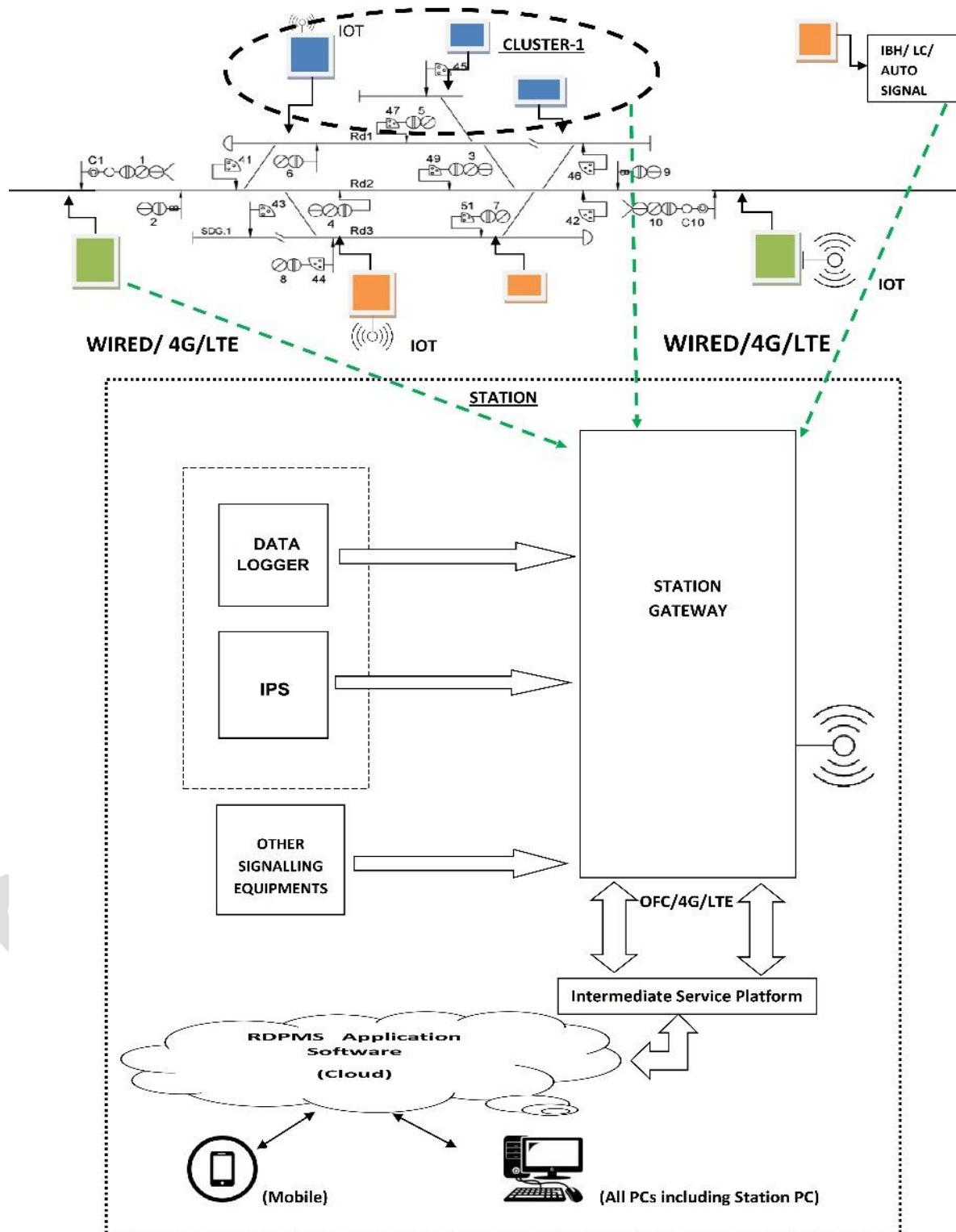


Figure-2

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- 7.2.3 For communication between indoor Interlocking systems/subsystems (such as data logger, IPS, SSDAC, MSDAC, BPAC, UFSBI, AFTC, and ELD etc.) and the Station Gateway, RS232/RS485 (Serial Interface), RJ45 (Copper Ethernet), and LC Port (Fiber Optic) may be used. Redundant communication path (wired/wireless) must be kept for reliability.
- 7.2.4 For far away field IoT's like for IBH, LC gates wired media like OFC or wireless system like 4G/LTE may be used.
- 7.2.5 For communication between the Station Gateway to/from Intermediate Service Platform (including RDPMS Application), the existing optical fiber network of RailTel or MPLS may be utilized as the primary communication medium. To ensure reliability and uninterrupted data transfer, 4G/5G/LTE connectivity shall be mandatory as a redundant communication channel, operating in parallel with the OFC/MPLS network. Minimum speed of 10 mbps shall be provided. However, speed may be increased depending on size of station and should be decided by Zonal Railway during planning stage.
- 7.2.6 In case of wireless communication between IoT devices at a location, a puck mount antenna (or any suitable small size antenna) shall be used to prevent animal damage and theft. Additionally, a proper gasket shall be used with these antennae to ensure secure mounting and environmental protection.

8 POWER SUPPLY REQUIREMENT AT STATION:

- 8.1 The power supply for IoT devices in location boxes shall be sourced from the signaling equipment supply provided by IPS, with a suitable rated fuse for protection. In locations where power is not available, 24V DC may be extended from a nearby location box to ensure continuous operation.
- 8.2 The power supply for Gateway, IoT devices in Indoor i.e. relay room shall be provided from 24V DC of IPS (preferably dedicated module in N+1 configuration).
- 8.3 If the IPS supply is not feasible as described in para 8.2, the Station Gateway shall be powered by a 230V UPS of good quality. The UPS input shall be sourced from the same IPS supply, i.e., Selective AT after auto-changeover for IPS. The UPS backup time shall be determined based on the power-cut duration at the specific station to ensure uninterrupted operation.

In such case, AC-DC adapter of required rating. Universal type adapter preferably commercial-off-the-shelf (COTS) type adopter shall be supplied by the vendor.

9 EARTHING AND SURGE PROTECTION REQUIREMENT:

- 9.1 Earthing shall be provided to the Station Gateway, IoT devices and armored cables, if any. Zonal Railways shall provide earthing arrangement in conformity to Code of

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practice for Earthing and Bonding RDSO/SPN/197/2016 (or latest) and the Guidelines issued for Earthing, Bonding, Surge, and Lightning Protection dated 01.01.2025 or latest.

- 9.2 Appropriate rating of SPDs shall be provided with IoT Devices, Station Gateway and Data-line as specified in the RDSO specification RDSO/SPN/165/2023 Ver.4.0 (or latest.) and the Guidelines issued for Earthing, Bonding, Surge, and Lightning Protection dated 01.01.2025 or latest.

10 STANDARD DATA FORMAT:

Standard Data format follow MQTT protocol. Station Gateway shall send/receive the data to/from RDPMS Application software through Intermediate service Platform (to be planned by Vendors) as per standard Data Format. This Data transmission shall be as per Publish and subscribe Model. Data sending entity will publish the data and Data receiving entity has to subscribe the desired data. Details are given in Annexure B (Annexure A also to be referred).

11 RDPMS APPLICATION SOFTWARE:-

- 11.1 The RDPMS Application Software shall be a GUI-based system developed by RDPMS vendors, designed to receive data from the Station Gateway through Intermediate service Platform (to be planned by Vendors) as per standard Data Format using MQTT protocol. This standard data format ensures interoperability between different vendors, allowing various Station Gateways (including IoT and sensors) to seamlessly communicate with application software of other vendors. The system must support secure, real-time data transmission while providing a user-friendly interface for monitoring, diagnostics, and predictive maintenance.
- 11.2 The RDPMS Application Software shall process data using advanced computing techniques with standard logics and various Machine Learning (ML) and Artificial Intelligence (AI) models to enable predictive maintenance. It shall generate alerts for predictions and failures of signaling assets, including probable causes, and deliver them to the mobile devices and PCs of Railway employees and Divisional Control for timely action. Additionally, the software shall have the capability to send configuration commands to the Station Gateway for various configuration functions as per the standard data format (Annexures B and A). It shall also detect and send alerts for faulty IoT devices or sensors, along with their probable causes, ensuring efficient monitoring and maintenance of the railway infrastructure.

11.3 Latency/Time delay in flow of Data:

The system shall be designed to achieve the objective of providing real-time information on the parameters of signaling assets, as proposed in this Functional Requirements Specification (FRS). The maximum time for updating an events at application shall

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normally be within one minute as per existing packet sending scheme, however it may vary, if packet sending scheme is changed.

- 11.4 User should be able to access the application on mobile and web browser Application on laptop/desktop. The mobile apps shall be compatible for both Android and iOS mobiles.
- 11.5 The RDPMS application supports different user roles with specific permissions. Head Quarter and Division Level Users can assign users, monitor, and generate reports but lack control functions. Station Level Users can acknowledge feeds, monitor, generate reports, and control functions but cannot assign users. Guest Users have limited monitoring access only. (Annexure D).
- 11.6 The RDPMS application shall require onetime device authentication for Android or iOS, using both OTP verification and device authentication, in addition to username and password. After successful authentication, auto-login will be available. Access shall be restricted to authorized mobile numbers stored in the database and device ID linked.
- 11.7 The app should not permit log from multiple devices with a single account (mobile no /email id), however One mobile and one desktop shall be permitted for a single user. However, Zonal Railway may also allow multiple access for a user if required.

11.8 Terminology: Various Terminology used in RDPMS Application:

- 11.8.1 Asset type:** It denotes different types of Assets like Point Machine, Track circuit etc. It shall be used as per Annexure A.
- 11.8.2 Asset number:** It denotes Asset number like PT-01, TC-101 etc. It shall be used as per Annexure A.
- 11.8.3 Asset make details:** It denotes Make of Asset like Crompton Greeves for Point Machine. It shall be used as per Annexure A.
- 11.8.4 Alert Types:** There shall be two types of Alerts ie “Failure Alert” and “Predictive Alert” with likely cause for each type of asset based on standard logics and AI/ML techniques. It shall also generate alert for failure of IoTs/sensors. On clicking of the particular alert, the detailed technical information of asset fault should come. It should be possible to give alerts to higher hierarchy. It shall be used as per Annexure A.
- 11.8.5 The non-availability of data due to failure of IoT device or normal train operation should not cause false alerts. The health of sensors and IoT devices should be considered for analysing the data. The health of sensors and IoT devices shall be communicated to

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RDPMS application software using standard data format. (annexure B) (Annexure A also to be referred for Standard Nomenclature).

11.8.6 Alert standard message format:

The systems shall generate alerts in best possible manner such that the cause of failure is pin pointed.

For example,

Failure Alert:

*Stn LKO, Sig S-12, Date: 13.12.25, Time: 15.35 hrs
Cause: 24 V DC Voltage for HPR Fail in Loc Box*

Predictive Alert:

*Stn LKO, Sig S-13, Date: 14.12.25, Time: 16.35 hrs
Cause: 24 V DC Voltage for HPR is Low in Loc Box*

11.8.7 Alert Status: There are two types of status, “cleared” and “pending”. “cleared” denotes that failure/prediction has been attended and feedback (T, F & M) with remarks have been given. “pending” denotes that Alert feedback (with remarks) has not yet been given. However, failure/prediction may or may not have been attended yet. It shall be used as per Annexure A.

11.8.8 Cause of Signalling Asset failure/prediction: It is cause of Failure/Prediction of Signalling Assets. It should be used in UIs & reports as per Annexure A.

11.8.9 Incidence Date & Time: It is actual time of Occurrence of Failure/Prediction. (Alert may take few seconds to generate and reach after occurrence). It shall be used as per Annexure A.

11.8.10 Rectification Date & Time: It is actual time of rectification of Failure/prediction. If rectification has not taken place, it will show “----”. It shall be used as per Annexure A.

11.8.11 Incidence duration: It is difference between above two timing i.e. actual duration of incidence. It shall be used as per Annexure A.

11.8.12 Alert feedback:

There shall be provision of feedback button in RDPMS Application to provide feedback whether generated alert was True (“T”) OR False (“F”) OR Maintenance (“M”) after

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attending the failure/prediction. "M" feedback option will exclude Alerts generated during maintenance for analysis. It shall be used as per Annexure A.

11.8.13 Maintenance mode of Alert:

1. There should be icon for enabling maintenance mode to stop Alerts during maintenance.
2. There should be icon for disabling maintenance mode to restore Alerts after maintenance.
3. In case, ESM forgets to disable maintenance mode. It automatically gets disabled after certain duration from its enabling time as tabled in Annexure C.
4. In case, Alert gets generated because of maintenance, ESM can press "M" button at the time of feed back of alert to exclude it in analysis and counting.

11.8.14 Remarks: The Railway Person shall give remarks after attending the failure/prediction in this head. The box for Remarks shall open after pressing "T" OR "F" OR "M" Tab for feedback to ensure that feedback is not missed. It shall be used as per Annexure A.

11.8.15 Alert feedback Date & Time: It is time of providing feed back (T, F or M) & Remarks of Alert. It shall be used as per Annexure A.

11.9 Selection of Alert for pushing when multiple Alerts are generated through multiple logics: To avoid multiple Alerts generated through multiple logics for one asset, a scheme should be followed to select one Alert for pushing. For this, Alert pushing flow has been described in Annexure C.

11.10 Repeat Frequency of same Alert: Failure and predictive Alerts shall be generated as per the logics and AI/ML models and as per Alert pushing flow at para 11.9 and sent to maintainer once. However the repetition of same Alerts will be sent to maintainer and higher officials only after duration as mentioned in Annexure C.

11.11 User Interface: UI shall be developed by vendors as per requirement of Railways. Efforts should be made to keep it simple so that it can easily be used by maintainer. Parameters should also be shown in circuit form in addition to tabular and other forms for easier understanding of maintainer. Standard User Interface requirement has been detailed in Annexure D. (Annexure A also to be referred for Standard Nomenclature).

11.12 Standard Reports Format: As defined in Annexure D. (Annexure A also to be referred for Standard Nomenclature).

11.13 SMMS interlinking:

11.13.1 RDPMS Application Software shall have provision of APIs/data format to take asset details from SMMS (Signalling Maintenance Management System) and to provide

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parameter values to SMMS on request. API/data format details have been provided in Annexure A & B.

- 11.13.2 RDPMS Vendor shall send one copy of parameters of Signalling assets to Railway Cloud (CRIS Or as decided by Railway management) from Station gateway or Intermediate service platform (as decided by Railway management based on technical feasibility) for further analysis or use as Railway being the custodian of Data. API/data format details have been provided in Annexure A & B.
- 11.14 If multiple instances of one vendor's application software is running, it shall have one common weblink to access all instances of Application Software of one vendor.
- 11.15 There shall/may be One common RDPMS Dashboard application for Railway management (to be developed under guidance of Railway management) to access reports from Application Software of all vendors. This will obviate the need of accessing several RDPMS Applications to see the reports by higher management. Common RDPMS Dashboard shall be hosted at Cloud as decided by Railway Management.
- 11.16 In order to achieve the above objective as per 11.15, Standard Application Programming Interface (API) shall be made by all vendors in their Application software for extracting reports/information so that common dashboard application for Railway management can access reports from application software of all vendors using standard APIs as per annexure E (Annexure A also to be referred for Standard Nomenclature).

11.17 Security Verification Certification of RDPMS Application Software:

The RDPMS Application Software shall have security features which can be deployed meeting the security assurance requirements as to be applicable for security, vulnerabilities, etc. Such requirement shall be mutually decided by Purchaser and CERT-In empaneled Information Security Auditing Organization i.e STQC (Ministry of Electronics & Information Technology) for testing and issuing the certificate / clearance.

12 HOSTING OF RDPMS APPLICATION SOFTWARE AND INTERMEDIATE SERVICE PLATFORM:

- 12.1 RDPMS Application Software and Intermediate service platform shall be hosted as decided by Zonal Railways.

13 MACHINE LEARNING AND AI TECHNIQUES:

- 13.1 Machine learning and artificial Intelligence is very vital component of this system. The AI/ ML algorithms should be as per ISO/IEC JTC 1/SC 42 standards or any other latest

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ISO/IEC standard. The system shall provide predictive maintenance and optimization with the help of advanced analytics, Machine Learning and Data visualization.

- 13.2 Machine Learning algorithm should be able to suggest and predict defects, device failure and remaining useful life (RUL). Application should be backed by intelligent health monitoring algorithms for assets using machine learning algorithms to predict the equipment failure or errors and send SMS alerts to the concerned official's mobile number. It is expected that accuracy of predictive alerts should be better than defined levels with time.
- 13.3 The data received is used by the AI algorithms to improve the failure models and predictive models. Initially, supervised learning will be done and gradually the learning will be more automated using AI techniques. The failures and maintenance activity data shall also be used for selecting and neglecting the raw data respectively. For example, if deterministic failure is reported by Edge device, the machine learning will analyse deep data screening to relate failure pattern and update its model. While, if maintenance activity is taken where disconnection or forced shutdown of equipment is done, the machine learning algorithm will discard such data to prevent wrong learning.
- 13.4 The existing failure models and predictive models are updated time to time by the Machine learning above. The real-time data of signalling gears is analysed with these machine learning models. The ML algorithms are applied to reveal hidden correlations in data sets and detect abnormal data patterns. The recognized data patterns are reflected to generate the predictive health information of signalling equipment.
- 13.5 The initial development rules include defining the allowable parameter limits. For example, if monitored 24V DC power supply for an equipment like axle counter of so and so make goes below "x" volt (as per equipment manual), it is likely to fail.
- 13.6 By monitoring patterns in real time and looking at historical data, the machine learning can identify repeat scenarios which it can then create rules for moving forward. Like in above example, after machine learning, the axle counter parameter limit will be fine-tuned together with information from other parameters like ambient temperature, level of induced voltage in cable etc. This process is an adaptive learning process, meaning that the system will use AI techniques to find pattern in data. The more data and scenarios it collects and encounters, the more it will self learn.
- 13.7 It is desirable that Cloud and AI shall be based on open source platforms and AI algorithms developed shall be property of Indian Railways. There shall be no propriety of industry partners on the intellectual property so emerged during trials and development of the system.

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14 CCSP LAYER (C-DOT COMMON SERVICE PLATFORM) Compliance:

System should be designed such that it shall remain compliant with OneM2M standards using MQTT protocol for future, if required. Vendor shall acquire basic understanding of oneM2M standards. (Refer <https://coi.cdot.in/docs/oneM2MGuideline.html>).

15.0 TEST REQUIREMENTS:

15.1 Conditions of Tests:

15.1.1 Unless otherwise specified all tests shall be carried out at ambient atmospheric conditions.

15.1.2 Inspection and testing shall be carried out to the effect that all requirements of this FRS and Standard referred in this FRS are complied with.

15.2 Type Test:

15.2.1 Type tests are performed to validate the design and ensure that it meets the functional requirements and standards referred in this FRS for its intended application and service life. The vendor shall submit Type test report from eligible laboratory as specified in this FRS at the time of offering the lot for Acceptance Test.

15.2.2 Sensor, IoT (including COTs type IoT), Station Gateway and RDPMS Application Software shall be subjected to following Type tests as applicable:

- i) Visual inspection:
For sensors, IoT devices, Station Gateway and RDPMS Application Software (Cl. No. 5.12, 6.5, 6.7, 6.14 & 15.5.1).
- ii) Performance test:
 - a. Sensors:- Clause No. 4.2.1, 4.2.3, & 4.2.5
 - b. IoT devices:- Clause No. 5.1, 5.2, 5.4, 5.6, 5.7 & 8.1
 - c. Station Gateway:- Clause No. 6.1, 6.4, 6.7, 6.9, 6.10, 6.11, 6.12, 6.18, 6.20, 7.2.1, 8.2, 8.3 & 10
- iii) Endurance test:
For sensors, IoT devices, Station Gateway (Cl. No. 15.5.2.1).
- iv) Environmental/Climatic Tests:
 - a. Sensors:- Clause No. 4.2.1, 4.2.3 & 4.2.5
 - b. IoT devices:- Clause No. 5.10.

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c. Station Gateway:- Clause No. 6.13.

- v) Security & vulnerabilities
 - a. IoT devices:- Clause No. 2.5, 5.11, 5.14
 - b. Station Gateway:- Clause No.6.15, 6.16 & 6.17.
 - c. RDPMS Application Software:- Clause No.11.17)

15.2.3 The system shall successfully pass all the type tests for proving conformity with this FRS. If any one of the equipment fails in any of the type tests, the purchaser or his nominee at his discretion, may call for another equipment and subject it to all tests or the test(s) in which failure occurred.

15.2.4 Any other tests shall be carried out as considered necessary by the manufacturer and purchaser.

15.2.5 No test shall be carried out on COTs items (excluding COTs Type IoTs). Acceptance of these items shall be based on certification and Datasheet verification issued by eligible Laboratory/OEMs. However performance of these items required for compliances to the FRS shall be checked.

15.2.6 RDSO approved Type Test format shall be used for type test.

15.3 Acceptance Test:

15.3.1 Acceptance test shall be carried out by the purchaser or an agency decided by the purchaser to ensure that it meets the functional requirements and standards referred in this FRS for its intended application and service life. The testing shall be carried out based on random sampling and Cl. No.15.3.3 shall be followed for sampling of Sensors (Voltage, Current, Temperature, Vibration and Humidity), IoT Devices and Station gateway.

15.3.2 The following shall constitute the acceptance tests which shall be carried out by the inspecting authority for the purpose of acceptance on randomly selected of items offered from the lot as per sampling plan (given in Cl. No. 15.3.3) offered for inspection by the supplier:

- i. Visual inspection.
For sensors, IoT devices, Station Gateway and RDPMS Application Software (Cl. No. 5.12, 6.5, 6.7, 6.14 and 15.5.1).
- ii. Performance Test.:

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- a) Sensors:- Clause No. 4.2.1.
- b) IoT devices:- Clause No. 5.1, 5.2, 5.4, 5.6, 5.7 & 8.2.
- c) Station Gateway:- Clause No. 6.4, 6.7, 6.12 & 8.2.

iii. Endurance test:

For sensors, IoT devices, Station Gateway (Cl. No. 15.5.2.2).

15.3.3 Sampling Plan:

Following table shall be applicable for sampling of Sensors (Voltage, Current, Temperature, Vibration and Humidity), IoT Devices and Station gateway:

Quantity offered (Lot Size)	Sample size
1	1
2 to 8	2
9 to 15	3
16 to 25	5
26 to 50	8
51 to 90	13
91 to 150	20
151 to 280	32
281 to 500	50
501 to 1200	80
1201 to 3200	125
3201 to 10000	200
10001 to 35000	315
35001 to 150000	500
150001 to 500000	800
500001 and over	1250

15.3.4 Any other tests shall be carried out as considered necessary by the inspecting authority.

15.3.5 RDSO approved Acceptance Test format shall be used for the purpose of acceptance of lots offered by manufacturer for Indian Railways use.

15.4 Routine Test :

15.4.1 Routine test shall be conducted by vendor on every equipment and the test results shall be submitted at the time of Acceptance Test.

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15.4.2 Firm shall submit the details such as make, model & version of every equipment including Software to inspecting authority along with Type Test reports.

15.5 TEST PROCEDURE:

The test procedure shall be based on the system design and the standard referred in this FRS. The methodologies to be adopted for various tests shall be decided taking into account the system design/configuration and the relevant standards.

15.5.1 Visual Inspection and Performance Test:

15.5.1.1 Each equipment of the system shall be visually inspected to ensure compliance with the requirement of relevant clauses of this FRS and Specification No. RDSO/SPN/144/2006(Latest Version).

15.5.1.2 The visual inspection shall broadly include:

- i) Constructional details
- ii) Dimensional check
- iii) General workmanship
- iv) Configuration

15.5.1.3 Performance of each equipment/system shall be tested to ensure compliance with the requirement of relevant clauses of this FRS.

15.5.2 Endurance Test:

15.5.2.1 During Type Test, Endurance test shall be conducted on Sensors, IoTs and Station Gateway for continuous operation which shall be 72 hrs at ambient room temperature without giving any deterioration of equipment performance.

15.5.2.2 During Acceptance Test, Endurance test shall be conducted on complete system for continuous operation which shall be 24 hrs at ambient room temperature without giving any deterioration of equipment performance.

15.6 Pre commissioning check:

A pre-commissioning checklist is a detailed list of tasks and inspections required to ensure that equipment, systems, and facilities as described in this FRS are ready for commissioning. This checklist helps to verify proper installation, functionality, and compliance with specifications and regulatory requirements before actual operation. RDSO approved Pre-commissioning check list, shall be used during commission of

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the system and shall be duly signed between Zonal Railways and vendors and shall be kept at Station. One copy also to be made available at Divisional Head Quarter.

- 15.7 Bench Marking:** Vendor shall deliver 95 % accuracy in implementation of business rules (static logics as per Annexure C) in Alert generation.

16 QUALITY ASSURANCE:

- 16.1 All materials & workmanship shall be of good quality.
- 16.2 Since the quality of the equipment bears a direct relationship to the manufacturing process and the environment under which it is manufactured, the manufacturer shall ensure Quality Assurance Program of adequate standard.

17 MARKING & PACKING:

- 17.1 All markings/ indications shall be easily legible and durable. It shall be placed in the vicinity of the components to which these refer and can not be replaced in such a way that the marking /indications can become misleading.
- 17.2 The words '**Indian Railway Property**' shall be etched, engraved or embossed on the equipment at a conspicuous position. The size of the letters shall be chosen depending upon the equipment's size but shall not be less than 20 mm high in any case.
- 17.3 Following information shall be etched, engraved or embossed on the equipment or on suitable name plate:
 - (a) Name or trade mark of the manufacturer.
 - (b) Serial number of the equipment.
 - (c) Month and year of manufacture.
 - (d) Rating (Power/voltage/current etc.)

Note: This requirement may be exempted for commercial-off-the-shelf (COTS) items.

- 17.4 The equipment and its sub-assemblies shall be packed in suitable packing so that it can withstand bumps and jerks encountered during transportation.

18 TRAINING:

- 18.1 Onsite training or as specified by the purchaser shall be provided to the Railway staff which shall include complete assembly of the system through the use of various modules, integration of hardware with software and complete operation of the system.

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Training shall also include complete use of RDPMS Application Software, Do's Don'ts, Network restoration, reconfiguration of IoT channels etc.

- 18.2 Sets of training manual in four hard copies and Soft copy containing details of technical specifications, installation and commissioning, trouble shooting & maintenance schedule etc. or as specified by the purchaser shall be supplied along with the equipment.

19 DOCUMENTATION:

The following documents or as specified by the purchaser shall be supplied along with the system:

- i) Schematic Diagram.
- ii) Installation and maintenance manual.
- iii) Operating and troubleshooting manual.
- iv) Mandatory declaration as required by Cl. No. 2.6 of this FRS.
- v) System commissioning report consisting of complete network diagram of IoTs/Station Gateway, networking diagram as per Clause No. 3 & 7.2.2.
- vi) RDSO approved Pre-commissioning check list duly signed between Zonal Railways and vendors.

20 WARRANTY and AMC/ARC:

The manufacturer/supplier shall warrant the material supplied to be free from defects in design, material and workmanship under ordinary use and service, his obligation under this warranty being limited to repair/replace free of cost those parts (Hardware/Software/Networking accessories etc.) which shall be found defective within 3 years after installation and commissioning of the system. Sufficient spares shall be kept for this purpose.

During a warranty period, the supplier is typically responsible for addressing any defects or issues with the supplied goods or services that arise due to faulty materials, design, or workmanship. The supplier is generally obligated to remedy these defects, including replacement or renewal of defective parts, at their own cost without any additional cost to the Railway.

AMC/ARC with vendors may be awarded as decided by Zonal Railway.

21 INFORMATION TO BE PROVIDED BY THE PURCHASER/RAILWAY:

- i. Signalling assets to be monitored with their quantities.
- ii. Type of communication to be used for sending IoT data to Station Gateway.
- iii. Type of communication to be used for sending Station Gateway data to Cloud(RDPMS application).

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- iv. Requirement of cloud (Railway Cloud or Vendor cloud).
- v. Requirement of PC at Station for monitoring purpose.

Other information/requirements to be provided by Railways as mentioned in the FRS and its annexures.

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Annexure A

Standard Nomenclature used in Standard Data format, Logics, APIs, UI & Reports.

Station Gateway is nodal device which collects data from various means as following

1. Sensors through IoT.
2. Datalogger Port
3. Diagnostic Port of various Equipment (as applicable)

Gateway then sends these data to Application software in standard data format using standard nomenclatures of different parameters as defined below. Apart from parameter value, few other important data is also sent/received like configuration, diagnostic, confirmation and time stamp etc. Similarly other nomenclatures pertaining to Application Software and used in User Interface and APIs have also been defined. The details are given below.

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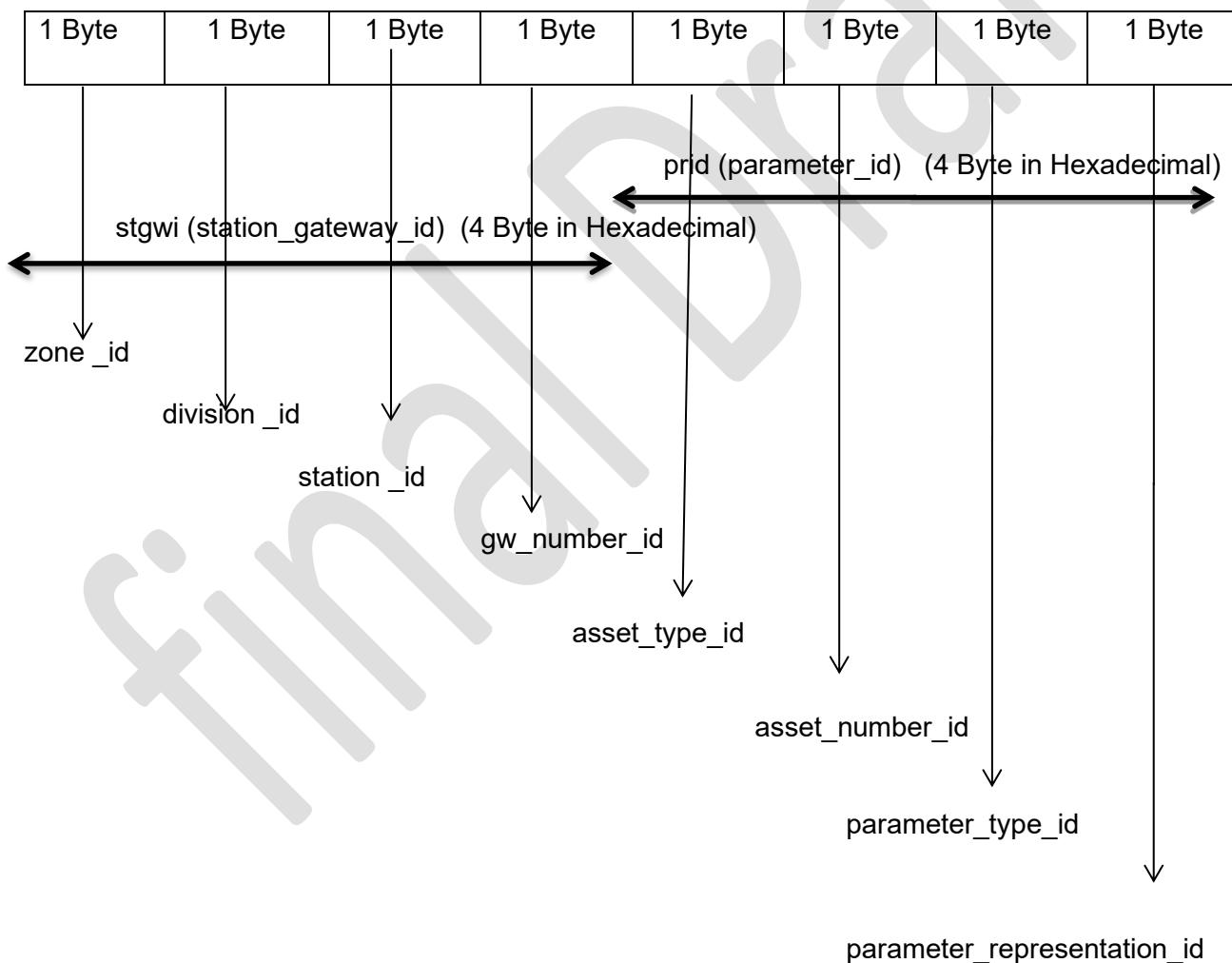
1. station_gateway_id:

It is 4 Byte (in Hexadecimal) id to uniquely define each gateway in Indian Railways. It is being used in standard data format. It is represented as "stgwi" in data packet.

2. parameter_id :

It is 4 Byte (in Hexadecimal) id to uniquely define each parameter within each station gateway. It may either be sensor input or digital status of relays from Data logger port. It is represented as "prid" in data packet. prid and stgwi, when used together, will uniquely define each parameter in Indian Railways. It is being used in standard data format.

Details of station_gateway_id and parameter_id has been shown below:



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3. Details of each byte of station_gateway_id and parameter_id :

a. **Zone details:** zone_id is part of stgwi (station gateway id) denoted in one byte in Hexadecimal. Zone information can be taken from this by Application software. Details given below. zone_code is short name of Zone which is represented as "zc" in datapacket.

b. **Division details:** division_id is part of stgwi (station gateway id) denoted in one byte in Hexadecimal. Division information can be taken from this by Application software. Details given below. division_code is short name of Division which is represented as "dc" in datapacket.

S. No.	zone_name (string)	zone_code (string)	zone_id (One Byte-shown in Hexadecimal)	division_name (string)	division_code (string)	division_id (One Byte-shown in Hexadecimal)
1	CENTRAL RAILWAY	CR	00	BHUSAVAL	BSL	00
				MUMBAI	CSTM	01
				NAGPUR	NGP	02
				PUNE	PUNE	03
				SOLAPUR	SUR	04
2	EAST CENTRAL RAILWAY	ECR	01	DANAPUR	DNR	00
				DHANBAD	DHN	01
				PT.DEEN DAYAL UPADHYAYA	DDU	02
				SAMASTIPUR	SPJ	03
				SONPUR	SEE	04
3	EAST COST RAILWAY	ECoR	02	KHURDA ROAD	KUR	00
				SAMBALPUR	SBP	01
				WALTAIR	WAT	02
4	EASTERN RAILWAY	ER	03	ASANSOL	ASN	00
				HOWRAH	HWH	01
				MALDA	MLDT	02
				SEALDAH	SDAH	03
5	NORTH CENTRAL RAILWAY	NCR	04	AGRA	AGRA	00
				JHANSI	JHS	01
				PRAYAGRAJ	PYRJ	02
6	NORTH EASTERN RAILWAY	NER	05	IZZATNAGAR	IZN	00
				LUCKNOW	LJN	01
				VARANASI	BSB	02
7	NORTH FRONTIER RAILWAY	NFR	06	ALIPURDUAR	APD	00
				KATIHAR	KIR	01
				LUMDING	LMG	02
				RANGIYA	RNY	03
				TINSUKIA	TSK	04
8	NORTHERN RAILWAY	NR	07	AMBALA	UMB	00
				DELHI	DLI	01

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				FEROZPUR	FZP	02
				LUCKNOW	LKO	03
				MORADABAD	MB	04
9	NORTH WESTERN RAILWAY	NWR	08	AJMER	AII	00
				BIKANER	BKN	01
				JAIPUR	JP	02
				JODHPUR	JU	03
				GUNTAKAL	GTL	00
10	SOUTH CENTRAL RAILWAY	SCR	09	GUNTUR	JNT	01
				HYDERABAD	HYB	02
				NANDED	NED	03
				SECUNDERA- BAD	SC	04
				VIJAYAWADA	BZA	05
				BILASPUR	BSP	00
11	SOUTH EAST CEN- TRAL RAIL- WAY	SECR	0A	NAGPUR	NGP	01
				RAIPUR	R	02
				ADRA	ADRA	00
12	SOUTH EASTERN RAILWAY	SER	0B	CHAKARDHARP UR	CKP	01
				KHARAGPUR	KGP	02
				RANCHI	RNC	03
				CHENNAI	MAS	00
13	SOUTHERN RAILWAY	SR	0C	MADURAI	MDU	01
				PALAKKAD	PGT	02
				SALEM	SA	03
				THIRUVANAN- THPURAM	TVC	04
				TIRUCHCHIRAP- PALLI	TPJ	05
				BENGALURU	SBC	00
14	SOUTH WESTERN RAILWAY	SWR	0D	HUBBALLI	UBL	01
				MYSURU	MYS	02
				BHOPAL	BPL	00
15	WEST CENTRAL RAILWAY	WCR	0E	JABALPUR	JPB	01
				KOTA	KOTA	02
				AHEMDABAD	ADI	00
16	WESTERN RAILWAY	WR	0F	BHAVNAGAR	BVC	01
				MUMBAI CEN- TRAL	BCT	02
				RAJKOT	RJT	03
				RATLAM	RTM	04
				VADODARA	BRC	05

c. **Station details:** station_id is part of stgwi (station gateway id) denoted in one byte in Hexadecimal. Station information can be taken from this by Application software. It is being used in

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standard data format. Details given below. station_code is short name of station which is represented as "sc" in datapacket.

S No	station_name (station name used in data format in string)	station_code (station code used in data format in string)	station_id (One Byte – shown in Hexadecimal)
1.	Lucknow	LJN	12

Note: station_id should be allotted by Division from 00 onwards in Lexicographical order of Station code within each Division.

- d. **Gate way details:** It is a number given to station gateway from 00 onwards at each station if multiple gateways are installed. It is part of stgwi (station gateway id). It has been denoted as gw_number_id (one byte in Hexadecimal).
- e. **Asset type:** asset_type_id is part of prid (parameter id) denoted in one byte in Hexadecimal. It is being used in standard data format. asset_type_code should be used in UIs , APIs & reports where Asst type is mentioned. asset_type_code is represented as "astc" in datapacket. These types are same as being used in SMMS. Details given below.

S No	asset_type_name (String)	as-set_type_code (String)	asset_type_id allotted by RDPMS (One Byte – shown in Hexa-decimal)	Remarks
1.	Point Machine	EOP	00	Code as per SMMS
2.	Main Signal	LED	10	
3.	Shunt Signal	LES	11	
4.	Calling On Signal	LEC	12	
5.	Route Signal	LER	13	No code defined in SMMS
6.	DC Track Circuit	DCT	20	Code as per SMMS
7.	Single Section Axle Counter - Eldyne	SSE	21	
8.	Single Section Axle Counter - CEL	SSC	22	
9.	Single Section Axle Counter – G.G. Tronics	SSG	23	
10.	Multi Section Axle Counter - Eldyne	MSE	24	

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11.	Multi Section Axle Counter - CEL	MSC	25	
12.	Multi Section Axle Counter - Siemens	MSS	26	
13.	Multi Section Axle Counter – Siemens ACM200	ACM	27	
14.	Multi Section Axle Counter - Fauscher	MSF	28	
15.	Multi Section Axle Counter - Medha	MSM	29	
16.	Multi Section Axle Counter – G.G. Tronics	MSG	2A	
17.	Multi Section Axle Counter – Sigma Altpro	MSA	2B	
18.	High Availability Single Section Digital Axle Counter - GGtron- ics	HAG	2C	
19.	Audio Frequency Track Circuit- Ansaldo/Alstom	AFA	2D	
20.	Audio Frequency Track Circuit- Siemens	AFS	2E	
21.	Audio Frequency Track Circuit- Bombardier	AFB	2F	
22.	Block Proving Axle Counter withUAC	BUA	30	
23.	Block Proving Axle Counter with UFSBI	BUF	31	
24.	SGE Double line Block Instrument	SGE	32	
25.	DIODO Type Single Line Block Instrument	DDT	33	
26.	Block Instrument – Push But- ton	PBT	34	
27.	Block Instrument – Push But- ton – Neal's Token	NLT	35	
28.	Mechanical Level Crossing Gate	MLC	40	
29.	Electrical Level Crossing Gate	ELC	41	
30.	Integrated Power Supply	IPS	50	
31.	Earth Leakage Detector	ELD	60	
32.	Temperature	TEMP	FE	Not asset hence asset type field can be defined by hex value as shown.
33.	Humidity	HUMD	FF	

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- f. Asset number id (hexadecimal) :** It is part of prid (parameter id). It is a numerical number allotted to asset to uniquely define parameter id. It has been denoted as `asset_number_id` (one byte in Hexadecimal). It may not be same as actual asset number at station. This number will start from 00 to FF for each asset type pertaining to one gateway. It is being represented as “asni” in standard data format.
- g. SMMS asset code (string):** It is unique id assigned to each asset in SMMS (Signalling Maintenance Management System) system. Smms Asset Code is system generated code which is created when the asset is defined (created) in the SMMS system. This SMMS code will be received from SMMS using API provided by SMMS system. This API interface is described in the annexure later in this document. SMMS will provide API based interface through which RDPMS will get details and meta data for each asset. This is denoted as `smms_asset_code`. This is similar to `asset_number_id` of RDPMS as mentioned above in (f).
- h. Asset number code (string):** It is used for asset number like PT-01, TC-101 which is actual asset number at station. It has been denoted as `asset_number_code` (in string). It should be used in standard data format, UIs, APIs and reports where asset number is mentioned. It is represented as “asnc” in standard data packet.
- i. SMMS asset number (string):** It is used by SMMS for asset name like PT-01, TC-101 which is actual asset name at station. This will be received from SMMS using API provided by SMMS system. This API interface is described in the annexure later in this document. This is represented as `smms_asset_name`. This is actually same as `asset_number_code` (asnc) of RDPMS system as defined in (h) above. There shall be a table in application software to map all 4 referred in (f), (g), (h) & (i) as given below.

<code>smms_asset_code</code> (String) (SMMS)	<code>smms_asset_name</code> (SMMS)	<code>asset_number_code</code> (string) (RDPMS)	<code>asset_number_id</code> (one byte in Hexadecimal) (RDPMS)
EOPMIU00013	PT-101	PT-101	00
EOPMIU00014	PT-102	PT-102	01
DCTMIU00047	TC-100	TC-100	10
DCTMIU00048	TC-101	TC-101	11
----	-----	For Temperature and humidity	FF

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j. Parameter type and unit details: It is part of prid (parameter id). It defines type and unit of parameter. It has been denoted as parameter_type_id (one byte in Hexadecimal). Details given below.

Parameter type	parameter_type_id (one byte in Hexadecimal)	Remarks
Current DC (unit -A)	00	Other units of current DC can be allotted bytes from 02 to 0F
Current DC (unit - mA)	01	
Current AC (unit -A)	10	Similar analogy as above
Current AC (unit - mA)	11	
Voltage DC (unit – V)	20	Similar analogy as above
Voltage DC (Unit-mV)	21	
Voltage AC (unit – V)	30	Similar analogy as above
Voltage AC (Unit-mV)	31	
Digital (It is digital status of Relay. Value of prid shall be 1 for UP & 0 for DN)	40	Similar analogy as above
Temperature (Unit – C (centigrade))	50	Similar analogy as above
Humidity (Relative humidity in %)	51	Similar analogy as above
Vibration	60	Similar analogy as above
Frequency (Unit - Khz)	70	Similar analogy as above
Frequency (Unit – Hz)	71	
Resistance (Unit-Ohm)	80	Similar analogy as above
Resistance (Unit-KOhm)	81	
Time (Unit – seconds)	90	Similar analogy as above
Time (Unit – mili seconds)	91	

k. Parameter representation details:

parameter_representation_id is part of prid (parameter id). It is represented in one byte in hexadecimal. parameter_representation_code is short nomenclature to define parameter of asset like current of point machine, voltage of point machine etc in string. It is being used in logics in Annexure C and can be used in Application Software for logic processing and in UI for displaying parameters.

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parameter_representation_name (string)	parameter_representation_code (string)	parameter_representation_id (one byte)
110 DC at Loc box for Normal.	V _{PT} 110 DC Loc N	0A

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Nomenclature of Parameter of Integrated Power Supply

Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)	Remarks
IPS Diagnostic Port as per latest Specs OR Using Sensors	IPS 110 DC O/P Voltage	V _{IPS 110 DC}	00	20	
	IPS 110 AC Sig-1 O/P Voltage	V _{IPS Sig-1 110 AC}	10	30	
	IPS 110 AC Sig-2 O/P Voltage	V _{IPS Sig-2 110 AC}	11	30	
	IPS 110 AC Sig-3 O/P Voltage	V _{IPS Sig-3 110 AC}	12	30	
	IPS 110 AC Sig-4 O/P Voltage	V _{IPS Sig-4 110 AC}	13	30	
	IPS 110 AC TR-1 O/P Voltage	V _{IPS TR-1 110 AC}	20	30	
	IPS 110 AC TR-2 O/P Voltage	V _{IPS TR-2 110 AC}	21	30	
	IPS 110 AC TR-3 O/P Voltage	V _{IPS TR-3 110 AC}	22	30	
	IPS 110 AC TR-4 O/P Voltage	V _{IPS TR-4 110 AC}	23	30	
	IPS SMR-1 Voltage	V _{IPS SMR-1 110 DC}	30	20	
	IPS SMR-2 Voltage	V _{IPS SMR-2 110 DC}	31	20	
	IPS SMR-3 Voltage	V _{IPS SMR-3 110 DC}	32	20	
	IPS SMR-4 Voltage	V _{IPS SMR-4 110 DC}	34	20	
	IPS SMR-5 Voltage	V _{IPS SMR-5 110 DC}	35	20	

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	IPS DC-DC Relay Internal Voltage	V _{IPS DC R INT}	40	20	parameter_representation_id can be can be used further from 40 upto 47 for individual module, if required.
	IPS DC-DC Relay External Voltage	V _{IPS DC R EXT}	48	20	parameter_representation_id can be can be used further from 50 upto 5F for individual module, if required.
	IPS DC-DC AXLE COUNTER Voltage	V _{IPS DC AXLE C}	50	20	parameter_representation_id can be can be used further from 60 upto 6F for individual module, if required.
	IPS DC-DC PANEL INDICATION Voltage	V _{IPS DC PAN IND}	58	20	parameter_representation_id can be can be used further from 70 upto 74 for individual module, if required.
	IPS DC-DC BLOCK LOCAL Voltage	V _{IPS DC BLOCK LOCAL}	5C	20	parameter_representation_id can be can be used further from 75 upto 79 for individual module, if required.

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	IPS DC-DC HKT MAGNETO Voltage	V _{IPS DC HKT MAG}	60	20	parameter_representation_id can be can be used further from 7A upto 7F for individual module, if required.
	IPS DC-DC BLOCK LINE UP Voltage	V _{IPS DC BLOCK LINE UP}	62	20	parameter_representation_id can be can be used further from 80 upto 88 for individual module, if required.
	IPS DC-DC BLOCK LINE DN Voltage	V _{IPS DC BLOCK LINE DN}	63	20	parameter_representation_id can be can be used further from 89 upto 8F for individual module, if required.
	IPS DC-DC BLOCK TELE UP Voltage	V _{IPS DC BLOCK TEL UP}	65	20	parameter_representation_id can be can be used further from 90 upto 98 for individual module, if required.
	IPS DC-DC BLOCK TELE DN Voltage	V _{IPS DC BLOCK TEL DN}	66	20	parameter_representation_id can be can be used further from 99 upto 9F for individual module, if required.

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	IPS DC-DC DATA-LOGGER Voltage	V _{IPS DC DATALOG}	68	20	parameter_representation_id can be can be used further from A0 upto A4 for individual module, if required.
	IPS DC-DC EI Voltage	V _{IPS DC EI}	70	20	parameter_representation_id can be can be used further from A5 upto AF for individual module, if required.
	IPS Battery charging Current	I _{IPS Batt Char 110 DC}	78	00	
	Individual battery voltage (optional)	V _{IPS Batt-1} V _{IPS Batt-2.....}	80-BF	20	parameter_representation_id can be can be used from 80 upto BF.
	SPD – 1 status	SPD ₁	C0	40	parameter_representation_id can be can be used further from C0 upto EF for individual SPDs, if required.
	Earthing -1	R _{Earth-1}	F0	80	parameter_representation_id can be can be used further from F0 upto FF for individual Earths, if required.

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Note: There can be three types of Parameters ie through Sensor, through Digital and derived. Allout efforts have been made to cover all Parameters. However, there are still spaces left in Parameter_representation_id (one byte hexadecimal). VENDOR can define new parameters with suitable Parameter_representation_id (one byte hexadecimal) and Parameter_representation_code (string) in consultation with Railways and under intimation to RDSO sothat suitable amendments may be issued in RDPMS FRS to review and include them.

Nomenclature of Parameter of Point Machine

Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)	Remarks
	Relay Room				
Sensor	24 VDC at RR from Loc Normal	V _{PT NWKR}	00	20	NWKR of individual point OR One NWKR for both Points
Sensor	24 VDC at RR from Loc Reverse	V _{PT RWKR}	01	20	RWKR of individual point OR One RWKR for both Points
Digital	Digital status of NWKR	NWKR	10	40	NWKR of individual point OR One NWKR for both Points
Digital	Digital status of RWKR	RWKR	11	40	RWKR of individual point OR

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					One RWKR for both Points
Digital	Digital status of NWCR	NWCR	12	40	Contactor Relay through which feed is passed for operation of individual or both points.
Digital	Digital status of RWCR	RWCR	13	40	Contactor Relay through which feed is passed for operation of individual or both points
Location Box					
Sensor	110 DC at Loc box for Normal.	V _{PT 110 DC Loc N}	20	20	For individual Point
Sensor	110 DC at Loc box for Reverse.	V _{PT 110 DC Loc R}	21	20	For individual Point
Sensor	Point Machine Current Normal	I _{PT N}	30	00	For individual Point
Sensor	Point Machine Current Reverse	I _{PT R}	31	00	For individual Point
Sensor	24 V DC going to Relay Room after detection at LOC for Normal	V _{PT 24 DC LOC N}	40	20	For individual Point
Sensor	24 V DC going to Relay Room after detection at LOC for Reverse	V _{PT 24 DC LOC R}	41	20	For individual Point
Sensor	Vibration	X	50	60	For individual Point
Derived	Normal Operation time	T _{PT N}	60	90	T _{PT N} Time should be calculated from current signature for individual point.
Derived	Reverse Operation time	T _{PT R}	61	90	T _{PT R} Time should be calculated from current signature for individual point.

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Nomenclature of Parameter of DC Track Circuit

Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)	Remarks
	Relay Room				
Sensor	24 V DC TPR I/P	V _{TC} 24 DC TPR I/P	00	20	
Digital	Digital status of TPR Relay	TPR	10	40	Repeater of track Relay in Relay room
	Feed End				
Sensor	Track Feed Charger I/P Voltage	V _{TC} TFC I/P	20	30	
Sensor	Track Feed Charger O/P Voltage (on load)	V _{TC} TFC O/P	21	30	
Sensor	Track Feed Charger O/P Current	I _{TC} TFC O/P	22	00	
Sensor	Voltage drop at feed end choke	V _{TC} CH FEED END	23	20	
Sensor	Track Feed end voltage (going to Rails)	V _{TC} FEED END	24	20	
Sensor	Track Feed Current	I _{TC} FEED END	25	01	
Derived	Bat Charging Current	I _{TC} BATT CHARG	26	01	I _{TC} BATT CHARG = I _{TC} TFC O/P - I _{TC} FEED END
Derived	Voltage at Variable Track Resistance	V _{TC} VAR RES	27	20	V _{TC} VAR RES = V _{TC} TFC O/P - V _{TC} FEED END - V _{TC} CH FEED END
Derived	Feed end choke resistance	R _{TC} CH FEED END	28	80	R _{TC} CH FEED END =

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					V _{TC CH FEED END} / I _{TC FEED END}
Derived	Variable resistance	R _{TC VAR RES}	29	80	R _{TC VAR RES} = V _{TC VAR RES} / I _{TC FEED END}
Relay End					
Sensor	Track Relay end Voltage (Coming from Rails)	V _{TC RELAY END}	40	20	
Sensor	Track Relay end Current	I _{TC RELAY END}	41	01	
Sensor	Track Relay Voltage QTA2 (1.4 V, 350mA)	V _{TC TR}	42	20	Either one to be used as per site
Sensor	Track Relay Voltage QBAT (1.75V, xxxxxx)	V _{TC TR}	43	20	
Sensor	24 V DC going to TPR after TR pick up contact	V _{TC 24 DC LOC}	44	20	
Derived	Relay end Choke Voltage	V _{TC CH RELAY END}	50	80	V _{TC CH RELAY END} = V _{TC RELAY END} - V _{TC TR}
Derived	Relay end choke resistance (Kohm)	R _{TC CH RELAY END}	51	80	R _{TC CH RELAY END} = V _{TC CH RELAY END} / I _{TC RELAY END}
Derived	Ballast/Sleeper Current	I _{BALST}	60	01	I _{TC FEED END} - I _{TC RELAY END}
Derived	Rail Resistance	R _{RAIL}	61	80	2*(V _{TC FEED END} - V _{TC RELAY END}) / (I _{TC FEED END} + I _{TC RELAY END})

Note: There can be three types of Parameters ie through Sensor, through Digital and derived. Allout efforts have been made to cover all Parameters. However, there are still spaces left in Parameter_representation_id (one byte hexadecimal). VENDOR can define new parameters with suitable Parameter_representation_id (one byte hexadecimal) and Parameter_representation_code (string) in consultation with Railways and under intimation to RDSO sothat suitable amendments may be issued in RDPMS FRS to review and include them.

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Nomenclature of Parameter of Main Signal

Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)
	Relay Room			
Digital	Digital status of HECR	HECR	00	40
Digital	Digital status of RECR	RECR	01	40
Digital	Digital status of DECR	DECR	02	40
Digital	Digital status of HHECR	HHECR	03	40
Digital	Digital status of DR	DR	10	40
Digital	Digital status of HR	HR	11	40
Digital	Digital status of HHR	HHR	12	40
	Location Box			
Sensor	DPR Voltage	V _{Sig DPR}	20	20
Sensor	HPR Voltage	V _{Sig HPR}	21	20
Sensor	HHPR Voltage	V _{Sig HHPR}	22	20
Sensor	Green Aspect Voltage	V _{Sig DG}	30	30
Sensor	Yellow Aspect Voltage	V _{Sig HG}	31	30
Sensor	Double Yellow Aspect Voltage	V _{Sig HHG}	32	30
Sensor	Red Aspect Voltage	V _{Sig RG}	33	30
Sensor	Green Aspect current	I _{Sig DG}	40	11
Sensor	Yellow Aspect current	I _{Sig HG}	41	11
Sensor	Double yellow Aspect current	I _{Sig HHG}	42	11
Sensor	Red Aspect current	I _{Sig RG}	43	11

Note: There can be three types of Parameters ie through Sensor, through Digital and derived. Above Parameters for Signal is general. It will apply to all type of Signals ie Main, Shunt, Route, Calling On & Distance. Allout efforts have been made to cover all Parameters. However, there are still spaces left in Parameter_representation_id (one byte hexadecimal). VENDOR can define new parameters with

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suitable Parameter_representation_id (one byte hexadecimal) and Parameter_representation_code (string) in consultation with Railways and under intimation to RDSO sothat suitable amendments may be issued in RDPMS FRS to review and include them.

Nomenclature of Parameter of Calling ON Signal

Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)
	Relay Room			
Digital	Digital status of Co-HECR	Co-HECR	00	40
Digital	Digital status of Co-HR	Co-HR	10	40
	Location Box			
Sensor	Co-HPR Voltage	V _{CoSig HPR}	20	20
Sensor	Calling ON Aspect Voltage	V _{CoSig}	30	30
Sensor	Calling ON Aspect current	I _{CoSig}	40	11

Note: There can be three types of Parameters ie through Sensor, through Digital and derived. Above Parameters for Signal is general. It will apply to all type of Signals ie Main, Shunt, Route, Calling On & Distance. Allout efforts have been made to cover all Parameters. However, there are still spaces left in Parameter_representation_id (one byte hexadecimal). VENDOR can define new parameters with suitable Parameter_representation_id (one byte hexadecimal) and Parameter_representation_code (string) in consultation with Railways and under intimation to RDSO sothat suitable amendments may be issued in RDPMS FRS to review and include them.

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Nomenclature of Parameter of Route Signal

Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)
	Relay Room			
Digital	Digital status of UCER	UECR	00	40
Digital	Digital status of UHR	UHR	10	40
Location Box				
Sensor	Route HPR Voltage	V _{RoSig HPR}	20	20
Sensor	Route Aspect Voltage	V _{RoSig}	30	30
Sensor	Route Aspect current	I _{RoSig}	40	11

Note: There can be three types of Parameters ie through Sensor, through Digital and derived. Above Parameters for Signal is general. It will apply to all type of Signals ie Main, Shunt, Route, Calling On & Distance. Allout efforts have been made to cover all Parameters. However, there are still spaces left in Parameter_representation_id (one byte hexadecimal). VENDOR can define new parameters with suitable Parameter_representation_id (one byte hexadecimal) and Parameter_representation_code (string) in consultation with Railways and under intimation to RDSO sothat suitable amendments may be issued in RDPMS FRS to review and include them.

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Nomenclature of Parameter of Shunt Signal

Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)
	Relay Room			
Digital	Digital status of Sh-ECROFF	Sh-ECROFF	00	40
Digital	Digital status of Sh-ECRON	Sh-ECRON	01	40
Digital	Digital status of Sh-HR	Sh-HR	10	40
	Location Box			
Sensor	Shunt HPR Voltage	V _{ShSig} HPR	20	20
Sensor	Shunt ON Aspect Voltage	V _{ShSig} ON	30	30
Sensor	Shunt OFF Aspect Voltage	V _{ShSig} OFF	31	30
Sensor	Shunt ON Aspect current	I _{ShSig} ON	40	11
Sensor	Shunt OFF Aspect current	I _{ShSig} OFF	41	11
Sensor	Shunt PILOT Aspect current	I _{ShSig} PILOT	42	11

Note: There can be three types of Parameters ie through Sensor, through Digital and derived. Above Parameters for Signal is general. It will apply to all type of Signals ie Main, Shunt, Route, Calling On & Distance. Allout efforts have been made to cover all Parameters. However, there are still spaces left in Parameter_representation_id (one byte hexadecimal). VENDOR can define new parameters with suitable Parameter_representation_id (one byte hexadecimal) and Parameter_representation_code (string) in consultation with Railways and under intimation to RDSO sothat suitable amendments may be issued in RDPMS FRS to review and include them.

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Nomenclature of Parameter of Electric Lifting Barrier				
Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)
	Location Box			
Sensor	ELB-A close Relay voltage (suitable Relay which indicates that button for operation has been initiated)	V _{ELB-A CLOSE BUTTON}	00	20
Sensor	ELB -A closed & Locked indication Relay voltage. (suitable final Relay which extends the 24 V to RR for closed and locked status)	V _{ELB-A CLOSED & LOCKED IND}	10	20
Sensor	ELB-B close Relay (suitable Relay which indicates that button for operation has been initiated)	V _{ELB-B CLOSE BUTTON}	20	20
Sensor	ELB -B closed & Locked indication Relay. (suitable final Relay which extends the 24 V to RR for closed and locked status)	V _{ELB-B CLOSED & LOCKED IND}	30	20
Sensor	110 V AC at ELB -A Feed going to motor for closing.	V _{ELB-A 110 AC CLOSE}	40	30
Sensor	110 V AC at ELB - A Feed going to motor for opening.	V _{ELB-A 110 AC OPEN}	41	30
Sensor	110 V AC at ELB -B Feed going to motor for closing.	V _{ELB-B 110 AC CLOSE}	50	30
Sensor	110 V AC at ELB - B Feed going to motor for opening.	V _{ELB-B 110 AC OPEN}	51	30
Sensor	ELB-A Closing current	I _{ELB-A CLOSE}	60	10
Sensor	ELB-A Opening current	I _{ELB-A OPEN}	61	10
Sensor	ELB-B Closing current	I _{ELB-B CLOSE}	70	10
Sensor	ELB-B Opening current	I _{ELB-B OPEN}	71	10

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Nomenclature of Parameter of Earth Leakage Detector

(ELD can be numbered as 1, 2,in asset_number_id if more than 1 ELD being used)

Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)
Digital	Channel 1	ELDCH1	00	40
Digital	Channel 2	ELDCH2	01	40
Digital	Channel 3	ELDCH3	02	40
Digital	Channel 4	ELDCH4	03	40
Digital	Channel 5	ELDCH5	04	40
Digital	Channel 6	ELDCH6	05	40
Digital	Channel 7	ELDCH7	06	40
Digital	Channel 8	ELDCH8	07	40
Digital	Channel 9	ELDCH9	08	40
Digital	Channel 10	ELDCH10	09	40
Digital	Channel 11	ELDCH11	0A	40
Digital	Channel 12	ELDCH12	0B	40
Digital	Channel 13	ELDCH13	0C	40
Digital	Channel 14	ELDCH14	0D	40
Digital	Channel 15	ELDCH15	0E	40
Digital	Channel 16	ELDCH16	0F	40

Note: There can be three types of Parameters ie through Sensor, through Digital and derived. Allout efforts have been made to cover all Parameters. However, there are still spaces left in

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Parameter_representation_id (one byte hexadecimal). VENDOR can define new parameters with suitable Parameter_representation_id (one byte hexadecimal) and Parameter_representation_code (string) in consultation with Railways and under intimation to RDSO sothat suitable amendments may be issued in RDPMS FRS to review and include them.

Nomenclature of Parameter of Temperature

(Indoor rooms and locations details should be defined and linked with each temp input)

Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)
Sensor	Temperature 1	TEMP1	00	50
Sensor	Temperature 2	TEMP2	01	50
Sensor	Temperature 3	TEMP3	02	50
Sensor	Temperature 4	TEMP4	03	50
Sensor	Temperature 5	TEMP5	04	50
Sensor	Temperature 6	TEMP6	05	50
Sensor	Temperature 7	TEMP7	06	50
Sensor	Temperature 8	TEMP8	07	50
Sensor	Temperature 9	TEMP9	08	50
Sensor	Temperature 10	TEMP10	09	50
Sensor	Temperature 11	TEMP11	0A	50
Sensor	Temperature 12	TEMP12	0B	50
Sensor	Temperature 13	TEMP13	0C	50
Sensor	Temperature 14	TEMP14	0D	50
Sensor	Temperature 15	TEMP15	0E	50
Sensor	Temperature 16	TEMP16	0F	50

Note: There can be three types of Parameters ie through Sensor, through Digital and derived. Allout efforts have been made to cover all Parameters. However, there are still spaces left in Parameter_representation_id (one byte hexadecimal). VENDOR can define new parameters with suitable Parameter_representation_id (one byte hexadecimal) and Parameter_representation_code (string) in

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consultation with Railways and under intimation to RDSO sothat suitable amendments may be issued in RDPMS FRS to review and include them.

Nomenclature of Parameter of Humidity

(Indoor rooms and locations details should be defined and linked with each Humidity input)

Type of Input	parameter_representation_name	parameter_representation_code	parameter_representation_id (one byte)	parameter_type_id (one byte)
Sensor	Humidity 1	HUMD1	00	51
Sensor	Humidity 2	HUMD2	01	51
Sensor	Humidity 3	HUMD3	02	51
Sensor	Humidity 4	HUMD4	03	51
Sensor	Humidity 5	HUMD5	04	51
Sensor	Humidity 6	HUMD6	05	51
Sensor	Humidity 7	HUMD7	06	51
Sensor	Humidity 8	HUMD8	07	51
Sensor	Humidity 9	HUMD9	08	51
Sensor	Humidity 10	HUMD10	09	51
Sensor	Humidity 11	HUMD11	0A	51
Sensor	Humidity 12	HUMD12	0B	51
Sensor	Humidity 13	HUMD13	0C	51
Sensor	Humidity 14	HUMD14	0D	51
Sensor	Humidity 15	HUMD15	0E	51
Sensor	Humidity 16	HUMD16	0F	51

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Note: There can be three types of Parameters ie through Sensor, through Digital and derived . Allout efforts have been made to cover all Parameters. However, there are still spaces left in Parameter_representation_id (one byte hexadecimal). VENDOR can define new parameters with suitable Parameter_representation_id (one byte hexadecimal) and Parameter_representation_code (string) in consultation with Railways and under intimation to RDSO sothat suitable amendments may be issued in RDPMS FRS to review and include them.

- 4. Parameter value details:** parameter_value is being used in Standard data format to send the value of given parameter.

It is represented as “prv” (in float for analogue values) (00 for DN and 01 for UP for digital value) in data packet.

- 5. Parameter time details:** parameter_time is being used in Standard data format to associate time of sampling of each parameter. It is represented in bytes in hexadecimal. Details given below :

It is represented as “prt” in data packet.

(yyyyMMdd'T'HHmmss,sss) example: 20231122023124565

- 6. Configuration details:** It is being used in Standard data format. It is used to configure station gateway as per config_id and config_value given by RDPMS Application. config_id and config_value are represented as “cfgi” and “cfgv” resepctively in data packet. Details given below :

sr	Configuration details	cfgi (config_id) (one byte hexadeci- mal)	cfgv (config_value) (two byte hexa- decimal)
1	parameter data packet sending frequency	01	10 (second)
2	Sensor health data packet sending frequency (if fault has occurred)	02	30 (min)
3	Sensor health data packet sending frequency (if No fault has occurred for last 6 hours)	03	6 (hours)
4	% variation in value for sending analog pa- rameters	03	1 (%)

- 7. Sensor health details:** Station gateway gives health details of Sensor/IOT in form of sensor_health_id to RDPMS Application. It is represented as sh_id (in one byte hexadecimal) in dataformat. sensor_health_code (in string as shown) should be referred in UI, API.

Details given below :

	Sensor health details	sensor_health_code (sensor health code) (string)	sensor_health_id Short name: sh_id (sensor health id) (one byte in hexa-decimal)	Remarks
	Faulty Sensor/IOT	“Sensor Faulty”	01	To be sent along with “prid” to correlate.
	Healthy Sensor/IOT	“Sensor Healthy”	00	when packet is being sent after 6 hours if No fault has occurred in last 6 hours. (Annexure B)

- 8. Station gateway Time stamp details:** cloud_time is being used to denote cloud time. RDPMs Application informs Station gateway about cloud time with date to make it sync with Cloud. It is represented in byte. (yyyyMMdd'T'HHmmss,sss) example: 20231122023124565. It is represented as “clt” in data packet.
- 9. Asset make details:** asset_make is being used in Standard data format, Standard APIs, UI & reports. Denoted in string format. It is represented as “make” in data packet.
- 10. Asset Model number:** asset_modelNo is being used in Standard data format, UI & reports. Denoted in string format. Details given below. (May be used, if required)
- It is represented as “model” in data packet.
- 11. Sub Asset Type details:** subAsset_type1 and subAsset_type2 are being used in Standard data format, UI & reports. Denoted in string format. Details given below. (May be used, if required)
- It is represented as “attr1” and “attr2” in data packet.
- 12. Parameter location details:** parameter_loc is being used in Standard data format, UI & reports. Denoted in string format. Details given below.
- It is represented as “prloc”.
- 13. Vendor details:** It is part of Standard data format, UI to uniquely identify Vendor of Field devices (station gateway and IOT/Sensor) and vendor of RDPMs Application in Indian Railways. Details given below with their short names used in datapacket.

vendor_cloud_code (vcc) (Vendor name of RDPMS Application used in string)	vendor_cloud_name (vcn) (Vendor name of RDPMS Application used in string)	vendor_gw_code (vgc) (Vendor name of Station Gateway and all Field devices in string)	vendor_gw_name (vgn) (Vendor name of Station Gateway and all Field devices in string)
xyz	Xyz technologies	abc	abc technologies

14. Version details: It is part of Standard data format to uniquely identify Version of Application Software of Station Gateway to keep track of Software update in Indian Railways. Details given below.

S No	stn_gw_ver (version code used in standard data format in string)
1.	"1.0"

15. Command: “cmd” is used in data packets to define the packet as “IMAGE”, “INFO”, “TIME_SYNC” or “CONFIG”. (ref-Annexure B).

16. Base address: it is used in Standard API for query address of RDPMS Application vendors. It should be possible to raise a query to RDPMS Application to take reports as described in Annexure E. This is to be used for APIs. Denoted as : base_address. Annexure E

17. Alert Type : Denoted as:

Alert Type	alert_type_code
Failure	“Failure”
Predictive	“Predictive”

alert_type_code should be used in UIs and APIs where Alert Type is mentioned.

18. Alert feedback: Feedback should be provided by Railway employee whether generated alert was True (“T”) OR False (“F”) OR Maintenance (“M”) after attending the failure/prediction. “M” feedback option will exclude Alerts generated during maintenance for analysis and counting. Denoted as:

Alert Feedback	alert_feedback_code
----------------	---------------------

True	"T"
False	"F"
Maintenance	"M"

alert_feedback_code should be used in UIs and APIs where Alert feedback is mentioned.

19. Cause of Asset failure: it is used in Standard API, UI & reports. Denoted as: Details of cause_code are given in Annexure C.

CAUSES	cause_detail	cause_code
Point Machine failure	1	
Point Machine Predictive	2	

cause_code should be used in UIs and APIs where Cause is mentioned.

20. Alert Status:

“cleared” denotes that failure/prediction has been attended and feedback (T, F & M) with remarks have been given. “pending” denotes that Alert feedback has not been given even if failure/prediction may have been attended.

Alert Status	alert_status_code
Cleared	“cleared”
Pending	“pending”

alert_status_code should be used in UIs and APIs where Alert feedback is mentioned

21.Incidence Date & Time: It is actual time of Occurrence of Failure/Prediction. (Alert may take some time to generate and reach after occurrence).

Denoted as “incidence_date_time” For ex 18/12/2023 14:40:20

incidence_date_time should be used in UIs and APIs where Incidence Date &Time is mentioned

22. Rectification Date & Time: It is actual time of rectification of Failure/prediction. If rectification has not taken place, it will show “----”. It shall be used as per Annexure A.

Denoted as “rectification_date_time” For example "18/12/2023 16:40:20"

rectification_date_time should be used in UIs and APIs where Rectification Date &Time is mentioned

23. Incidence duration: It is actual duration of Failure/prediction.

Denoted as: "incidence_duration": 120"

incidence_duration should be used in UIs and APIs where Incidence duration is mentioned

24. Remarks: The Railway Person shall give remarks after attending the failure/prediction in this head. The box for Remarks shall open after pressing "T" OR "F" OR "M" Tab for feedback to ensure that feedback is not missed.

Denoted as "remarks". It is to be used in UI, API & Reports.

25. Alert feedback Date & Time: It is time of providing feed back of (T, F & M) & Remarks of Alert.

Denoted as "alert_feedback_date_time" For example "18/12/2023 16:40:20"

alert_feedback_date_time should be used in UIs and APIs where Alert feedback Date &Time is mentioned

26. Sampling details of parameters:

Asset	Parameter	Standard operating value	Sampling
Point Machine	Operating Voltage	110 V DC	Absolute value every 20 ms OR sampling frequency as decided
	Operating Current	1.5 A	Absolute value every 20 ms OR sampling frequency as decided
	NWKR/RWKR Voltage	24 VDC	± 2% of Standard operating value OR % as decided
	Operation Time	4 seconds	± 2% of Standard operating value OR % as decided
Signal	Operating Voltage	110 V AC	± 2% of Standard operating value OR % as decided
	Operating Current	130 mA	± 2% of Standard operating value OR % as decided
	HPR/HHPR/DPR	24 V DC	± 2% of Standard operating value OR % as decided
DC Track Circuit	TFC Charger Input	110 V AC	± 2% of Standard operating value OR % as decided
	TFC charger Output	10 V DC	± 2% of Standard operating value OR % as decided

TFC Charger Current	1000 mA	\pm 2% of Standard operating value OR % as decided
Voltage across Choke at Feed end	1 V DC	\pm 2% of Standard operating value OR % as decided
Voltage across Rail at Feed end	5 V DC	\pm 2% of Standard operating value OR % as decided
Feed End current at Rail	500 mA	\pm 2% of Standard operating value OR % as decided
Relay End current from Rail	350 mA	\pm 2% of Standard operating value OR % as decided
Voltage across Rail at Relay end	4 V DC	\pm 2% of Standard operating value OR % as decided
Voltage across Track Relay.	3.5 V DC	\pm 2% of Standard operating value OR % as decided
Voltage at Loc after TR relay going to TPR	24 V DC	\pm 2% of Standard operating value OR % as decided

Summary of all nomenclatures

Sr	Description	Short name used	Remarks	Use case
1	station_gw_id	stgwi	4 byte hexadecimal	Data format, APPLICATION
2	gw_number_id	-	One byte hexadecimal	Part of station_gw_id

3	request_id	rqi	Unique string to identify requests uniquely	Data format, APPLICATION
4	response_id	resi	Response ID for a request, this should be same as rqi	Data format, APPLICATION
5	vendor_cloud_code	vcc	string	Data format, APPLICATION , API
6	Vendor_gw_code	vgc	string	Data format, APPLICATION, API
7	version_code	ver	string	Data format, APPLICATION
8	Station_id	-	One byte Hexadecimal	Part of parameter_id
9	station_code	sc	string	Data format, APPLICATION, API
10	station_name	sn	string	Data format, APPLICATION
11	division_id	-	One byte hexadecimal	Part of parameter_id
12	division_code	dc	string	APPLICATION , API
13	division_name	-	string	APPLICATION
14	Zone_id	-	One byte hexadecimal	Part of parameter_id
15	Zone_code	zc	string	APPLICATION , API
16	Zone_name	-	string	APPLICATION
17	asset_number_code	asnc	string	Data format, API
18	asset_number_id	asni	One byte hexadecimal	Data format, API
19	asset_type_id	-	One byte hexadecimal	Part of parameter_id
20	asset_type_code	astc	string	Data format, API
21	asset_make	make	string	Data format, API
22	asset_modelNo	model	string	Data format,
23	subAsset_type1	attr1	string	Data format,
24	subAsset_type2	attr2	string	Data format,
25	parameter_id	prid	4 byte hexadecimal	Data format,
26	parameter_type_id	-	One byte hexadecimal	Part of parameter_id
27	parameter_representation_id	-	One byte hexadecimal	Part of parameter_id
28	parameter_representation_code	-	string	APPLICATION
29	parameter_representation_name	-	string	APPLICATION (for reference)
30	parameter_loc	prloc	string	Data format,
31	parameter_time	prt	hexadecimal	Data format,
32	parameter_value	prv	hexadecimal	Data format,
33	sensor_health_code		string	APPLICATION
34	sensor_health_id	sh_id	One byte hexadecimal	Data format,
35	cloud_time	clt	hexadecimal	Data format,
36	config_id	cfdi	One byte hexadecimal	Data format,
37	config_value	cfdv	hexadecimal	Data format,
38	command	cmd	Its value shall be one of these. "IMAGE", "INFO", "CONFIG", "TIME_SYNC"	Data format,

39	alert_type_code	-	string	APPLICATION , API
40	alert_feedback_code	-	string	APPLICATION , API
41	alert_status_code	-	string	APPLICATION
	cause_detail			
42	cause_code	-	string	APPLICATION , API
43	incidence_date_time	-	Date & time format as described	APPLICATION , API
44	rectification_date_time	-	Date & time format as described	APPLICATION , API
45	incidence_duration	-	Date & time format as described	APPLICATION , API
46	alert_feedback_date_time	-	Date & time format as described	APPLICATION , API
47	remarks	-	string	APPLICATION , API
48	total_count	-	hexadecimal	APPLICATION , API
49	true_count	-	hexadecimal	APPLICATION , API
50	maintainer_name	-	string	APPLICATION , API
51	maintainer_designation	-	string	APPLICATION , API
52	maintainer_mobile	-	string	APPLICATION , API

Annexure-B

Standard Data Format

1.1 Types of Data Packet in Standard Data format:

1.1.1 Asset details from SMMS (Signalling Maintenance Management System):

RDPMS Application shall take asset details from SMMS as per request and response format described in Annexure A & B.

1.1.2 Discovery: This data packet shall be based on publish and subscribe model. Station gateway sends a data packet to Application software for connection at the

time of new installation Or at addition/deletion of sensors/IOT Or at reboot or power failure. (Annexure B) (Annexure A also to be referred for Standard Nomenclature).

- 1.1.3 Time Sync:** This data packet shall be based on publish and subscribe model. Application software sends this data packet with Time sync information to station gateway in response to discovery data packet (para 10.2.2) to set the time of station gateway with application time.

In addition to sending this time sync packet in response to discovery packet, Application Software may also initiate a time sync data packet on its own and send it to station gateway to set the time at a definite interval of 7 days or as and when required or as decided by Zonal Railway. This duration should be programmable. (Annexure B)(Annexure A also to be referred for Standard Nomenclature).

- 1.1.4 Time Sync Confirmation:** This data packet shall be based on publish and subscribe model. This data packet pertains to confirmation of Time sync process done by Station gateway. Station gateway sends a data packet to Application software in response to Time sync packet received from application software after completing Time sync process. (Annexure B) (Annexure A also to be referred for Standard Nomenclature).

- 1.1.5 Information:** This data packet shall be based on publish and subscribe model. This data packet pertains to Asset and other basic information. Application software initiates a request packet (with asset information taken from SMMS) in response to discovery packet from station gateway. In response to request packet, Station gateway sends information data packet (After modifying/adding information taken from SMMS) to Application software.

In addition to sending the request packet in response to discovery packet, Application software may also initiate a request packet (with asset information taken from SMMS) on its own to Station Gateway at a definite interval of one month or as and when required or as decided by Zonal Railway. This duration should be programmable. In response to request packet, Station gateway sends information data packet (After modifying/adding information taken from SMMS) to Application software. (Annexure B)(Annexure A also to be referred for Standard Nomenclature).

- 1.1.6 Image:** This data packet shall be based on publish and subscribe model. This data packet pertains to value of all parameters at approximate one instance with time stamp. Application software initiates a request packet in response to discovery packet from station gateway. In response to request packet, Station gateway sends image data packet to Application software.

In addition to sending the request packet in response to discovery packet, Application software may also initiate a request packet on its own to Station Gateway at a definite interval of 7 days or as and when required or as decided by Zonal Railway. This duration should be programmable. In response to request

packet, Station gateway sends image data packet to Application software. (Annexure B)(Annexure A also to be referred for Standard Nomenclature).

1.1.7 Parameter: This data packet shall be based on publish and subscribe model. This data packet pertains to

(a) Value of all those analog parameters (except (b)) whose value changes with $\pm 2\%$ (or as defined) with respect to current value with time stamp.

(b) Value of those analog parameters whose value is sampled every 20 ms (Voltage and current of Point Machine and Electric Lifting Barrier during operation) with time stamp during its complete operation.

(c) Value of all Digital status changed with time stamp.

If parameters as described above at 10.2.7 (a) & (c) are involved, Station gateway sends this data packet to Application software at every 5 second (configurable) or as decided by Zonal Railway. So this data packet shall contain value of all parameters as per 10.2.7 (a) & (c) during last 5 seconds (configurable).

If Parameters as per 10.2.7 (b) are also involved, then packet should be sent after completion of operation of point machine/ELB or after 5 seconds whichever is longer. (Annexure A & B to be referred for Standard Nomenclature)

1.1.8 Sensor health: This data packet shall be based on publish and subscribe model. This data packet pertains to health status of sensor whether they are healthy or faulty. Station gateway sends a data packet to Application software at every 30 min (If at least one fault has occurred) OR after 6 hours (if no fault has occurred for last 6 hours) or as decided by Zonal Railways. Both duration are configurable (Annexure B) (Annexure A also to be referred for Standard Nomenclature).

1.1.9 Configuration: This data packet shall be based on publish and subscribe model. This data packet pertains to configuration command details for configuring station gateway. Application software sends data packet to station gateway. (Annexure B) (Annexure A also to be referred for Standard Nomenclature).

1.1.10 Configuration Confirmation: This data packet shall be based on publish and subscribe model. This data packet pertains to confirmation of Configuration process done by Station gateway. Station gateway sends a data packet to Application software in response to configuration packet received from application software after completing configuration process. (Annexure B) (Annexure A also to be referred for Standard Nomenclature).

1.1.11 Telemetry data from RDPMS Application to SMMS (Signalling Maintenance Management System): SMMS shall take Telemetry data (Live parameter values of asset) from RDPMS application as per request and response data format described in Annexure A & B.

1.1.12 RDPMS Vendor shall send image data packet and parameter data packets to Railway Cloud (CRIS or as decided by Railway management) from Station gateway or Intermediate service platform (as decided by Railway management based on technical feasibility) for further analysis or use as Railway being the custodian of Data. Necessary APIs/data format should be designed in RDPMS system in consultation with Railway Cloud (CRIS or as decided by Railway management) to ensure smooth flow of desired packets. Details of packets have been given ahead in this Annexure B.

- 1.2 Intermediate Service Platform (ISP):** The Intermediate Service Platform (ISP) is a secure and intelligent middleware designed to facilitate seamless communication between Station Gateways and the Cloud (RDPMS) Application. It manages bidirectional command and data exchanges, including time synchronization, system discovery, configuration commands, continuous parameter monitoring, and sensor health updates. ISP should be compliant to [MQTT specifications](#).

The ISP ensures reliable and secure data transmission through built-in acknowledgement mechanisms, retry logic, and encryption. It supports logging and auditing of all transactions, handles large data payloads, and is designed to scale across distributed infrastructure with fault tolerance for continuous uptime.

Furthermore, the ISP provides an option for **authorized third-party systems** to access real-time data streams via a **subscription model**.

ISP shall operate on a publish-subscribe communication model as follows:

- **Publishers** (message senders) may publish messages to designated topics.
- **Subscribers** (message receivers) can subscribe to these topics to receive the corresponding messages.
- A single topic can support multiple concurrent subscribers, all of whom will receive the messages published to that topic.

Technical and Security Considerations:

Certificate-Based Authentication: All publishers and subscribers must be authenticated using digital certificates issued by a trusted Certificate Authority (CA). Only clients with valid certificates will be allowed to establish a connection to the ISP.

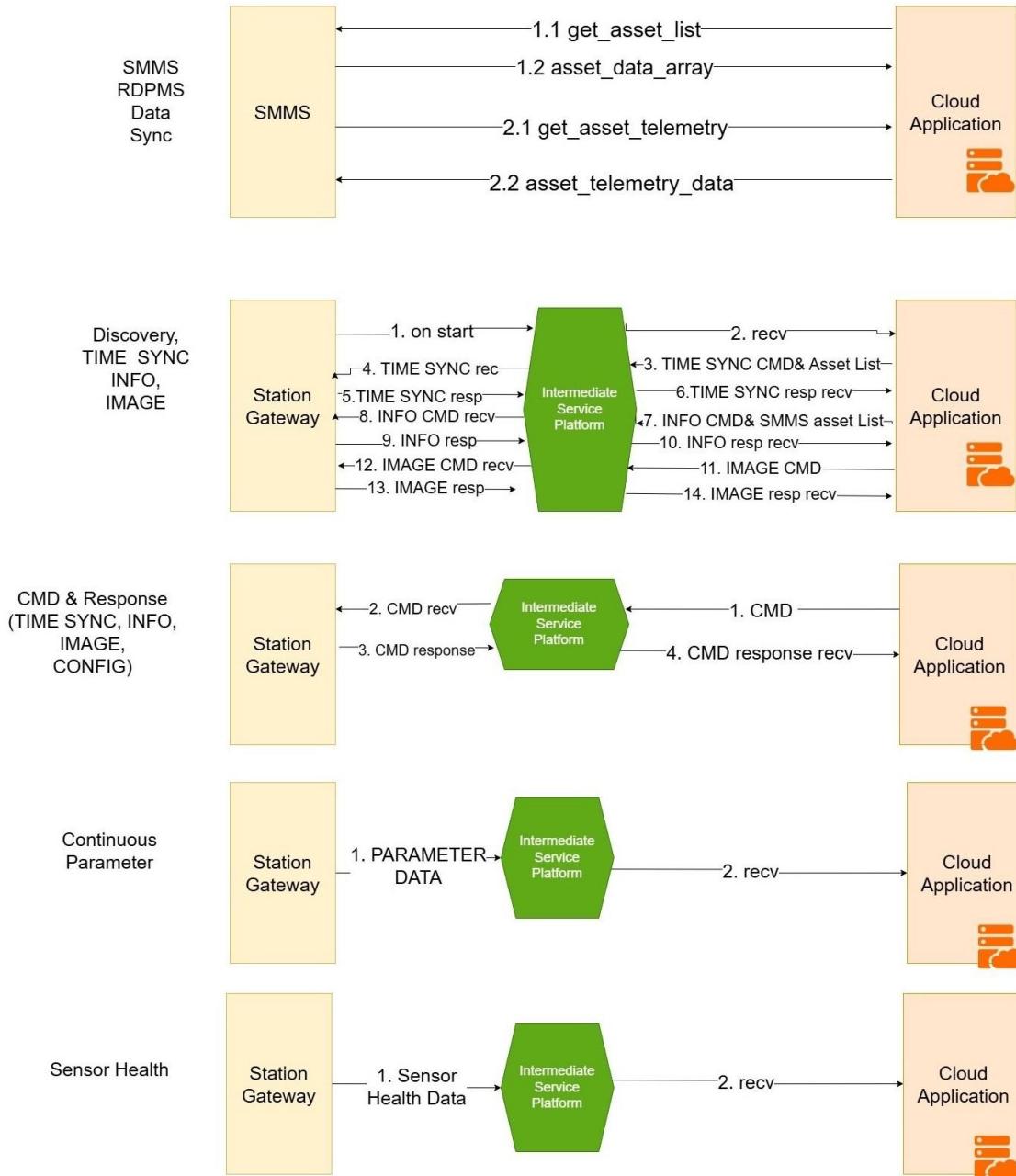
Certificate Blacklisting and Revocation: The ISP shall maintain a dynamic Certificate Revocation List (CRL) or implement Online Certificate Status Protocol (OCSP) to ensure that compromised, expired, or unauthorized certificates are denied access. Clients with blacklisted certificates will be automatically disconnected and denied any further interaction with the platform.

Encrypted Communication: All communication between publishers, subscribers, and the ISP shall be secured using Transport Layer Security (TLS) to ensure data confidentiality and integrity.

Access Control and Topic Authorization: Publishers and subscribers shall be allowed to publish or subscribe only to authorized topics, as defined in the access control policies. Unauthorized attempts will be logged and rejected.

Logging and Monitoring: All publish-subscribe transactions, authentication events, and security violations shall be logged for auditing and monitoring purposes.

1.3 High level flow



2 Long Name-Short Name Mapping for payloads: Pl refer Annexure A.

3. STATION GATEWAY

3.1 MQTT Packet and MQTT Topics for station gateway and Cloud

MQTT Packet: <Client-Id> (as a simple string)

→ ClientID will be set to **station_gateway_id**

Publish topic:

discovery/{stn_gw_id}/{vendor_cloud_code}
 parameter/{stn_gw_id}/{vendor_cloud_code}
 sensor_health/{stn_gw_id}/{vendor_cloud_code}
 cmd/{stn_gw_id}/{vendor_cloud_code}

Topic to be subscribed:

cmd/{vendor_cloud_code}/{ stn_gw_id }

4. CLOUD APPLICATION

- 4.1 MQTT Packet:** <Client-Id> (as a simple string)
 → ClientID will be set to vendor_cloud_code

Publish topic:

cmd/{vendor_cloud_code}/{stn_gw_id }

Topic to be Subscribed topic:

discovery/{stn_gw_id}/{vendor_cloud_code}
 parameter/{ stn_gw_id}/{vendor_cloud_code}
 sensor_health/{ stn_gw_id}/{vendor_cloud_code}
 cmd/{ stn_gw_id}/{vendor_cloud_code}

Note : MQTT topics are designed with following naming convention
 => {role}/{sender_id}/{receiver_id}

5. MESSAGE EXCHANGE FORMAT BETWEEN SMMS, STATION GATEWAY AND CLOUD APPLICATION

5.1 RDPMS Application to SMMS for Asset Data information

API URL : /get_asset_list/{zone_code}/{division_code}/{station_code}

The API will be called by providing zone code, division code and station code (as provided in this document earlier).

Example: /get_asset_list/NCR/PYRJ/MIU

SMMS, Vendors will exchange API Security Key to enable the communication.

Request from Cloud (RDPMS) Application to SMMS for Asset Data information	
Structure	Sample
<pre>{ "rqi": "string-unique", "vcc": "string", "zc": "string", // zone code }</pre>	<pre>{ "rqi": "01JM50ETKYVV1WHC9KVFEVPAEP", "vcc": "XYZ", "zc": "NCR", }</pre>

<pre>"dc": "string", // division code "sc": "string", // Station code }</pre>	<pre>"dc": "PYRJ", "sc": "MIU", }</pre>
Response from SMMS to Cloud (RDPMs) Application for Asset Data information	
Structure	Sample
<pre>{ "resi": "string-unique", "vcc": "string", "zc": "string", // zone code "dc": "string", // division code "sc": "string", // Station code "info": [{ "smms_asset_number": "string", // readable name of asset that will be used "smms_asset_code": "string", "additional_info": [[{ "key": "string", "value": "string", }]] }] }</pre>	<pre>{ "resi": "01JM50ETKYVV1WHC9KVFEVPAEP", "vcc": "XYZ", "zc": "NCR", "dc": "PYRJ", "sc": "MIU", "info": [{ "smms_asset_number": "PT-01", "smms_asset_code": "EOPMIU00021", "additional_info": [[{ "key": "make", "value": "ABC" }, { "key": "modelabc1", "value": "UVZ" }], { "smms_asset_number": "PT-01", "smms_asset_code": "EOPMIU00023", "additional_info": [[{ "key": "make", "value": "ABC" }, { "key": "model", "value": "UVZ" }] } }] }] }</pre>

5.2 Station Gateway to Cloud (RDPMs) Application Discovery request (This will be sent on start of station gateway as described)

Topic : discovery/{stn_gw_id}/{vendor_cloud_code}

Structure	Sample
<pre>{ "rqi": "string-unique", }</pre>	<pre>{ "rqi": "01JM4ZZ9AQ384MW63JT6EBVVC7", }</pre>

<pre> "stgwi": "string (4 Byte hexadecimal)", "vcc": "string", "vgc": "string", "stn_gw_ver": "string" } </pre>	<pre> "stgwi": "456523AB", "vcc": "XYZ", "vgc": "ABC", "stn_gw_ver": "1.0" } </pre>
---	---

5.3 Cloud (RDPMs) Application to Station gateway time sync command (in response to discovery packet as well as and independent request)

Topic :cmd/{vendor_cloud_code}/{stn_gw_id}

Structure	Sample
<pre> { "rqi": "string-unique", "stgwi": "string (4 Byte hexadecimal)", "vcc": "string", "vgc": "string", "stn_gw_ver": "string", "cmd": "TIME_SYNC", "clt": "20250215195600000" } </pre>	<pre> { "rqi": "01JMCGE4EK9N1481N8KQQHH3SJ", "stgwi": "456523AB", "vcc": "XYZ", "vgc": "ABC", "stn_gw_ver": "1.0", "cmd": "TIME_SYNC", "clt": "20250215195600000" } </pre>

5.4 Station gateway to Cloud (RDPMs) Application Time Sync Confirmation response

Topic :cmd/{stn_gw_id}/{vendor_cloud_code}

Structure	Sample
<pre> { "resi": "string-unique", "stgwi": "string (4 Byte hexadecimal)", "vcc": "string", "vgc": "string", "stn_gw_ver": "string", "cmd": "TIME_SYNC", "clt": "20250215195600000" } </pre>	<pre> { "resi": "01JMCGE4EK9N1481N8KQQHH3SJ", "stgwi": "456523AB", "vcc": "XYZ", "vgc": "ABC", "stn_gw_ver": "1.0", "cmd": "TIME_SYNC", "clt": "20250215195600000" } </pre>

5.5 Cloud (RDPMs) Application to Station gateway Asset info request (in response to discovery packet as well as and independent request)

(Note: Asset Information received from SMMS is also sent to station gateway through this)

Topic :cmd/{vendor_cloud_code}/{stn_gw_id}

Structure	Sample
<pre> { "rqi": "string-unique", "stgwi": "string (4 Byte hexadecimal)", "vcc": "string", "vgc": "string", } </pre>	<pre> { "rqi": "01JM50ETKYVV1WHC9KVFEVPAEP", "stgwi": "456523AB", "vcc": "XYZ", "vgc": "ABC", } </pre>

<pre> "stn_gw_ver": "string", "cmd": "INFO" "info": [{ "smms_asset_number": "string", // readable name of asset that will be used "smms_asset_code": "string", "additional_info": [{ { "key": "string", "value": "string", }] }] } </pre>	<pre> "stn_gw_ver": "1.0", "cmd": "INFO" "info": [{ "smms_asset_number": "PT-01", "smms_asset_code": "EOPMIU00021", "additional_info": [{ { "key": "make", "value": "ABC" }, { "key": "model", "value": "UVZ" }] }, { "smms_asset_number": "PT-01", "smms_asset_code": "EOPMIU00023", "additional_info": [{ { "key": "make", "value": "ABC" }, { "key": "model", "value": "UVZ" }] }] } </pre>
---	--

5.6 Station gateway to Cloud (RDPMS) Application Info request response

Topic :cmd/{ stn_gw_id }/{vendor_cloud_code}

Structure	Sample
<pre> { "resi": "string-unique", "stgwi": "string (4 Byte hexadecimal)", "vcc": "string", "vgc": "XYZ", "stn_gw_ver": "string", "sc": "string", // Station code "sn": "String value", // station name "cmd": "INFO", "info": [{ "asnc": "string", // readable name of asset that will be used "asni": "string (1 Byte hexadecimal)", "astc": "string", "smms_asset_code": "string", // readable name of asset that will be used }] } </pre>	<pre> { "resi": "01JM50ETKYVV1WHC9KVFEVPAEP", "stgwi": "456523AB", "vcc": "XYZ", "vgc": "ABC", "stn_gw_ver": "1.0", "sc": "LKO", "sn": "Lucknow", "cmd": "INFO", "info": [{ "asnc": "PT-01", "asni": "01", "astc": "PT", "smms_asset_code": "EOPMIU00023", "additional_info": [{ }] }] } </pre>

<pre> "additional_info" : { "make" : "string", // make of asset "model" : "string", // model of asset "attr1" : "string", // more attribute info (dynamic verndor can add more as they see fit "attr2" : "string" } "prid": [], // list of "string (4 Byte hexadecimal)", "prloc": [], // list of string that represent monitoring locations for each parameterseg LB-1, RR etc } } </pre>	<pre> "make": "ABC", "model": "UVZ", "attr1": "TWS" }, "prid": ["0001000C", "0001000D", "0001120A"], "prloc": ["LB-1", "RR", "LB-2"] }, { "asnc": "PT-02", "asni": "02", "astc": "PT", "smms_asset_code": "EOPMIU00024", "additional_info": { "make": "DEF", "model": "KLM", "attr1": "IRS" }, "prid": ["0002000A", "0002000B"], "prloc": ["LB-3", "RR"] }] } </pre>
--	---

Note : Parameter ids have been defined as per Annexure A.

0001000C	Normal current of PT-01
0001000D	Reverse current of PT-01
0001120A	Normal operation voltage of PT-01
0001120B	Reverse operation Voltage of PT-01
00012604	NWKR Digital
00012605	RWKR Digital

5.7 Cloud (RDPMs) Application to Station gateway Monitoring image snapshot request (in response to discovery packet as well as and independent request)

Topic :cmd/{vendor_cloud_code}/{stn_gw_id }

Structure	Sample
<pre>{ "rqi": "string-unique", "stgwi": "string (4 Byte hexadecimal)", "cmd": "IMAGE" }</pre>	<pre>{ "rqi": "01JMCG6R4MC37N3XVC2G2GT16W", "stgwi": "456523AB", "cmd": "IMAGE" }</pre>

5.8 Station gateway to Cloud (RDPMs) Application Image snapshot request response

Topic :cmd/{stn_gw_id }/{vendor_cloud_code}

Structure	Sample
<pre>{ "resi": "string-unique", "stgwi": "string (4 Byte hexadecimal)", "cmd": "IMAGE", "image": [</pre>	<pre>{ "resi": "01JMCG6R4MC37N3XVC2G2GT16W", "stgwi": "456523AB", "cmd": "IMAGE", "image": [</pre>

<pre>{ "prid": "parameter id string (4 Byte hexadecimal)", // 4 Byte long word "prv": [], //last float value for the prid measured. (This shall exclude event type parameter like current of point machine.) "prt": [] // last time stamp of the measurement value in format yyyyMMddHHmmssss }</pre>	<pre>{ "prid": "0001000C", "prv": [12.34], "prt": ["20231015123045999"] }, { "prid": "0001000D", "prv": [98], "prt": ["20231015123046001"] }</pre>
---	--

5.9 Station gateway to Cloud (RDPMS) Application parameter data on fixed intervals

OR after completing the event as described in 1.1.6 of this Annexure

Topic :parameter/{stn_gw_id}/{vendor_cloud_code}

Structure	Sample
<pre>{ "rqi": "string-unique", "stgwi": "string (4 Byte hexadecimal)", "parameters": [{ "prid": "parameter id string (4 Byte hexadecimal)", // 4 Byte long word "prv": [], //array of all value changes in float happened within (x seconds as mentioned in the FRS, for event case directly such as point operation) "prt": [] // array of station gateway Time stamp -in yyyyMMddHHmmssss of all corresponding values },] }</pre>	<pre>{ "rqi": "01JMCG7JS749C1NEGP9BWXE1XP", "stgwi": "456523AB", "parameters": [{ "prid": "0001000C", "prv": [1.34, 1.35, 1.45, 1.46], "prt": [20240204220232045, 20240204220232065, 20240204220232085, 20240204220232105] }, { "prid": "0001000B", "prv": [1.33, 1.36, 1.44, 1.45], "prt": [20240204220233040, 20240204220233060, 20240204220233080, 20240204220233100] }] }</pre>

5.10 Station gateway to Cloud (RDPMS) Application sensor health request response

(To be sent only when there is an unhealthy sensor OR as per frequency defined in 1.1.8 of this Annexure)

Topic :sensor_health/{stn_gw_id}/{vendor_cloud_code}

Structure	Sample
Packet to be sent every 30 min OR as decided by Zonal Railway if at least one fault occurs	
<pre>{ "rqi": "string-unique", "stgwi": "string (4 Byte hexadecimal)", "sensor_health": [{ "prid": "parameter id string (4 Byte hexadecimal)", // 4 Byte long word }] }</pre>	<pre>{ "rqi": "01JMCGA8Z2JJ31NPG06NPBNG42", "stgwi": "456523AB", "sensor_health": [{ "prid": "0001000D", "sh_id": "01" }] }</pre>

<pre> "sh_id": "string (1 Byte hexadecimal)", // 01 means faulty }] } </pre> <p>Packet to be sent after 6 hours OR as decided by Zonal Railway if No fault has occurred for last 6 hours (as of above duration) .</p>	<pre> { "prid": "0001000E", "sh_id": "01" }] } </pre>
---	--

5.11 Cloud (RDPMS) Application to Station gateway configuration request

Topic :cmd/{vendor_cloud_code}/{stn_gw_id}

Structure	Sample
<pre> { "rqi": "string-unique", "stgwi": "string (4 Byte)", "cmd": "CONFIG", "config": [{ "cfgi": "string", // string (one byte hexadecimal) "cfgv": "string", // string representing config value (two bytes hexadecimal) }] } </pre>	<pre> { "rqi": "01JMCGE4EK9N1481N8KQQHH3SJ", "stgwi": "456523AB", "cmd": "CONFIG", "config": [{ "cfgi": "01", "cfgv": "01" }, { "cfgi": "02", "cfgv": "01" },] } </pre>

5.12 Station gateway to Cloud (RDPMS) Application Configuration Confirmation response

Topic :cmd/{stn_gw_id}/{vendor_cloud_code}

Structure	Sample
<pre> { "resi": "string-unique", "stgwi": "string (4 Byte hexadecimal)", "cmd": "CONFIG", "config": [{ "cfgi": "string", // string (one byte hexadecimal) to confirm that command has been executed }] } </pre>	<pre> { "resi": "01JMCGE4EK9N1481N8KQQHH3SJ", "stgwi": "456523AB", "cmd": "CONFIG", "config": [{ "cfgi": "01" }] } </pre>

<pre> },] } </pre>	<pre> }, { "cfgj": "02" },] } </pre>
-----------------------------	---

5.13 Cloud (RDPMs) Application to SMMS for Telemetry Data

API URL :

/get_asset_telemetry/{zone_code}/{division_code}/{station_code}/{smms_asset_code}

If smms_asset_code is not provided, then the response will contain all asset telemetry data of that station. Also, if prid is null then data will be sent for all prid, otherwise only for specified prid.

Request from SMMS to Cloud (RDPMs) Application for Telemetry Data	
Structure	Sample
<pre> { "rqi": "string-unique", "vcc": "string", "zc": "string", // zone code "dc": "string", // division code "sc": "string", // Station code "smms_asset_code": "string", "prid": [], // list of "string (4 Byte hexadecimal)" } </pre>	<pre> { "rqi": "01JMCGE4EK9N1481N8KQQHH3SJ", "vcc": "XYZ", "zc": "NCR", "dc": "PYRJ", "sc": "MIU", "smms_asset_code": "EOPMIU00021", "prid": ["0001000C", "0001000D", "0001120A"] } </pre>
Response from Cloud (RDPMs) Application to SMMS for Telemetry Data	
Structure	Sample
<pre> { "resi": "string-unique", "vcc": "string", "zc": "string", // zone code "dc": "string", // division code "sc": "string", // Station code "telemetry_data": [{ "smms_asset_code": "string" }, "parameters": [{ "prid": "parameter id string (4 Byte hexadecimal)", // 4 Byte long word "prv": "value", // last available value "prt": "value" }]] } </pre>	<pre> { "resi": "01JM50ETKYVV1WHC9KVFEVPAEP", "vcc": "XYZ", "zc": "NCR", "dc": "PYRJ", "sc": "MIU", "telemetry_data": [{ "smms_asset_code": "EOPMIU00021", "parameters": [{ "prid": "0001000C", "prv": 1.34, "prt": 20240204220232045 }, { "prid": "0001000B", "prv": 1.33, "prt": 20240204220233040 }] }] } </pre>

6. SECURITY

Security will be achieved by mTLS

mTLS Implementation Guide for Three-Entity Architecture

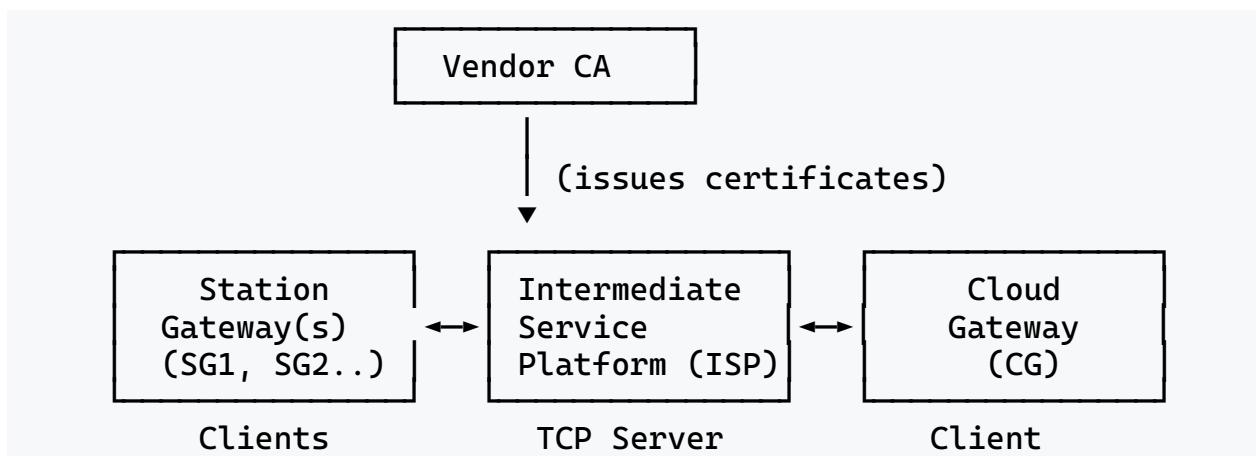
What is a Certificate Authority (CA)?

A Certificate Authority (CA) is like a trusted third party that issues digital ID cards (certificates) to people or systems like government office issues Aadhaar cards or passports:

1. The CA verifies your identity before issuing you a certificate
2. The certificate contains your public information and is signed by the CA
3. When you present this certificate to others, they can trust you're legitimate because they trust the CA that issued your certificate
4. The CA's signature on your certificate is like an official stamp that can't be forged

In this system, each vendor acts as their own CA, issuing certificates to all their entities. This allows all entities within a vendor's ecosystem to trust each other's identities.

Architecture Overview



Part 1: Understanding mTLS in this architecture of ISP, cloud and station gateway

mTLS Authentication Process

1. Initialization:

- Vendor acts as the Certificate Authority (CA)
- Each entity receives its own private key and certificate
- All certificates are signed by the Vendor CA

2. Connection Process:

- When an SG or CG (For RDPMs Application) connects to the ISP:
 - TCP connection established
 - TLS handshake initiated
 - Client sends "Client Hello" with supported cipher suites
 - Server responds with "Server Hello" and chosen cipher suite
 - Server sends its certificate
 - Client verifies server certificate using CA certificate
 - Client sends its certificate
 - Server verifies client certificate using CA certificate
 - Key exchange occurs and session keys established
 - Encrypted application data flows after successful TLS handshake

3. Certificate Verification:

- Each entity validates the other's certificate by:
 - Verifying the digital signature using the CA's public key
 - Checking certificate expiration dates
 - Confirming the certificate isn't revoked (via CRL (certificate revocation list) or OCSP (online certificate status protocol))
 - Verifying the certificate's purpose is appropriate

4. Encryption/Decryption Process:

- After successful mTLS handshake, all communication is encrypted
- Data is encrypted using negotiated session keys (not the certificate keys)
- Common cipher suites include **TLS_AES_256_GCM_SHA384 or TLS_CHACHA20_POLY1305_SHA256 or** any other.

Part 2: Step-by-Step Certificate Creation Process

Files Security Classification

Private (Never Share or Expose):

- All private keys (*.key files)
- CA private key (ca.key) is especially sensitive and should have the highest protection

Restricted (Internal Use Only):

- CA certificate signing request (ca.csr)
- Entity certificate signing requests (*.csr files)
- CA database files (index.txt, serial, etc.)

Public (Can Be Shared):

- CA certificate (ca.crt) - must be distributed to all entities
- Entity certificates (isp.crt, cg.crt, sg1.crt, etc.)
- Certificate Revocation Lists (CRLs)

1. Create Certificate Authority (CA)

```
# Create directory structure
mkdir -p ca/certs ca/private ca/newcerts ca/crl
touch ca/index.txt
echo 1000 > ca/serial

# Create CA configuration file
cat > ca/openssl.cnf << EOF
[ ca ]
default_ca = CA_default

[ CA_default ]
dir = ./ca
certs = $dir/certs
crl_dir = $dir/crl
new_certs_dir = $dir/newcerts
database = $dir/index.txt
serial = $dir/serial
RANDFILE = $dir/private/.rand
```

```

private_key      = $dir/private/ca.key
certificate     = $dir/certs/ca.crt

crlnumber       = $dir/crlnumber
crl             = $dir/crl/ca.crl
crl_extensions  = crl_ext
default_crl_days = 30

default_md      = sha256
name_opt        = ca_default
cert_opt        = ca_default
default_days    = 3650
preserve         = no
policy          = policy_strict

[ policy_strict ]
countryName      = match
stateOrProvinceName = match
organizationName = match
organizationalUnitName = optional
commonName       = supplied
emailAddress     = optional

[ req ]
default_bits     = 4096
distinguished_name = req_distinguished_name
string_mask      = utf8only
default_md       = sha256
x509_extensions  = v3_ca

[ req_distinguished_name ]
countryName      = Country Name (2 letter code)
stateOrProvinceName = State or Province Name
localityName     = Locality Name
0.organizationName = Organization Name
organizationalUnitName = Organizational Unit Name
commonName       = Common Name
emailAddress     = Email Address

[ v3_ca ]
subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid(always,issuer
basicConstraints = critical, CA:true
keyUsage = critical, digitalSignature, cRLSign, keyCertSign

[ server_cert ]
basicConstraints = CA:FALSE
nsCertType = server

```

```

nsComment = "OpenSSL Generated Server Certificate"
subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid,issuer:always
keyUsage = critical, digitalSignature, keyEncipherment
extendedKeyUsage = serverAuth

[ client_cert ]
basicConstraints = CA:FALSE
nsCertType = client
nsComment = "OpenSSL Generated Client Certificate"
subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid,issuer:always
keyUsage = critical, digitalSignature, keyEncipherment
extendedKeyUsage = clientAuth
EOF

# Generate CA private key (KEEP THIS SECURE!)
openssl genrsa -out ca/private/ca.key 4096

# Generate CA certificate (This can be shared publicly)
openssl req -config ca/openssl.cnf -key ca/private/ca.key -new -x509 -days 36500 -sha256 -extensions v3_ca -out ca/certs/ca.crt -subj "/C=IN/ST=UttarPradesh/L=Noida/O=Bitcomm/OU=IoT/CN=VendorCA"

# View CA certificate
openssl x509 -noout -text -in ca/certs/ca.crt

```

2. Create Certificate for the Intermediate Service Platform (ISP)

```

# Generate ISP private key (KEEP THIS SECURE!)
openssl genrsa -out isp.key 2048

# Create Certificate Signing Request (CSR) - temporary file, not sensitive once used
openssl req -new -key isp.key -out isp.csr -subj "/C=IN/ST=UttarPradesh/L=Noida/O=Bitcomm/OU=IoT/CN=isp"

# Sign the certificate with CA
openssl ca -config ca/openssl.cnf -extensions server_cert -days 36500 -notext -md sha256 -in isp.csr -out isp.crt

# Verify the certificate
openssl verify -CAfile ca/certs/ca.crt isp.crt

# The isp.crt file can be shared publicly
# The isp.key file must be kept private and secure

```

3. Create Certificate for Cloud Gateway (CG)

```
# Generate CG private key (KEEP THIS SECURE!)
openssl genrsa -out cg.key 2048

# Create Certificate Signing Request (CSR) - temporary file, not
# sensitive once used
openssl req -new -key cg.key -out cg.csr -subj "/C=IN/ST=UttarPra-
desh/L=Noida/O=Bitcomm/OU=IoT/CN=cloud-gateway"

# Sign the certificate with CA
openssl ca -config ca/openssl.cnf -extensions client_cert -days
36500 -notext -md sha256 -in cg.csr -out cg.crt

# Verify the certificate
openssl verify -CAfile ca/certs/ca.crt cg.crt

# The cg.crt file can be shared publicly
# The cg.key file must be kept private and secure
```

4. Create Certificates for Station Gateways (SGs)

```
# This example creates certificates for SG1 - repeat for each SG
# with a unique common name
# Generate SG1 private key (KEEP THIS SECURE!)
openssl genrsa -out sg1.key 2048

# Create Certificate Signing Request (CSR) - temporary file, not
# sensitive once used
openssl req -new -key sg1.key -out sg1.csr -subj "/C=IN/ST=Ut-
tarPradesh/L=Noida/O=Bitcomm/OU=IoT/CN=station-gateway-1"

# Sign the certificate with CA
openssl ca -config ca/openssl.cnf -extensions client_cert -days
36500 -notext -md sha256 -in sg1.csr -out sg1.crt

# Verify the certificate
openssl verify -CAfile ca/certs/ca.crt sg1.crt

# The sg1.crt file can be shared publicly
# The sg1.key file must be kept private and secure

# Repeat for additional SGs (sg2, sg3, etc.)
```

5. Distributing Certificates

1. For each entity, distribute:

- Its own private key (keep secure!)
- Its own certificate (can be public)
- The CA certificate (can be public)

2. Distribution Matrix:

Entity	Files Needed	Security Classification
ISP	isp.key	PRIVATE - Keep secure
	isp.crt	PUBLIC - Can be shared
	ca.crt	PUBLIC - Can be shared
CG	cg.key	PRIVATE - Keep secure
	cg.crt	PUBLIC - Can be shared
	ca.crt	PUBLIC - Can be shared
SG1	sg1.key	PRIVATE - Keep secure
	sg1.crt	PUBLIC - Can be shared
	ca.crt	PUBLIC - Can be shared
SG2	sg2.key	PRIVATE - Keep secure
	sg2.crt	PUBLIC - Can be shared
	ca.crt	PUBLIC - Can be shared
...

Part 3: TCP Server and Client Configuration

Configuring the ISP (TCP Server)

Mqtt servers support mTLS. Here's a typical configuration structure:

```
# Example server configuration
port = 8883
ca_certificate = /path/to/ca.crt
server_certificate = /path/to/isp.crt
server_key = /path/to/isp.key
require_client_certificate = true
verify_client = true
nection
```

Part 4: Certificate Revocation and Management

Certificate Revocation

```
# Create a Certificate Revocation List (CRL)
openssl ca -config ca/openssl.cnf -gencrl -out ca/crl/ca.crl

# Revoke a compromised certificate
openssl ca -config ca/openssl.cnf -revoke ca/newcerts/1001.pem -
crl_reason keyCompromise

# Regenerate the CRL after revocation
openssl ca -config ca/openssl.cnf -gencrl -out ca/crl/ca.crl

# The CRL (ca.crl) can be publicly shared
```

Best Practices

1. **Key Length:** Use at least 2048-bit RSA keys (4096 for CA)
2. **Certificate Validity:**
 - CA certificates: 5-10 years
 - Entity certificates: 1-3 years
3. **Password Protection:**
 - Protect private keys with strong passwords
 - Use secure key storage where available
4. **Certificate Naming:**
 - Use meaningful Common Names (CN) to identify entities

- Consider including entity IDs in certificate Subject Alternative Names (SAN)

5. Automation:

- Script certificate creation for multiple SGs
- Consider using automated certificate management tools for large deployments

Annexure – C

Standard Failure and Prediction Logics and Alert mechanism

1. ALERT MECHANISM:

1.1 Selection of Alert for pushing when generated through multiple logics: To avoid multiple Alerts generated through multiple logics for one asset, a scheme should be followed to select one Alert for pushing. For this, Alert pushing flow has been described as below:

- (ii) Once first predictive Alert is pushed for any particular asset say PT-201, It will not be eligible for other predictive Alerts (due to other predictive logics) for same asset ie PT-201 till Alert feedback is given with remarks. However data and Alerts generated during this intervening period may be kept for records to show whenever required.

However, if Failure Alert is generated during the intervening period between First Predictive Alarm and before feedback with remarks, Failure Alert shall be pushed.

- (iii) Once First Failure Alert is pushed for any particular gear say PT-201 OR Failure Alert is pushed after one Predictive Alert as mentioned in sr (i) above, It will not be eligible for other Failure & Predictive Alerts for same asset ie PT-201 till failure Alert feedback is given with remarks. However data and Alerts generated during this intervening period may be kept for records to show whenever required.

1.2 Repeat Frequency of same Alert to maintainer: Failure and predictive Alerts shall be generated as per the logics and AI/ML models and as per 1.1 above and sent to maintainer immediately once. However the repetition of same Alerts for will be sent to maintainer only after duration as mentioned below OR as decided by Zonal Railway (configurable) to avoid excessive Alerts till the cause of failure/prediction is rectified and alert feedback with remarks are given. Repeat Alerts should not be counted in total Alerts for analysis. However, it can be separately analysed for the purpose of checking promptness of staff.

Sr no	Gear	Designa-tion for pushing	Failure Alert Freq (in hrs)	Predictive Alert Freq (in hrs)
1	Point Machine	ESM	2 (if not acknowledge)	12
2	LC gate	ESM	2 (if not acknowledge)	12
3	Block Instrument	ESM	2(if not acknowledge)	12
4	IPS	ESM	1 (if not acknowledge)	12
5	Signal	ESM	3 (if not acknowledge)	12
6	Track circuit /Axe Counter	ESM	3 (if not acknowledge)	12

1.3 Repeat Frequency of same Alert to higher hierarchy: Alerts should be pushed to higher hierarchy (JE/SE) 30 min after occurrence. However, repetition of same alerts should be as below.

Sr no	Gear	Designation for pushing	Failure Alert Freq (in hrs)	Predictive Alert Freq (in hrs)
1	Point Machine	Supervisor	3 (if not acknowledge)	18
2	LC gate	Supervisor	3 (if not acknowledge)	18
3	Block Instrument	Supervisor	3 (if not acknowledge)	18
4	IPS	Supervisor	1 (if not acknowledge)	18
5	Signal	Supervisor	4(if not acknowledge)	18
6	Track circuit /Axe Counter	Supervisor	4(if not acknowledge)	18

Alerts should be pushed to higher hierarchy (SSE) 1 hour after occurrence. However, repetition of same alerts should be as below.

Sr no	Gear	Designation for pushing	Failure Alert Freq (in hrs)	Predictive Alert Freq (in hrs)
1	Point Machine	SSE	6(if not acknowledge)	24
2	LC gate	SSE	6 (if not acknowledge)	24
3	Block Instrument	SSE	6 (if not acknowledge)	24
4	IPS	SSE	1 (if not acknowledge)	24
5	Signal	SSE	8 (if not acknowledge)	24
6	Track circuit /Axe Counter	SSE	8 (if not acknowledge)	24

Alerts should be pushed to higher hierarchy (ASTE/DSTE) 2 hours after occurrence. However, repetition of same alerts should be as below.

Sr no	Gear	Designation for pushing	Failure Alert Freq (in hrs)	Predictive Alert Freq (in hrs)
1	Point Machine	ASTE/DSTE	9(if not acknowledge)	36
2	LC gate	ASTE/DSTE	9 (if not acknowledge)	36
3	Block Instrument	ASTE/DSTE	9 (if not acknowledge)	36
4	IPS	ASTE/DSTE	2 (if not acknowledge)	36
5	Signal	ASTE/DSTE	12 (if not acknowledge)	36
6	Track circuit /Axe Counter	ASTE/DSTE	12 (if not acknowledge)	36

Note: All duartions mentioned above are indicative. Zonal Railway may decide the durations.

1.4 Maintenance mode of Alert:

1. There should be icon for enabling maintenance mode to stop Alerts during maintenance.
2. There should be icon for disabling maintenance mode to restore Alerts after maintenance.
3. In case, ESM forgets to disable maintenance mode. It automatically gets disabled after certain duration from its enabling time as tabled below. There should be a provision in Application to input/extend the duration of auto disable at the time of enabling or at any stage in case block/disconnection is extended.
4. In case, Alert gets generated because of maintenance, ESM can press "M" button at the time of feed back of alert to exclude it in analysis and counting.

Time after which maintenance mode shall automatically be disabled, if maintainer forgets to disable.		
Sr	Name of Asset	Duaration
1	Track Circuit	60 min
2	Point Machine	60 min
3	Signal	45 min

Note: Above time duration are indicative. Zonal Railways can decide timing duration depending on disconnection/block duration for all equipments which shall be configurable in RDPMS Application.

2. DETAILS OF PARAMETERS, PREDICTION LOGICS AND FAILURE LOGICS OF ASSETS: Static Logics of failure and prediction for all types of Signals, Point machine, DC Track circuit have been given. However, logics for rest of the assets, Earthing, SPDs, temperature and humidity and data taken from diagnostic ports of various types of assets like IPS, Axle counter etc should be prepared by vendors and approved by Zonal Railways under intimation to RDSO so that FRS can be suitably amended based on experience after review.

2.1 (a) Details of Parameters of Integrated Power Supply

(Details given in Annexure A)

(Total number of Sensors = 27 excluding SPDs, Earth & other individual modules for one IPS, if diagnostic port not available.)

1. Avg value is defined as average operating parameter taking Avg value of 15 days (not counting failure data). In case of replacement of asset, this value should be counted afresh. For example, average value of operating voltage of point machine for 15 days may be 105 V whereas it may have different value at any time. Avg value has not been defined here as it may be different for each asset.
2. Min safe value of parameter shall be the boundary value for safe operation.
3. Min fail value of parameter shall be the boundary value beyond which equipment will fail.
4. All Boundary values shall be decided by Zonal Railway as per field condition. Though some of the values have been given for reference based on operating range of parameters as per Specifications of asset.

sr	Parameter_representation_name (string)	Parameter_representation_code (string)	Value in V/A		Type of Input	Re-marks
			Min safe	Min fail		
	Relay Room					
1	IPS 110 DC O/P Voltage	V _{IPS 110 DC}	*	*	Sensor	* Zonal Railway shall decide the values as per site requirement. OR Diagnostic Port
2	IPS 110 AC Sig-1 O/P Voltage	V _{IPS Sig-1 110 AC}	*	*		
3	IPS 110 AC Sig-2 O/P Voltage	V _{IPS Sig-2 110 AC}	*	*		
4	IPS 110 AC Sig-3 O/P Voltage	V _{IPS Sig-3 110 AC}	*	*		
5	IPS 110 AC Sig-4 O/P Voltage	V _{IPS Sig-4 110 AC}	*	*		
6	IPS 110 AC TR-1 O/P Voltage	V _{IPS TR-1 110 AC}	*	*		
7	IPS 110 AC TR-2 O/P Voltage	V _{IPS TR-2 1110 AC}	*	*		
8	IPS 110 AC TR-3 O/P Voltage	V _{IPS TR-3 110 AC}	*	*		
9	IPS 110 AC TR-4 O/P Voltage	V _{IPS TR-4 110 AC}	*	*		
10	IPS SMR-1 Voltage	V _{IPS SMR-1 110 DC}	*	*		
11	IPS SMR-2 Voltage	V _{IPS SMR-2 110 DC}	*	*		
12	IPS SMR-3 Voltage	V _{IPS SMR-3 110 DC}	*	*		
13	IPS SMR-4 Voltage	V _{IPS SMR-4 110 DC}	*	*		
14	IPS SMR-5 Voltage	V _{IPS SMR-5 110 DC}	*	*		
15	IPS DC-DC Relay Internal Voltage	V _{IPS DC R INT}	*	*		
16	IPS DC-DC Relay External Voltage	V _{IPS DC R EXT}	*	*		
17	IPS DC-DC AXLE COUNTER Voltage	V _{IPS DC AXLE C}	*	*		
18	IPS DC-DC Panel INDICATION Voltage	V _{IPS DC PAN IND}	*	*		

19	IPS DC-DC BLOCK LOCAL Voltage	V _{IPS DC BLOCK LOCAL}	*	*		
20	IPS DC-DC HKT MAGNETO Voltage	V _{IPS DC HKT MAG}	*	*		
21	IPS DC-DC BLOCK LINE UP Voltage	V _{IPS DC BLOCK LINE UP}	*	*		
22	IPS DC-DC BLOCK LINE DN Voltage	V _{IPS DC BLOCK LINE DN}	*	*		
23	IPS DC-DC BLOCK TELE UP Voltage	V _{IPS DC BLOCK TEL UP}	*	*		
24	IPS DC-DC BLOCK TELE DN Voltage	V _{IPS DC BLOCK TEL DN}	*	*		
25	IPS DC-DC DATALOGGER Voltage	V _{IPS DC DATALOG}	*	*		
26	IPS DC-DC EI Voltage	V _{IPS DC EI}	*	*		
27	IPS Battery charging Current	I _{IPS Batt Char 110 DC}	*	*		

2.1 (b) Prediction Logics of Integrated Power Supply

Note:

1. These logics are primitive logics for Prediction of failures. However, in addition to these primitive logics, these primitive logics, various AI/ML Techniques and learning models need to be developed and applied by Vendors for prediction of failures. The models used by them shall be shared with Zonal Railways/RDSO.
2. Comparisons in logics have been made with deviation in parameter value in terms of certain % of avg value OR deviation from Min/Max safe. Although % deviation has been given for predictive logics for reference, however, % may be modified as decided by Zonal Railway. **This % is being denoted by “LD” for lower side deviation. For IPS LD = 90.**
3. For Predictive logic, the analog continuous deviation (say < 80% of avg value) should occur for at least certain duration to avoid predictive alerts for short transients. Indicative timing has been mentioned against logics. However, time duration can be decided by Zonal Railways as per site requirement.
4. The deviation should occur for entire duration of at least 1 operation in discrete cases like voltage and current of point machine.
5. Prediction Logics have been given based on defined parameters. However, Vendors may add new logics and modify given logics based on new parameters added OR otherwise also under approval of Railways and under intimation to RDSO sothat suitable amendment may be issued in FRS after review.

	cause_detail	Logic	cause_code	Remarks on logics
1	IPS 110 DC O/P Voltage low.	$V_{IPS\ 110\ DC} < \text{LD \% of avg value OR Min safe value}$ && $I_{IPS\ Batt\ Char} > 0^+$	IPS 110 DC VOLT LOW	<p>Avg value of $V_{IPS\ 110\ DC}$ should be calculated when IPS Battery charging Current ie $I_{IPS\ Batt\ Char}$ 110 DC is more than 0^+.</p> <p>0^+ can be taken reasonable positive value to confirm that current is not zero.</p> <p>Logic to be checked for</p>

				5 min when IPS Batt Char 110 DC is more than 0+.
2	IPS 110 AC Sig-1 O/P Voltage low.	$V_{IPS\ Sig-1\ 110\ AC} <$ LD % of avg value OR Min safe value	IPS 110 AC Sig-1 VOLT LOW	Logic to be checked for 5 min. To be done for all similar modules, if required.
3	IPS 110 AC TR-1 O/P Voltage low.	$V_{IPS\ TR-1\ 110\ AC} <$ LD % of avg value OR Min safe value	IPS 110 AC TR-1 VOLT LOW	Logic to be checked for 5 min. To be done for all similar modules, if required.
4	IPS SMR-1 Voltage low.	$V_{IPS\ SMR-1\ 110\ DC} <$ LD % of avg value OR Min safe value	IPS SMR-1 VOLT LOW	Logic to be checked for 5 min. To be done for all similar modules, if required.
5	IPS DC-DC Relay Internal Voltage low.	$V_{IPS\ DC\ R\ INT} <$ LD % of avg value OR Min safe value	IPS DC-DC R INT VOLT LOW	Logic to be checked for 5 min.
6	IPS DC-DC Relay External Voltage Low.	$V_{IPS\ DC\ R\ EXT} <$ LD % of avg value OR Min safe value	IPS DC-DC R EXT VOLT LOW	Logic to be checked for 5 min.
7	IPS DC-DC AXLE COUNTER Voltage Low.	$V_{IPS\ DC\ AXLE\ C} <$ LD % of avg value OR Min safe value	IPS DC-DC AXLE C VOLT LOW	Logic to be checked for 5 min.
8	IPS DC-DC PANEL INDICATION Voltage Low.	$V_{IPS\ DC\ PAN\ IND} <$ LD % of avg value OR Min safe value	IPS DC-DC PAN IND VOLT LOW	Logic to be checked for 5 min.

9	IPS DC-DC BLOCK LOCAL Voltage Low.	$V_{IPS\ DC\ BLOCK\ LOCAL} < LD\ %\ of\ avg\ value\ OR\ Min\ safe\ value$	IPS DC-DC BLOCK LOCAL VOLT LOW	Logic to be checked for 5 min.
10	IPS DC-DC HKT MAGNETO voltage Low.	$V_{IPS\ DC\ HKT\ MAG} < LD\ %\ of\ avg\ value\ OR\ Min\ safe\ value$	IPS DC-DC HKT MAG VOLT LOW	Logic to be checked for 5 min.
11	IPS DC-DC BLOCK LINE UP Voltage Low.	$V_{IPS\ DC\ BLOCK\ LINE\ UP} < LD\ %\ of\ avg\ value\ OR\ Min\ safe\ value$	IPS DC-DC BLOCK LINE UP VOLT LOW	Logic to be checked for 5 min.
12	IPS DC-DC BLOCK LINE DN Voltage Low.	$V_{IPS\ DC\ BLOCK\ LINE\ DN} < LD\ %\ of\ avg\ value\ OR\ Min\ safe\ value$	IPS DC_DC BLOCK LINE DN VOLT LOW	Logic to be checked for 5 min.
13	IPS DC-DC BLOCK TEL UP Voltage Low.	$V_{IPS\ DC\ BLOCK\ TEL\ UP} < LD\ %\ of\ avg\ value\ OR\ Min\ safe\ value$	IPS DC-DC BLOCK TEL UP VOLT LOW	Logic to be checked for 5 min.
14	IPS DC-DC BLOCK TEL DN Voltage Low.	$V_{IPS\ DC\ BLOCK\ TEL\ DN} < LD\ %\ of\ avg\ value\ OR\ Min\ safe\ value$	IPS DC-DC BLOCK TEL DN VOLT LOW	Logic to be checked for 5 min.
15	IPS DC-DC DATALOGGER Voltage Low.	$V_{IPS\ DC\ DATALOG} < LD\ %\ of\ avg\ value\ OR\ Min\ safe\ value$	IPS DC-DC DATA-LOG VOLT LOW	Logic to be checked for 5 min.
16	IPS DC-DC EI Voltage Low.	$V_{IPS\ DC\ EI} < LD\ %\ of\ avg\ value\ OR\ Min\ safe\ value$	IPS DC-DC EI VOLT LOW	Logic to be checked for 5 min.

17	IPS Battery Charging current low	$I_{IPS \text{ Batt Char } 110 \text{ DC}} < \text{LD \% of avg value OR Min safe value}$	IPS BATT CHAR CURR LOW	Logic to be checked for 5 min.
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2.1 (c) Failure Logics of Integrated Power Supply				
	cause_detail	Logic	cause_code	Remarks on logics
1	IPS 110 DC O/P Voltage failed	$V_{IPS \text{ 110 DC}} < \text{Min Fail value}$	IPS 110 DC VOLT FAIL	Logic to be checked for 1 min.
2	IPS 110 AC Sig-1 O/P Voltage failed.	$V_{IPS \text{ Sig-1 110 AC}} < \text{Min Fail value}$	IPS 110 AC Sig-1 VOLT FAIL	Logic to be checked for 1 min.
3	IPS 110 AC TR-1 O/P Voltage failed.	$V_{IPS \text{ TR-1 110 AC}} < \text{Min Fail value}$	IPS 110 AC TR-1 VOLT FAIL	Logic to be checked for 1 min.
4	IPS SMR-1 Voltage failed.	$V_{IPS \text{ SMR-1 110 DC}} < \text{Min Fail value}$	IPS SMR-1 VOLT FAIL	Logic to be checked for 1 min.
5	IPS DC-DC Relay Internal Voltage failed.	$V_{IPS \text{ DC R INT}} < \text{Min Fail value}$	IPS DC-DC R INT VOLT FAIL	Logic to be checked for 1 min.
6	IPS DC-DC Relay External Voltage failed.	$V_{IPS \text{ DC R EXT}} < \text{Min Fail value}$	IPS DC-DC R EXT VOLT FAIL	Logic to be checked for 1 min.
7	IPS DC-DC AXLE COUNTER Voltage failed.	$V_{IPS \text{ DC AXLE C}} < \text{Min Fail value}$	IPS DC-DC AXLE C VOLT FAIL	Logic to be checked for 1 min.
8	IPS DC-DC PANEL INDICATION Voltage failed.	$V_{IPS \text{ DC PAN IND}} < \text{Min Fail value}$	IPS DC-DC PAN IND VOLT FAIL	Logic to be checked for 1 min.
9	IPS DC-DC BLOCK LOCAL Voltage failed.	$V_{IPS \text{ DC BLOCK LOCAL}} < \text{Min Fail value}$	IPS DC-DC BLOCK LOCAL VOLT FAIL	Logic to be checked for 1 min.

10	IPS DC-DC HKT MAGNETO failed.	$V_{IPS\ DC\ HKT\ MAG} < \text{Min Fail value}$	IPS DC-DC HKT MAG VOLT FAIL	Logic to be checked for 1 min.
11	IPS DC-DC BLOCK LINE UP Voltage failed.	$V_{IPS\ DC\ BLOCK\ LINE\ UP} < \text{Min Fail value}$	IPS DC-DC BLOCK LINE UP VOLT FAIL	Logic to be checked for 1 min.
12	IPS DC-DC BLOCK LINE DN Voltage failed.	$V_{IPS\ DC\ BLOCK\ LINE\ DN} < \text{Min Fail value}$	IPS DC-DC BLOCK LINE DN VOLT FAIL	Logic to be checked for 1 min.
13	IPS DC-DC BLOCK TELE UP Voltage failed.	$V_{IPS\ DC\ BLOCK\ TEL\ UP} < \text{Min Fail value}$	IPS DC-DC BLOCK TEL UP VOLT FAIL	Logic to be checked for 1 min.
14	IPS DC-DC BLOCK TELE DN Voltage failed.	$V_{IPS\ DC\ BLOCK\ TEL\ DN} < \text{Min Fail value}$	IPS DC-DC BLOCK TEL DN VOLT FAIL	Logic to be checked for 1 min.
15	IPS DC-DC DATA-LOGGER Voltage failed.	$V_{IPS\ DC\ DATALOG} < \text{Min Fail value}$	IPS DC-DC DAT-ALOG VOLT FAIL	Logic to be checked for 1 min.
16	IPS DC-DC EI Voltage failed.	$V_{IPS\ DC\ EI} < \text{Min Fail value}$	IPS DC-DC EI VOLT FAIL	Logic to be checked for 1 min.
17	IPS Battery Charging current failed.	$I_{IPS\ Batt\ Char\ 110\ DC} < \text{Min Fail value}$	IPS DC-DC BATT CHAR CURR FAIL	Logic to be checked for 1 min.

2.2 (a) Details of Parameters of Point

(Details given in Annexure A)

(Total number of Sensors = 9 for one point machine, if NWKR is separate for each machine)

1. Avg value is defined as average operating parameter taking Avg value of 15 days (not counting failure data). In case of replacement of asset, this value should be counted afresh. For example, average value of operating voltage of point machine for 15 days may be 105 V whereas it may have different value at any time. Avg value has not been defined here as it may be different for each asset.
2. Min and Max safe value of parameter shall be the boundary value for safe operation.
3. Min fail value of parameter shall be the boundary value beyond which equipment will fail.

4. All Boundary values shall be decided by Zonal Railway as per field condition. Though some of the values have been given for reference based on operating range of parameters as per Specification of asset.

	Parameter_representation_name (string)	Parameter_representation_code (string)	Values in V/A/Sec			Type of Input	Remarks
			Max safe	Min safe	Min fail		
	Relay Room						
	24 VDC at RR from Loc for Normal	V _{PT NWKR}	—	21	18	Sensor	NWKR of individual point OR one NWKR for both point
	24 VDC at RR from Loc for Reverse	V _{PT RWKR}	—	21	18	Sensor	RWKR of individual point OR one RWKR for both point
	Digital status of NWKR	NWKR	—	—	—	Datalogger input	NWKR of individual point OR One NWKR for both Points
	Digital status of RWKR	RWKR	—	—	—		RWKR of individual point OR One RWKR for both Points
	Digital status of NWCR	NWCR	—	—	—		Contactor Relay through which feed is passed for operation of individual OR both Point.
	Digital status of RWCR	RWCR	—	—	—		Contactor Relay through which feed is passed for operation of individual OR both Point.
	Location Box						
	110 DC at Loc box for Normal.	V _{PT 110 DC Loc N}	—	90	82	Sensor	For individual Point

110 DC at Loc box for Reverse.	$V_{PT110\ DC\ Loc\ R}$	—	90	82	Sensor	For individual Point
Point Machine Current Normal	$I_{PT\ N}$	—	1	0.5	Sensor	For individual Point
Point Machine Current Reverse	$I_{PT\ R}$	—	1	0.5	Sensor	For individual Point
Normal Operation time	$T_{PT\ N}$	8	—	—	Derived	<p>$T_{PT\ N}$ Time should be calculated from current signature for individual point.</p> <p>Max safe time should be about 1.5 sec less than WJR timer time so that obstruction can be declared when when $T_{PT\ N} >$ max safe time during obstruction.</p>
Reverse Operation time	$T_{PT\ R}$	8	—	—	Derived	<p>$T_{PT\ R}$ Time should be calculated from current signature for individual point.</p> <p>Max safe time should be about 1 sec less than WJR timer time so that obstruction can be declared when when $T_{PT\ N} >$ max safe time during obstruction.</p>
24 V DC going to Relay Room after detection at LOC for Normal	$V_{PT\ 24\ DC\ LOC\ N}$	—	—	—	Sensor	For individual Point
24 V DC going to Relay Room after detection at LOC for Reverse	$V_{PT\ 24\ DC\ LOC\ R}$	—	—	—	Sensor	For individual Point
Vibration	X	—	—	—	Sensor	For individual Point

2.2 (b) Prediction Logics of Points

Note:

1. These logics are primitive logics for Prediction of failures. However, in addition to these primitive logics, these primitive logics, various AI/ML Techniques and learning models need to be developed and applied by Vendors for prediction of failures. The models used by them shall be shared with Zonal Railways/RDSO.
2. Comparisons in logics have been made with deviation in parameter value in terms of certain % of avg value OR deviation from Min/Max safe. Although % deviation has been given for predictive logics for reference, however, % may be modified as decided by Zonal Railway. **This % is being denoted as LD1 , LD2 for lower side deviation and “HD” for higher side deviation. For Points, LD1 = 80, LD2 = 90 and HD = 150.**
3. For Predictive logic, the analog continuous deviation (say < than 80% of avg value) should occur for at least certain duration to avoid predictive alerts for short transients. Indicative timing has been mentioned against logics. However, time duration can be decided by Zonal Railways as per site requirement.
4. The deviation should occur for entire duration of at least 1 operation in discrete cases like voltage and current of point machine.
5. Prediction Logics have been given based on defined parameters. However, Vendors may add new logics and modify given logics based on new parameters added OR otherwise also under approval of Railways and under intimation to RDSO sothat suitable amendment may be issued in FRS after review.
- 6. Point predictive logics have been shown for one individual Point (not cross over) assuming that NWKR is separate for each point (not cross over). However, if one NWKR is used for cross over, remarks have been given against each logic.**

	cause_detail	Logic	cause_code	Remarks on logics
1	Predictive Alert for PT---. Voltage OR Current for Normal operation Low at Loc.	[NWCR ↑ (entire UP duration or 10 sec) && $I_{IPS\ Batt\ Char\ 110\ DC} > 0^+$ && ($V_{IPS\ 110\ DC} \geq \text{Min safe value}$	PT N VOLT/CURR AT LOC LOW	(1) Avg value of $V_{PT\ 110\ DC\ Loc\ N}$ should be calculated when IPS Battery charging Current ie $I_{IPS\ Batt\ Char\ 110\ DC}$ is more than 0^+ . A small positive value can be used in place of 0^+ to account for errors. (2) [] Logic is checked for

		$V_{PT\ 110\ DC\ Loc\ N} < LD1\ %\ of\ avg\ value\ OR\ Min\ safe\ value$ $I_{PT\ N} < LD1\ %\ of\ avg\ value\ OR\ Min\ safe\ value$)] NWKR ↑		entire period of NWCR UP (or 10 sec) and I_{IPS} Batt Char 110 DC is more than 0+. (3) Value of voltage and current should be taken after transients settles.
2	Predictive Alert for PT---. Voltage OR current for Reverse operation Low at Loc.	[RWCR ↑ (entire UP duration or 10 sec) && $I_{IPS\ Batt\ Char\ 110\ DC} > 0^+$ && ($V_{IPS\ 110\ DC} \geq$ Min safe value $V_{PT110\ DC\ Loc\ R} < LD1\ %\ of\ avg\ value\ OR\ Min\ safe\ value$ $I_{PT\ R} < LD1\ %\ of\ avg\ value\ OR\ min\ safe\ value$)] RWKR ↑	PT R VOLT/CURR AT LOC LOW	(1) Avg value of $V_{PT\ 110\ DC\ Loc\ R}$ should be calculated when IPS Battery charging Current ie I_{IPS} Batt Char 110 DC is more than 0+. A small positive value can be used in place of 0+ to account for errors. (2) [] Logic is checked for entire period of RWCR UP (or 10 sec) and I_{IPS} Batt Char 110 DC is more than 0. (3) Value of voltage and current should be taken after transients settles.
3	Predictive Alert for PT---. Normal Indication Voltage Low at Loc after detection.	[NWKR ↑ && $V_{IPS\ DC\ R\ EXT} \geq$ Min safe value && $V_{PT\ 24\ DC\ LOC\ N} < LD1\ %\ of\ avg\ value$]	PT N IND VOLT AT LOC LOW	(1) [] Logic is checked for 30 sec duration. (2) If one NWKR is being used after taking indication of both points in series, then logic may be modified to consider

				individual indication voltage of each point at location ie $V_{PT\ 24\ DC\ LOC\ N}$ in such a way to arrive at conclusion whether which point has low voltage.
4	Predictive Alert for PT---. Reverse Indication Voltage Low at Loc after detection.	[RWKR ↑ && $V_{IPS\ DC\ R\ EXT} \geq$ Min safe value && $V_{PT\ 24\ DC\ LOC\ R} <$ LD1 % of avg value]	PT R IND VOLT AT LOC LOW	(1) [] Logic is checked for 30 sec duration. (2) If one RWKR is being used after taking indication of both points in series, then logic may be modified to consider individual indication voltage of each point at location ie $V_{PT\ 24\ DC\ LOC\ R}$ in such a way to arrive at conclusion whether which point has low voltage.
5	Predictive Alert for PT---. Normal indication voltage is ok at loc but low at Indoor NWKR. Cable may be defective.	[NWKR↑ && $V_{PT\ 24\ DC\ LOC\ N} \geq$ LD2 % of avg value && $V_{PT\ NWKR} <$ LD1 % of avg value OR Min safe value]	PT VOLT AT IN-DOOR NWKR LOW	(1) [] Logic is checked for 30 sec duration. (2) If one NWKR is being used after taking indication of both points in series, then $V_{PT\ 24\ DC\ LOC\ N}$ of point which is last in series

				shall be taken for comparison. In this case Alert msg can be given for both points.
6	Predictive Alert for PT---. Reverse indication voltage ok at Loc but low at Indoor RWKR. Cable may be defective.	[RWKR↑ && $V_{PT\ 24\ DC\ LOC\ R} \geq LD2\ %\ of\ avg\ value$ && $V_{PT\ RWKR} < LD1\ %\ of\ avg\ value\ OR\ Min\ safe\ value$]	PT VOLT AT IN-DOOR RWKR LOW	(1) [] Logic is checked for 30 sec duration. (2) If one RWKR is being used after taking indication of both points in series, then $V_{PT\ 24\ DC\ LOC\ R}$ of point which is last in series shall be taken for comparison. In this case Alert msg can be given for both points.
7	Predictive Alert for PT---. Normal Operation Time high	[NWCR ↑ (entire UP duration or 10 sec) NWKR ↑ $T_{PT\ N} > HD\ %\ of\ avg\ value$]	PT N TIME HIGH	(1) Normal operation time is calculated as per parameter details in 2 (a) of this Annexure .
8	Predictive Alert for PT---. Reverse Operation Time high	[RWCR ↑ (entire UP duration or 10 sec) RWKR ↑ $T_{PT\ R} > HD\ %\ of\ avg\ value$]	PT R TIME HIGH	(2) Reverse operation time is measured as per parameter details in 2 (a) of this Annexure

2.2 (c) Failure Logics of Points

Note:

1. Failure Logics have been given based on defined parameters. However, Vendors may add new logics and modify given logics based on new parameters added OR otherwise also under approval of Railways and under intimation to RDSO so that suitable amendment may be issued in FRS after review. **The % deviation for Failure of Points is being denoted as LD1, LD2 for lower side deviation. LD1=70 & LD2=90.**
2. Point failure logics have been shown for one individual Point (not cross over) assuming that NWKR is separate for each point (not cross over). However, if one NWKR is used for cross over, remarks have been given against each logic.

	cause_detail	Logic	cause_code	Remarks on Logics
1	Point No. PT---- failed in Normal. Normal Indication Voltage at Loc is low/failed/detection break.	[NWCR ↓ && RWCR ↓ && RWKR ↓ && NWKR ↑ to ↓ && V _{IPS DC R EXT} ≥ Min fail value && V _{PT 24 DC LOC N} < LD1 % of avg value]	PT N IND VOLT AT LOC FAIL	(1) [] Logic is checked for 2 sec duration. after NWKR goes from UP to DN. (2) If one NWKR is being used after taking indication of both points in series, then logic may be modified to consider individual indication voltage of each point at location ie V _{PT 24 DC LOC N} in such a way to arrive at conclusion whether which point has low voltage.

2	Point No. PT---- failed in Reverse. Reverse indication Voltage at Loc is low/failed/detection break.	[NWCR ↓ && RWCR ↓ && NWKR ↓ && RWKR ↑ to ↓ && $V_{IPS\ DC\ R\ EXT} \geq$ Min fail value && $V_{PT\ 24\ DC\ LOC\ R} <$ LD1 % of avg value]	PT R IND VOLT AT LOC FAIL	(1) [] Logic is checked for 2 sec duration. after RWKR goes from UP to DN. (2) If one RWKR is being used after taking indication of both points in series, then logic may be modified to consider individual indication voltage of each point at location ie V_{PT} 24 DC LOC R in such a way to arrive at conclusion whether which point has low voltage.
3	Point No. PT---- failed in Normal. Voltage at Loc is ok but fail at Indoor NWKR.	[NWCR ↓ && RWCR ↓ && RWKR ↓ && NWKR ↑ to ↓ && $V_{PT\ 24\ DC\ LOC\ N} \geq$ LD2 % of avg value && $V_{PT\ NWKR} <$ Min Fail value]	PT VOLT AT INDOOR NWKR FAIL	(1) [] Logic is checked for 2 sec duration. after NWKR goes from UP to DN. (2) If one NWKR is being used after taking indication of both points in series, then V_{PT} 24 DC LOC N of point which is last in series shall be taken for comparison. In this case Alert msg can be

				given for both points.
4	Point No. PT---- failed in Reverse. Voltage at Loc is ok but fail at Indoor RWKR.	[NWCR ↓ && RWCR ↓ && NWKR ↓ && RWKR ↑ to ↓ && $V_{PT\ 24\ DC\ LOC\ R} \geq LD2\ %\ of\ avg\ value$ && $V_{PT\ RWKR} < Min\ Fail\ value$]	PT VOLT AT INDOOR RWKR FAIL	(1) [] Logic is checked for 2 sec duration. after RWKR goes from UP to DN. (2) If one RWKR is being used after taking indication of both points in series, then $V_{PT\ 24\ DC\ LOC\ R}$ of point which is last in series shall be taken for comparison. In this case Alert msg can be given for both points.
5	Point No. PT---- failed in Normal. Voltage at NWKR is Ok. NWKR Relay may be defective.	[NWCR ↓ && RWCR ↓ && RWKR ↓ && NWKR ↑ to ↓ && $V_{PT\ NWKR} \geq Min\ Safe\ value$]	PT NWKR RELAY DEFECT	(1) [] Logic is checked for 2 sec duration. after NWKR goes from UP to DN. (2) If one NWKR is being used after taking indication of both points in series, then Alert msg can be given for both points.
6	Point No. PT---- failed in Reverse. Voltage at RWKR is ok. RWKR Relay may be defective.	[NWCR ↓ && RWCR ↓ &&	PT RWKR RELAY DEFECT	(1) [] Logic is checked for 2 sec duration. after RWKR goes from UP to DN.

		<p>NWKR ↓ && RWKR ↑ to ↓ && $V_{PT\ RWKR} \geq$ Min Safe value]</p>		(2) If one RWKR is being used after taking indication of both points in series, then Alert msg can be given for both points.
7	<p>Point No. PT---- in Normal. Voltage Or Current for normal operation in Loc failed.</p>	<p>[NWCR ↑ (Entire UP duration or 10 sec) && $V_{IPS\ 110\ DC} \geq$ Min fail value && ($V_{PT\ 110\ DC\ Loc\ N} <$ Min Fail value OR $I_{PT\ N} <$ Min Fail value >)] NWKR ↓ (remaining DN upto 2 sec after completion of above logic)</p>	PT N VOLT/CURR FAIL	<p>(1) [] Logic is checked for entire period of NWCR UP (or 10 sec). It is followed by NWKR remaining DN upto 2 sec after completion of [] logic.</p> <p>(2) Value of voltage and current should be taken after transients settles.</p>
8	<p>Point No. PT---- failed in Reverse. Voltage Or Current for reverse operation in Loc failed.</p>	<p>[RWCR ↑ (Entire UP duration or 10 sec) && $V_{IPS\ 110\ DC} \geq$ Min fail value && ($V_{PT\ 110\ DC\ Loc\ R} <$ Min Fail value OR $I_{PT\ R} <$ Min Fail value >)</p>	PT R VOLT/CURR FAIL	<p>(1) [] Logic is checked for entire period of RWCR UP (or 10 sec). It is followed by RWKR remaining DN upto 2 sec after completion of [] logic.</p> <p>(2) Value of voltage and current should be taken after transients settles.</p>

]		
		RWKR ↓ (remaining DN upto 2 sec after completion of above logic)		
9	Point No. PT---- failed in Normal. Normal induction Voltage at Loc failed OR Point in Obstruction.	[NWCR ↑ (Entire UP duration or 10 sec) && $V_{PT\ 110\ DC\ Loc\ N} \geq$ Min safe value && $I_{PT\ N} \geq$ Min safe value] NWKR ↓ (remaining DN upto 2 sec after completion of above logic) $T_{PT\ N} >$ Max Safe Value	PT N OBS	(1) [] Logic is checked for entire period of NWCR UP (or 10 sec). (2) Value of operation voltage and current should be taken after transients settles.
10	Point No. PT---- failed in Reverse. Reverse induction Voltage at Loc failed OR Point in Obstruction.	[RWCR ↑ (Entire UP duration or 10 sec) && $V_{PT\ 110\ DC\ Loc\ R} \geq$ Min safe value && $I_{PTR} \geq$ Min safe value] RWKR ↓ (remaining DN upto 2 sec after completion of above logic) $T_{PTR} >$ Max Safe Value	PT R OBS	(1) [] Logic is checked for entire period of NWCR UP (or 10 sec). (2) Value of operation voltage and current should be taken after transients settles.
11	Point No. PT---- failed in Normal. Normal indication Voltage at LOC is ok but failed at NWKR.	[NWCR ↑ (Entire UP duration or 10 sec) &&	PT VOLT AT INDOOR NWKR FAIL	(1) First [] Logic is checked for entire period of NWCR UP (or 10 sec).

		$V_{PT\ 110\ DC\ Loc\ N} \geq \text{Min safe value}$ $\&\&$ $I_{PT\ N} \geq \text{Min safe value}$ $]$ $[$ NWKR ↓ (remaining DN upto 2 sec after completion of above logic) $\&\&$ $V_{PT\ 24\ DC\ LOC\ N} \geq \text{LD2 \% of avg value}$ $\&\&$ $V_{PT\ NWKR} < \text{Min Fail value}$ $]$		<p>(2) Value of operation voltage and current should be taken after transients settles.</p> <p>(3) In Second [] logic, Normal indication voltage at Loc and at NWKR are compared for 2 sec after completion of just previous logic.</p> <p>(4) If one NWKR is being used after taking indication of both points in series, then $V_{PT\ 24\ DC\ LOC\ N}$ of point which is last in series shall be taken for comparison. In this case Alert msg can be given for both points.</p>
12	Point No. PT---- failed in Reverse. Reverse indication Voltage at LOC is ok but failed at RWKR.	[RWCR ↑ (Entire UP duration or 10 sec) $\&\&$ $V_{PT110\ DC\ Loc\ R} \geq \text{Min safe value}$ $\&\&$ $I_{PT\ R} \geq \text{Min safe value}$ $]$	PT VOLT AT INDOOR RWKR FAIL	<p>(1) First [] Logic is checked for entire period of RWCR UP (or 10 sec).</p> <p>(2) Value of operation voltage and current should be taken after transients settles.</p>

		<p>[</p> <p>RWKR ↓ (remaining DN upto 2 sec after completion of above logic)</p> <p>&&</p> <p>$V_{PT\ 24\ DC\ LOC\ R} \geq LD2\ %\ of\ avg\ value$</p> <p>&&</p> <p>$V_{PT\ RWKR} < Min\ Fail\ value$</p> <p>]</p>		<p>(3) In Second [] logic, Reverse indication voltage at Loc and at NWKR are compared for 2 sec after completion of just previous logic.</p> <p>(4) If one RWKR is being used after taking indication of both points in series, then $V_{PT\ 24\ DC\ LOC\ R}$ of point which is last in series shall be taken for comparison. In this case Alert msg can be given for both points.</p>
13	<p>Point No. PT---- failed in Normal.</p> <p>Normal indication voltage at NWKR is ok. NWKR Relay may be defective.</p>	<p>[</p> <p>NWCR ↑ (Entire UP duration or 10)</p> <p>&&</p> <p>$V_{PT\ 110\ DC\ Loc\ N} \geq Min\ safe\ value$</p> <p>&&</p> <p>$I_{PT\ N} \geq Min\ safe\ value$</p> <p>]</p> <p>[</p> <p>NWKR ↓ (remaining DN upto 2 sec after completion of above logic)</p> <p>&&</p> <p>$V_{PT\ NWKR} \geq Min\ safe\ value$</p> <p>]</p>	<p>PT NWKR RELAY DEFECT</p>	<p>(1) First [] Logic is checked for entire period of NWCR UP (or 10 sec).</p> <p>(2) Value of operation voltage and current should be taken after transients settles.</p> <p>(3) In Second [] logic, Normal indication voltage at NWKR is compared for 2 sec after completion of</p>

				just previous logic. (4) If one NWKR is being used after taking indication of both points in series, then Alert msg can be given for both points.
14	Point No. PT---- failed in Reverse. Reverse indication voltage at RWKR is ok. RWKR Relay may be defective.	[RWCR ↑ (Entire UP duration or 10) && $V_{PT110\ DC\ Loc\ R} \geq$ Min safe value && $I_{PTR} \geq$ Min safe value] [RWKR ↓ (remaining DN upto 2 sec after completion of above logic) && $V_{PT\ RWKR} \geq$ Min safe value]	PT RWKR RELAY DEFECT	(1) [] Logic is checked for entire period of RWCR UP (or 10 sec). It is followed by RWKR remaining DN upto 2 sec after completion of [] logic. (2) Value of operation voltage and current should be taken after transients settles. (3) In Second [] logic, Reverse indication voltage at NWKR is compared for 2 sec after completion of just previous logic. (4) If one RWKR is being used after taking indication of both points in series, then Alert msg can

				be given for both points.
15	Point No. PT---- failed in Normal but reasons not diagnosed.	[NWCR ↓ && RWCR ↓ && RWKR ↓ && NWKR ↑ to ↓ If any of remaining logic at Sr 1, 3 & 5 do not qualify]	PT N FAIL UNKNOWN	
16	Point No. PT---- failed in Reverse but reasons not diagnosed.	[NWCR ↓ && RWCR ↓ && NWKR ↓ && RWKR ↑ to ↓ If any of remaining logic at Sr 2, 4 & 6 do not qualify]	PT R FAIL UNKNOWN	
17	Point No. PT---- failed in Normal but reasons not diagnosed.	[NWCR ↑ (Entire UP duration or 10 sec) && If any of remaining logic at Sr 7, 9, 11 & 13 do not qualify	PT N FAIL UNKNOWN	

		NWKR ↓ (remaining DN upto 2 sec after completion of above logic)]		
18	Point No. PT---- failed in Reverse but reasons not diagnosed.	[RWCR ↑ (Entire UP duration or 10 sec) && If any of remaining logics from sr 8, 10, 12 & 14 do not qualify RWKR ↓ (remaining DN upto 2 sec after completion of above logic)]	PT R FAIL UNKNOWN	

2.3 (a) Details of Parameters of DC Track Circuit

(Details given in Annexure A)

(Total number of Sensors = 11 for One DC track circuit)

1. Avg value is defined as average operating parameter taking Avg value of 15 days (not counting failure data). In case of replacement of asset, this value should be counted afresh. For example, average value of operating voltage of point machine for 15 days may be 105 V whereas it may have different value at any time. Avg value has not been defined here as it may be different for each asset.
2. Min and Max safe value of parameter shall be the boundary value for safe operation.
3. Min fail value of parameter shall be the boundary value beyond which equipment will fail.
4. All Boundary values shall be decided by Zonal Railway as per field condition. Though some of the values have been given for reference based on operating range of parameters as per Specification of asset.

	Parameter_representation_name (string)	Parameter_representation_code (string)	Value in V/mA			Type of input	Remarks
			Max safe	Min safe	Min fail		
	Relay/Power Room						
	24 V DC TPR I/P	$V_{TC\ 24\ DC\ TPR\ I/P}$	—	21	18	Sensor	
	Digital status of TPR Relay	TPR	—	—	—	Datalogger digital status	Repeater of Track Relay in Relay room.
	Feed End						
	Track Feed Charger I/P Voltage	$V_{TC\ TFC\ I/P}$	—	*	—	Sensor	* Should be defined by Zonal railways depending on input tapping used for different track circuits.
	Track Feed Charger O/P Voltage (on load)	$V_{TC\ TFC\ O/P}$	—	*	*	Sensor	* Should be defined by Zonal railways. for 3 or 2 battery used.
	Track Feed Charger O/P Current	$I_{TC\ TFC\ O/P}$	—	—	—	Sensor	

	Voltage drop at feed end choke	$V_{TC\ CH\ FEED\ END}$	—	—	—	Sensor	
	Track Feed end voltage (Going to Rails)	$V_{TC\ FEED\ END}$	—	—	—	Sensor	
	Track Feed Current	$I_{TC\ FEED\ END}$	—	—	—	Sensor	
	Bat Charging Current	$I_{TC\ BATT\ CHARG}$	*	*	—	Derived	* Should be defined by Zonal railway for each Track ckt. $I_{TC\ BATT\ CHARG} = I_{TC\ TFC\ O/P} - I_{TC\ FEED\ END}$
	Voltage at Variable Track Resistance	$V_{TC\ VAR\ RES}$	—	—	—	Derived	$V_{TC\ VAR\ RES} = V_{TC\ TFC\ O/P} - V_{TC\ FEED\ END} - V_{TC\ CH\ FEED\ END}$
	Feed end choke resistance	$R_{TC\ CH\ FEED\ END}$	—	—	—	Derived	$R_{TC\ CH\ FEED\ END} = V_{TC\ CH\ FEED\ END} / I_{TC\ FEED\ END}$
	Variable resistance	$R_{TC\ VAR\ RES}$	—	—	—	Derived	$R_{TC\ VAR\ RES} = V_{TC\ VAR\ RES} / I_{TC\ FEED\ END}$
	Relay End						
	Track Relay end Voltage (Coming from Rails)	$V_{TC\ RELAY\ END}$	—	—	—	Sensor	
	Relay end Current for QTA2 Track Relay	$I_{TC\ RELAY\ END}$	—	210	100	Sensor	
	Track Relay Voltage QTA2	$V_{TC\ TR}$	4.2	2.1	—	Sensor	May be different for other Relays
	24 V DC going to TPR after TR pick up contact	$V_{TC\ 24\ DC\ LOC}$	—	—	—	Sensor	
	Relay end Choke Voltage	$V_{TC\ CH\ RELAY\ END}$	—	—	—	Derived	$V_{TC\ CH\ RELAY\ END} = V_{TC\ RELAY\ END} - V_{TC\ TR}$
	Relay end choke resistance	$R_{TC\ CH\ RELAY\ END}$	—	—	—	Derived	$R_{TC\ CH\ RELAY\ END} = V_{TC\ CH\ RELAY\ END} / I_{TC\ RELAY\ END}$
	Misc						

	Ballast/Sleeper Current	I_{BALST}	—	—	—	Derived	$I_{TC\ FEED\ END} - I_{TC\ RELAY\ END}$
	Rail Resistance	R_{RAIL}	—	—	—	Derived	$2*(V_{TC\ FEED\ END} - V_{TC\ RELAY\ END}) / (I_{TC\ FEED\ END} + I_{TC\ RELAY\ END})$

2.3 (b) Prediction Logics of DC Track Circuit

Note:

1. These logics are primitive logics for Prediction of failures. However, in addition to these primitive logics, these primitive logics, various AI/ML Techniques and learning models need to be developed and applied by Vendors for prediction of failures. The models used by them shall be shared with Zonal Railways/RDSO.
2. Comparisons in logics have been made with deviation in parameter value in terms of certain % of avg value OR deviation from Min/Max safe. Although % deviation has been given for predictive logics for reference, however, % may be modified as decided by Zonal Railway. **This % is being denoted as LD1, LD2, LD3 for lower side deviation and as HD1, HD2 for higher side deviation. For DC Track ckts, LD1=80, LD3=90, LD2=50, HD1=120, HD2=150.**
3. For Predictive logic, the analog continuous deviation (say < than 80% of avg value) should occur for at least certain duration to avoid predictive alerts for short transients. Indicative timing has been mentioned against logics. However, time duration can be decided by Zonal Railways as per site requirement.
4. The deviation should occur for entire duration of at least 1 operation in discrete cases like voltage and current of point machine.
5. Prediction Logics have been given based on defined parameters. However, Vendors may add new logics and modify given logics based on new parameters added OR otherwise also under approval of Railways and under intimation to RDSO sothat suitable amendment may be issued in FRS after review.

	cause_detail	Logic	cause_code	Remarks on Logics
1	Track Ckt predictive Alert for T----: TFC input voltage Low/failed in Loc.	[TPR ↑ && VIPS TR-1 110 AC ≥ Min safe value && V _{TC TFC I/P} < LD1% of avg value OR Min safe value]	TC TFC I/P VOLT LOW	[] Logic is checked for 15 min.
2	Track Ckt predictive Alert for T----: Battery charging but but TFC output voltage Low/fail.	[TPR ↑ && I _{TC BATT CHARG} > 0 ⁺ && V _{IPS TR-1 110 AC} ≥ Min safe value && LD1% of avg value OR Min safe value	TC TFC O/P VOLT LOW	[] Logic is checked for 30 sec when Battery is being charged. Avg value of V _{TC TFC} O/P should be calculated when Track Battery charging Current ie I _{TC BATT CHARG} is more than

		$V_{TC\ TFC\ O/P} < 0$		0. A small positive value can be used in place of 0^+ to account for errors.
3	Track Ckt predictive Alert for T----: Batt charging current high.	[TPR ↑ && $ I_{TC\ BATT\ CHARG} > \text{Max safe value}$]	TC BT CHG CURR HIGH	[] Logic is checked for 30 sec.
4	Track Ckt predictive Alert for T----: Batt not charging	[TPR ↑ && $ I_{TC\ BATT\ CHARG} < \text{Min safe value}$]	TC BT CHG CURR LOW	[] Logic is checked for 30 sec.
5	Track Ckt predictive Alert for T----: Feed End Choke Resistance Low or short.	[TPR ↑ && $R_{TC\ CH\ FEED\ END} < LD2\ %\ of\ avg\ value$]	TC FE CH RES LOW	[] Logic is checked for 30 sec. Voltage and Current (for R) shall be taken after transient settles.
6	Track Ckt predictive Alert for T----: Feed End Choke Resistance High.	[TPR ↑ && $R_{TC\ CH\ FEED\ END} > HD2\ %\ of\ avg\ value$]	TC FE CH RES HIGH	[] Logic is checked for 30 sec. Voltage and Current (for R) shall be taken after transient settles.
7	Track Ckt predictive Alert for T----: Feed End Variable Resistance Low or short.	[TPR ↑ && $R_{TC\ VAR\ RES} < LD2\ %\ of\ avg\ value$]	TC VAR RES LOW	[] Logic is checked for 30 sec. Voltage and Current (for R) shall be taken after transient settles.
8	Track Ckt predictive Alert for T----: Feed End Variable Resistance high.	[TPR ↑ &&	TC VAR RES HIGH	[] Logic is checked for 30 sec. Voltage and Current (for R) shall be taken after transient settles.

		$R_{TC\ VAR\ RES} > HD2\ %\ of\ avg\ value$]		
9	Track Ckt predictive Alert for T----: Track Relay voltage/Current is low due to Ballast/sleeper low resistance.	[TPR ↑ && $I_{TC\ RELAY\ END} < LD1\ %\ of\ avg\ value\ OR\ Min\ safe\ value$ && $\Delta I_{BALST} > \Delta I_{TC\ RELAY\ END}$]	TC BALST/SLPR RES LOW	[] Logic is checked for 30 sec. Current shall be taken after transient settles.
10	Track Ckt predictive Alert for T----: Track Relay voltage is low due to high series Rail resistance.	[TPR ↑ && $R_{RAIL} > HD2\ %\ of\ avg\ value$]	TC RAIL RES HIGH	[] Logic is checked for 30 sec. Voltage and Current (for R) shall be taken after transient settles.
11	Track Ckt predictive Alert for T----: Track Relay Voltage high/Over energization.	[TPR ↑ && $V_{TC\ TR} > HD1\ %\ of\ avg\ value\ OR\ Max\ safe$]	TC TR OVER ENERIZA- TION	[] Logic is checked for 30 sec. Voltage shall be taken after transient settles.
12	Track Ckt predictive Alert for T----: Track Relay Voltage Low/ Under energization.	[TPR ↑ && $V_{TC\ TR} < LD1\ %\ of\ avg\ value\ OR\ Min\ safe\ value$]	TC TR UN- DER ENERI- ZATION	[] Logic is checked for 30 sec. Voltage shall be taken after transient settles.
13	Track Ckt predictive Alert for T----: Relay END Choke Resistance Low.	[TPR ↑ && $R_{TC\ CH\ RELAY\ END} < LD2\ %\ of\ avg\ value$]	TC RE CH RES LOW	[] Logic is checked for 30 sec. Voltage and Current (for R) shall be taken after transient settles.

14	Track Ckt predictive Alert for T----: Relay END Choke Resistance High.	[TPR ↑ && $R_{TC\ CH\ RELAY\ END} > HD2\ %\ of\ avg\ value$]	TC RE CH RES HIGH	[] Logic is checked for 30 sec. Voltage and Current (for R) shall be taken after transient settles.
15	Track Ckt predictive Alert for T----: Track Relay contact resistance high	[TPR ↑ && $V_{IPS\ DC\ R\ EXT} \geq \text{Min safe value}$ && $V_{TC\ 24\ DC\ LOC} < LD1\ %\ of\ avg\ value$]	TC TR CONTACT RES HIGH	[] Logic is checked for 30 sec. Voltage shall be taken after transient settles.
16	Track Ckt predictive Alert for T----: TPR input voltage Low in relay room. Cable may be defective.	[TPR ↑ && $V_{TC\ 24\ DC\ LOC} \geq LD3\ %\ of\ avg\ value$ $V_{TC\ 24\ DC\ TPR\ I/P} < LD1\ %\ of\ avg\ value\ OR\ Min\ safe\ value$]	TC TPR I/P VOLT LOW	[] Logic is checked for 30 sec. Voltage shall be taken after transient settles.

2.3 (c) Failure Logics of DC Track Circuit

Note:

1. Failure Logics have been given based on defined parameters. However, Vendors may add new logics and modify given logics based on new parameters added OR otherwise also under approval of Railways and under intimation to RDSO sothat suitable amendment may be issued in FRS after review. **The % deviation for Failure of Track is being denoted as LD1, LD2 for lower side deviation. LD1= 70 and LD2=90.**

	<p>2. Logic for declaring track circuit failure: Suppose T1, T2 & T3 are track circuits in sequence. Then Logic to ascertain failure of track circuit T2 is (to exclude it from occupancy):</p> <p>T1 ↑ && T3 ↑ At least delay of 5 sec T2 ↓ (remain DN for 10 sec)</p> <p>Logics for ascertaining failure of First and last track circuits at station shall be decided by Zonal Railways.</p> <p>3. Time for Alert logic as given against each logic below shall be counted after confirmation of track circuit failure as per above logic.</p>			
	cause_detail	Logic	cause_code	Remarks on Logic
1	Track Ckt No. T---- failed. TR Down. Possible shorting in track.	[TPR ↓ && $I_{TC\ RELAY\ END} < \text{Min Fail value}$ && $I_{TC\ RELAY\ END} > 0^+$ && $\Delta I_{BALST} > \Delta I_{TC\ RELAY\ END}$]	TC SHORT	[] Logic is checked for 10 sec. Current shall be taken after transient settles. A small positive value can be used in place of 0^+ to confirm that current is not zero.
2	Track Ckt No. T---- failed. TR Down. Feed End choke resistance high Or open	[TPR ↓ && $I_{TC\ RELAY\ END} < \text{Min Fail value}$ && $I_{TC\ FEED\ END} > 0^+$ && $R_{TC\ CH\ FEED\ END} > 2 * R_{TC\ CH\ FEED\ END\ (avg)}$]	TC FE CH RES OPEN	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles. A small positive value can be used in place of 0^+

				to confirm that current is not zero.
3	Track Ckt No. T---- failed. TR Down. Feed End variable resistance high Or open.	[TPR ↓ && $I_{TC\ RELAY\ END} < \text{Min Fail value}$ && $I_{TC\ FEED\ END} > 0^+$ && $R_{TC\ VAR\ RES} > 2 * R_{TC\ VAR\ RES\ (avg)}$]	TC VAR RES OPEN	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles. A small positive value can be used in place of 0^+ to confirm that current is not zero.
4	Track Ckt No. T---- failed. TR Down. Relay End choke resistance high OR open.	[TPR ↓ && $I_{TC\ RELAY\ END} < \text{Min Fail value}$ && $I_{TC\ RELAY\ END} > 0^+$ && $R_{TC\ CH\ RELAY\ END} > 2 * R_{TC\ CH\ RELAY\ END\ (avg)}$]	TC RE CH RES OPEN	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles. A small positive value can be used in place of 0^+ to confirm that current is not zero.
5	Track Ckt No. T---- failed. TR Down. Rail resistance high OR Open/TLJB cable open	[TPR ↓ && $I_{TC\ RELAY\ END} < \text{Min Fail value}$	TC RAIL RES OPEN	[] Logic is checked for 10 sec. Voltage and

		$\begin{aligned} & \& \\ & I_{TC\ RELAY\ END} > 0^+ \\ & \& \\ & I_{TC\ FEED\ END} > 0^+ \\ & \& \\ & R_{RAIL} > 2 * R_{RAIL\ (avg)} \\ &] \end{aligned}$		<p>Current shall be taken after transient settles.</p> <p>A small positive value can be used in place of 0^+ to confirm that current is not zero.</p>
6	<p>Track Ckt No. T---- failed.</p> <p>TR Down. TFC Output Voltage Fail</p>	$\begin{aligned} & [\\ & TPR \downarrow \\ & \& \\ & I_{TC\ RELAY\ END} < \text{Min Fail value} \\ & \& \\ & I_{TC\ FEED\ END} > 0^+ \\ & \& \\ & V_{TC\ TFC\ O/P} < \text{Min Fail value} \\ &] \end{aligned}$	TC TFC O/P VOLT FAIL	<p>[] Logic is checked for 10 sec.</p> <p>Voltage and Current shall be taken after transient settles.</p> <p>A small positive value can be used in place of 0^+ to confirm that current is not zero.</p>
7	<p>Track Ckt No. T---- failed.</p> <p>TR Down. Circuit open.</p>	$\begin{aligned} & [\\ & TPR \downarrow \\ & \& \\ & (\\ & I_{TC\ RELAY\ END} < 0^+ \\ & \ \\ & I_{TC\ FEED\ END} < 0^+ \\ &) \\ &] \end{aligned}$	TC CKT OPEN	<p>A small positive value can be used in place of 0^+ to confirm that current is not zero.</p>

8	Track Ckt No. T---- failed. TR Current is Ok but TR Relay may be defective.	[TPR ↓ && $I_{TC\ RELAY\ END} \geq$ Min safe value && $V_{IPS\ DC\ R\ EXT} \geq$ Min fail value && $V_{TC\ 24\ DC\ LOC} < LD1\ %\ of\ avg\ value$]	TC TR RE-LAY DE-FECT	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
9	Track Ckt No. T---- failed. Track relay UP. TPR input voltage in Relay Room low/zero. Possible cable fault.	[TPR ↓ && $I_{TC\ RELAY\ END} \geq$ Min safe value && $V_{TC\ 24\ DC\ LOC} \geq LD2\ %\ of\ avg\ value$ && $V_{TC\ 24\ DC\ TPR\ I/P} < Min\ Fail\ value$]	TC TR UP TPR DN	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
10	Track Ckt No. T---- failed. Track relay UP. TPR input voltage in Relay Room is OK. TPR Relay may be defective	[TPR ↓ && $I_{TC\ RELAY\ END} \geq$ Min safe value && $V_{TC\ 24\ DC\ TPR\ I/P} \geq$ Min safe value]	TC TPR RE-LAY DE-FECT	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
11	Track Ckt No. T---- failed. Reason not diagnosed.	[TPR ↓ && If any of above Logics do not qualify]	REASON UNKNOWN	

2.4 (a) Details of Parameters of Main Signal

(Details given in Annexure A)

(Total number of Sensors = 3 for One OFF aspect and 2 for One ON aspect)

1. Avg value is defined as average operating parameter taking Avg value of 15 days (not counting failure data). In case of replacement of asset, this value should be counted afresh. For example, average value of operating voltage of point machine for 15 days may be 105 V whereas it may have different value at any time. Avg value has not been defined here as it may be different for each asset.
2. Min and Max safe value of parameter shall be the boundary value for safe operation.
3. Min fail value of parameter shall be the boundary value beyond which equipment will fail.
4. All Boundary values shall be decided by Zonal Railway as per field condition. Though some of the values have been given for reference based on operating range of parameters as per Specification of asset.

	Parameter_representation_name (string)	Parameter_representation_code (string)	Value in V/mA			Type of Input	Remarks
			Max safe	Min Safe	Min fail		
	Relay Room						
	Digital status of HECR	HECR	—	—	—	Datalogger digital status	
	Digital status of RECR	RECR	—	—	—		
	Digital status of DECR	DECR	—	—	—		
	Digital status of HHECR	HHECR	—	—	—		
	Digital status of DR	DR	—	—	—		
	Digital status of HR	HR	—	—	—		
	Digital status of HHR	HHR	—	—	—		
	Location Box						
	DPR Voltage	V _{SigDPR}	—	21	18	Sensor	
	HPR Voltage	V _{Sig HPR}	—	21	18	Sensor	
	HHPR Voltage	V _{Sig HHPR}	—	21	18	Sensor	
	Green Aspect current	I _{SigDG}	150	110	90	Sensor	
	Yellow Aspect current	I _{SigHG}	150	110	90	Sensor	
	Double yellow Aspect current	I _{SigHHG}	150	110	90	Sensor	
	Red Aspect current	I _{SigRG}	150	110	90	Sensor	
	Green Aspect Voltage	V _{SigDG}	—	90	82	Sensor	
	Yellow Aspect Voltage	V _{SigHG}	—	90	82	Sensor	
	Double Yellow Aspect Voltage	V _{SigHHG}	—	90	82	Sensor	
	Red Aspect Voltage	V _{SigRG}	—	90	82	Sensor	

2.4 (b) Prediction Logic for Main Signal

Note:

1. These logics are primitive logics for Prediction of failures. However, in addition to these primitive logics, these primitive logics, various AI/ML Techniques and learning models need to be developed and applied by Vendors for prediction of failures. The models used by them shall be shared with Zonal Railways/RDSO.
2. Comparisons in logics have been made with deviation in parameter value in terms of certain % of avg value OR deviation from Min/Max safe. Although % deviation has been given for predictive logics for reference, however, % may be modified as decided by Zonal Railway. **This % is being denoted by “LD” for lower side deviation and “HD” for higher side deviation. For Main Signal, LD=80 and HD=120.**
3. For Predictive logic, the analog continuous deviation (say < than 80% of avg value) should occur for at least certain duration to avoid predictive alerts for short transients. Indicative timing has been mentioned against logics. However, time duration can be decided by Zonal Railways as per site requirement.
4. The deviation should occur for entire duration of at least 1 operation in discrete cases like voltage and current of point machine.
5. Prediction Logics have been given based on defined parameters. However, Vendors may add new logics and modify given logics based on new parameters added OR otherwise also under approval of Railways and under intimation to RDSO sothat suitable amendment may be issued in FRS after review.

	cause_detail	Logic	cause_code	Remarks on Logics
1	Sig predictive Alert for S---: Voltage or Current of RG Aspect Low.	[RECR ↑ && $V_{IPS\ Sig-1\ 110\ AC} \geq$ Min safe value && ($V_{SigRG} <$ LD % of avg value OR Min safe value $I_{SigRG} <$ LD % of avg value OR Min safe value)	SIG RG VOLT/CURR LOW	[] Logic is checked for 15 sec. Voltage and Current shall be taken after transient settles.

]		
2	Sig predictive Alert for S---: Voltage or Current of HG Aspect Low.	[HECR ↑ && $V_{IPS\ Sig-1\ 110\ AC} \geq$ Min safe value && ($V_{SigHG} <$ LD % of avg value OR Min safe value $I_{Sig\ HG} <$ LD % of avg value OR Min safe value)]	SIG HG VOLT/CURR LOW	[] Logic is checked for 15 sec. Voltage and Current shall be taken after transient settles.
3	Sig predictive Alert for S---: Voltage or Current of HHG Aspect Low.	[HHECR ↑ && $V_{IPS\ Sig-1\ 110\ AC} \geq$ Min safe value && ($V_{SigHHG} <$ LD % of avg value OR Min safe value $I_{SigHHG} <$ LD % of avg value)]	SIG HHG VOLT/CURR LOW	[] Logic is checked for 15 sec. Voltage and Current shall be taken after transient settles.
4	Sig predictive Alert for S---: Voltage or Current of DG Aspect Low.	[DECR ↑ && $V_{IPS\ Sig-1\ 110\ AC} \geq$ Min safe value && ($V_{SigDG} <$ LD % of avg value OR Min safe value $I_{SigDG} <$ LD % of avg value OR Min safe value	SIG DG VOLT/CURR LOW	[] Logic is checked for 15 sec. Voltage and Current shall be taken after transient settles.

)]		
5	Sig predictive Alert for S---: Current of RG Aspect high.	[RECR ↑ && I _{Sig RG} > HD % of avg value OR Max safe value]	SIG RG CURR HIGH	[] Logic is checked for 15 sec. Current shall be taken after transient settles.
6	Sig predictive Alert for S---: Current of HG Aspect high.	[HECR ↑ && I _{Sig HG} > HD % of avg value OR Max safe value]	SIG HG CURR HIGH	[] Logic is checked for 15 sec. Current shall be taken after transient settles.
7	Sig predictive Alert for S---: Current of HHG Aspect high.	[HHECR ↑ && I _{Sig HHG} > HD % of avg value OR Max safe value]	SIG HHG CURR HIGH	[] Logic is checked for 15 sec. Current shall be taken after transient settles.
8	Sig predictive Alert for S---: Current of DG Aspect high.	[DECR ↑ && I _{Sig DG} > HD % of avg value OR Max safe value]	SIG DG CURR HIGH	[] Logic is checked for 15 sec. Current shall be taken after transient settles.
9	Sig predictive Alert for S---: Voltage of HPR is Low in Loc Box	[HECR ↑ && V _{IPS DC R EXT} ≥ Min safe value && V _{Sig HPR} < LD % of avg value OR Min safe value]	SIG HPR VOLT LOW	[] Logic is checked for 15 sec. Voltage shall be taken after transient settles.
10	Sig predictive Alert for S---:	[HHECR ↑	SIG HHPR VOLT LOW	[] Logic is checked for 15 sec.

	Voltage of HHPR is Low in Loc Box	$\begin{aligned} & \& \\ & V_{IPS\ DC\ R\ EXT} \geq \text{Min safe value} \\ & \& \\ & V_{Sig\ HHPR} < \text{LD \% of avg value} \\ & \quad \text{OR Min safe value} \\ & \end{aligned}$		Voltage shall be taken after transient settles.
11	Sig predictive Alert for S---: Voltage of DPR is Low in Loc Box	$\begin{aligned} & [\\ & \text{DECR} \uparrow \\ & \& \\ & V_{IPS\ DC\ R\ EXT} \geq \text{Min safe value} \\ & \& \\ & V_{Sig\ DPR} < \text{LD \% of avg value} \\ & \quad \text{OR Min safe value} \\ &] \end{aligned}$	SIG DPR VOLT LOW	$[]$ Logic is checked for 15 sec. Voltage shall be taken after transient settles.

2.4 (c) Failure Logic for Main Signal				
	cause_detail	Logic	cause_code	Remarks on logics
1	Sig No --- RG Aspect failed: HR DN. Signal blank in ON position. Voltage or current of RG Aspect failed.	[HR ↓ && RECR ↓ && $V_{IPS\ Sig-1\ 110\ AC} \geq$ Min fail value && ($V_{Sig\ RG} <$ Min Fail value $I_{Sig\ RG} <$ Min Fail value)]	SIG RG VOLT/CURR FAIL	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
2	Sig No --- RG Aspect failed: HR DN. Signal blank in ON position. RECR Relay may be defective.	[HR ↓ && RECR ↓ && ($V_{Sig\ RG} \geq$ Min safe value && $I_{Sig\ RG} \geq$ Min safe value)]	SIG RG RECR RE-LAY DEFECT	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
3	Sig No --- RG Aspect failed: HR DN. Signal blank in ON position. Reasons not diagnosed.	[HR ↓ &&	SIG RG UN-KOWN	

		RECR ↓ If any of the remaining logic at sr 1 & 2 does not qualify]		
4	Sig No --- HG Aspect failed: Voltage of HPR OK at Loc. But Voltage or Current of HG aspect failed.	[HR ↑ && HHR ↓ && DR ↓ && HECR ↓ && RECR ↑ && $V_{Sig\ HPR} \geq$ Min safe value && $V_{IPS\ Sig-1\ 110\ AC} \geq$ Min fail value && ($V_{Sig\ HG} <$ Min Fail value $I_{Sig\ HG} <$ Min Fail value)]	SIG HG VOLT/CURR FAIL	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
5	Sig No. --- HG Aspect failed. Voltage of HPR failed.	[HR ↑ && HHR ↓ && DR ↓ && HECR ↓ && RECR ↑	SIG HG HPR VOLT FAIL	[] Logic is checked for 10 sec. Voltage shall be taken after transient settles.

		$\begin{aligned} & \& \\ & V_{IPS\ DC\ R\ EXT} \geq \text{Min fail value} \\ & \& \\ & V_{SigHPR} < \text{Min Fail value} \\ &] \end{aligned}$		
6	Sig No. --- HG Aspect failed. HECR Relay may be defective.	$\begin{aligned} & [\\ & HR \uparrow \\ & \& \\ & HHR \downarrow \\ & \& \\ & DR \downarrow \\ & \& \\ & HECR \downarrow \\ & \& \\ & RECR \uparrow \\ & \& \\ & V_{Sig\ HPR} \geq \text{Min safe value} \\ & \& \\ & V_{Sig\ HG} \geq \text{Min safe value} \\ & \& \\ & I_{Sig\ HG} \geq \text{Min safe value} \\ &] \end{aligned}$	SIG HG HECR RE-LAY DEFECT	<p>[] Logic is checked for 10 sec.</p> <p>Voltage and Current shall be taken after transient settles.</p>
7	Sig No. --- HG Aspect failed. Reasons not diagnosed.	$\begin{aligned} & [\\ & HR \uparrow \\ & \& \\ & HHR \downarrow \\ & \& \\ & DR \downarrow \\ & \& \\ & HECR \downarrow \\ & \& \\ & RECR \uparrow \\ & \& \\ & \text{If any of the remaining logic at sr 4, 5 & 6 does not qualify.} \end{aligned}$	SIG HG UN-KOWN	

]		
8	Sig No. --- HHG Aspect failed. Voltage of HPR & HHPR OK at loc but Voltage or Current of HHG aspect failed.	[HR ↑ && HHR ↑ && DR ↓ && (HECR ↓ HHECR ↓) && (RECR ↑ HEGR ↑ HHECR ↑) && $V_{Sig\ HPR} \geq$ Min safe value && $V_{Sig\ HHPR} \geq$ Min safe value && $V_{IPS\ Sig-1\ 110\ AC} \geq$ Min fail value && ($V_{Sig\ HG} <$ Min Fail value $V_{Sig\ HG} <$ Min Fail value $I_{Sig\ HG} <$ Min Fail value $I_{Sig\ HG} <$ Min Fail value)]	SIG HHG VOLT/CURR FAIL	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
9	Sig No. --- HHG Aspect failed. Voltage of HPR OR HHPR failed.	[HR ↑ && HHR ↑ && DR ↓	SIG HHG HHPR VOLT FAIL	[] Logic is checked for 10 sec. Voltage shall be taken after transient settles.

		$\begin{aligned} & \& \\ & (\text{HECR} \downarrow \parallel \text{HHECR} \downarrow) \\ & \& \\ & (\text{RECR} \uparrow \parallel \text{HECR} \uparrow \parallel \text{HHECR} \\ & \uparrow) \\ & \& \\ & V_{\text{IPS DC R EXT}} \geq \text{Min fail value} \\ & \& \\ & (\\ & V_{\text{Sig HPR}} < \text{Min Fail value} \\ & \parallel \\ & V_{\text{Sig HHPR}} < \text{Min Fail value} \\ &) \\ &] \end{aligned}$		
10	Sig No. --- HHG Aspect failed. HECR OR HHECR Relay may be defective.	$\begin{aligned} & [\\ & \text{HR} \uparrow \\ & \& \\ & \text{HHR} \uparrow \\ & \& \\ & \text{DR} \downarrow \\ & \& \\ & (\text{HECR} \downarrow \parallel \text{HHECR} \downarrow) \\ & \& \\ & (\text{RECR} \uparrow \parallel \text{HECR} \uparrow \parallel \text{HHECR} \\ & \uparrow) \\ & \& \\ & V_{\text{Sig HPR}} \geq \text{Min safe value} \\ & \& \\ & V_{\text{Sig HHPR}} \geq \text{Min safe value} \\ & \& \\ & V_{\text{Sig HG}} \geq \text{Min safe value} \\ & \& \\ & V_{\text{Sig HHG}} \geq \text{Min safe value} \\ & \& \\ & I_{\text{Sig HG}} \geq \text{Min safe value} \\ & \& \end{aligned}$	SIG HHG HHECR RELAY DEFECT	<p>[] Logic is checked for 10 sec.</p> <p>Voltage and Current shall be taken after transient settles.</p>

		$I_{\text{Sig HHG}} \geq \text{Min safe value}$]		
11	Sig No. --- HHG Aspect failed. Reasons not diagnosed.	[HR ↑ && HHR ↑ && DR ↓ && (HECR ↓ HHECR ↓) && (RECR ↑ HECR ↑ HHECR ↑) If any of the remaining logic at sr 8, 9 & 10 does not qualify]	SIG HHG UN-KOWN	
12	Sig No. --- DG Aspect failed. Voltage of DPR OK at Loc. But Voltage or Current of DG aspect failed.	[HR ↑ && HHR ↑ && DR ↑ && DECR ↓ && (RECR ↑ HECR ↑ HHECR ↑) && $V_{\text{Sig DPR}} \geq \text{Min safe value}$ && $V_{\text{IPS Sig-1 110 AC}} \geq \text{Min fail value}$ && (SIG DG VOLT/CURR FAIL	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.

		$V_{SigDG} < \text{Min Fail value}$ $I_{Sig DG} < \text{Min Fail value}$)]		
13	Sig No. --- DG Aspect failed. Voltage of DPR failed.	[HR ↑ && HHR ↑ && DR ↑ && DECR ↓ && (RECR ↑ HECR ↑ HHECR ↑) && $V_{IPS DC R EXT} \geq \text{Min fail value}$ && $V_{Sig DPR} < \text{Min Fail value}$]	SIG DG DPR VOLT FAIL	[] Logic is checked for 10 sec. Voltage shall be taken after transient settles.
14	Sig No. --- DG Aspect failed. DECR Relay may be defective.	[HR ↑ && HHR ↑ && DR ↑ && DECR ↓ && (RECR ↑ HECR ↑ HHECR ↑) && $V_{Sig DPR} \geq \text{Min safe value}$	SIG DG DECR RELAY DEFECT	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.

		$\begin{aligned} & \& \\ & V_{\text{Sig DG}} \geq \text{Min safe value} \\ & \& \\ & I_{\text{Sig DG}} \geq \text{Min safe value} \\ &] \end{aligned}$		
15	Sig No. --- DG Aspect failed. Reasons not diagnosed.	$\begin{aligned} & [\\ & HR \uparrow \\ & \& \\ & HHR \uparrow \\ & \& \\ & DR \uparrow \\ & \& \\ & DECR \downarrow \\ & \& \\ & (RECR \uparrow \parallel HECR \uparrow \parallel HHECR \\ & \uparrow) \\ & \text{If any of the remaining logic at} \\ & \text{sr 12, 13 \& 14 does not qualify.} \\ &] \end{aligned}$	SIG DG UN-KOWN	
16	Sig No. --- Signal Blank in OFF position. Possible Cable cut.	$\begin{aligned} & [\\ & HR \uparrow \\ & \& \\ & RECR \downarrow \\ & \& \\ & HECR \downarrow \\ & \& \\ & HHECR \downarrow \\ & \& \\ & DECR \downarrow \\ &] \end{aligned}$	SIG BLANK	[] Logic is checked for 10 sec.

2.5 (a) Details of Parameters Calling ON Signal

(Details given in Annexure A)
(Total number of Sensors = 3 per Calling On)

1. Avg value is defined as average operating parameter taking Avg value of 15 days (not counting failure data). In case of replacement of asset, this value should be counted afresh. For example, average value of operating voltage of point machine for 15 days may be 105 V whereas it may have different value at any time. Avg value has not been defined here as it may be different for each asset.
2. Min and Max safe value of parameter shall be the boundary value for safe operation.
3. Min fail value of parameter shall be the boundary value beyond which equipment will fail.
4. All Boundary values shall be decided by Zonal Railway as per field condition. Though some of the values have been given for reference based on operating range of parameters as per Specification of asset.

	Parameter_representation_name (string)	Parameter_representation_code (string)	Value in V/mA			Type of Input	Remarks
			Max safe	Min Safe	Min fail		
	Relay Room						
	Digital status of Co-HECR	Co-HECR	—	—	—	Datalogger digital status	
	Digital status of Co-HR	Co-HR	—	—	—		
	Location Box						
	Co-HPR Voltage	$V_{CoSig\ HPR}$	—	21	18	Sensor	
	Calling ON Aspect current	I_{CoSig}	165	120	90	Sensor	
	Calling ON Aspect Voltage	V_{CoSig}	—	93	87	Sensor	

2.5 (b) Prediction Logic for Calling ON Signal

Note:

1. These logics are primitive logics for Prediction of failures. However, in addition to these primitive logics, these primitive logics, various AI/ML Techniques and learning models need to be developed and applied by Vendors for prediction of failures. The models used by them shall be shared with Zonal Railways/RDSO.
2. Comparisons in logics have been made with deviation in parameter value in terms of certain % of avg value OR deviation from Min/Max safe. Although % deviation has been given for predictive logics for reference, however, % may be modified as decided by Zonal Railway. **This % is being denoted by “LD” for lower side deviation and “HD” for higher side deviation. For Calling ON Signal, LD=80 and HD=120.**
3. For Predictive logic, the analog continuous deviation (say < than 80% of avg value) should occur for at least certain duration to avoid predictive alerts for short transients. Indicative timing has been mentioned against logics. However, time duration can be decided by Zonal Railways as per site requirement.
4. The deviation should occur for entire duration of at least 1 operation in discrete cases like voltage and current of point machine.
5. Prediction Logics have been given based on defined parameters. However, Vendors may add new logics and modify given logics based on new parameters added OR otherwise also under approval of Railways and under intimation to RDSO sothat suitable amendment may be issued in FRS after review.

	cause_detail	Logic	cause_code	Remarks on Logics
1	Co-Sig predictive Alert for Co---: Voltage or Current of Calling ON aspect Low.	[Co-HECR ↑ && $V_{IPS\ Sig-1\ 110\ AC} \geq$ Min safe value && ($V_{CoSig} <$ LD % of avg value OR Min safe value $I_{CoSig} <$ LD % of avg value OR Min safe value)]	Co-SIG AS-PECT VOLT/CURR LOW	[] Logic is checked for 15 sec. Voltage and Current shall be taken after transient settles.
2	Co-Sig predictive Alert for Co---: Current high for Calling ON aspect	[Co-HECR ↑ && $I_{CoSig} >$ HD % of avg value OR Max safe value	Co-SIG AS-PECT CURR HIGH	[] Logic is checked for 15 sec. Current shall be taken after transient settles.

]		
3	Co-Sig predictive Alert for Co---: Voltage of Co-HPR is Low in Loc Box	[Co-HECR ↑ && $V_{IPS\ DC\ R\ EXT} \geq$ Min safe value $V_{CoSig\ HPR} <$ LD % of avg value OR Min safe value]	Co-SIG HPR VOLT LOW	[] Logic is checked for 15 sec. Voltage shall be taken after transient settles.

2.5 (c) Failure Logic for Calling ON Signal				
	cause_detail	Logic	cause_code	Remarks on logics
1	Co-Sig No --- failed: Voltage of Co-HPR OK at Loc. But Voltage or Current of Co-aspect failed.	[Co-HR ↑ && Co-HECR ↓ && $V_{CoSig\ HPR} \geq$ Min safe value && $V_{IPS\ sig-1\ 110\ AC} \geq$ Min fail value && ($V_{CoSig} <$ Min Fail value $I_{CoSig} <$ Min Fail value)]	Co-SIG AS- PECT VOLT/CURR FAIL	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient set- tles.
2	Co-Sig No. --- failed. Voltage of Co-HPR failed.	[Co-HR ↑ && Co-HECR ↓ && $V_{IPS\ DC\ R\ EXT} \geq$ Min fail value && $V_{CoSig\ HPR} <$ Min Fail value]	Co-SIG HPR VOLT FAIL	[] Logic is checked for 10 sec. Voltage shall be taken after transient set- tles.
3	Co-Sig No. --- failed. Co-HECR Relay may be defective.	[Co-HR ↑ &&	Co-SIG HECR RELAY DEFECT	[] Logic is checked for 10 sec.

		Co-HECR ↓ && $V_{CoSig\ HPR} \geq$ Min safe value && $V_{CoSig} \geq$ Min safe value && $I_{CoSig} \geq$ Min safe value]		Voltage and Current shall be taken after transient settles.
4	Co-Sig No. --- failed. Reasons not diagnosed.	[Co-HR ↑ && Co-HECR ↓ If any of the remaining logic above does not qualify.]	Co-SIG REASON UN-KOWN	

2.6 (a) Details of Parameters Route Signal

(Details given in Annexure A)
(Total number of Sensors = 3 per Route Signal)

1. Avg value is defined as average operating parameter taking Avg value of 15 days (not counting failure data). In case of replacement of asset, this value should be counted afresh. For example, average value of operating voltage of point machine for 15 days may be 105 V whereas it may have different value at any time. Avg value has not been defined here as it may be different for each asset.
2. Min and Max safe value of parameter shall be the boundary value for safe operation.
3. Min fail value of parameter shall be the boundary value beyond which equipment will fail.
4. All Boundary values shall be decided by Zonal Railway as per field condition. Though some of the values have been given for reference based on operating range of parameters as per Specification of asset.

	Parameter_representation_name (string)	Parameter_representation_code (string)	Value in V/mA			Type of Input	Remarks
			Max safe	Min Safe	Min fail		

	Relay Room						
	Digital status of UECR	UECR	—	—	—	Datalogger digital status	
	Digital status of UHR	UHR	—	—	—		
	Location Box						
	Ro-HPR Voltage	$V_{RoSig\ HPR}$	—	21	18	Sensor	
	Route Aspect current	I_{RoSig}	131	119	90	Sensor	
	Route Aspect Voltage	V_{RoSig}	—	93	87	Sensor	

2.6 (b) Prediction Logic for Route Signal

Note:

- These logics are primitive logics for Prediction of failures. However, in addition to these primitive logics, these primitive logics, various AI/ML Techniques and learning models need to be developed and applied by Vendors for prediction of failures. The models used by them shall be shared with Zonal Railways/RDSO.
- Comparisons in logics have been made with deviation in parameter value in terms of certain % of avg value OR deviation from Min/Max safe. Although % deviation has been given for predictive logics for reference, however, % may be modified as decided by Zonal Railway. **This % is being denoted by “LD” for lower side deviation and “HD” for higher side deviation. For Route Signal, LD=80 and HD=120.**
- For Predictive logic, the analog continuous deviation (say < than 80% of avg value) should occur for at least certain duration to avoid predictive alerts for short transients. Indicative timing has been mentioned against logics. However, time duration can be decided by Zonal Railways as per site requirement.
- The deviation should occur for entire duration of at least 1 operation in discrete cases like voltage and current of point machine.
- Prediction Logics have been given based on defined parameters. However, Vendors may add new logics and modify given logics based on new parameters added OR otherwise also under approval of Railways and under intimation to RDSO sothat suitable amendment may be issued in FRS after review.

	cause_detail	Logic	cause_code	Remarks on Logics
1	Ro-Sig predictive Alert for Ro---: Voltage or Current of Route Aspect low.	[UECR ↑	Ro-SIG ASPECT VOLT/CURR LOW	[] Logic is checked for 15 sec.

		$\begin{aligned} & \& \\ & V_{IPS\ Sig-1\ 110\ AC} \geq \text{Min safe value} \\ & \& \\ & (\\ & \quad V_{RoSig} < \quad \text{LD \% of avg value} \\ & \quad \quad \quad \text{OR Min safe value} \\ & \quad \\ & \quad I_{RoSig} < \quad \text{LD \% of avg value} \\ & \quad \quad \quad \text{OR Min safe value} \\ &) \\ &] \end{aligned}$		Voltage and Current shall be taken after transient settles.
2	Ro-Sig predictive Alert for Ro---: Current high for Route aspect.	$\begin{aligned} & [\\ & \quad \text{UECR} \uparrow \\ & \quad \& \\ & \quad I_{RoSig} > \quad \text{HD \% of avg value} \\ & \quad \quad \quad \text{OR Max safe value} \\ &] \end{aligned}$	Ro-SIG ASPECT CURR HIGH	<p>[] Logic is checked for 15 sec.</p> <p>Current shall be taken after transient settles.</p>
3	Ro-Sig predictive Alert for Ro---: Voltage of Ro-HPR is Low in Loc Box	$\begin{aligned} & [\\ & \quad \text{UECR} \uparrow \\ & \quad \& \\ & \quad V_{IPS\ DC\ R\ EXT} \geq \text{Min safe value} \\ & \quad \& \\ & \quad V_{RoSig\ HPR} < \quad \text{LD \% of avg value} \\ & \quad \quad \quad \text{OR Min safe value} \\ &] \end{aligned}$	Ro-SIG HPR VOLT LOW	<p>[] Logic is checked for 15 sec.</p> <p>Voltage shall be taken after transient settles.</p>

2.6 (c) Failure Logic for Route Signal				
	cause_detail	Logic	cause_code	Remarks on logics
1	Ro-Sig No --- failed: Voltage of Ro-HPR OK at Loc. But Voltage or Current of Ro-aspect failed.	[UHR ↑ && UECR ↓ && $V_{RoSig\ HPR} \geq$ Min safe value && $V_{IPS\ Sig-1\ 110\ AC} \geq$ Min fail value && ($V_{RoSig} <$ Min Fail value $I_{RoSig} <$ Min Fail value)]	Ro-SIG AS- PECT VOLT/CURR FAIL	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient set- tles.
2	Ro-Sig No. --- failed. Voltage of Ro-HPR failed.	[UHR ↑ && UECR ↓ && $V_{IPS\ DC\ R\ EXT} \geq$ Min fail value && $V_{RoSig\ HPR} <$ Min Fail value]	Ro-SIG HPR VOLT FAIL	[] Logic is checked for 10 sec. Voltage shall be taken after transient set- tles.
3	Ro-Sig No. --- failed. UECR Relay may be defective.	[UHR ↑ &&	Ro-SIG UECR RE- LAY DEFECT	[] Logic is checked for 10 sec.

		UECR ↓ && $V_{RoSig\ HPR} \geq$ Min safe value && $V_{RoSig} \geq$ Min safe value && $I_{RoSig} \geq$ Min safe value]		Voltage and Current shall be taken after transient settles.
4	Ro-Sig No. --- failed. Reasons not diagnosed.	[UHR ↑ && UECR ↓ If any of the remaining logic above does not qualify.]	Ro-SIG REASON UNKNOWN	

2.7 (a) Details of Parameters Shunt Signal

(Details given in Annexure A)
(Total number of Sensors = 6 for one independent Shunt Signal)

1. Avg value is defined as average operating parameter taking Avg value of 15 days (not counting failure data). In case of replacement of asset, this value should be counted afresh. For example, average value of operating voltage of point machine for 15 days may be 105 V whereas it may have different value at any time. Avg value has not been defined here as it may be different for each asset.
2. Min and Max safe value of parameter shall be the boundary value for safe operation.
3. Min fail value of parameter shall be the boundary value beyond which equipment will fail.
4. All Boundary values shall be decided by Zonal Railway as per field condition. Though some of the values have been given for reference based on operating range of parameters as per Specification of asset.

	Parameter_representation_name (string)	Parameter_representation_code (string)	Value in V/mA	Type of Input	Remarks

			Max safe	Min Safe	Min fail		
	Relay Room		—	—	—		
	Digital status of Sh-ECR OFF	Sh-ECROFF	—	—	—	Datalogger digital status	
	Digital status of Sh-ECR ON	Sh-ECRON	—	—	—		
	Digital status of Sh-HR	Sh-HR	—	—	—		
	Location Box		—	—	—		
	Sh-HPR Voltage	V _{ShSig HPR}	—	21	18	Sensor	
	Shunt OFF Aspect Current	I _{ShSig OFF}	58	52	90	Sensor	Min fail value is for combined value of (I _{ShSig OFF} + I _{ShSig PILOT})
	Shunt OFF Aspect Voltage	V _{ShSig OFF}	—	93	87	Sensor	
	Shunt ON Aspect Current	I _{ShSig ON}	58	52	90	Sensor	Min fail value is for combined value of (I _{ShSig ON} + I _{ShSig PILOT})
	Shunt PILOT Aspect Current	I _{ShSig PILOT}	58	52	—		
	Shunt ON Aspect Voltage	V _{ShSig ON}	—	93	87	Sensor	

2.7 (b) Prediction Logic for Shunt Signal

Note:

- These logics are primitive logics for Prediction of failures. However, in addition to these primitive logics, these primitive logics, various AI/ML Techniques and learning models need to be developed and applied by Vendors for prediction of failures. The models used by them shall be shared with Zonal Railways/RDSO.
- Comparisons in logics have been made with deviation in parameter value in terms of certain % of avg value OR deviation from Min/Max safe. Although % deviation has been given for predictive logics for reference, however, % may be modified as decided by Zonal Railway.
This % is being denoted by “LD” for lower side deviation and “HD” for higher side deviation. For Shunt Signal, LD=80 and HD=120.

3. For Predictive logic, the analog continuous deviation (say < than 80% of avg value) should occur for at least certain duration to avoid predictive alerts for short transients. Indicative timing has been mentioned against logics. However, time duration can be decided by Zonal Railways as per site requirement.
4. The deviation should occur for entire duration of at least 1 operation in discrete cases like voltage and current of point machine.
5. Prediction Logics have been given based on defined parameters. However, Vendors may add new logics and modify given logics based on new parameters added OR otherwise also under approval of Railways and under intimation to RDSO sothat suitable amendment may be issued in FRS after review.
6. These logics have been designed for independent Shunt Signal. Suitable modifications shall be done by Zonal railways for Shunt below Starter.

	cause_detail	Logic	cause_code	Remarks on Logics
1	Sh-Sig predictive Alert for Sh---: Voltage or Current of Shunt ON Aspect low.	[Sh-HR ↓ && Sh-ECR _{ON} ↑ && (V _{IPS Sig-1 110 AC} ≥ Min safe value && (V _{ShSig ON} < LD % of avg value OR Min safe value I _{ShSig ON} < LD % of avg value OR Min safe value I _{ShSig PILOT} < LD % of avg value OR Min safe value))]	Sh-SIG ON ASPECT VOLT/CURR LOW	[] Logic is checked for 15 sec. Voltage and Current shall be taken after transient settles.
2	Sh-Sig predictive Alert for Sh---: Current high for Shunt ON aspect	[Sh-HR ↓ && Sh-ECR _{ON} ↑ && (I _{ShSig ON} > HD % of avg value OR Max safe value I _{ShSig PILOT} > HD % of avg value OR Max	Sh-SIG ON ASPECT CURR HIGH	[] Logic is checked for 15 sec. Current shall be taken after transient settles.

)]		
3	Sh-Sig predictive Alert for Sh---: Voltage or Current of Shunt OFF Aspect low.	[Sh-HR ↑ && Sh-ECR _{OFF} ↑ && $V_{IPS\ Sig-1\ 110\ AC} \geq$ Min safe value && ($V_{ShSig\ OFF} <$ LD % of avg value OR Min $I_{ShSig\ OFF} <$ LD % of avg value OR Min safe value $I_{ShSig\ PILOT} <$ LD % of avg value OR Min safe value)]	Sh-SIG OFF ASPECT VOLT/CURR LOW	[] Logic is checked for 15 sec. Voltage and Current shall be taken after transient settles.
4	Sh-Sig predictive Alert for Sh---: Current high for Shunt OFF aspect	[Sh-HR ↑ && Sh-ECR _{OFF} ↑ && ($I_{ShSig\ OFF} >$ HD % of avg value OR Max safe value $I_{ShSig\ PILOT} >$ HD % of avg value OR Max)]	Sh-SIG OFF ASPECT CURR HIGH	[] Logic is checked for 15 sec. Current shall be taken after transient settles.
5	Sh-Sig predictive Alert for Sh---: Voltage of Sh-HPR is Low in Loc Box	[Sh-HR ↑ && Sh-ECR _{OFF} ↑ && $V_{IPS\ DC\ R\ EXT} \geq$ Min safe value LD % of avg value OR Min safe value	Sh-SIG OFF ASPECT HPR VOLT LOW	[] Logic is checked for 15 sec. Voltage shall be taken after transient settles.

	V _{ShSig HPR <}]		
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2.7 (c) Failure Logic for Shunt Signal				
	Note: 1. Failure Logics have been given based on defined parameters. However, Vendors may add new logics and modify given logics based on new parameters added OR otherwise also under approval of Railways and under intimation to RDSO sothat suitable amendment may be issued in FRS after review. 2. These logics have been designed for independent Shunt Signal. Suitable modifications shall be done by Zonal railways for Shunt below Starter.			
	cause_detail	Logic	cause_code	Remarks on logics
1	Sh-Sig No --- ON aspect failed: Voltage or Current of Shunt ON aspect failed.	[Sh-HR ↓ && Sh-ECR _{ON} ↓ && V _{IPS Sig-1 110 AC} ≥ Min fail value && (V _{ShSig ON} < Min Fail value (I _{ShSig ON} + I _{ShSig PILOT}) < Min Fail value)]	Sh-SIG ON ASPECT VOLT/CURR FAIL	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
2	Sh-Sig No --- ON aspect failed: Voltage or Current of Shunt ON aspect ok but ECR _{ON} may be defective.	[Sh-HR ↓ && Sh-ECR _{ON} ↓ && (V _{ShSig ON} ≥ Min safe value && I _{ShSig ON} ≥ Min safe value &&	Sh-SIG ON ASPECT ECR RELAY DEFECT	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.

		$I_{ShSig\ PILOT} \geq \text{Min safe value}$)]		
3	Sh-Sig No --- ON aspect failed: Voltage or Current of Shunt ON aspect failed.	[Sh-HR ↓ && Sh-ECR _{ON} ↓ && If any of the remaining logic above does not qualify.]	Sh-SIG ON ASPECT REASON UNKNOWN	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
4	Sh-Sig No --- OFF aspect failed: Voltage of HPR OK at Loc. But Voltage or Current of Shunt OFF aspect failed.	[Sh-HR ↑ && Sh-ECR _{OFF} ↓ && $V_{ShSig\ HPR} \geq \text{Min safe value}$ && $V_{IPS\ Sig-1\ 110\ AC} \geq \text{Min fail value}$ && ($V_{ShSig\ OFF} < \text{Min Fail value}$ $(I_{ShSig\ OFF} + I_{ShSig\ PILOT}) < \text{Min Fail value}$)]	Sh-SIG OFF ASPECT VOLT/CURR FAIL	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
5	Sh-Sig No. --- OFF aspect failed. Voltage of HPR failed.	[Sh-HR ↑ && Sh-ECR _{OFF} ↓ && $V_{IPS\ DC\ R\ EXT} \geq \text{Min fail value}$ && $V_{ShSig\ HPR} < \text{Min Fail value}$	Sh-SIG OFF ASPECT HPR VOLT FAIL	[] Logic is checked for 10 sec. Voltage shall be taken after transient settles.

]		
6	Sh-Sig No. --- OFF aspect failed. Sh-ECR _{OFF} Relay may be defective.	[Sh-HR ↑ && Sh-ECR _{OFF} ↓ && $V_{ShSig\ HPR} \geq$ Min safe value && $V_{ShSig\ OFF} \geq$ Min safe value && $I_{ShSig\ OFF} \geq$ Min safe value && $I_{ShSig\ PILOT} \geq$ Min safe value]	Sh-SIG OFF ASPECT ECR RELAY DEFECT	[] Logic is checked for 10 sec. Voltage and Current shall be taken after transient settles.
7	Sh-Sig No. --- failed. Reasons not diagnosed.	[Sh-HR ↑ && SH-ECR _{OFF} ↓ If any of the remaining logic above does not qualify.]	Sh-SIG OFF ASPECT REASON UNKNOWN	

Annexure D
**Standard User Interface of RDPMS Application software for
web application**

1. The RDPMS application supports different user roles with specific permissions. Head Quarter and Division Level Users can assign users, monitor, and generate reports but lack control functions. Station Level Users can monitor, generate reports, and control functions but cannot assign users. Guest Users may also be defined for users other than three user defined. Guest users have limited monitoring access only.
2. User interface functions have been defined below and indicative UI display template has been shown ahead.
3. **Landing page:** It has been defined where user id and password can be entered.
4. **Sidebar:** Various functions of Applications like Home, reports, Telemetry etc has been mentioned at side bar which can be made collapsible. It shall appear at every page. It shall have icon with dropdown menu. Each function can be selected by clicking the icon. Various functions has been defined below:
5. **Home:** After entering user id and pass word, it lands on Home page where live status of asset types has been displayed whether how many are healthy, preditive and failure. This page has searchable fields to select Zone, Division or station with a drop down menu. After selecting various options, search icon should be clicked to implement the search.
6. **Alerts:** This icon shall have 3 dropdown menu.

6.1 Alert Live: Alert Live Status gives details of each alert which are not yet attended or feedback with remarks not yet given, if attended. If failure has been attended, date & time of rectification shall appear else “---” shall appear in table shown in respective column. It has searchable fields with dropdown options as shown. Right side icon will display only those fields in drop down which are pertaining to fields selected in its left side icon. There should be feature of selecting “one field”, “more than one field” and “ALL field” in each drop down menu. Result shall display only after search icon is clicked after selecting all dropdown fields. Feedback can be given by clicking “T” or “F” or “M” icon after failure/prediction is attended. Remarks box shall appear after clicking “T” or “F” or “M” icon to ensure feedback is given. If cause given by Alert message is not correct and “F” feedback is being given then drop down should also appear with all causes so that correct cause can be selected at the time of feedback along with text remarks.

6.2 Alert detail report: Clicking this icon shall open a Alert detail page. It shall have searchable icons with dropdown menu to select various options. Alert detail report gives details of each alert for selected duration and for selected fields for all cleared Alerts as per definition in different presentable form. Right side icon will display only those fields in drop down which are pertaining to fields selected in its left side icon. There should be feature of selecting “one field”, “more than one field” and “ALL field” in each drop down menu. Result shall display only after search tab is clicked. (shown ahead)

6.3 Alert Summary report: Clicking this icon shall open a Alert Summary page. It shall have searchable icons with dropdown menu to select various options. Alert summary report gives count of total and true Alerts for selected duration and for selected fields for all cleared Alerts as per definition in different presentable form. Right side icon will display only those fields in drop down which are pertaining to fields selected in its left side icon. There should be feature of selecting “one field”, “more than one field” and “ALL field” in each drop down menu. Result shall display only after search tab is clicked. (shown ahead)

7. Telemetry: This icon shall have 2 dropdown menu.

7.1 Telemetry Live: Clicking this icon shall open a Telemetry Live page. It shall have searchable icons with dropdown menu to select various options. Telemetry Live gives Live parameters of various assets for selected fields in different presentable form. Right side icon will display only those fields in drop down which are pertaining to fields selected in its left side icon. There should be feature of selecting “one field”, “more than one field” and “ALL field” in each drop down menu. Result shall display only after search tab is clicked. (shown ahead)

7.2 Telemetry History: Clicking this icon shall open a Telemetry History page. It shall have searchable icons with dropdown menu to select various options. Telemetry History gives parameters of various assets for selected fields for selected duration in different presentable form. Right side icon will display only those fields in drop down which are pertaining to fields selected in its left side icon. There should be feature of selecting “one field”, “more than one field” and “ALL field” in each drop down menu. Result shall display only after search tab is clicked. (shown ahead)

8. IOT/Sensor Health : This icon shall have 2 dropdown menu.

8.1 IOT/Sensor health Live: Clicking this icon shall open a IOT/Sensor health Live page. It shall have searchable icons with dropdown menu to select various options. IOT/Sensor health Live gives healthy and faulty status of IOT/Sensor for various assets for selected fields in different presentable form. Right side icon will display only those fields in drop down which are pertaining to fields selected in its left side icon. There should

be feature of selecting “one field”, “more than one field” and “ALL field” in each drop down menu. Result shall display only after search tab is clicked. (shown ahead)

8.2 IOT/Sensor health History: Clicking this icon shall open a IOT/Sensor health History page. It shall have searchable icons with dropdown menu to select various options. IOT/Sensor health history gives healthy and faulty status of IOT/Sensor for various assets for selected fields for selected duration in different presentable form. Right side icon will display only those fields in drop down which are pertaining to fields selected in its left side icon. There should be feature of selecting “one field”, “more than one field” and “ALL field” in each drop down menu. Result shall display only after search tab is clicked. (shown ahead)

9. Asset: This icon shall have 2 dropdown menu

9.1 Asset details: Clicking this icon shall open a Asset detail page. It shall have searchable icons with dropdown menu to select various options. Asset detail gives count of total assets for each type of asset with its details as on present date for selected fields in different presentable form. Right side icon will display only those fields in drop down which are pertaining to fields selected in its left side icon. There should be feature of selecting “one field”, “more than one field” and “ALL field” in each drop down menu. Result shall display only after search tab is clicked. (shown ahead)

9.1 Asset utilization: Clicking this icon shall open a Asset utilization page. It shall have searchable icons with dropdown menu to select various options. Asset utilization gives utilization of various assets for selected fields for selected duration in different presentable form. Right side icon will display only those fields in drop down which are pertaining to fields selected in its left side icon. There should be feature of selecting “one field”, “more than one field” and “ALL field” in each drop down menu. Result shall display only after search tab is clicked. (shown ahead)

10. Admin: Vendor may design as per requirement.

11. User: Vendor may design as per requirement.

Note: Above is indicative basic functional requirements, however Vendor/Zonal Railway may add/modify functions. They may also augment each functions with suitable analysis/reports. Shortcut icons may also be added to switch between different pages/functions.

Landing page

Remote Diagnostic and Predictive Maintenance System

Vendor name

User id

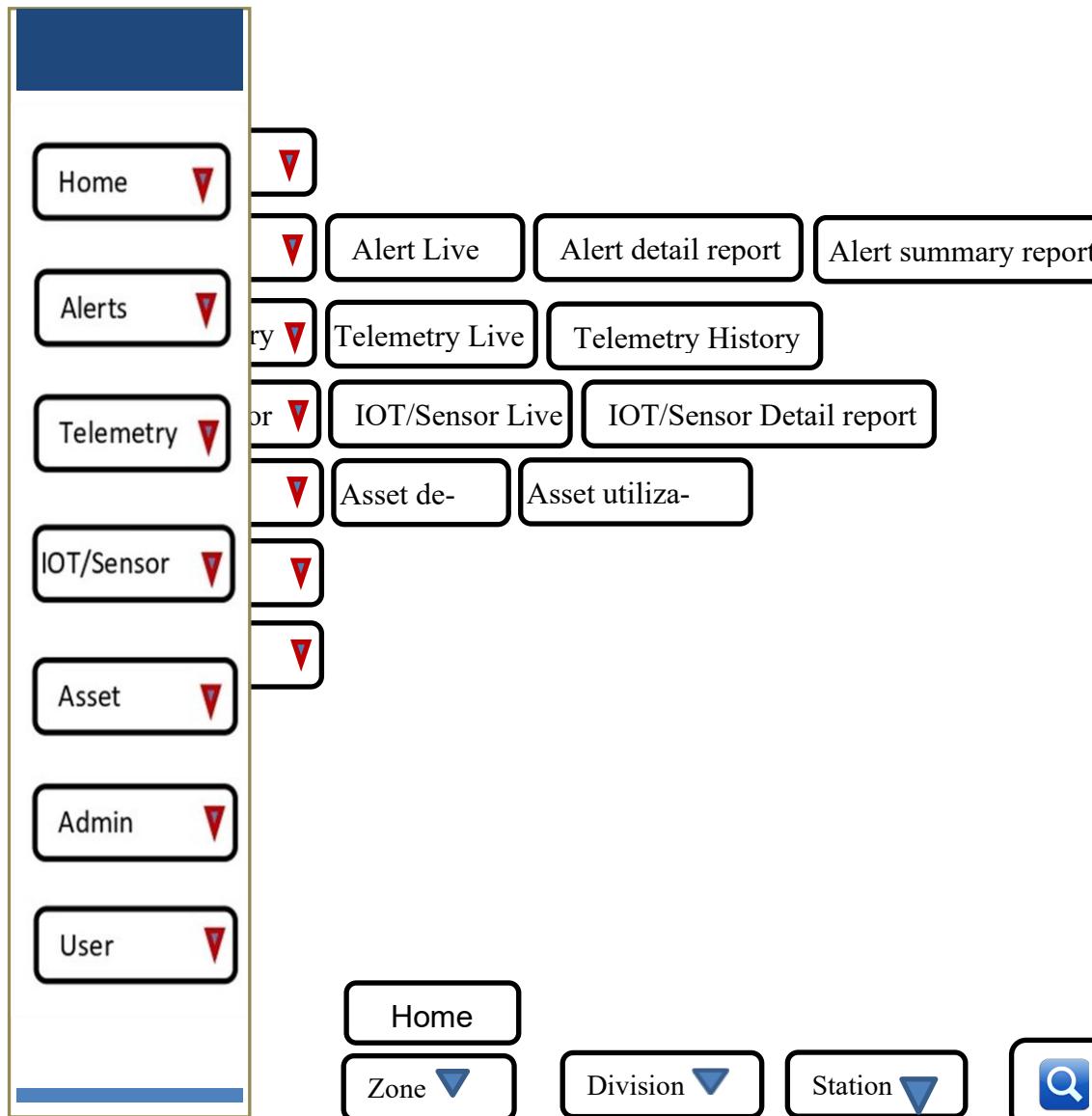
XYZ

Password

OTP based

Sign in for New User

Side Bar



Note: Sub-tabs have been shown horizontally in front of main tab for the purpose of clarity. However, it shall actually appear as a drop down menu vertically when main tab is clicked.

DC Track Circuit

Healthy – 60/75
Predictive – 10
Failure – 5

Main Signal

Healthy – 34/42
Predictive – 6
Failure – 2

Axe Counter

Healthy – 34/42
Predictive – 6
Failure – 2

LC Gate

Healthy – 34/42
Predictive – 6
Failure – 2

Point Machine

Healthy – 34/42
Predictive – 6
Failure – 2

Total Assets

Healthy – 170/200
Predictive – 20
Failure – 10

Suitable bar chart may be placed here

Sensor/IoT

Healthy – 170/200
Predictive – 20
Failure – 10

Alert Live status

Zone



Division



Station



Alert Type



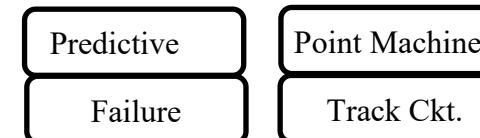
ALL

Asset Type



ALL





Predictive	20	Failure	5	Total	25
-------------------	-----------	----------------	----------	--------------	-----------

Sr no.	Zone	Division	Station	Alert Type	Asset Type	Asset Number	Incidence Date & Time	Duration	Rectification date & Time	Cause of Asset failure	Feedback & Remarks
1										<input type="checkbox"/> T <input type="checkbox"/> F <input type="checkbox"/> M	
2										<input type="checkbox"/> T <input type="checkbox"/> F <input type="checkbox"/> M	

Alert detail report

Zone	Division	Station	Alert type	Asset Type	Asset number	Cause	Alert Feedback	From date	From time	To date	To time	
ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL					
NR	LKO	NDLS	Predictive	As per SMM	As per SMM	PT-OBS	T					
NER			Failure	As per SMM	As per SMM		F				M	

From :-

To :-

Sr number	Zone	Division	Station	Alert Type	Asset Type	Asset Number	Cause of Asset failure	Alert Feedback (T/M/F)	Incidence Date & Time	Rectification Date& Time	Incidence Duration	Alert feedback date & Time	Maintainer Name	Maintainer designation	Maintainer Mobile Number	Maintainer Re-marks
1																

Alert summary report

Zone 	Division 	Station 	Alert Type 	Asset Type 	Asset Number 	Cause 	From date 	From time 	To date 	To time 	View 	
Table Pie Bar Grap												

From :-

To :-

Zone	Division	Station	Alert Type	Asset Type	Asset Number	Cause of Asset failure	Total Alert Count	True Alert Count	% of True feedback of Alerts

Telemetry Live	
Zone ▼	Division
Station ▼	Asset Type ▼
DCT	Asset Number ▼
TC-12	
View. ▼	
Table	
Graph	
Circuit	
Yard	
<input type="button" value="NCR"/> <input type="button" value="PRYG"/> <input type="button" value="Prayagraj"/> <input type="button" value="Track ckt"/> <input type="button" value="TC-12"/>	

Parameters as per annexures											

Telemetry History

Zone 	Division 	Station	Asset Type 	Asset No 	From date 	From time 	To date 	To time 	View 	
--	--	---------	--	---	---	---	---	---	--	---

NCR	PRYG	Prayagraj	Track Circuit	TC-12
-----	------	-----------	---------------	-------

Date & Time	Parameters as per annexures											

IOT/Sensor Health Live

Zone 

Division 

Station 

Asset Type 

View 



Table

Pie

Bar

Graph

Zone	Division	Station	Asset Type	Asset Number	Total number of Sensors	Number of faulty Sensors	% of faulty sensors

IOT/Sensor Health detail

Zone 	Division 	Station 	Asset Type 	From date 	From time 	To date 	ToTime 	View 	
								Table	
								Pie	
								Bar	
								Graph	

From

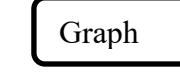
To

Zone	Division	Station	Asset Type	Total number of Sensors	Number of faulty Sensors	% of faulty sensors

Asset detail report

Zone 	Division 	Station 	Asset Type 	Asset Make 	View 	
				ALL	Table	
				XYZ	Pie	
					Bar	

As on “current date”

 Graph

Zone	Division	Station	Asset Type	Asset make	Count

Asset utilization

Zone ▼

Division ▼

Station ▼

Asset Type ▼

Asset No ▼

From date ▼

To date ▼

View. ▼



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Annexure E

Standard APIs

There are three types of reports which are to be generated by common dashboard application (to be used by Railway management). In order to generate these reports, standard APIs (Application Programming Interface) have been designed to access these reports from Application software of various Vendors. Vendors shall incorporate this in their application. Three types of reports are as following:

1. Alert Summary report
2. Alert detail report
3. Telemetry history report
4. Asset detail report

1.(a) Alert Summary Report request structure

Summary Report

Summary Report outlines the count by selecting various fields.

Here is sample report format:

Zone	Division	Station	Vendor Name	Alert Type	Asset Type	Asset Number	Cause of Asset failure	Total Alert Count	True Alert Count	% of True Feedback of Alerts

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URL Structure

base_address/vc_alert_summary

In the URL address vcc will be replaced by the actual value. Similarly, the base address will be replaced with hostname/address along with the path to the API endpoint.

Request Structure

The request is composed of following items:

- Start date – provided in “start_date” key in JSON request payload
- Start time – provided in “start_time” key in JSON request payload
- End date – provided in “end_date” key in JSON request payload
- End time – provided in “end_time” key in JSON request payload
- Zone array – provided in “zone” key enclosed in request object in JSON request payload. zone_code is passed in array.
- Division array – provided in “division” key enclosed in request object in JSON request payload. division_code is passed in array.
- Station array – provided in “station” key enclosed in request object in JSON. sc is passed in array.
- Alert Type array – provided in “alert_type” key enclosed in request object in JSON. alert_type_code is passed in array.
- Asset Type array – provided in “asset_type” key enclosed in request object in JSON. asset_type_code is passed in array.
- Asset Number array – Asset number cannot be provided alone as there may be asset with same name across stations. Hence Asset Number array should be in Key Value pairs where key should be the station code and value should be the asset number. This should also be there enclosed in request object. sc and asset_number_code is passed in array.
- Cause array – provided in “cause” key enclosed in request object in JSON. cause_code is passed in array.
- Page Number – provided in “page_number” key in JSON
- page size count – provided in “page_size” key in JSON
- API Key – to be provided as a part of request header

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Suppose we want to list all stations in NR zone, and cause if Obstruction, then the payload be like:

```
{
  "start_date": "12/11/2023",
  "start_time": "12:40:20",
  "end_date": "20/11/2023",
  "end_time": "13:35:30",
  "request": {
    "zone": [
      "NR"
    ],
    "cause": [
      "OBS"
    ]
  }
}
```

If we don't pass Zone array then the API would assume that all zone data is required.

```
{
  "start_date": "12/11/2023",
  "start_time": "12:40:20",
  "end_date": "20/11/2023",
  "end_time": "13:35:30",
  "request": {
    "cause": [
      "OBS"
    ]
  }
}
```

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If we want the data for station from multiple zone/division/section, we can skip the zone, division, section array and pass the station array only.

```
{
    "start_date": "12/11/2023",
    "start_time": "12:40:20",
    "end_date": "20/11/2023",
    "end_time": "13:35:30",
    "request": {
        "station": [
            "DHN", "MAS", "NDLS", "JAT", "MMCT"
        ]
    }
}
```

Since absence or presence of multiple keys can increase validation complexities, so API should always take the lowest level of the keys and ignore higher level if present. For example, consider following request:

```
{
    "start_date": "12/11/2023",
    "start_time": "12:40:20",
    "end_date": "20/11/2023",
    "end_time": "13:35:30",
    "request": {
        "zone": [
            "NR"
        ],
        "station": [
            "DHN"
        ]
    }
}
```

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Now, since DHN station is not part of NR zone and both keys present here (zone and station), the API will ignore higher key and process based on lower key. This behaviour should be only applicable with – zone, division, station and asset number related keys. For alert type, asset type, because it will do a cartesian product or the array with the lowest keys of station hierarchy.

Here is an example of how to use asset number:

```
{
  "start_date": "12/11/2023",
  "start_time": "12:40:20",
  "end_date": "20/11/2023",
  "end_time": "13:35:30",
  "request": {
    "asset Number": [
      {
        "sc": "DHN",
        "asset_number_code": "P-101"
      }
    ],
    "page_number": 1,
    "page_size": 20
  }
}
```

In above example, if zone or division or station array are also provided, they will be ignored.

Key Details

- a) start_date – Compulsory. Represents start date.
- b) start_time – Compulsory. Represents start time.
- c) end_date – Optional. Represents end date, if not provided then current date is assumed as end date.
- d) end_time - Optional. Represents end time, if not provided then current time is assumed as end time.
- e) request – Compulsory. This key encapsulates all other keys except the two date keys and two pagination related keys.
- f) zone – Optional. Represents selected zones. If not given, it will assume that data is required for all Zones individually.
- g) division – Optional. Represents selected divisions. Zones if present with this key will be ignored. If not given, it will assume that data is required for all Divisions individually for given Zones.

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- h) station – Optional. Represents selected stations. Zones, Divisions, Sections if present with this key will be ignored. If not given, it will assume that data is required for all stations individually for given Divisions & Zones.
- h) alert_type – Optional. Represents specific alert type. This key can exist with station hierarchy keys and asset type key. Same cartesian product rule is applied. If this key is present alone, then by default all station across all zones and applicable asset type is assumed.
- i) asset_type – Optional. Represents specific asset type (point machine, track circuit, etc.). This key can exist with station hierarchy keys and will perform cartesian product with lowest key. If this key is present alone then by default all station across all zones will be assumed.
- j) asset_number – Optional. Represents specific asset at a given station. If this key is present, zones, divisions, sections, stations, asset type keys are ignored.
- k) cause – Optional. Represents specific cause for an alert type. This key can exist with station hierarchy keys and alert type key as well. Same cartesian product rule is applied. If this key is present alone, then by default all station across all zones and applicable asset type, applicable alert type is assumed.
- l) Total count – total_count of alerts for given cause code (see API below).
- m) True count – true_count feedback of alerts for given cause code (see API below).
- n) page – Optional. Represents the page_number in record set. Must be provide with page_size key. If absent then complete record will be sent at once.
- o) Page_size – Optional. Represents how many records should be there in one page. Must be provided with page key.

1. (b) Alert Summary Report response Sample:

It shall provide count information for fields as per request.

```
{
  "vcc": "XYZ",
  "vcn": "XYZ TECHNOLOGIES",
  "start_date": "1/11/2023",
  "start_time": "13:40:20",
  "end_date": "15/11/2023",
  "end_time": "14:40:20",
  "zone": [
    {
      "zc": "NCR",
      "division": [
        {
          "dc": "PRYJ",
          "station": [
            {
              "sc": "MJA",
              ...
            }
          ]
        }
      ]
    }
  ]
}
```

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```
"alert_type": [
    {
        "alert_type_code": "Failure"
        "asset_type": [
            {
                "astc": "PM",
                "asset_number": [
                    {
                        "asnc": "PT-101",
                        "cause": [
                            {
                                "cause_code": "PT-OBS"
                                "total_count": 3
                                "true_count": 2
                            }
                        ]
                    }
                ]
            }
        ]
    }
]
```

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2. (a) Alert detail report Request structure:

Detailed Report

Zone	Division	Station	Vendor Name	Alert Type	Asset Type	Asset Nnumber	Cause of Asset failure	Alert Feedback (T/F/M)	ncidence Date & Time	Rectification Date& Time ration	Incidence Duration	Alert feedback Date & Time	Maintainer Name	Maintainer Designation	Maintainer Mobile Number	Maintainer Remarks

URL Structure

```
base_address/vc_alert_detail
```

In the URL address vcc will be replaced by the actual value. Similarly, the base address will be replaced with hostname/address along with the path to the API endpoint.

Request Structure

The request is composed of following items:

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- Start date – provided in “start_date” key in JSON request payload
- Start time – provided in “start_time” key in JSON request payload
- End date – provided in “end_date” key in JSON request payload
- End time – provided in “end_time” key in JSON request payload
- Zone array – provided in “zone” key enclosed in request object in JSON request payload. zone_code is passed in array.
- Division array – provided in “division” key enclosed in request object in JSON request payload. division_code is passed in array.
- Station array – provided in “station” key enclosed in request object in JSON. sc is passed in array.
- Alert Type array – provided in “alert_type” key enclosed in request object in JSON. alert_type_code is passed in array.
- Asset Type array – provided in “asset_type” key enclosed in request object in JSON. asset_type_code is passed in array.
- Asset Number array – Asset number cannot be provided alone as there may be asset with same name across stations. Hence Asset Number array should be in Key Value pairs where key should be the station code and value should be the asset number. This should also be there enclosed in request object. sc and asset_number_code is passed in array.
- Cause array – provided in “cause” key enclosed in request object in JSON. cause_code is passed in array.
- Alert feedback - given as T, M or F
- Page Number – provided in “page_number” key in JSON
- page size count – provided in “page_size” key in JSON
- API Key – to be provided as a part of request header

Suppose we want to list all stations in NR zone, and cause if Obstruction, then the payload be like:

```
{
  "start_date": "12/11/2023",
  "start_time": "12:40:20",
  "end_date": "20/11/2023",
  "end_time": "13:35:30",
  "request": {
    "zone": [
      "NR"
    ],
    "cause": [
      "Obstruction"
    ]
  }
}
```

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```

        "OBS"
    ]
}
}
```

If we don't pass Zone array then the API would assume that all zone data is required.

```
{
  "start_date": "12/11/2023",
  "start_time": "12:40:20",
  "end_date": "20/11/2023",
  "end_time": "13:35:30",
  "request": {
    "cause": [
      "OBS"
    ]
  }
}
```

If we want the data for station from multiple zone/division/section, we can skip the zone, division, section array and pass the station array only.

```
{
  "start_date": "12/11/2023",
  "start_time": "12:40:20",
  "end_date": "20/11/2023",
  "end_time": "13:35:30",
  "request": {
    "station": [
      "DHN", "MAS", "NDLS", "JAT", "MMCT"
    ]
  }
}
```

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Since absence or presence of multiple keys can increase validation complexities, so API should always take the lowest level of the keys and ignore higher level if present. For example, consider following request:

```
{
    "start_date": "12/11/2023",
    "start_time": "12:40:20",
    "end_date": "20/11/2023",
    "end_time": "13:35:30",
    "request": {
        "zone": [
            "NR"
        ],
        "station": [
            "DHN"
        ]
    }
}
```

Now, since DHN station is not part of NR zone and both keys present here (zone and station), the API will ignore higher key and process based on lower key. This behaviour should be only applicable with – zone, division, section, station and asset number related keys. For alert type, asset type, because it will do a cartesian product or the array with the lowest keys of station hierarchy.

Here is an example of how to use asset number:

```
{
    "start_date": "12/11/2023",
    "start_time": "12:40:20",
    "end_date": "20/11/2023",
    "end_time": "13:35:30",
    "request": {
        "asset Number": [
            {
                "sc": "DHN",
                "asset_number_code": "P-101"
            }
        ]
    }
}
```

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```
},
  "page_number":1,
  "page_size":20
}
```

In above example, if zone or division or section or station array are also provided, they will be ignored.

Key Details

- a) start_date – Compulsory. Represents start date.
- b) start_time – Compulsory. Represents start time.
- c) end_date – Optional. Represents end date, if not provided then current date is assumed as end date.
- d) end_time - Optional. Represents end time, if not provided then current time is assumed as end time.
- e) request – Compulsory. This key encapsulates all other keys except the two date keys and two pagination related keys.
- f) zone – Optional. Represents selected zones.
- g) division – Optional. Represents selected divisions. Zones if present with this key will be ignored.
- h) station – Optional. Represents selected stations. Zones, Divisions, Sections if present with this key will be ignored.
- i) alert_type – Optional. Represents specific alert type. This key can exist with station hierarchy keys and asset type key. Same cartesian product rule is applied. If this key is present alone, then by default all station across all zones and applicable asset type is assumed.
- j) asset_type – Optional. Represents specific asset type (point machine, track circuit, etc.). This key can exist with station hierarchy keys and will perform cartesian product with lowest key. If this key is present alone then by default all station across all zones will be assumed.
- k) Asset Number – Optional. Represents specific asset at a given station. If this key is present, zones, divisions, sections, stations, asset type keys are ignored.
- l) cause – Optional. Represents specific cause for an alert type. This key can exist with station hierarchy keys and alert type key as well. Same cartesian product rule is applied. If this key is present alone, then by default all station across all zones and applicable asset type, applicable alert type is assumed.
- m) Alert feedback - given as T, M or F
- n) page – Optional. Represents the page_number in record set. Must be provide with page_size key. If absent then complete record will be sent at once.
- o) Page_size – Optional. Represents how many records should be there in one page. Must be provided with page key.

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2. (b) Alert detailed Report response sample :It shall provide following information for following fields as per request.

incidence_date_time
rectification_date_time
incidence_duration
alert_feedback_date_time
maintainer_name
maintainer_designation
maintainer_mobile
remarks

Sample:

```
{
    "vcc": "XYZ",
    "vcn": "XYZ TECHNOLOGIES",
    "start_date": "1/11/2023",
    "start_time": "13:40:20",
    "end_date": "15/11/2023",
    "end_time": "14:40:20",
    "zone": [
        {
            "zc": "NCR",
            "division": [
                {
                    "dc": "PRYJ",
                    "station": [
                        {
                            "sc": "MJA",
                            "alert_type": [
                                {
                                    "alert_type_code": "FLR",
                                    "asset_type": [
                                        {

```

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```
        "astc": "PM",
    "asset_number": [
        {
            "asnc": "PM-101",
            "casue": [
                {
                    "casue_code": "PT_OBS",
                    "alert_feedback": [
                        {
                            "alert_feedback_code": "T",
                            "alert_fields": [
                                {
                                    "incidence_date_time": "18/12/2023 14:40:20",
                                    "rectification_date_time": "18/12/2023 16:40:20",
                                    "incidence_duration": 120,
                                    "alert_feedback_date_time": "18/12/2023 14:40:20",
                                    "maintainer_name": "Ranjan Kumar",
                                    "maintainer_designation": "tech3",
                                    "maintainer_mobile": "7549510195",
                                    "remarks": "found stone chip"
                                }
                            ]
                        }
                    ]
                }
            ]
        }
    ]
}
]
```

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]
}

3.(a) Telemetry History Report request structure

Telemetry history Report

Telemetry history Report outlines the parameters of asset by selecting various fields.

Here is sample report format:

Zone	Division	Station	Vendor Name	Asset Type	Asset Number	Parameters as per Annexure

URL Structure

base_address/vc_telemetry_history

In the URL address vcc will be replaced by the actual value. Similarly, the base address will be replaced with hostname/address along with the path to the API endpoint.

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Request Structure

The request is composed of following items:

- Start date – provided in “start_date” key in JSON request payload
- Start time – provided in “start_time” key in JSON request payload
- End date – provided in “end_date” key in JSON request payload
- End time – provided in “end_time” key in JSON request payload
- Zone array – provided in “zone” key enclosed in request object in JSON request payload. zone_code is passed in array.
- Division array – provided in “division” key enclosed in request object in JSON request payload. division_code is passed in array.
- Station array – provided in “station” key enclosed in request object in JSON. sc is passed in array.
- Asset Type array – provided in “asset_type” key enclosed in request object in JSON. asset_type_code is passed in array.
- Asset Number array – Asset number cannot be provided alone as there may be asset with same name across stations. Hence Asset Number array should be in Key Value pairs where key should be the station code and value should be the asset number. This should also be there enclosed in request object. sc and asset_number_code is passed in array.
- Page Number – provided in “page_number” key in JSON
- page size count – provided in “page_size” key in JSON
- API Key – to be provided as a part of request header

Suppose we want to list all stations in NR zone, then the payload be like:

```
{
  "start_date": "12/11/2023",
  "start_time": "12:40:20",
  "end_date": "20/11/2023",
  "end_time": "13:35:30",
  "request": {
    "zone": [
      "NR"
    ]
  }
}
```

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```
        ],
    }
}
```

If we don't pass Zone array then the API would assume that all zone data is required.

```
{
  "start_date": "12/11/2023",
  "start_time": "12:40:20",
  "end_date": "20/11/2023",
  "end_time": "13:35:30",
  "request": {

}
```

If we want the data for station from multiple zone/division/section, we can skip the zone, division, section array and pass the station array only.

```
{
  "start_date": "12/11/2023",
  "start_time": "12:40:20",
  "end_date": "20/11/2023",
  "end_time": "13:35:30",
  "request": {
    "station": [
      "DHN", "MAS", "NDLS", "JAT", "MMCT"
    ]
  }
}
```

Since absence or presence of multiple keys can increase validation complexities, so API should always take the lowest level of the keys and ignore higher level if present. For example, consider following request:

```
{
```

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```

    "start_date": "12/11/2023",
    "start_time": "12:40:20",
    "end_date": "20/11/2023",
    "end_time": "13:35:30",
    "request": {
        "zone": [
            "NR"
        ],
        "station": [
            "DHN"
        ]
    }
}

```

Now, since DHN station is not part of NR zone and both keys present here (zone and station), the API will ignore higher key and process based on lower key. This behaviour should be only applicable with – zone, division, station and asset number related keys. For alert type, asset type, because it will do a cartesian product or the array with the lowest keys of station hierarchy.

Here is an example of how to use asset number:

```

{
    "start_date": "12/11/2023",
    "start_time": "12:40:20",
    "end_date": "20/11/2023",
    "end_time": "13:35:30",
    "request": {
        "asset Number": [
            {
                "sc": "DHN",
                "asset_number_code": "P-101"
            }
        ]
    },
    "page_number": 1,
    "page_size": 20
}

```

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{}

In above example, if zone or division or station array are also provided, they will be ignored.

Key Details

- i) start_date – Compulsory. Represents start date.
- j) start_time – Compulsory. Represents start time.
- k) end_date – Optional. Represents end date, if not provided then current date is assumed as end date.
- l) end_time - Optional. Represents end time, if not provided then current time is assumed as end time.
- m) request – Compulsory. This key encapsulates all other keys except the two date keys and two pagination related keys.
- n) zone – Optional. Represents selected zones. If not given, it will assume that data is required for all Zones individually.
- o) division – Optional. Represents selected divisions. Zones if present with this key will be ignored. If not given, it will assume that data is required for all Divisions individually for given Zones.
- p) station – Optional. Represents selected stations. Zones, Divisions, Sections if present with this key will be ignored. If not given, it will assume that data is required for all stations individually for given Divisions & Zones.
- q) asset_type – Optional. Represents specific asset type (point machine, track circuit, etc.). This key can exist with station hierarchy keys and will perform cartesian product with lowest key. If this key is present alone then by default all station across all zones will be assumed.
- r) asset_number – Optional. Represents specific asset at a given station. If this key is present, zones, divisions, sections, stations, asset type keys are ignored.
- s) page – Optional. Represents the page_number in record set. Must be provide with page_size key. If absent then complete record will be sent at once.
- t) Page_size – Optional. Represents how many records should be there in one page. Must be provided with page key.

3.(b) Telemetry History Report response Sample:

It shall provide value of parameters as per desired field as per request.

```
{
  "vcc": "XYZ",
  "vcn": "XYZ TECHNOLOGIES",
  "start_date": "1/11/2023",
  "start_time": "13:40:20",
  "end_date": "15/11/2023",
  "end_time": "14:40:20",
  "zone": [
    {
      "id": 1,
      "name": "Zone A"
    },
    {
      "id": 2,
      "name": "Zone B"
    }
  ]
}
```

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```
"zc": "NCR",
"division": [
{
    "dc": "PRYJ",
        "station": [
            {
                "sc": "MJA",
                "asset_type": [
                    {
                        "astc": "PM",
                            "asset_number": [
                                {
                                    "asnc": "PT-101",
                                        "parameter code as per annexure)": "...",
                                            "prv": [... , ... , ...],
                                            "prt": [... , ... , ...]
                                                }
                                            ]
                                }
                            ]
                }
            ]
        }
    ]
}
]
```

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4. (a) Asset report request structure:

Asset Report

Zone	Division	Station	Vendor Name	Asset Type	Make of Asset	Count

URL Structure

```
base_address/vc_asset
```

In the URL address vcc will be replaced by the actual value. Similarly, the base address will be replaced with hostname/address along with the path to the API endpoint.

Request Structure

The request is composed of following items:

- Zone array – provided in “zone” key enclosed in request object in JSON request payload. zone_code is passed in array.
- Division array – provided in “division” key enclosed in request object in JSON request payload. division_code is passed in array.
- Station array – provided in “station” key enclosed in request object in JSON. sc is passed in array.

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- Asset Type array – provided in “asset_type” key enclosed in request object in JSON. asset_type_code is passed in array.
- Page Number – provided in “page_number” key in JSON
- page size count – provided in “page_size” key in JSON
- API Key – to be provided as a part of request header

If we want the data for station from multiple zone/division/section, we can skip the zone, division, section array and pass the station array only.

```
{
  "request": {
    "station": [
      "DHN", "MAS", "NDLS", "JAT", "MMCT"
    ]
  }
}
```

Since absence or presence of multiple keys can increase validation complexities, so API should always take the lowest level of the keys and ignore higher level if present. For example, consider following request:

```
{
  "request": {
    "zone": [
      "NR"
    ],
    "station": [
      "DHN"
    ]
  }
}
```

Now, since DHN station is not part of NR zone and both keys present here (zone and station), the API will ignore higher key and process based on lower key.

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In above example, if zone or division or section or station array are also provided, they will be ignored.

Key Details

- a) request – Compulsory. This key encapsulates all other keys except the two date keys and two pagination related keys.
- b) zone – Optional. Represents selected zones.
- c) division – Optional. Represents selected divisions. Zones if present with this key will be ignored.
- d) station – Optional. Represents selected stations. Zones, Divisions, Sections if present with this key will be ignored.
- e) asset_type – Optional. Represents specific asset type (point machine, track circuit, etc.). This key can exist with station hierarchy keys and will perform cartesian product with lowest key. If this key is present alone then by default all station across all zones will be assumed.
- f) page – Optional. Represents the page_number in record set. Must be provide with page_size key. If absent then complete record will be sent at once.
- g) Page_size – Optional. Represents how many records should be there in one page. Must be provided with page key.

4. (b) Asset Report response Sample: It shall provide make and count of each asset type for fields as per request as on date status.

```
{
  "vcc": "BT",
  "vnapp": "XYZ TECHNOLOGIES",
  "zone": [
    {
      "zc": "NCR",
      "division": [
        {
          "dc": "PRYJ",
          "station": [
            {
              "sc": "MJA",
              "asset_type": [
                {
                  "astc": "M-Sig",
                  "asset_make": [
                    {
                      "make": "wbg",
                      "total_count": 10
                    }
                  ]
                }
              ]
            }
          ]
        }
      ]
    }
  ]
}
```

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```
        },
        {
          "make": "xvz",
          "total_count": 1
        }
      ]
    }
  ]
}
]
```

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Reasoned Document of RDPMS (Document No. RDSO/RDPMS/FRS /2025, Version 1.0): Jun-2025

FRS Cl. No.	Existing Spec. Clause Description	Firm's Comments/Suggestions	Revised Spec Clause Description/shifted/Deleted	RDSO Remarks
1	<p>This document contains the functional requirement for Remote Diagnostic and Predictive Maintenance System for Indian Railway Signalling equipment using IoT based data acquisition systems and Machine learning/Artificial Intelligence.</p> <p>To ensure that the FRS is not restrictive to propriety systems, the functional requirements have been laid down and device specific details are avoided to keep scope of widely available systems without any proprietary hardware and protocols. Hence, the scope of this FRS is to standardize the requirements for ensuring conformity and interoperability such that data being collected on any platform/IoT device shall be utilized for machine learning/AI based data processing in the system.</p> <p>Note: This Functional requirement is released for</p>	Nil	<p>This document explains the requirements for a Remote Diagnostic and Predictive Maintenance System for Indian Railway Signalling equipment. The system will use IoT to collect data, standard logics & AI/ML to monitor, diagnose, and predict equipment performance.</p> <p>The purpose of this FRS is to standardize and set clear requirements to ensure that data collected from any platform or IoT device is consistent and compatible. This data will be used for machine learning (ML) and AI-based data analytics for predictive maintenance.</p> <p>Note: This Functional requirement is released for development of Specification for Remote diagnostic and predictive maintenance system. Development of system together with initial trials & further improvisation based on the experience will be done in the</p>	<p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>

	development of Specification for Remote diagnostic and predictive maintenance system. Development of system together with initial trials &further improvisation based on the experience will be done in the course of time.		course of time.	
2.2	Remote Diagnostic: of Signalling assets to reduce MTTR and to provide aid to maintenance staff in rectifying the signal failures. This is achieved by automated analysis of parameters of Signal assets collected remotely using IoT devices through Sensors. The system shall be able to give alerts on mobile/PC with probable cause of failure to aid the maintenance staff for early restoration reducing MTTR.	.	Remote Diagnostic: The purpose of the Remote Diagnostic System for Signalling Assets is to minimize MTTR (Mean Time to Restore) and provide real-time insights to maintenance teams for efficient resolution of signal failures. This is accomplished through the automated analysis of telemetry data and operational parameters collected from signalling assets via IoT enabled sensors. The system leverages edge computing for on-site processing and cloud-based analytics for advanced diagnostics. The system delivers fault alerts to mobile devices or PCs, along with possible root cause analysis (RCA). This enables faster fault resolution, streamlined troubleshooting, and improved operational uptime	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.

2.3	<p>Predictive Maintenance: Facilitating predictive maintenance by giving Predictive maintenance alerts on mobile/PC with probable cause by using standard logics and advance computing of Big data using standard logics and various models of Machine Learning and Artificial Intelligence. The data of all the stations shall be continuously analysed by system for developing the supervised and unsupervised machine learning. The system shall be able to send automatic alerts for Signalling assets which are likely to fail based on the system learning. This will assist the maintenance staff to take necessary action to eliminate failure before it occurs.</p>		<p>Predictive Maintenance:—The system facilitates predictive maintenance by delivering predictive alerts to mobile devices or PCs, identifying probable causes through data analysis and AI/ML models. It continuously analyzes data from all stations to develop supervised and unsupervised machine learning models. Based on these models, the system can send automated alerts for signalling assets at risk of failure, enabling maintenance staff to take proactive measures to prevent failures before they occur.</p>	<p>Several meetings were held with RDPMs Vendors for finalization of RDPMs FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>
2.4	<p>Sensors, IoTs, Station gateway and networks shall be regularly monitored for ensuring their reliability and uptime and shall alert for any failure of Sensors/IoTs/Gateways/Network.</p>	<p>M/s Amara Raja Power Sys. Ltd., Comments: Sensor health monitoring is confined to scenarios involving short or open circuit conditions, especially when the physical wiring is disrupted due to staff movement while performing regular maintenance tasks.</p>	<p>IoT devices , station gateways, and networks shall be continuously monitored to ensure their reliability and uptime. The system shall provide alerts in case of any failure or malfunction in IoT devices, gateways, or network infrastructure, enabling timely intervention and maintenance. Sensor failures may be identified through logical monitoring of sensor values and correlation with other relevant</p>	<p>Cl. No.2.4 has been revised. Methodology of monitoring of health of IoT devices ,station gateways, and networks have been defined.</p>

		<p>Suggestions:</p> <p>Network reliability between the field IoT and the gateway has been established every 60-second interval, and alerts are triggered if the network's (between IoT & gateway) is not active over 60 seconds.</p>	<p>parameters, probable inconsistencies in either the sensors or the signaling assets.</p>	
2.5	<p>System shall be able to identify any suspicious activity/data theft which shall help identify and respond to security breaches quickly. for identifying any suspicious activity/data theft which shall help identify and respond to security breaches quickly.</p>	<p>M/s Phoenix Contact :</p> <p>IOT device must be cyber certified according to IEC 62443-4-2 and installed with inbuilt firewall with the following functionalities:</p> <ol style="list-style-type: none"> 1. There should be minimum six months sys log retention at any point of time for cyber forensic investigation. 2. There should be facility to block all malicious IPs, hashes and domains received from threat intel platforms 3. All unused ports must be in blocked condition there should be facility to write the policies as per the cyber resilience requirements web based GUI must be there to check all the above facilities. <p>Reason: IEC 62443-4-2 Standard is very important for cyber security at Hardware level to prevent from any kind of cyber attack and reduction</p>	<p>The system shall be capable of detecting unauthorized access, such as login attempts by unknown users and any suspicious activity/data theft and promptly notifying the relevant stakeholders to ensure system integrity.</p>	<p>Pls refer Clause No. 5.11 & 5.14 for IoT and clause no. 6.17, 6.18 for Station Gateway and Clause No. 11.17 for Application software. Cyber Security requirement has been defined and IR-NIYANTRAC FRS has been taken as reference.</p> <p>Also as per discussion, minor modification has been done and given in alongside column.</p>

		of vulnerability points.		
2.6	If any vendor is found in any malpractice or misuse of data/information, all its contracts should be immediately rescinded under intimation to Railway Board and RDSO. Communication from any device of such a vendor at all locations in any Railway will be stopped with immediate effect. Any other legal/penal action as deemed fit by Railways should be taken against such a vendor.	Nil	If any vendor is found in any malpractice or misuse of data/information, all its contracts should be immediately rescinded under intimation to Railway Board and RDSO. Communication from any device of such a vendor at all locations in any Railway will be stopped with immediate effect. Any other legal/penal action as deemed fit by Railways should be taken against such a vendor.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
3	System Architecture	ECR: Diagram to be updated.	Diagram updated with following Note. The schematic diagram shown in Figure-1 is indicative. OEMs are required to prepare a detailed station schematic diagram that clearly defines the architecture, incorporating signalling assets, sensors, IoT devices, communication media, station gateways, station computers, and other components.	Standardization of various protocol converter is not possible as these assets have different protocol for different OEMs. Also RDSO specification for these assets doesn't specify any standard protocol.
3.1	Sensors: They are fitted on the signaling assets or near location Box so as to capture the desired parameters such		They shall be installed on the signalling assets or in nearby location boxes to capture the	Several meetings were held with RDPMS Vendors for finalization of

	as voltage, current (non intrusive), temperature, relay etc. Details are in section no 4.		required parameters, such as voltage, current (non-intrusive), temperature, relay status, and other critical data points Details are in section no 4.	RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
3.2	IoT devices: An embedded electronic unit that is used to collect data/parameters value of Signalling Assets through the sensors connected to IoT devices and transmit it to the station gateway located at Station using over the wired/wireless data transmission method.		An embedded electronic unit designed to collect data or parameter values from signalling assets through connected sensors/Digital input/PF contacts. These devices transmit the collected data to the station gateway located at the station using wired or wireless data transmission methods. Details are in section no 5.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
3.3	Station Gateway : An embedded electronic unit which shall receive raw data/parameters value from Sensors through IoT devices and from diagnostic ports of various equipments for Signalling assets. It shall send/receive the data to/from RDPMS Application software through Intermediate service Plateform(to be planned by	ECR: It mentions that the data-logger is compulsorily to be connected to RDPMS and the protocol converter is to be provided by the data-logger OEM. The data-logger specification does not cover protocol converters. The type of port is required in the Gateway is specified as serial port in the clause 6.10. Once the data-logger is connected to RDPMS Gateway using serial port, RDPMS can get	An embedded electronic unit which shall receive raw data/parameters value from Sensors through IoT devices and from diagnostic ports of various equipments for Signalling assets. It shall receive data mandatorily from Data-logger and IPS interface port. Details are provided in Section No. 6.	Pls refer revised FRS, requirement of Ethernet port has already been provisioned, so future requirement of integration of Ethernet enable data logger can be done. Based on

	<p>Vendors) as per standard Data Format (Annexure B) using MQTT protocol. It shall act as edge computing Device at station. It shall have a inbuilt protocol convertor for connectivity with datalogger through Protocol Convertor to be provided by Datalogger OEMs for RDPMS for taking Digital inputs as desired by RDPMS OEMs(compulsory). Protocol Data Format details shall be as per Datalogger specification IRS: S: 99/2006 (latest version). Station gateway shall also have inbuilt protocol converter for connectivity with other equipments ie IPS(compulsory and configurable as per OEM), SSDAC/MSDAC/BPAC/UFS BI/AFTC/ELD(optional and configurable as per OEM) through Protocol Convertors to be provided by Equipment OEMs for taking input data. Details are in section no 6.</p> <p>Note: Since interoperable at</p>	<p>data using the packet protocol defined in the Data-logger specification. The protocol converter with API will be required only for Ethernet based data-logger, the specs for which are being worked on.</p> <p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Datalogger specification IRS S9/2006 (para 4.2.16) states that at least 6 serial ports shall be provided for communication with other dataloggers, CMU, RTU, EI, IPS, etc. However, there is no mention of any output ports carrying consolidated data of all its inputs, such as analog voltages, digital inputs, and other input ports.</p> <ul style="list-style-type: none"> • Practical experience suggests that dataloggers do not monitor all the analog voltages of the IPS in a station. 		<p>discussion, minor modification has been made in the clause and given in alongside column.</p> <p>SP of Datalogger are reconfigurable, so any spare ports can be used for RDPMS purpose. Consolidated data shall be prepared at the Station Gateway level. Analog channels being monitored by the data-logger can be used and remaining channels whose values are required for generation of Alerts/Fault can be collected by using sensors and IoTs.</p>
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	IoT label is not there, data format between IoTs to Station gateway will be vendor dependent (i.e. not following an interoperable standard protocol) in the interest of efficient data transmission (volume, speed, band width).			
3.4	<p>Network: The real time field data (Voltage, current, temperature, humidity, relay status, vibration etc.) shall be captured by various sensors by IoT devices and processed . Then processed data is sent to station gateway from IoT devices. Wired communication (Quad cable, dark fiber, Voice channel etc) and wireless communication technology (4G/LTE) shall be preferred for sending data from IoT devices to station gateway. Short range wireless technology (LoRa, Zigbee etc.) should not be preferred to avoid delay in transmission of data from IoT devices to station</p>	<p>M/s ENERGY7:</p> <p>"The real-time field data (Voltage, current, temperature, humidity, relay status, vibration, etc.) shall be captured by various sensors through IoT devices and processed. The processed data shall then be transmitted from IoT devices to the station gateway. Wired communication (Quad cable, dark fiber, Voice channel, etc.) and wireless communication technology (4G/LTE) shall be preferred for sending data from IoT devices to the station gateway. In locations where quad cable or optical fiber is not available, 4G/LTE shall be used, considering the future potential of LTE and NB-IoT. Use of signalling cables should be restricted. Short-range wireless technology (LoRa, Zigbee,</p>	<p>Real-time field data, such as voltage, current, temperature, humidity, relay status, vibration, shall be captured by various sensors through IoT devices and processed locally. The processed data will then be transmitted from the IoT devices to the station gateway. For above data transmission, wired/wireless communication technologies shall be used as detailed in Section No. 7.</p> <p>For communication between the Station Gateway to/from Intermediate service platform (including RDPMS Application) shall be used as detailed in section-7.</p>	<p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>

	<p>gateway. Details are in section no 7.</p> <p>For communication from Station Gateway to/from CCSP to/from RDPMS Application, existing optical fibre network of Railtel or MPLS may be used. For redundancy 4G/LTE may be used along with OFC/MPLS network.</p>	<p>etc.) may also be permitted where 4G/LTE coverage is poor, and wired communication is not feasible. Details are in section no. 7.</p> <p>For communication between the Station Gateway and CCSP/RDPMS Application, the existing optical fibre network of Railtel or MPLS may be used. For redundancy, 4G/LTE may be used along with the OFC/MPLS network.</p> <p>"</p> <p>Reason:</p> <p>Signalling cables are prone to surges and interference, making them unreliable for real-time data transmission. They should be reserved for critical signalling operations. 4G is mandatory due to its higher reliability and future potential with LTE and NB-IoT. Zigbee and LoRa may be permitted where 4G is unavailable and wired options are not feasible.</p> <p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Due to the limited availability of spare cables in older station</p>	
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	<p>infrastructure, adopting wireless technology is a more viable solution.</p> <p>Advanced solutions now enable long-distance data transmission using wireless technology. A Sub-GHz RF module based on mesh technology can operate on a free band of the wireless spectrum, transmitting data beyond 2 km with a latency of 30-40 seconds</p> <p>wireless technology (RF) OR 4G technology can be used to transmit data from distant location boxes to Station Gateway.</p> <p>(This suggestions are for 3.4, 6.9, & 7.2.1)</p> <p>M/s JARS Services Private Limited:</p> <p>The real-time field data (Voltage, current, temperature, humidity, relay status, vibration, etc.) shall be captured by various sensors through IoT devices and processed. The processed data shall then be transmitted from IoT devices to the station gateway. Wired communication (Quad cable, dark fibre, Voice channel, etc.) and wireless communication technology (4G/LTE) shall be preferred for sending data from IoT</p>	
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		<p>devices to the station gateway. In locations where quad cable or optical fibre is not available, 4G/LTE shall be used, considering the future potential of LTE and NB-IoT. Use of signalling cables should be restricted. Short-range wireless technology (LoRa, Zigbee, etc.) may also be permitted only where 4G/LTE coverage is poor, and wired communication is not feasible. Details are in section no. 7.</p> <p>For communication between the Station Gateway and CCSP/RDPMS Application, the existing optical fibre network of Railtel or MPLS may be used. For redundancy, 4G/LTE may be used along with the OFC/MPLS network.</p> <p>Reason:</p> <p>Use of Signalling cables is not feasible due to data corruption as the area is high in EMI/EMC which effects data packets hence data collected will not be accurate.</p>		
3.6	<p>3.6 RDPMS Application Software: Details are in section no 11.</p> <p>3.6.1 RDPMS Application software of OEMs shall</p>	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Ensures application security aligns with ISO 27001:2022 standards</p>	<p>3.6.2</p> <p>The Application Software shall process data using advanced computing techniques, including</p>	<p>Several meetings were held with RDPMS Vendors for finalization of</p>

	<p>be designed to receive/send data from/to Station Gateway through Intermediate service Platform (to be planned by Vendors) as per standard Data Format (Annexure B) using MQTT protocol. The standard data format will ensure interoperability of Station Gateway (including Sensors/IOT) of various OEM with Application Software of other OEMs.</p> <p>3.6.2 Application Software shall process the data by advance computing using standard logics and big data analysis by using various models of Machine Learning and Artificial Intelligence. It shall be able to generate alerts for occurrence of Failures and Prediction of Failures with</p>	<p>and OWASP guidelines, addressing vulnerabilities comprehensively at all development stages and protecting user data.</p> <p>M/s Amara Raja Power Sys. Ltd.,</p> <p>Comments: The application software is available for access on both mobile devices (via an app) and desktop computers (through a browser), as per RDSO remarks in Reasoned Document No. RDSO/RDPMS/FRS/2024, Version 1.0, dated June 2024. Clause 3. However, it is important to highlight that the term "web browser" has been omitted in the final draft version under Clause No. 10.4.</p> <p>Suggestions: The web browser access utilizes OTP-based authentication, and in the same manner, access via web and mobile applications is restricted to one login per user on both platforms. This form of communication ensure the reliability and in term of safety also.</p>	<p>standard logics, data analysis, and various models of Machine Learning (ML) and Artificial Intelligence (AI). It shall be capable of generating alerts for the occurrence of failures and prediction of failures, along with their probable causes, which will be sent to the Mobile/PC of Railway personnel or the Divisional Control.</p>	<p>RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p> <p>ISO 27001:2022 standard is for organization and in Indian Railways systems are networked through a secure network i.e Railtel hence reference of ISO 27001:2022 is not required.</p>
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	<p>probable cause to Mobile/PC of Railway employees/Divisional Control. It shall send configuration commands to Station gateway for various configuration functions (like changing sampling time etc) as given in Annexure A &B. It shall also send alerts for faulty sensors with cause.</p> <p>RDPMS application software shall ALSO have signalling interface circuit input feature and the signaling circuit shall be shown in pictorial form with live data and highlight abnormal behavior of any signalling gears in the circuit.</p>			
4.1	<p>The data from each signalling gear at the station shall be collected on real-</p> <p>M/s Gadgeon Smart Systems pvt Ltd.: Support from equipment vendors is</p>	<p>M/s Gadgeon Smart Systems pvt Ltd.: Support from equipment vendors is</p>	<p>The data from signalling assets at the station shall be collected in real-time using either the inbuilt</p>	<p>Several meetings were held with RDPMS Vendors for</p>

	time basis using the inbuilt diagnostic ports of the signalling assets and/or the external sensors.	essential to determine the appropriate communication protocols and standards, such as RS232 or RS485. Based on the FRS, we understand that a standard protocol has not been defined. To ensure accurate and effective implementation, practical knowledge and field insights will be crucial in finalizing these details. Additionally, the FRS statement needs to be more specific by clearly specifying which signaling assets' data should be collected in this manner. We kindly request your support in addressing this to ensure clarity and alignment.	diagnostic ports of the signalling assets or through external sensors, ensuring accurate and continuous monitoring of the equipment.	finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column. Understood the issue raised. Support from equipment vendors shall be dealt on case to case basis with supervision of Zonal Railways.
4.2.1	For measuring the currents non-intrusive sensor shall be used. Voltage sensor shall also be preferably non-intrusive. In case of non suitability/non availability of non intrusive sensor for voltage, voltage transducer having high impedance and galvanic isolation can also be considered with minimum withstand voltage of 2.5KV for 60sec. Loading on signalling circuit should be minimum and in no case it should be more than 5ma per channel.		For measuring currents, non-intrusive sensors shall be used. Voltage sensors should also preferably be non-intrusive. In cases where intrusive voltage sensors are used for measuring voltage, voltage sensor with high impedance and galvanic isolation shall be considered, provided they have a minimum withstand voltage of 2.5kV for 60 seconds. The loading on the signalling circuit shall be minimal and must not exceed 1 mA per channel (sensor).	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.

4.2.2	<p>The accuracy of sensors should be such that it will not cause noise in the data being used for machine learning. Proper accuracy and stability of sensors is very important for end goal of predictive maintenance. If the raw data is noisy and not reflecting true value of field gear, the machine learning will be inaccurate.</p> <p>Noise in the data to be identified and alerted by RDPMS application software. Maintenance activity and performance of equipment in the form of user feedback should be given as Input to the system as absence of such data will affect machine learning, while performance of gear will change.</p>	<p>M/s Bitcomm Technologies Pvt. Ltd.:</p> <p>The accuracy of sensors should be such that it will not cause noise in the data being used for machine learning. Proper accuracy and stability of sensors is very important for end goal of predictive maintenance. If the raw data is noisy and not reflecting true value of field gear, the machine learning will be inaccurate.</p> <p>Noise in the data to be identified and alerted by RDPMS application software.</p> <p>Maintenance activity and performance of equipment in the form of user feedback should be given as Input to the system as absence of such data will affect machine learning, while performance of gear will change. measurement Tolerance should be +/- 2% .</p> <p>Reason: Sensor measurement tolerance shall be defined.</p>	<p>The accuracy of sensors must ensure that no noise is introduced into the data used for machine learning. Proper accuracy and stability of sensors are critical for achieving the end goal of predictive maintenance.</p>	<p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p> <p>Please refer clause no. 4.2.5 for accuracy. It is as prescribed in IEC 60688.</p>
4.2.3	Most of the sensors would be transducers converting current, voltage, vibration, etc to very weak electrical signals. Hence,		Most sensors will function as transducers, converting parameters such as current,	Several meetings were held with RDPMS Vendors

	<p>proper safeguard against EMI effects on the stability and accuracy of readings should be taken. Protection arrangement for sensors against surges coming from lightning/power line/ OHE shall be made. Appropriate signal processing technique and filtering shall be used to remove unwanted signals.</p> <p>For example, in the RE area, the induce voltage is dynamic varying due to change in OHE current during presence or absence of train. Hence, the length of cables/wires from transducer/sensor to IoT device shall be such that induced voltage are within limit to ensure desired accuracy of stable readings.</p> <p>Further, the transducer/sensor wires should not run parallel to dynamic current carrying conductors which may alter the readings of the sensors.</p>		<p>voltage, and vibration into very weak electrical signals. Therefore, proper safeguards must be implemented to protect against the effects of Electromagnetic Interference (EMI) to ensure the stability and accuracy of the readings. Additionally, sensors must be equipped with protection arrangements against surges originating from lightning, power lines, or Overhead Equipment (OHE). To maintain data integrity, appropriate signal processing techniques and filtering mechanisms shall be employed to remove unwanted signals and noise.</p> <p>For example, in the RE (Railway Electrification) area, the induced voltage is dynamic and varies due to changes in OHE current caused by the presence or absence of a train. Therefore, the length of cables/wires connecting the transducer/sensor to the IoT device should be optimized to keep the induced voltage within permissible limits, ensuring accurate and stable readings. Additionally, the transducer/sensor wires should not run parallel to dynamic</p>	<p>for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>
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			current-carrying conductors, as this may alter the sensor readings and compromise accuracy.	
4.2.4	Proper rated sensors shall be used as per parameter monitoring range of gear type to be monitored. Since the machine learning will depend on the variation of data to capture health signature, the least count of sensor for each category of equipment shall be appropriate.		Properly rated sensors shall be selected based on the parameter monitoring range of the specific gear type to be monitored. Since machine learning relies on variations in data to identify health signatures, the least count of the sensor for each category of equipment must be appropriate to ensure accurate and meaningful data collection for analysis. Number of sensors for each type of asset has been detailed in Annexure A & C.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
4.2.5	Sensor should comply to IEC 60688 and accuracy shall be of class 1 as per table 1 of IEC60688 and environmental condition shall be of usages group-II (K70) as per table 6 of IEC60688. Sensor should also comply immunity requirement as per table-2: immunity test requirement for equipment intended to be	M/s Bitcomm Technologies Pvt. Ltd.: Sensor should comply to IEC 60688 and accuracy shall be of class 1 as per table 1 of IEC60688 and environmental condition shall be of usages group-II (K70) as per table 6 of IEC60688. Sensor should also comply immunity requirement as per table-2: immunity test requirement for equipment intended to be used in	Sensors shall comply with IEC 60688 standards, with an accuracy rating of Class 1, as specified in Table 1 of IEC 60688, and shall meet the environmental conditions of Usage Group II (K70), as outlined in Table 6 of IEC 60688. Additionally, sensors must adhere to the immunity requirements specified in Table 2 of IEC 61326 for equipment intended to operate in an	Lab criteria has been modified broadly meeting QOD-8.1-10. CI no. 4.3.5.1 of ISO QOD 8.1-10. To ensure quality, Priority has been given to Govt Lab. As per discussion,

	<p>used in an industrial electromagnetic environment, of IEC 61326.Test certificate in this regard shall be submitted. Test certificate from Signal Lab of RDSO or government accredited/NABL Lab. Shall be submitted.</p> <p>M/s ENERGY7: Sensor should comply to IEC 60688 and accuracy shall be of class 1 as per table 1of IEC60688 and environmental condition shall be of usages group-II (K70) as per table 6 of IEC60688. Sensor should also comply immunity requirement as per table-2: immunity test requirement for equipment intended to be used in an industrial electromagnetic environment, of IEC 61326.Test certificate in this regard shall be submitted. Test certificate from Signal Lab of RDSO or NABL accredited government Lab shall be submitted.</p> <p>Reason:</p> <p>Private lab things can be manipulated</p>	<p>an industrial electromagnetic environment, of IEC 61326.Test certificate in this regard shall be submitted. Test certificate from Signal Lab of RDSO or NABL accredited government Lab shall be submitted.</p>	<p>industrial electromagnetic environment. A test certificate confirming compliance with these standards shall be submitted from Govt. Lab. If test facility is not available in Govt. Lab, test shall be carried out from NABL accredited Lab.</p>	<p>minor modification done with this clause and produce in alongside column.</p> <p>Please refer revised FRS.</p>
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4.2.6	Provision of on-site calibration every year by using suitable measuring equipment duly calibrated by Govt Lab/NABL accredited Lab shall be kept.		Provision shall be made for on-site calibration of sensors every year using suitable measuring equipment that has been duly calibrated by a Government Laboratory or a NABL accredited Laboratory to ensure accuracy and reliability of measurements. Before due date of calibration, parameters value should not drip. However out of turn calibration can be done by Zonal Railways if any alteration, maintenance work etc for better accuracy.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
4.2.7	Tentative number of sensors to be used gear-wise is attached at Annexure-C	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Annexure C covers only four asset</p>	Clause is now deleted and content is now added to cl. no.4.2.4	As already clarified in previous version reasoned

		<p>types,IPS,Point,DC track circuit and Signals. Need to add the required parameters for equipments listed under section 4.3 and 4.4</p> <p>M/s Amara Raja Power Sys. Ltd.,</p> <p>Comments: In annexure C 4(a) table the route check relay status has been missing. Need more clarity on monitoring the subsidiary signals like shunt, calling on etc. The final draft does not include the route check relay status that was present in the nomenclature of signal parameters in the earlier draft's Annex A.</p>		<p>documents, for other assets(whose parameters are not specified)</p> <p>Railway shall provide parameters and its limit based on their circuit/type of equipments and practices to OEMs for configuration.</p> <p>Please refer revised FRS.</p>
4.2.8	The codal life of sensor shall be 5 10 years from the date of commissioning.		Deleted	As per discussion, Clause is now deleted .
4.3.1	<p>The parameters of Signals, Points, DC Track circuits and LC gates shall be as per Annexure C.</p> <p>i) Note*: Voltage and current signature of motor shall be recorded by capturing data</p>	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>a. Parameters to be captured from LC gates is not provided in Annexure. b.Data capturing rate for Point machine is defined as 20mS,there is no</p>		Please refer revised annexure

	at the rate of 20ms during operation of Point Machine/ELB. The rate of capturing data should be configurable from Application software.	specification provided for other assets (polling interval).		
4.3.2	Presently the External sensors are required to be provided for monitoring the health of Points, Signals and DC Track circuits as these are yet not inbuilt on Indian Railways. The details of nominal voltage/current range for the Signal, Points and DC track circuits and other information is given in Annexure-C for ready reference.		External sensors are required to be provided for monitoring the health of Points, Signals and DC Track circuits. The details of nominal voltage/current range for the Signal, Points and DC track circuits and other information is given in Annexure- C for ready reference.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
4.3.3	Axle Counters (SSDAC, MSDAC etc): Input Voltage, current and status of vital relays and Diagnostic data from Diagnostic port of Axle counter evaluator shall be captured. Voltage, current, frequency of Trackside equipment of Axle counter shall also be captured. Protocol shall be shared by OEM for sharing diagnostic data. (Optional).	ECR: Voltage, Current and frequency of trackside equipment of Axle counter has been mandated for measurement in this FRS. It is informed that when sensors are used for the Track side device, there is a chance that the turning of the wheel sensor gets disturbed .Hence, the OEM must either certify a sensor or provide mechanisms for such measurement.	Axle Counters (SSDAC, MSDAC etc) and AFTC (Optional): Input Voltage and current shall be captured by using sensor. Potential free contacts of vital relays shall be captured through IoT/Datalogger. For using sensors in these equipment, clearance from Zonal Railways/AXLE Counter OEM/AFTC OEMs shall be taken to avoid any interference in AXLE COUNTER working or breach of Safety.	Noted and clause is modified and given in along side column.

	<p>M/s Efftronics System Pvt. Ltd:</p> <p>Interfering with track side equipment of Axle counter to monitor Coil voltage, current & frequency of axle counter could pose a risk of failure / unsafe side failure of Axle counters. Hence this is not recommended or ISA level certification required for integrating RDPMS to monitor coils parameters of Axle counter</p> <p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <ul style="list-style-type: none"> a. Parameters to be captured is not provided in Annexure. b. More information about the protocols required. <p>M/s Amara Raja Power Sys. Ltd.,</p> <p>Comments: The input voltage, current, and critical relay status of the axle counter can be monitored within the location box. This monitoring takes into account the parameters of trackside equipment, such as voltage, current, and frequency, which are</p>	<p>For using diagnostic port of MSDAC/SSDAC/AFTC for monitoring the health of these equipment, Zonal Railway shall facilitate the sharing of protocol of these equipment from respective OEMs to RDPMS vendors. However, it shall be responsibility of RDPMS vendor to integrate the interface port, if made available.</p>	<p>Agreed.</p> <p>Pls refer above remarks.</p> <p>Please refer above remark.</p>
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		determined by the original equipment manufacturer's design and are typically installed in open environments, and some OEM doesn't have separate track side equipment design pattern. Which in turn obtaining unique solution is difficult to monitor those parameters.		
4.3.4	AFTC:Voltage, current, frequency data of EJB installed in field and Diagnostic data from Diagnostic port of AFTC evaluator shall be captured. Protocol shall be shared by OEM for sharing diagnostic data. (Optional).	M/s Gadgeon Smart Systems pvt Ltd.: a. Parameters to be captured is not provided in Annexure. b.Need more information about the protocols.		Clause is now merged with Cl No.4.3.3. Please refer revised FRS.
4.4	Indoor Assets And Their Tentative Parameters To Be Monitored Through Datalogger Port :	M/s Gadgeon Smart Systems pvt Ltd.: We assume that ,all the parameters to be captured from the equipments listed under 4.4 will be available from datalogger. Is our assumption correct?	Data-logger: Data such as the status of relays, IPS's PF contacts, and similar parameters are already available in the existing Data Loggers installed in the relay room. To avoid redundant wiring to each relay, the same data shall be utilized. The protocol information for Data Loggers is provided in Annexure A of the Specification IRS: S-99/2006 or its latest version. The Station Gateway shall include provisions for	Pls refer Data logger Specification IRS:S 99/2006(Latest Version). If it is found that recommended analog inputs and digital inputs are not being logged in Data logger, same may be made updated with

		<p>M/s DCC Pvt. Ltd:</p> <p>We shall need more experience about feasibility of this in actual implementation, since this will need complex hardware with OTDR functionalities for proper measurements of dBLoss and location of OFC cut.</p>	<p>interface compatible with the Datalogger.</p>	<p>consultation of concerned Zonal railways and Datalogger OEM.</p> <p>Implementing new functionalities for proper measurements of dBLoss and location of OFC cut is a new concept in IR so it is not feasible to provide details inputs in this FRS, however available technology and hardware can be tried by OEMs and result can be submitted to RDSO for further inclusion in the next version of FRS. Please note that monitoring of OFC is now deleted as Telecom Dte has initiated the same job.</p>
4.4.1	Data like status of relays, IPS PF contacts, etc is already		Same as 4.4	Several meetings were held with

	<p>available in existing Data loggers installed in relay room. The same data shall be used to avoid redundant wiring to each relay. Protocols information of Data Logger is available in Annexure A of Specification IRS: S-99/2006 or Latest version. Station gateway should have provision of inbuilt protocol converter compatible with Datalogger Protocol converter provided for RDPMS.</p>			RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
4.4.2	<p>Integrated Power Supply (IPS) / Battery Charger:</p> <p>The following shall be monitored: (detailed list of parameters at Annexure C):</p> <ul style="list-style-type: none"> i) All voltage outputs ii) Health of IPS modules from potential free contacts iii) Availability of standby input power supplies from Auto-changeover system of IPS. 		<p>The following parameters shall be monitored (detailed list provided in Annexure A & C):</p> <ul style="list-style-type: none"> i. All voltage outputs through sensor/diagnostic port. ii. Battery: Overall Voltage and current of 110V battery bank through sensor. (Individual Battery monitoring is optional). iii. Parameters using Diagnostic port. iv. Status of potential free contact through Data logger. <p>The Station Gateway shall include an inbuilt protocol converter to interface with the IPS diagnostic port as per RDSO/SPN/165/2023 ver 4.0 amdt 1.0 and Annexure-I</p>	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.

	Station gateway should have inbuilt Protocol convertor for interfacing with IPS diagnostic port. IPS OEMs shall share data format of diagnostic port with RDPMS OEMs.		(Modbus register mapping of IPS for RDPMS uploaded in RDSO website under policy letter section. Use of diagnostic port of IPS (old version) for monitoring purpose is optional. If required, Zonal Railway shall facilitate the sharing of protocol of these IPS from respective OEMs to RDPMS vendors. However, it shall be responsibility of RDPMS vendor to integrate the interface port, if made available.	
4.4.3	<p>Surge Protection Devices:</p> <p>The potential free contacts of SPD devices where available shall be monitored. Care should be taken to keep sensor wiring from SPD such that (electrically) dirty cable in SPD box is not in parallel to sensor wires.</p>	<p>M/s Phoenix Contact :</p> <p>All Power Line and Communication line / data line shall be protected with Type -3 pluggable surge protection device, device shall be tested and certified in Accordance to IEC 61643-11:2011 by KEMA/UL/VDE and shall be self-contained and self-resetting.</p> <p>Reason:</p> <p>IEC Standard is most important and its already mentioned RDSO TAN No STS/E/TAN/3006.</p>	<p>The potential-free contacts of SPD devices, where available, shall be monitored through Data logger.</p> <p>If the potential-free contacts of SPD devices are not logged in Data logger, same can be captured by using IoT. Care must be taken to ensure that the wiring from the SPD is routed in a manner that prevents it from running parallel to electrically "dirty" cables within the SPD box, thereby minimizing interference and ensuring accurate data</p>	<p>The purpose of this clause is to monitor the status of PF contact of SPD being used in signaling Ckt. No need to mention the details of SPD because these are irrelevant with the scope of RDSO.</p>

			capture.	
4.4.4	OFC Cable: Monitoring of Dark Fibre for monitoring the health of OFC cable, especially those not under NMS monitoring (like OFC for distributed EI, EI to ASM room, etc). The dark fibre of the cable shall be used to detect the following: i) OFC cut and Geographical Location of Cut. ii) dBLoss / Degradation.	M/s Amara Raja Power Sys. Ltd., Suggestions: The approaches taken for monitoring through OTDR/RFMS are adequate and expensive; nonetheless, it would be preferable to establish a common monitoring device at the network provider's server or exchange rather than installing separate devices at each station is more meaningful. Mostly tele room to EI and assets communicated through cat5/6 cables.	Deleted	Remark already given.
4.4.5	All Networking switches/dc-dc convertors and other devices having potential free contacts for monitoring.			Based on discussion, Clause has been deleted
4.4.6	Fuse Auto changeover system: Status of main and standby fuse.			Based on discussion, Clause has been deleted
4.4.7(old)	Battery: Overall Voltage and current of 110V battery bank will be monitored.	M/s Efftronics System Pvt. Ltd:		This clause is now merged with Clause no. 4.4.2. Monitoring individual

	<p>Individual cell voltage monitoring is recommended</p> <p>Because a single weak cell can degrade the performance of the entire battery bank, it's not possible to identify a weak cell if bank voltage only is monitored</p> <p>Monitoring individual cell voltages allows for the early detection of underperforming cells and enable timely replacement</p> <p>Zonal railways are asking us to provide each cell monitoring along with RDPMs.</p> <p>M/s Amara Raja Power Sys. Ltd.,</p> <p>Comments: The monitoring of bank voltage and current, as specified in Annex C, fails to detect weak cells at an early stage. As a result, predictive outcomes are not achievable, and it becomes difficult to ascertain which battery is performing poor until a failure/fault arises or under load conditions. The process of monitoring individual battery accomplish a lower Mean Time to Repair (MTTR).</p>		<p>Battery terminal Voltage is kept optional.</p> <p>In earlier reasoned Document, Zonal Railways were requested to offer comments/suggest whether individual cell voltage monitoring is required or not. No suggestion has been received, hence suggestion has not been considered.</p> <p>Same as above.</p> <p>.</p>
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4.4.9 (Now 4.4.7)	<p>Cables:</p> <p>The use of coordinated data shall be made by the machine learning to monitor the voltage drop analysis for checking the health of signalling and power cables. Hence, existing data collected from voltage in IPS room, Voltage in field, ELD data etc will serve for the health of cables.</p>	<p>M/s Amara Raja Power Sys. Ltd.,</p> <p>Suggestions: To effectively detect geographical cable faults, it is essential to monitor bus bar voltage in conjunction with the total incoming and outgoing current at location box. Integrating this monitoring with data from IPS parameters yields a more detailed perspective on the performance of cables, including those identified as Bx110, B100 and B24. This strategy helps prevent unnecessary entire isolation or megger work on the relevant upstream and downstream sections.</p>	<p>4.4.7 Earth Leakage Detector (ELD) and Cable:</p> <p>Status of earth leakage from the ELD shall be monitored through Potential-Free contacts/diagnostic port.</p> <p>The potential-free contacts of ELD shall be monitored through Data logger. If the potential-free contacts of ELD are not logged in Data logger, same can be captured by using IoT.</p> <p>Use of diagnostic port of ELD for monitoring of cable health is optional. If required, Zonal Railway shall facilitate the sharing of protocol of ELD from respective OEMs to RDPMS vendors. However, it shall be responsibility of RDPMS vendor to integrate the interface port, if made available.</p> <p>Coordinated data shall be utilized by machine learning to perform voltage drop analysis, enabling the monitoring of the health of signalling and power cables. Data already being collected, such as voltage readings in the IPS room, voltage in the field, and ELD (Earth Leakage Detector) data, will be leveraged to assess the</p>	<p>Please refer Cl. No. 4.4.2. It has been suggested to integrate Station gateway with IPS through Protocol converter. ELD is also being monitored by RDPMS so cable fault shall be calculated at application level.</p> <p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>
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			health and reliability of the cables.	
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4.4.9	<p>Block Instruments:</p> <p>Line current and selective data for different types of Block Instruments using non-intrusive sensors.</p>	<p>4.4.9 Block Instruments (Optional):</p> <p>Relay status (potential-free contacts) of the Block Instrument shall be monitored through Datalogger. Line current and selective data for various types of Block Instruments shall be monitored using non-intrusive sensors. These sensors will ensure accurate data collection without interfering with the operation of the block instruments, maintaining system integrity and reliability.</p>	<p>Several meetings were held with RDPMs Vendors for finalization of RDPMs FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>
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4.4.10	<p>UFSBI:</p> <p>Relay status and Potential free contacts of UFSBI modem, Data from Diagnostic port, etc shall be monitored. Protocol shall be shared by OEM for sharing diagnostic data. (Optional).</p>		<p>4.4.10 UFSBI(Optional):</p> <p>Relay status (potential-free contacts) of the UFSBI modem shall be monitored through Datalogger. If the potential-free contacts of UFSBI are not logged in Data logger, same can be captured by using IoT.</p> <p>Use of diagnostic port of UFSBI for monitoring of it's health is optional. If required, Zonal Railway shall facilitate the sharing of protocol of UFSBI from respective OEMs to RDPMS vendors. However, it shall be responsibility of RDPMS vendor to integrate the interface port, if made available.</p>	<p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>
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4.4.11	Ambient Temperature and humidity of Battery room, relay room, power room, IoT devices location, etc shall be recorded. The temperature data may help in machine learning algorithms to model the environmental effects.		The ambient temperature and humidity of the battery room, relay room, power room, and Outdoor shall be recorded. This temperature data can be utilized in machine learning algorithms to model and analyze the impact of changes in these parameters on system performance and asset health.	Several meetings were held with RDPMs Vendors for finalization of RDPMs FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
4.4.12	Ambient Temperature and humidity of Battery room, relay room, power room, IoT devices location, etc shall be recorded. The temperature data may help in machine learning algorithms to model the environmental effects.	<p>M/s Bitcomm Technologies Pvt. Ltd.:</p> <p>Ambient Temperature and humidity of Battery room, relay room, power room, etc shall be recorded. The temperature data may help in machine learning algorithms to model the environmental effects.</p> <p>Reason:</p> <p>Only one ambient temperature is sufficient for outdoor devices. Not required in each devices.</p>	The ambient temperature and humidity of the battery room, relay room, power room, and Outdoor (Location may be decided by Zonal railway) shall be recorded. This temperature data can be utilized in machine learning algorithms to model and analyze the impact of changes in these parameters on system performance and asset health	<p>Agreed to Bitcom Suggestion.</p> <p>Several meetings were held with RDPMs Vendors for finalization of RDPMs FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>
4.4.13	Any other equipment not in above list or any additional parameter of above listed		Deleted	

	equipment as found suitable for better predictive maintenance will be incorporated. However, to avoid unnecessary wiring for monitoring, it is recommendatory to monitor only required assets and parameters.			
4.4.13 (new)	Different Colour cable shall be used for sensors wiring in CT rack for easy identification. Colour scheme should be decided by Zonal Railways.	M/s Efftronics System Pvt. Ltd: Alongside colors, Type of cables, standard of cables to be used may be specified for uniformity.	Different color-coded cables shall be used for sensor wiring in the CT rack to facilitate easy identification. The color scheme shall be determined by the respective Zonal Railways. Note: 1. Assets indicated as optional in this FRS are to be specified clearly in the schedule of work, if Zonal Railways want to monitor. If it is not specified by Zonal Railways, it will be assumed that the scope of work does not cover these items. 2. For assets where logics have not been defined in FRS in Annexure C, the logics for them should be prepared by Zonal Railways and get approved by RDSO.	Noted. It will cover in Pre-Commissioning checklist. Minor modification made in the clause as discussed.
5.1	The IoT device shall be software embedded system preferably COTS	M/s Bitcomm Technologies Pvt. Ltd.: The IoT device shall be a software-	The IoT device shall be a software-embedded system preferably COTS (commercially	COTs IoTs are internationally used product and proven

	<p>(commercially off the shelf) to meet the required performance level of RDPMS system and will do the basic function of capturing the parameters from the Signalling devices using the sensors and diagnostic ports and transmit the data to Station Gateway at the station.</p> <p>Reason:</p> <p>COTS item will not meet the Railway track side requirement. It has to be customized embedded device as per railways requirement.</p> <p>M/s Phoenix Contact :</p> <p>Additional Point to be added: IOT Device required technical information which are:</p> <ul style="list-style-type: none"> 1. Degree of Protection: IP20 2. Ambient temperature: -25 C to 60 C 3. Permissible Humidity : 5% to 95% (according to DIN EN 61131-2) <p>Reason: IOT Technical Data is missing.</p>	<p>embedded system, designed to meet the required performance standards of the RDPMS system. Its primary function will be to capture parameters from signalling devices using sensors and diagnostic ports and transmit this data to the Station Gateway located at the station.</p>	<p>off the shelf), designed to meet the required performance standards of the RDPMS system. Its primary function will be to capture parameters from signalling devices using sensors/Digital input/PF contacts and diagnostic ports and transmit this data to the Station Gateway located at the station.</p>	<p>design.</p> <p>Please refer Cl. No. 5.10. Compliance of RDSO/SPN/144 has been mentioned. Degree of Protection is not required as it is to be used either inside location boxes or in Relay room/power room/IPS room: IP20 requirement unnecessarily increase the cost.</p>
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		M/s Gadgeon Smart Systems pvt Ltd.: Protects embedded devices from unauthorized access and vulnerabilities by applying encryption, secure boot processes, and regular security assessments in line with ISO 27001:2022 and IEC 62443 standards		Minor modification made in the clause as discussed. For vulnerabilities, please refer cl. no. 5.11. Compliance with the TEC (Telecommunication Engineering Center) Code of practice for securing Consumer Internet of Things (IoT) (TEC 31318:2021 or latest).
5.2	IoTs should have inbuilt memory - Minimum 10 days or 20 lakhs events data backup would be required.		IoTs should have inbuilt memory of minimum 10 days. Events shall be recorded on a first-in, first-out (FIFO) basis, ensuring that the latest data remains available in the system. Additionally, the IoT device must prevent event loss in case of power failure or communication failure, ensuring data integrity and reliability.	Several meetings were held with RDPMs Vendors for finalization of RDPMs FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
5.3	For monitoring at IBS/LC/Auto Signalling assets, the IoT device shall be linked to nearest station and its Station Gateway through wired communication (Copper cable /		For monitoring at IBS (Intermediate Block Signaling), LC (Level Crossing), and Auto Signaling Assets, the IoT device shall be linked to the nearest	Several meetings were held with RDPMs Vendors for finalization of RDPMs FRS. As

	OFC).		station and its Station Gateway through communication technologies (such as quad/PIJF cables, wireless communication technologies (such as 4G/5G/LTE) shall be used to ensure reliable and fast data transfer.	per discussion in these meeting, minor modification done with this clause and produce in alongside column.
5.4	<p>It shall work on available 24V DC power of IPS as available at site. Provision to work with 110V AC may also be kept as second option. If IPS power supply is not available at location, Railway should provide 24 DC or 110VAC.</p> <p>If 110VAC is used for power supply, the OEM shall supply DIN Rail Mounting type AC-DC adopter of required rating. Universal type adopter preferably commercial-off-the-shelf(COTS) type adopter shall be supplied.</p>	<p>M/s Bitcomm Technologies Pvt. Ltd.:</p> <p>It shall work on available 24V DC power of IPS as available at site. Provision to work with 110V AC may also be kept as second option. If IPS power supply is not available at location, Railway should provide 24 DC or 110VAC.</p> <p>If 110VAC is used for power supply, the OEM shall supply DIN Rail Mounting type AC-DC adopter of required rating. Universal type adopter preferably commercial-off-the shelf(COTS) type adopter shall be supplied. OR Internal converter to be used.</p> <p>Reason: External Converter or Internal Converter Option should be there for integrated Power Supply.</p>	<p>The IoT device shall operate on the available 24V DC power supply from the IPS at the site. Additionally, a provision to operate on 110V AC shall be included as a secondary option. If an IPS power supply is not available at the location, Railways shall provide either a 24V DC or 110V AC power supply.</p> <p>If 110VAC is used for power supply, the OEM shall supply DIN Rail Mounting type AC-DC adopter of required rating. Universal type adopter preferably commercial-off-the-shelf (COTS) type adopter shall be supplied OR 110 V AC internal converter should be used.</p>	<p>Commercial-off-the-shelf(COTS) type adopter in case of 110 VAC is preferred based on suggestion of ECR so that universal design type adopter can be used to avoid OEM dependancy. Use of internal converter will defeat the purpose.</p> <p>Minor modification made in the clause as discussed.</p>

5.5	IoT shall communicate with other IoTs and station gateway through wired/wireless technologies based on local site conditions and feasibility.		The IoT device shall communicate with the Station Gateway using either wired or wireless technologies, depending on local site conditions and feasibility as detailed in Section-7.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
5.6	IoT shall send health of sensors attached with it to station gateway for monitoring of health of sensors. The health data packet shall be sent to Application Software with cause of failure of sensors as described in annexure A & B.	<p>M/s Bitcomm Technologies Pvt. Ltd.: IoT shall send heartbeat as health of own status periodically to station gateway for monitoring of health of IOT devices. The health of sensor connected to the IOT devices may be identified by analysing and correlating data at station gateway or Centralized RDPMS Application end.</p> <p>Reason: Sensor output being analog absolute values , the health of sensor may not be identified with 100% accuracy.</p> <p>M/s ENERGY7: The IoT device shall periodically send its own health status (heartbeat) to the Station Gateway for continuous monitoring. This health status data, along with any</p>	The IoT device shall periodically send its own health status to the Station Gateway for continuous monitoring. This health status data, along with any detected anomalies, shall be transmitted to the Application Software, as described in Annexures A and B.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.

		<p>detected anomalies, shall be transmitted to the Application Software, adhering to the OneM2M standards outlined in Annexures A and B.</p> <p>Reason:</p> <p>Sensors are analog device. Health can be derived by comparing values rather some direct means</p> <p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Some abnormalities in sensor behavior can be monitored but complete cases of sensor failure cannot be monitored from Voltage or Current output sensors</p>		
5.7	<p>It is imperative that the IoT device will continuously monitor the sensors for the parameters depending on scanning interval. Scanning interval to be defined keeping in mind type of gear/parameter, requirement for machine learning & AI and availability of COTS IOT devices. However, device should support scanning interval of 20ms or less. It should be possible to configure scanning interval. by Application Software using Configuration data packet as</p>	<p>ECR:</p> <p>The scan interval for all sensors as 20ms is considered to be very stringent. As mentioned in clause 4.3.1, a 20ms scan interval for point's voltage and current during its operation will be required. For others, this may be considered for relaxation to about 100-150ms.</p>	<p>The IoT device shall continuously monitor sensors for parameters based on a configurable scanning interval. The scanning interval shall be determined by considering the type of gear/parameter, the requirements for Machine Learning and AI, and the capabilities of the IoT devices. The device must support a scanning interval of 20ms or less and should be configurable by RDPMS Application/Station</p>	<p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p> <p>Scanning interval of 20 ms has been kept for effective</p>

	described in annexure A & B.		Gateway.	generation of fault/alert.
5.8	Further, the data captured by IoT device will be transferred to station gateway. However, if the data is transferred every cycle, there would be two issues: first is the bandwidth requirement for channel and second is the large data which may be difficult to handle and will be ignored at processing level at higher stages. Hence, selective methodology is required to be made for each type of devices per general guidelines below:		<p>Some examples for ready reference are as below:</p> <ul style="list-style-type: none"> i) Track circuits and Signal Lamp or indication voltages of Point Machine and ELBs, which are available continuously the operational parameters may be sent conditionally whenever change of reading is more/less than specific percentage (say $\pm 2\%$) of standard operating value last sent value. The % should be configurable from Application software. For transition from one level to other like 110 V to 0 V, intermediate voltages during transition may be skipped till the value is settled. ii) However, for Point machine & ELB motor which operates only for few seconds, the operating voltage and current for every operation will be important to capture its current signature. The 	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.

			<p>current signature may help in deciding machine learning to predict cases of less lubrication, friction clutch issue, stone obstruction and gap, Health of motor etc. For such application data will be captured & stored at an interval of 20ms along with tolerance which shall be configurable. by Application software.</p> <p>iii) Digital status should be sampled for every change from UP to DN or vice versa.</p> <p>Note: Sampling details have been given in Annexure A.</p>	
5.9	IoT device should be rugged and industrial grade suitable for 24x7 working.		<p>The IoT device shall be rugged and of industrial grade, designed to operate reliably under 24x7 working conditions.</p>	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce

				in alongside column.
5.10	IOT devices shall be tested as per RDSO/SPN/144 from Signal Lab of RDSO or government accredited/NABL Lab. IOT device should comply immunity requirement as per table-2 of IEC 61326 (Immunity test requirement for equipment intended to be used in an industrial electromagnetic environment). The test certificate shall be submitted.	<p>M/s Bitcomm Technologies Pvt. Ltd.: IOT devices shall be tested as per RDSO/SPN/144 from Signal Lab of RDSO or NABL accredited government Lab. IOT device should comply immunity requirement as per table-2 of IEC 61326 (Immunity test requirement for equipment intended to be used in an industrial electromagnetic environment). The test certificate shall be submitted.</p> <p>Reason: For better scrutiny only government lab shall be preferred.</p> <p>M/s ENERGY7: IOT devices shall be tested as per RDSO/SPN/144 from Signal Lab of RDSO or NABL accredited government Lab. IOT device should comply immunity requirement as per table-2 of IEC 61326 (Immunity test requirement for equipment intended to be used in an industrial electromagnetic environment). The test certificate shall be submitted.</p>	<p>The IoT devices shall be tested in accordance with RDSO/SPN/144 as per RDSO approved test format.</p> <p>The IoT devices must also comply with the immunity requirements specified in Table-2 of IEC 61326 (Immunity test requirements for equipment intended to be used in an industrial electromagnetic environment).</p> <p>Test certificate confirming compliance with above standards shall be submitted from Govt. Lab. If test facility is not available in Govt. Lab, test shall be carried out from NABL accredited Lab.</p>	<p>Lab criteria is being revised as per ISO Doc. QOD 8.1-10.</p> <p>Modified clause is given in alongside clause.</p>

		<p>Reason:</p> <p>Private lab things can be manipulated</p>		
5.11	<p>It should be ensured that IoTs themselves are secure, including protection against firmware and software vulnerabilities and tamper proof to prevent unauthorized access to the device. Vendor should ensure compliance with the TEC (Telecommunication Engineering Center) Code of practice for securing Consumer Internet of Things (IoT) (TEC 31318:2021 or latest).</p>	<p>M/s Efftronics System Pvt. Ltd: Since IoT devices are installed in a closed network and not directly exposed to any external network, they are developed on bare metal, making the probability of unauthorized access very low. Moreover, these IoT devices are used for monitoring the signaling system and not for controlling any gear. Hence, compliance with TEC 31318:2021 is not required.</p> <p>M/s Bitcomm Technologies Pvt. Ltd.: IOT devices are Industrial IOT . Hence cosumer IOT security option shall not be exercised.</p>	<p>It must be ensured that IoT devices are secure, including protection against firmware and software vulnerabilities, and are tamper-proof to prevent unauthorized access. Vendor should ensure compliance with the TEC (Telecommunication EngineeringCenter) Code of practice for securing Consumer Internet of Things (IoT) (TEC 31318:2021 or latest).</p>	<p>This clause is mainly for compliance of security, including protection against firmware and software vulnerabilities and tamper proof.</p> <p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>
5.12	<p>System should be modular and scalable in design to make it economical; preferably rack mountable. It should be compact in nature so as to accommodate in existing location boxes.</p>		<p>The system should have a modular and scalable design. Preferably, it should be rack mountable and compact enough to fit within existing location boxes.</p>	<p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting,</p>

				minor modification done with this clause and produce in alongside column.
5.13	The codal life of IoT device shall be 10 years from the date of commissioning.	<p>ECR:</p> <p>The codal life of 10 years is quite long for industrial COTS Electronics project. This may be reduced 5 years has been done for station Gateway in clause 6.14.</p> <p>M/s Bitcomm Technologies Pvt. Ltd.:</p> <p>The IoT device shall have a codal life of minimum 5 years from the date of commissioning.</p> <p>M/s ENERGY7:</p> <p>The IoT device shall have a codal life of minimum 5 years from the date of commissioning.</p> <p>Reason:</p> <p>Request to consider 5 Years</p>	Deleted	
5.14	Cyber Security of IoT devices installed by the vendor will be		The cybersecurity of IoT devices	Several meetings were held with

	<p>the responsibility of the vendor. Third party cyber security audits of IoTs installed by vendors at respective sites on sample basis as deemed fit by Railways, subject to regulatory requirements applicable, will have to be done by vendor from cybersecurity organizations empanelled by CERT-In and compliance of audit observations shall be ensured by Railways. As a general guideline, it may be ensured that audit of devices is done in such a way that atleast 10% IoT devices under jurisdiction of each station is covered.</p>		<p>shall be ensured, with third-party cybersecurity audits conducted on a sample basis as deemed necessary by Railways, in accordance with applicable regulatory requirements. These audits must be carried out by cybersecurity organizations empanelled by CERT-In i.e SQTC (Ministry of Electronics & Information Technology),,</p>	<p>RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>
5.15	<p>The IoT device should be capable of connecting with external devices (laptop, mobile, etc.) to read, download realtime microcontroller logs, saved data, etc. during audits.</p>		<p>The IoT device should support connectivity with external devices such as laptops and mobile phones to enable reading and downloading of real-time microcontroller logs and saved data</p>	<p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>
5.16 (New)		<p>M/s Bitcomm Technologies Pvt. Ltd.:</p> <p>Spare Channel</p> <p>IOT devices should have up to 4 Channel Spare in each location to</p>	<p>New Clause:</p> <p>IOT devices deployed in each location shall have at least 10% spare Channels which can be used in future for any</p>	<p>Agreed.</p> <p>10% spare channel with IoT device has been provisioned and new clause has</p>

		<p>cater provision of future parameter/gear addition this will avoid reinstallation and modifications if any.</p> <p>The minimum technical specification for IOT device will be helpful for the OEM and Purchaser.</p>	augmentation/modification.	been added to FRS as given in alongside column.
6.1	<p>At each station, there shall be one embedded electronic unit called Station Gateway. It shall receive raw data/parameters value from Sensors through IoT devices and from diagnostic ports of various equipments for Signalling assets. It shall send/receive the data to/from RDPMS Application software through Intermediate service Platform (to be planned by Vendors) as per standard Data Format using MQTT protocol. It shall act as edge computing Device at station. It shall have inbuilt protocol convertors for connectivity with datalogger, IPS and other equipments as referred in clause 3.3 & 4 of this document as shown in architecture at Fig – 1. It shall have diagnostic features and</p>		<p>At each station, there shall be an embedded electronic unit called the Station Gateway. It will receive raw data and parameter values from sensors via IoT devices and diagnostic ports of various signaling assets. It shall send/receive the data to/from RDPMS Application software through Intermediate service Platform (to be planned by Vendors) as per standard Data Format using MQTT protocol (Annexure A & B). It shall also send Sensor/IOT health status to Application Software as per Annexure A & B. It will function as an edge computing device at the station and include built-in interface (protocol converters) for connectivity with dataloggers and IPS as detailed in Section-4.</p>	<p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>

	<p>configuration capabilities as per Annexure A & B. Details of Data Format are given in Annexure B. (Annexure A also to be referred for Standard Nomenclature).</p>	<p>Station Gateway shall also be capable to receive data from diagnostic port of SSDAC, MSDAC, BPAC, UFSBI, AFTC, and ELD etc. Interfacing with diagnostic port of these equipment is optional. If required, Zonal Railway shall facilitate the sharing of protocol of these equipment from respective OEMs to RDPMS vendors. However, it shall be responsibility of RDPMS vendor to integrate the interface port, if made available.</p> <p>It shall also have diagnostic features and configuration capabilities. Details of Data Format are given in Annexure B. (Annexure A also to be referred for Standard Nomenclature).</p>	
6.2	<p>Initially, there will be one Gateway (with its IoTs and sensors) at one station at the time of first installation by any OEM. This Gateway can either be connected to Application software of same OEM (If new section is being done) OR can be connected to Application Software of existing OEMs (if addition of new station is being done in existing RDPMS</p>	<p>IoT devices, sensors, and the Station Gateway from a single vendor shall be installed according to the specific requirements of each station. To ensure interoperability, Station Gateways (along with IoT devices and sensors) from different vendors shall be seamlessly integrated with application</p>	<p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p>

	section). Interoperability will be ensured by standard Data format.		software from other vendors utilizing the standardized data format.	
6.3	Later on, in case when augmentation of same station is planned, another Gateway (with its IOTs and Sensors) can be added by same/different OEMs with connectivity to existing Application software which will be ensured by interoperability feature. Standard data format has provision of defining multiple Gateways at one station as per Annexure A.		During future station augmentations, an additional Gateway, along with its IoT devices and sensors, may be deployed by the same or a different vendor. Integration with the existing application software will be facilitated through standard data format ensuring seamless interoperability. The standard nomenclature and data format supports the definition of multiple Gateways at a single station. For further details, refer to Annexure B, with Annexure A providing the standard nomenclature.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
6.4	Event logging facility for minimum 50 Lac events OR Minimum 10 days whichever is higher shall be provided in a Station gateway. Events shall be recorded on first in – first out basis so that latest data is available in the system. There should be no loss of events from the station gateway memory in case of		The Station Gateway shall have an event logging capacity of minimum 10 days. Events shall be recorded on a first-in, first-out (FIFO) basis, ensuring that the latest data remains available in the system. Additionally, the Station Gateway must prevent event loss in case of power failure or communication failure,	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce

	power supply or failure of communication.		ensuring data integrity and reliability.	in alongside column.
6.5	The hardware structure of the system shall be modular.		The system's hardware architecture shall adopt a modular design, enabling scalability, flexibility, and ease of maintenance.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
6.6	The system shall be easily reconfigurable to any changes required by user, whenever modifications are carried out in the yard.		The system shall be easily reconfigurable to accommodate user-required changes, ensuring seamless adaptation to modifications made in the yard.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
6.7	Implementation of version control and change of software shall be as per RDSO/SPN/144.		The implementation of version control and software modifications shall comply with RDSO/SPN/144 standards.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this

				clause and produce in alongside column.
6.8	The embedded software of the Station Gateway shall be of approved type and written in a structured format so that the purchaser can reconfigure it, if required.	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>We have the Station Gateway firmware complying to standard structure to be followed for such embedded device firmware. The parameters which undergo change from station to station are a set of "configurable parameters" which can be changed by customer also.</p> <p>We seek clarity and confirmation from Railway that this is the meaning of "approved structured format" written in the FRS.</p> <p>M/s Amara Raja Power Sys. Ltd.,</p> <p>Comments : clarification required regarding the approval of software types. Will the gateway configuration be implemented using a graphical user interface, or is it expected to align with the guidelines that RDSO will issue</p>	<p>The user interface for configuring the Station Gateway shall be designed in a structured manner, ensuring that the Purchaser can reconfigure the station gateway if required.</p>	<p>Structured programming (sometimes known as modular programming) is a programming paradigm that facilitates the creation of programs with readable code and reusable components.</p> <p>However it is not possible to clarify whether your software is written in a structured format or not and also it is not in the scope of this comments/suggestion.</p> <p>Approval of software/overall system is a management decision and same will be done with due course.</p>

		guidelines in the future?		Minor modification made in the clause as discussed.
6.9	<p>Station Gateway consists of:</p> <ul style="list-style-type: none"> (i) Protocol converter module for electronic signalling equipment like Data logger (compulsory) & IPS(Compolsory), ELD, SSDAC/MSDAC/BPAC, AFTEC etc. (Optional) as per site requirement (Caluse 3.3 & 4 should be reffered). (ii) Communication module i.e. E1 converters, Ethernet converter, wireless module (wifi, LoRA, Zigbee, LTE/4G & Media Converters module and Leased line Voice Modem(s). Suitable communication module shall be supplied as per site requirements and approved plan. 		<p>Station Gateway consists of:</p> <ul style="list-style-type: none"> (i) Suitable Interface for electronic signalling equipment like Data logger, IPS, ELD, SSDAC/MSDAC/BPAC, AFTEC etc as detailed in clause no.6.1. (ii) Edge Computing Hardware, Edge Application Software, and Communication Interfaces, including Ethernet, LTE/4G, RS485/RS232 (Serial Interface), wifi, LoRA, Zigbee , etc and additional interfaces as required. 	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
6.10	At least 12 serial ports shall be provided for communication with dataloggers, IPS, ELD, MSDAC, etc. These ports shall be re-configurable. Unused ports should be blocked/disabled and same	<p>ECR:</p> <p>Serial ports have been asked for communication with data-loggers and other signaling systems. As the whole is world moving towards Ethernet, minimum two 100mbps Ethernet ports should be planned.</p>	The communication interface ports of the Station Gateway shall be configurable, ensuring flexibility for integration with various interlocking systems and subsystems. Unused ports shall be blocked/disabled and shall	<p>Pls refer Clause no. 6.11 of revised FRS. Ethernet port provision is included in Station Gateway.</p> <p>Several meetings were held with</p>

	<p>shall be enabled when required under approval of Zonal Railway.</p> <p>M/s Bitcomm Technologies Pvt. Ltd.:</p> <p>Minumim 6 serial ports shall be provided for communication with dataloggers, IPS, ELD,MSDAC, etc. These ports shall be re-configurable. Unused ports should be blocked/disabled and same shall be enabled when required under approval of Zonal Railway.</p> <p>Reason:</p> <p>Minimum 12 serial ports would not be required in most of the stations . Hence the number of ports shall be defined by Railways during the schedule instead of fixing it in the specs .</p> <p>M/s DCC Pvt. Ltd:</p> <p>We suggest that no. of serial ports should be left open as 'as required' instead of 'at least twelve'. This can be specified by the purchaser railway, depending on the actual site requirements of interfacing external equipment. External</p>	<p>only be enabled when required.</p>	<p>RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.</p> <p>Please refer revised clause given in alongside column.</p>
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		devices like serial servers and Ethernet switches may be used for required number and nature of connections.		
6.11	Station Gateway shall be capable of working with different transmission media like underground telecom cable, OFC (dark fiber or digital network & wireless network. It should be capable of working on E1 Channel, Ethernet, voice channel. Provision of suitable accessories (modem/converters) as per requirement of consignee shall be made available. The modem/converter will be housed with in the gateway cabinet.		<p>The Station Gateway shall be capable of operating with various transmission media, including quad/PIJF cable/optical fiber cable (dark fiber), IP network and wireless networks (4G/5G/LTE) including Ethernet and E1. Provision of other Short-range wireless technologies (LoRa, Zigbee or any licence free band technology etc. may also be made based on requirement.</p> <p>Provision of suitable accessories as per requirement of consignee shall be made available.</p>	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
6.12	Power Supply: The system shall work on 24V DC (+/- 30%). 24VDC IPS channel shall be used.		<p>The system shall operate on 24V DC with a tolerance of ±30%. The 24V DC IPS channel shall be utilized for power supply.</p>	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in

				these meeting, minor modification done with this clause and produce in alongside column.
6.13	Station gateway device should be rugged and industrial grade suitable for 24x7 working.		<p>The Station Gateway device shall be rugged and industrial-grade, designed for 24x7 continuous operation, ensuring high reliability and durability in demanding environments.</p> <p>The Station Gateway shall be tested in accordance with RDSO/SPN/144 as per RDSO approved format.</p> <p>A test certificate confirming compliance with these standards shall be submitted from Govt. Lab. If test facility is not available in Govt. Lab, test shall be carried out from NABL accredited Lab.</p>	Several meetings were held with RDPMs Vendors for finalization of RDPMs FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
6.14	The codal life of Station Gateway device shall be 10 years from the date of commissioning.		Deleted	
6.15	Cabinet shall be modular and ergonomic in design with good maintainability. The cabinet should be powder coated. There shall be locking		The cabinet shall be modular and ergonomically designed, ensuring ease of maintenance. It shall be powder-coated for durability and corrosion resistance. There shall	Several meetings were held with RDPMs Vendors for finalization of RDPMs FRS. As

	arrangement for the whole equipment to avoid unauthorized access.		be locking arrangement for the whole equipment to avoid unauthorized access.	per discussion in these meeting, minor modification done with this clause and produce in alongside column.
6.18 (New- 6.16)	It should be ensured that gateways deployed at stations are secure, including protection against firmware and software vulnerabilities and tamper proof to prevent unauthorized access to the device. Vendor should ensure compliance with the TEC (Telecommunication Engineering Center) Code of practice for securing Consumer Internet of Things (IoT) (TEC 31318:2021 or latest).		It shall be ensured that Station Gateways are secure, incorporating protection against firmware and software vulnerabilities. The devices shall be tamper-proof to prevent unauthorized access and ensure the integrity of the system. Vendor should ensure compliance with the TEC (Telecommunication Engineering Center) Code of practice for securing Consumer Internet of Things (IoT) (TEC 31318:2021 or latest).	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
6.20 (New- 6.17)	Cyber Security of Gateways installed by the vendor will be the responsibility of the vendor. Third party cyber security audits of gateways installed by vendors at respective sites on sample basis as deemed fit by Railways, subject to regulatory requirements applicable, will have to be done by vendor from cybersecurity organizations empanelled by CERT-In and compliance of audit observations shall be ensured by Railways.		Cybersecurity of station gateway shall be ensured, with third-party cybersecurity audits conducted on a sample basis as deemed necessary by Railways, in accordance with applicable regulatory requirements. These audits must be carried out by cybersecurity organizations empanelled by CERT-In i.e SQTC (Ministry of Electronics & Information Technology).	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.

6.21 (New-6.18)	The station gateway should be capable of connecting with external devices (laptop, mobile, etc.) to read, download realtime microcontroller logs, saved data, etc. during audits.		The station gateway should support connectivity with external devices such as laptops and mobile phones to enable reading and downloading of real-time microcontroller logs and saved data.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
6.21 (New-6.19)	Edge computing shall be done by suitable Industrial grade hardware for 24x7 operation and unmanned functioning.	ECR: This clause talks about edge computing to be done by suitable industrial hardware. Clause 3.3 indicates that edge computing is to be done by station-gateway.	Deleted	
6.22 (New-6.20)	The Station gateway shall have Web Server Interface to allow remote access for <ul style="list-style-type: none"> ▪ Updating firmware ▪ Operating System ▪ Data log & export configuration, also provision to export data to any desired IP. ▪ Configuring polling interval, Calibrations of IoTs channels ▪ Configuring wireless channel for each IoTs from either 	M/s Efftronics System Pvt. Ltd: For data security reasons webserver interface to station gateway may be prohibited. Guidelines to be defined for remote access of station gateways for updating firmware, operating system data log and configuration etc. M/s Bitcomm Technologies Pvt. Ltd.:	The Station Gateway shall have remote access from for configurations from RDPMS Application as described in Annexure A ensuring seamless operation and adaptability. It should also be possible to configure it locally at station.	Agreed. Clause is modified and given in alongside column.

	<p>RF/LORA/WLAN.</p> <ul style="list-style-type: none"> ▪ Configuring or updating individual IoT data. ▪ For any other required function. 	<p>The Station gateway shall have Web Server Interface to allow remote access for:</p> <ul style="list-style-type: none"> • Data log & export configuration, also provision to export data to any desired IP. • Configuring polling interval • Configuring wireless channel for each IoTs from either RF/LORA/WLAN. • Configuring or updating individual IoT data. • For any other required function. <p>Reason: OS update and firmware update should not be remotely as this critical and required validation.</p> <p>M/s Amara Raja Power Sys. Ltd.,</p> <p>Comments: Clauses 6.22 and 10.12 outline a weblink for configuring the gateway and providing access to multiple OEMs through a single common link. This setup contradicts the web application requirements detailed in clauses 6.22, 10.12 with 10.4, where the use of a web browser has been excluded/strikeout in 10.4.</p>	
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Purpose of Cl. No.6.22 and 10.12 are different.
Cl. No 6 describes about Station Gateway where as Cl. No 10.12 mention a common weblink is required to access in case of multiple instances of

		<p>Suggestion: If a desktop application is selected for its security advantages, it is important the same could be implemented through the web application also. Desktop applications can be complex, as they require manual installation on each workstation and are limited to specific platforms (such as Windows, macOS, or Linux). In contrast, a web application serves as a universal platform that can be accessed by all users without the need for individual installations.</p> <p>(This suggestion is common for 6.22, 10.4 and 10.12)</p>		one OEM's application software is running.
7		<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Strengthens network defenses by isolating sensitive systems, detecting intrusions promptly, and ensuring adherence to industry security standards like ISO 27001:2022</p>		Comment is not understood.
7.1	The time synchronization is an important requirement between various IoT devices and Station gateway for meaningful data interpretation in machine learning. This has been taken care in the standard	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Time synchronization should be part of all modules like Data Logger, IPS in addition to Station Gateway and IoT devices</p>	<p>Time synchronization is a critical requirement for ensuring accurate data interpretation between various IoT devices and the Station Gateway, particularly for machine learning applications. This requirement is addressed through time sync standard data</p>	<p>Suggestion of M/s Gadgeon is noted.</p> <p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As</p>

	protocol as specified in Annexure- B Using Time sync Container. For master clock, the IRNSS (Indian Regional Navigation Satellite System) clock shall be taken for reference.		packet specified in Annexure-B. For the master clock, the IRNSS (Indian Regional Navigation Satellite System) clock shall be used as the reference.	per discussion in these meeting, minor modification done with this clause and produce in alongside column.
7.2.1 (Revised clause)	The real time field data (Voltage, current, temperature, humidity, relay status, vibration etc.) shall be captured by various sensors and processed .Then processed data is sent to station gateway through IoT devices. Wired communication (Quad cable, Signalling cable, dark fiber, Voice channel etc) and wireless communication (4G/LTE) shall be preferred for sending data from IoT to the station gateway. Short range wireless technology (LoRa, Zigbee etc.) should not be preferred in order to avoid delay in transmission of data from IoT devices to station gateway. Data from IoT devices deployed in location boxes on same side of tracks shall be collected by creating a networked clusters before sending it to	<p>ECR:</p> <p>Figure-2 shows the data-logger protocol convertor only from datalogger OEM This restriction may kindly be reviewed in line with Figure-1 and protocol converter may be allowed from third party as well.</p> <p>M/s Bitcomm Technologies Pvt. Ltd.:</p> <p>The real time field data (Voltage, current, temperature, humidity, relay status, vibration etc.) shall be captured by various sensors and processed .Then processed data is sent to station gateway</p>	<p>The real-time field data (such as voltage, current, temperature, humidity, relay status, vibration, etc.) shall be captured by various sensors and processed before being transmitted to the Station Gateway through IoT devices. For above data transmission, wired communication technologies (such as quad/PIJF cables, dark fiber) and /or wireless communication technologies (such as 4G/5G/LTE) shall be used to ensure reliable and fast data transfer. Short-range wireless technologies (LoRa, Zigbee, any licence free band technology etc.) may also be used for data transmission between IoT devices and station Gateway. Data from IoT devices deployed in location boxes on the same side of the tracks shall be aggregated into networked clusters (or any suitable means) before being sent to the Station</p>	<p>ECR suggestion have been addressed and Architecture has been updated.</p> <p>Allow of third party for supplying of protocol converter is not being considered to ensure smooth working of whole system and data confidentiality of Data logger data.</p> <p>Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in</p>

	<p>station gateway. A tentative station architecture is depicted in the figure-2.</p> <p>However exact communication media shall be decided based on site condition and same shall be decided by Zonal Railways during planning.</p>	<p>through IoT devices. Wired communication (Quad cable, Signalling cable, dark fiber, Voice channel etc) and wireless communication (4G/LTE) shall be preferred for sending data from IoT to the station gateway. Short range wireless technology (LoRa, Zigbee etc.) should not be preferred in order to avoid delay in transmission of data from IoT devices to station gateway. Data from IoT devices deployed in location boxes on same side of tracks shall be collected by creating a networked clusters before sending it to station gateway. A tentative station architecture is depicted in the figure-2.</p> <p>The IOT devices which are sending data via 4G/LTE/5G to Station gateway , it shall be transmitted via cluod/Central server.</p> <p>Reason:</p> <p>Outdoor LTE/4G Data: Data collected from outdoor IoT devices using LTE/4G technology will be transmitted to the Cloud/Server (typically with a public IP/domain) for further storage, processing, and</p>	<p>Gateway.</p>	<p>these meeting, minor modification done with this clause and produce in alongside column.</p>
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	<p>analysis.</p> <p>Once data is in the Cloud/Server, it will then be routed back to the Station Gateway, possibly for integration with other station systems, analysis, or to inform decisions.</p> <p>M/s ENERGY7:</p> <p>The real time field data (Voltage, current, temperature, humidity, relay status, vibration etc.) shall be captured by various sensors and processed .Then processed data is sent to station gateway through IoT devices. Wired communication (Quad cable,Signalling cable, dark fiber, Voice channel etc) and wireless communication (4G/LTE) shall be preferred for sending data from IoT to the station gateway. In locations where quad cable or optical fiber is not available, 4G/LTE shall be used, considering the future potential of LTE and NB-IoT. Use of signalling cables should be restricted. Short-range wireless</p>		Pls refer above remark.
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		<p>technology (LoRa, Zigbee, etc.) may also be permitted where 4G/LTE coverage is poor, and wired communication is not feasible. Data from IoT devices deployed in location boxes on same side of tracks shall be collected by creating a networked clusters before sending it to station gateway. A tentative station architecture is depicted in the figure-2.</p> <p>Reason:</p> <p>Signalling cables are prone to surges and interference, making them unreliable for real-time data transmission. They should be reserved for critical signalling operations. 4G is mandatory due to its higher reliability and future potential with LTE and NB-IoT. Zigbee and LoRa may be permitted where 4G is unavailable and wired options are not feasible</p>		
7.2.2 (Revised)	For communication from IoT device (in station yard near	ECR: This clause mandates OFC LC	It is preferable to choose One wired and one wireless interface,	Earlier Clause deleted.

clause)	<p>point, signals and other equipments) to Gateway at station–</p> <ul style="list-style-type: none"> - Copper cable. (RJ45 interfaces [IEC 60603-7]) - Optical fiber LC interface [IEC 61754-20](mandatory for outdoor field IoTs) - Wireless media onLoRA, Zigbee or any opensource technology in free band of wireless spectrum.In case of connectivity issue on the open source free band wireless system due to higher distance or due to other technical reason, 4G/LTE may be used for that location. <p>Wi-Fi communication:</p> <p>Note: It is preferable to choose One wired and one wireless interface, however based on site requirement, zonal Railway can decide types of communication media</p>	<p>interface as mandatory for outdoor field IoTs. It is requested that Ethernet as the protocol for OFC LC interface may also be specified for sake of standardization. Wireless technology other than 4G LTE should not be allowed for sake of standardization and to keep the RDPMS system easy to maintain.</p> <p>M/s Bitcomm Technologies Pvt. Ltd.: For communication from IoT device (in station yard near point, signals and other equipments) to Gateway at station–</p> <ul style="list-style-type: none"> - Copper cable. (RJ45 interfaces [IEC 60603-7]) if available. - Optical fiber LC interface [IEC 61754-20](Optional for outdoor field IoTs) - 4G/LTE (Wireless) - Wireless media onLoRA, Zigbee or any open source technology in free band of wireless spectrum may be used in the near cluster location boxes <p>Reason: Hybrid communication to be used for seamless data transmission.</p> <p>M/s ENERGY7: For communication from IoT device (in station yard near point,</p>	<p>however based on site requirement. Zonal Railway can decide types of communication media to be used for sending IoT data to Station Gateway.</p> <p>A tentative station architecture is illustrated in Figure-2.</p>	<p>Pls refer Clause no. 6.11 of revised FRS. Ethernet port provision is included in Station Gateway.</p>
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	<p>to be used for sending IoT data to Station Gateway.</p> <p>signals and other equipments) to Gateway at station–</p> <ul style="list-style-type: none"> - Copper cable. (RJ45 interfaces [IEC 60603-7]) - Optical fiber LC interface [IEC 61754-20](mandatory for outdoor field IoTs) - In locations where quad cable or optical fiber is not available, 4G/LTE shall be used, considering the future potential of LTE and NB-IoT. Use of signalling cables should be restricted. Short-range wireless technology (LoRa, Zigbee, etc.) may also be permitted where 4G/LTE coverage is poor, and wired communication is not feasible. <p>Reason:</p> <p>Signalling cables are prone to surges and interference, making them unreliable for real-time data transmission. They should be reserved for critical signalling operations. 4G is mandatory due to its higher reliability and future potential with LTE and NB-IoT. Zigbee and LoRa may be permitted where</p>		
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		4G is unavailable and wired options are not feasible		
7.2.3	For communication from outdoor type IoT devices (for field assets like signal, point, track circuits, etc) to Gateway at station, the wired connectivity is mandatory along with wireless connectivity as a redundant option.	<p>ECR: As OFC LC interface with Ethernet protocol has been suggested in clause 7.2.2, it is suggested that wireless interface need not be kept mandatory as ring protection on OFC Ethernet media is a better option. However, in case wireless for redundancy is proposed to be retained, then only 4G/LTE may be specified for sake of standardization.</p> <p>M/s Gadgeon Smart Systems pvt Ltd.: This contradicts the wireless option. With RF technology, wireless can be the preferred choice, especially in stations where wiring over longer distances is not feasible.</p> <p>What type of communication cable will be provided by the railway? Will it be a UTP cable, quad cable, twisted pair cable, or signaling cable?</p>	Deleted	Please refer clause NO. 7 for various communication requirement.

7.2.4 (Revised clause 7.2.3)	<p>While for communication from indoor type IoT device (for IPS, Axle counter evaluator, Datalogger, etc) to Gateway at station – RJ45 (copper) and/or LC port (Fiber) may be used.</p> <p>Redundant communication path (wired/wireless) must be kept for reliability.</p>	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <ul style="list-style-type: none"> • IPS, axle counters, and dataloggers do not typically support Ethernet port connectivity. Therefore, UTP, RJ45, and fiber connectivity may not be useful. • Alternative communication options such as twisted pair cables and wireless redundancy should be considered. 	<p>For communication between indoor Interlocking systems/subsystems (such as data logger, IPS, SSDAC, MSDAC, BPAC, UFSBI, AFTC, and ELD etc.) and the Station Gateway, RS232/RS485 (Serial Interface), RJ45 (Copper Ethernet), and LC Port (Fiber Optic) may be used. Redundant communication path (wired/wireless) must be kept for reliability.</p>	<p>Here communication between indoor type IoT and Station gateway has been discussed.</p> <p>Minor modification has been done in the clause and given in alongside clause as discussed.</p>
7.2.5 (Revised clause 7.2.4)	<p>For far away field IoT's like for IBH, LC gates wired media like OFC or wireless system like 4G/LTE may be used.</p>	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Fiber connectivity is beneficial at any location; however, will new OFC cable laying be planned alongside RDPMS implementation? Based on our experience, railways may not have spare fibers available for these locations. In such cases, RF(wireless)/ 4G/LTE should be considered as the primary solution.</p>		<p>Please refer revised FRS.</p> <p>Both media i.e OFC or wireless system like 4G/LTE have been mentioned, so requirement mention under this clause is sufficient.</p>
7.2.6 (Revised clause 7.2.5)	<p>For communication from Station Gateway to/from CCSP to/from RDPMS Application, existing MPLS network of Railways Station shall be used. For redundancy, 4G/LTE</p>	<p>M/s Efftronics System Pvt. Ltd:</p> <p>Quality of service (QoS) for MPLS network & SLA need to be defined. This should be completely tested before commissioning</p>	<p>For communication between the Station Gateway to/from Intermediate Service Platform to/from RDPMS Application, the existing optical fiber network of RailTel or MPLS may be utilized as the primary communication</p>	<p>Suggestion of M/s Efftronics is noted and it will be covered in Pr-commissioning check list.</p>

	may be used. Minimum speed of 10 mbps shall be provided. However, speed may be increased depending on size of station and should be decided by Zonal Railway during planning stage.		medium. To ensure reliability and uninterrupted data transfer, 4G/5G/LTE connectivity shall be mandatory as a redundant communication channel, operating in parallel with the OFC/MPLS network. Minimum speed of 10 mbps shall be provided. However, speed may be increased depending on size of station and should be decided by Zonal Railway during planning stage.	
7.2.7 (Revised clause 7.2.6)	In case of wireless communication between IoTs at location, puck mount antenna shall be used to avoid animal damage/theft. Proper gasket should be used with puck mount antenna.		In case of wireless communication between IoT devices at a location, a puck mount antenna shall be used to prevent animal damage and theft. Additionally, a proper gasket shall be used with the puck mount antenna to ensure secure mounting and environmental protection.	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
8.1	The power supply for IoT devices in location boxes shall be taken from signalling equipment supply coming from IPS with suitable rating fuse. Where power is not existing, 24V DC may be extended from nearby location box.		The power supply for IoT devices in location boxes shall be sourced from the signaling equipment supply provided by IPS, with a suitable rated fuse for protection. In locations where power is not available, 24V DC may be extended from a nearby location box to ensure continuous	Several meetings were held with RDPMS Vendors for finalization of RDPMS FRS. As per discussion in these meeting, minor modification done with this clause and produce

			operation.	in alongside column.
8.3	In case of non-feasibility of IPS supply as described in para 8.2 above, The power supply for Gateway shall be provided from 230V UPS of good quality. The input to UPS shall be from same source of IPS i.e. selective AT after auto-changeover of IPS. The backup time of UPS to be decided based on the power-cut duration at particular station.		<p>If the IPS supply is not feasible as described in para 8.2, the Station Gateway shall be powered by a 230V UPS of good quality. The UPS input shall be sourced from the same IPS supply, i.e., Selective AT after auto-changeover for IPS. The UPS backup time shall be determined based on the power-cut duration at the specific station to ensure uninterrupted operation.</p> <p>In such case, AC-DC adopter of required rating. Universal type adopter preferably commercial-off-the-shelf (COTS) type adopter shall be supplied by the vendor.</p>	Several meetings were held with RDPMs Vendors for finalization of RDPMs FRS. As per discussion in these meeting, minor modification done with this clause and produce in alongside column.
9 (New)	New requirement added		<p>EARTHING AND SURGE PROTECTION REQUIREMENT:</p> <p>9.1 Earthing shall be provided to the Station Gateway, IoT devices and armored cables, if any. Zonal Railways shall provide earthing arrangement in</p>	New clause added to address earthing and surge protection.

			<p>conformity to Code of practice for Earthing and Bonding RDSO/SPN/197/2016 (or latest) and the Guidelines issued for Earthing, Bonding, Surge, and Lightning Protection dated 01.01.2025 or latest.</p> <p>9.2 Appropriate rating of SPDs shall be provided with IoT Devices, Station Gateway and Data-line as specified in the RDSO specification RDSO/SPN/165/2023 Ver.4.0 (or latest.) and the Guidelines issued for Earthing, Bonding, Surge, and Lightning Protection dated 01.01.2025 or latest.</p>	
10.1 (Old clause. - 9.1)	Standard Data format follow MQTT protocol. Details are given in Annexure B (Annexure A also to be referred). Station Gateway shall send/receive the data to/from RDPMS Application software through Intermediate service Platform(to be planned by Vendors) as per standard	ECR: It has been specified that the Intermediate Service Platform to send/receive data to/from station gateway and RDPMS Application is to be planned by vendor. As per the architecture, an MQTT broker will have to be established. It is suggested that this MQTT server must be established in Zonal		Noted. Planning of MQTT server in Zone shall be considered in future. Please refer revise FRS for Standard data format

	Data Format. This Data transmission shall be as per Publish and subscribe Model. Data sending entity will publish the data and Data receiving entity has to subscribe the desired data Annexure B).	Railways and should be accessed via a VPN. The OEM can access the same through normal subscription if the same is required Asking the vendor to deploy a MQTT broker without Railways ownership of the same is not recommended.		
10.2.3 (Old clause-9.2.3)	Time Sync Confirmation: This data packet pertains to confirmation of Time sync process done by Station gateway. Station gateway sends a data packet to Application software in response to Time sync packet received from application software after completing Time sync process process. (Annexure B) (Annexure A also to be referred for Standard Nomenclature).	ECR: It is not mentioned that the Time Sync Confirmation will also use a Pub/Sub model. Request to clarify that Pub./3ub model will be used for this purpose as well.		Please refer revised FRS. This requirement has been reviewed.
10.2.7 (Old clause-9.2.6)	Parameter: This data packet shall be based on publish and subscribe model. This data packet pertains to (a) Value of all those analog parameters except (b) whose value changes with ± 2 % with respect to current value (or as defined) with	ECR: The duration of sending data by the station-gateway has been specified as 5s or as configured by the Zonal Railways. As this data will be used for AI/ML analysis. It is suggested that this duration be kept uniform so that consistent data set is prepared for AI/ML		Please refer revised FRS. This requirement has been reviewed.

	<p>time stamp.</p> <p>(b) Value of those analog parameters whose value is sampled every 20 ms (Voltage and current of Point Machine and Electric Lifting Barrier during operation) with time stamp during its complete operation.</p> <p>(c) Value of all Digital status changed with time stamp. If parameters as described above at 9.2.4 (a) & (c) are involved, Station gateway sends this data packet to Application software at every 5 second (configurable) or as decided by Zonal Railway. So this data packet shall contain value of all parametrs as per 9.2.4 (a) & (c) during last 5 seconds (configurable).</p> <p>If Parameters as per 9.2.4 (b) are also involved, then packet should be sent after completion of event like complete operation of point machine/ELB. (Annexure B) (Annexure A also to be referred for Standard</p>	analysis.		
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	Nomenclature).			
10	RDPMS APPLICATION SOFTWARE			
		<p>M/s Amara Raja Power Sys. Ltd.,</p> <p>Comments: Annexure C covers four assets—IPS, Point Machine, DC Track Circuit, and Signal. Would it be sufficient to initially apply AI/ML models to these assets (point, track, signal, battery) alone in the Proof of Concept Phase, or should all the assets (Point, Track, Signal, LC gate, IPS, Battery, Axle Counter, UFSBI and ELD) be considered.</p>		<p>Please refer revised Annexure.</p> <p>Based on trials and discussion held in meeting at Railway board, these annexure are revised to bring implementable points.</p>
11.3 (Old Clause-10.3)	<p>Latency/Time delay in flow of Data: The system shall be so designed so as to achieve the overall objective of providing real time information related to the parameters of signalling assets as proposed in this FRS. The maximum response time between flow of data between various stages shall be as following:</p>	<p>M/s ENERGY7:</p> <p>The system shall be so designed so as to achieve the overall objective of providing real time information related to the parameters of signalling assets as proposed in this FRS. The maximum response time between flow of data between various stages shall be within a minute</p> <p>Reason:</p> <p>Defining such number may lead</p>	<p>The system shall be designed to achieve the objective of providing real-time information on the parameters of signaling assets, as proposed in this Functional Requirements Specification (FRS). The maximum time for updating an event at application shall normally be within one minute as per existing packet sending scheme, however it may vary, if packet sending scheme is changed.</p>	<p>Please refer revised FRS, subject clause has been modified based on trial and discussion.</p>

	<p>to ambiguous scenario</p> <p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>The Latency shall be set to reasonable limits for e.g. Sensor to Station Gateway shall be 30 seconds, so as to account for the large amount of sensors and parameters that shall be handled by the gateway, as well as the transmission times of the wired/wireless media and the protocols involved. Sensor - Station Gate way 20 - 30 sec Station Gateway - Application software in Railway Cloud 5 sec Sensor - Alert generation for Mobile/PC 25 - 35 sec This again depends on the internet service provider's link speed.</p> <p>M/s JARS Services Private Limited:</p> <p>The system shall be so designed so as to achieve the overall objective of providing real time information related to the parameters of signalling assets as proposed in this FRS. The maximum response time between flow of data between various</p>	
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		stages shall be within a minute		
11.4 (Old Clause- 10.4)	RDPMS Application	<p>M/s ENERGY7:</p> <p>User should be able to access the application both on mobile application and web browser application. The mobile apps shall be compatible for both Android and iOS mobiles</p> <p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Web browser based interface is removed and instead "Desktop application" is added. Request to make change as "Web Browser" or "Desktop" Application</p> <p>Enhances cloud security by implementing least privilege access, securing IAM policies, ensuring encrypted communications, and maintaining compliance with ISO 27001:2022 for secure cloud operations.</p>	User should be able to access the application on mobile and web browser Application on laptop/desktop. The mobile apps shall be compatible for both Android and iOS mobiles.	Agreed. Please refer revised FRS, subject clause has been modified based on trial and discussion.

				needs of the organization.
11.5 (Old Clause-10.5)	The application shall have provision to configure different types of user such as Head Quarter level user, Division Level User, Sectional User, Station level User and guest user etc. The access label of various user shall be as per table-	M/s Gadgeon Smart Systems pvt Ltd.: Is this required for any sections involving guest users? What is the real use case for this guest user	The RDPMS application supports different user roles with specific permissions. Head Quarter and Division Level Users can assign users, monitor, and generate reports but lack control functions. Station Level Users can acknowledge feeds, monitor, generate reports, and control functions but cannot assign users. Guest Users have limited monitoring access only. (Annexure D).	Guest user means a user needed for testing purpose or temporary means. Please refer revised FRS, subject clause has been modified based on trial and discussion.
11.6 (Old Clause-11.6)	It shall require one time device authentication (android or iOS) as per pre-configuration in software there after option of auto-login will be given and same to agreed by user if desired. The authentication shall be based on Mobile no of Railway personnel. Authorised mobile number has to be fed in database and access from only these number shall be allowed by sharing OTP. The authentication can be	M/s ENERGY7: The RDPMS application will require a one-time device authentication process for both Android and iOS platforms. This will involve OTP verification alongside standard username and password authentication. Once successfully verified, users will have the option of auto-login for subsequent access. Additionally, access will be strictly limited to authorized mobile numbers stored in the database, with	The RDPMS application shall require onetime device authentication for Android or iOS, using both OTP verification and device authentication, in addition to username and password. After successful authentication, auto-login will be available. Access shall be restricted to authorized mobile numbers stored in the database and device ID linked.	Please refer revised FRS, subject clause has been modified based on trial and discussion.

	<p>one of below OTP based authentication: Mobile no/email id of Railway personnel shall be used for authentication. Authorized mobile number/email id has to be fed in database and access from only these number shall be allowed by sharing OTP.</p>	<p>authentication linked to the registered device ID. Reason: OTP & Device Authentication both shall be considered</p>		
11.9.16 (Old Clause-10.9.16)	<p>Alert Pushing Flow: To avoid multiple Alarms, following is to be ensured for pushing Alarms for other causes for same gear:</p> <p>(i) Once first predictive Alarm is pushed for any particular gear say PT-201, It will not be eligible for other predictive Alarms for same gear ie PT-201 till Alarm feedback is given with remarks. However data and Alarms generated during this intervening period may be kept for records to show whenever required.</p> <p>However, if Failure Alarm is generated during the intervening period between</p>	<p>M/s Amara Raja Power Sys. Ltd.,</p> <p>Issues: Upon the activation of the first failure alarm for a specific gear (like PT-201), or if a failure alarm is triggered subsequent to a predictive alarm as indicated in point 1, that gear will be disqualified from receiving any further failure or predictive alarms until feedback with observations is provided.</p> <p>Suggestion: When the current alert is acknowledged and a new failure alarm for the same device is logged in the application, it becomes necessary to decide if the individual involved should be notified or not?</p>	<p>Selection of Alert for pushing when multiple Alerts are generated through multiple logics: To avoid multiple Alerts generated through multiple logics for one asset, a scheme should be followed to select one Alert for pushing. For this, Alert pushing flow has been described in Annexure C.</p>	<p>Please refer revised clause given in along side column.</p> <p>Clause is modified based on discussion and trials.</p>

	<p>First Predictive Alarm and before feedback with remarks, Failure Alarm shall be pushed.</p> <p>(ii) Once First Failure Alarm is pushed for any particular gear say PT-201 OR Failure Alarm is pushed after One Predictive Alarm as mentioned in sr 1 above, It will not be eligible for other Failure & Predictive Alarm both for same gear ie PT-201 till Alarm feedback is given with remarks. However data and Alarms generated during this intervening period may be kept for records to show whenever required.</p>			
11.13 (Old Clause-10.12)	If multiple instances of one OEM's application software is running, it shall have one common weblink to access all instances of Application Software of one OEM.	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>It needs to be clearly mentioned what is the meaning of multiple instances, is it the front end software or back end software? Ideally it should be defined as multiple users using the same frontend software, catered to by a single backend software.</p>		Please refer revised FRS,
12.	RDPMS Application	M/s ENERGY7:	RDPMS Application Software and Intermediate service plate form	It is to be decided

(Old Clause No. 11.1)	Software and Intermediate service plateform shall be hosted as decided by OEMS/Zonal Railways.	RDPMS Application Software and Intermediate service plat form shall be on cris.till criss is ready oem shall continue on there respective server. Reason: As per MOM dated 31st JAN. M/s Amara Raja Power Sys. Ltd., Comments: Should an OEM host the application on their server, it is important to know the security protocols/standards and firewall configurations that the OEM will implement moving forward as railway server follows.	shall be hosted as decided by Zonal Railways.	by Zonal Railway as no development seen on CRIS part.
11.17		M/s Amara Raja Power Sys. Ltd., Suggestion: The mobile application user interface is not referenced in the FRS 2025. It is essential to provide clarity on the mobile user interface		Pls refere revised FRS.
12	MACHINE LEARNING AND AI TECHNIQUES:	M/s Efftronics System Pvt. Ltd: Implementation& Prediction of Signal gears failures / RUL by AI /ML immediately after provision of		Noted.

		<p>RDPMS is practically difficult due to the following reasons.</p> <ol style="list-style-type: none"> 1. AI /ML models require lot of data and patterns of various failure modes of signaling system and this is unique for each gear of same type, this makes it hard to develop generalized AI Model because ML algorithms created for one gear will not suitable for other gear. 2. It is difficult to train ML without meaningful patterns and enough failure data 3. Since signal gears failure are fewer than earlier creation of historical data takes lot of time. <p>It may take 6 to 12 months to capture all possible patterns and train the ML models for improved failure predictions, Remaining Useful Life (RUL) estimations etc..</p>		
13 Performance evalution .	Let us define an experiment from P positive instances and N negative instances for some condition. The four outcomes can be formulated	M/s Efftronics System Pvt. Ltd: Refining algorithms for generation of predictive alarms for an asset depends on the number of assets	Deleted and a benchmark has been specified	Please refer revised FRS, subject clause has been modified based on discussion.

	<p>in a 2×2 matrix, as follows:</p> <p>Table:</p> <p>System performance will be treated as satisfactory only if Accuracy of prediction is > 60% in initial project implementation as Proof of concept (POC). The accuracy should improve to > 70 % within 6 months after installation and to > 85 % with in 12 months after installation.</p> <p>Note: OEMs who have already installed sensor based IOT devices on Indian railways at station for more than one year should have their system performance by accuracy of prediction to be > 85 %.</p>	<p>monitored and the number of occasions the performance deteriorated / failed / improved. The number of such occasions depends on</p> <p>Number of assets monitored</p> <p>Ager of the assets</p> <p>Different failure modes</p> <p>Quality of maintenance</p> <p>Period of one year after the installation of RDPM may not uniformly provide opportunity for improving algorithms, because there are stations with zero or very few failures in a year, especially stations which commissioned recently.</p> <p>M/s Bitcomm Technologies Pvt. Ltd.: System Performance shall be categorised as new OEM and Established OEM . The established OEM shall have successfully installed RDPM system in atleast 10 stations for 12 months and performance is satisfactory . The OEM with satisfactory performance of less than 10 station</p>	
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		<p>RDPMS installation shall be treated as new OEM.</p> <ul style="list-style-type: none"> - To measure the performance it should be based on the True / False acknowledge predictive and failure alerts. - Only True Positive , False Positive cases to be taken for evaluation. <p>Reason: True Negative and False negative cases can't be judge for the performance thus should not be consider for evaluation. Only alert marked as True/False shall be count for performance evaluation.</p>		
15 Now cl. no.20)	The manufacturer/supplier shall warrant the material supplied to be free from defects in design, material and workmanship under ordinary use and service, his obligation under this warranty being limited to repair/replace free of cost those parts which shall be found defective within 3 years after installation and commissioning of the system. Sufficient spares shall be kept for this	<p>M/s Efftronics System Pvt. Ltd:</p> <p>An upfront long warranty period of 3 years will increase the equipment cost.</p> <p>There are instances where RDPMS cannot be commissioned even years after being supplied to railways due to the non-readiness of stations or the signaling system.</p> <p>Hence, a warranty model of 12/18 months from the date of</p>	<p>The manufacturer/supplier shall warrant the material supplied to be free from defects in design, material and workmanship under ordinary use and service, his obligation under this warranty being limited to repair/replace free of cost those parts (Hardware/Software/Networking accessories etc.) which shall be found defective within 3 years after installation and commissioning of the system. Sufficient spares shall be kept for</p>	<p>For evaluation of accurate performance and generate AI model, it is important to put the working of system under the supervision of OEMs. Longer warranty period can be awarded during new sanction as it is convenient for Zonal Railways. In view of above, 3 years</p>

	<p>purpose.</p> <p>AMC/ARC with OEM or its authorized agency may be awarded as decided by Zonal Railway.</p>	<p>commissioning can be specified.</p>	<p>this purpose.</p> <p>During a warranty period, the supplier is typically responsible for addressing any defects or issues with the supplied goods or services that arise due to faulty materials, design, or workmanship. The supplier is generally obligated to remedy these defects, including replacement or renewal of defective parts, at their own cost without any additional cost to the Railway.</p> <p>AMC/ARC with vendors may be awarded as decided by Zonal Railway.</p> <p>.</p>	<p>warranty period has been kept.</p> <p>Clause is modified based on discussion and given in alongside column.</p>
Annexur e- A	<p>As per the document, PRID is a 4-byte ID that uniquely identifies each input parameter within each station gateway.</p> <p>Stations Hexa decimal code</p>	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Some divisions name the PM pair with A and B (e.g., AAM 64WA and AAM 64WB). In such cases, the attributes zone_id, division_id, station_id, gw_number, asset_type_id, asset_number_id, and parameter_type_id are not sufficient to uniquely identify the asset parameters.</p>		<p>Please refer revised FRS as many changes have been done in FRS and its Annexures based on discussion held with OEMs during Trial period to address various issues.</p>

		Details missing, it would be better if the hexa decimal code is defined in the FRS for all stations.		
	Nomenclature of Parameter of DC Track Circuit	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>If the parameter category is "VTC TR", the system may get confused about whether to assign ID: 42 or ID: 43.</p> <p>To avoid confusion, assign distinct Parameter Representation Codes for each parameter while maintaining clarity and consistency. Here's a refined version:</p> <p>For the two parameters:</p> <ol style="list-style-type: none"> 1. Track Relay Voltage QTA2 (1.4V) ○ Representation Code: "VTC TR" <ul style="list-style-type: none"> ○ Representation ID: 42 ○ Suggested Code: "VTC TR QTA2" 2. Track Relay Voltage QBAT (1.75V) ○ Representation Code: "VTC TR" <ul style="list-style-type: none"> ○ Representation ID: 43 ○ Suggested Code: "VTC TR QBAT" <p>By incorporating the specific</p>		

		parameter name in the representation code, you ensure clarity and avoid confusion while keeping the naming convention structured.		
A	Nomenclature of Parameter of Signal	<p>M/s Amara Raja Power Sys. Ltd.,</p> <p>Comments : The Nomenclature of Parameter of Signal table in Annexure A lacks the Route Check Relay Status. More detailed clarification is necessary regarding the monitoring parameters for Route Signal, Calling On Signal, and other associated subsidiary signals.</p>		
Annexure G	Event-based filter metrics	<p>M/s Gadgeon Smart Systems pvt Ltd.:</p> <p>Users can view failures across different assets for an entire station in a single view. Required filter based on the alert name, which enhance the overall visibility failures. Consider this a enhancement feature</p>		
2©	Failure Logics of Points	<p>M/s Efftronics System Pvt. Ltd:</p> <p>Logic – 15 to 18 (point failure but reasons not diagnosed) – these alarms are not useful, may be omitted.</p> <p>e.g Point failed in normal without</p>		

		operation, since NWKR is down when point is in Normal, the system will generate point failed in normal alarm probable reason is Relay defective / 24V not available for NWKR.		
3(a)	Parameters of DC Track Circuit	<p>M/s Efftronics System Pvt. Ltd:</p> <p>Voltage drop at feed end choke is not recommended due to probability of infinite rate of change of current</p> <p>Voltage across Variable resistor may be monitored</p>		
General	Page no – 79, 24 VDC at RR from Loc for Reverse	<p>M/s Efftronics System Pvt. Ltd:</p> <p>Typo Error – NWKR to be corrected as RWKR</p>		
	Page no – 79, Digital status of RWKR	<p>M/s Efftronics System Pvt. Ltd:</p> <p>Typo Error – NWKR to be corrected as RWKR</p>		
	Pre- commissioning check lit	<p>M/s Efftronics System Pvt. Ltd:</p> <p>Pre- commissioning check list for RDSO to be added in Spec</p>		

Following requirements have been further added:

1. TEST REQUIREMENTS
2. QUALITY ASSURANCE
3. MARKING & PACKING
4. TRAINING
5. DOCUMENTATION
6. INFORMATION TO BE PROVIDED BY THE PURCHASER/RAILWAY

Note: Based on several discussions with OEMs, inputs received from site during trials, several changes have been made in FRS and these changes may not highlighted in this documents also few clause are either deleted or merged with other relevant clause. So all concerned are requested to go through the revised FRS and offer comments/suggestions if any.