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SIGNAL & TELECOM DIRECTORATE

(TELECOM SECTION)

Research, Design and Standards Organization,
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SPECIFICATION
FOR
ELEPHANT INTRUSION DETECTION SYSTEM FOR INDIAN RAILWAYS

(Using Distributed Acoustic Optical Fiber Sensing)

I- Amendment History

S. N.	Amendment Date	Version	Reason for Amendment
1.	24-10-2024	1.0	First Issue

II- Standard Committee

S. N.	Committee Composition	Member Name & Designation	Organisation
1.	Chairperson (EX officio)	Sh. Suresh Kumar PED/S&T	Signal & Telecom Directorate, RDSO, Lucknow
2.	Member Secretary	Sh. Vijay Garg Director/Telecom-1	Signal & Telecommunication directorate Telecom wing RDSO Lucknow
3.	Members (Consumers)	Smt. Shubh Varshney Dy. CSTE/Project, NFR	N. F. Railway, Maligaon, Guwahati.
4.	Member (Industry)	Sh. Vipul Goel, Joint Secretary, MSME.	Ministry of Micro, Small, and Medium Enterprises (MSME), New Delhi.
5.	Member (R&D Institutions) / Technologists	Sh. R. Dinesh, Professor, Telecom/IRISET	IRISET, Secunderabad
6.	Member (Testing Labs)	Sh. Mohammad Aamir Siddiqui Jt. Director/Telecom-II	Signal & Telecom Directorate, RDSO, Lucknow
7.	Member Inspection	Sh. Ved Prakash, Jt. Director/Signal-1	Signal & Telecom Directorate, RDSO, Lucknow

III. Reference Documents

S. N.	Document No.	Title/Name of Document
1.	IRS: TC 55-2006	Indian Railways Standards specification for 24 Fibre Armoured Optical Fibre Cable
2.	RDSO/SPN/TC/110/2020	RDSO Specification for 24/48 Fibre Armoured Optical Fibre Cable
3.	IS:9000 Series	Indian Standard for Basic Environmental Testing Procedures For Electronic and Electrical Items
4.	IEC:61000 Series	Electromagnetic compatibility (EMC)
5.	CISPR 22/32, EN: 55022/32	Electromagnetic compatibility of multimedia equipment. Emission Requirements: Conducted and Radiated Emission

6.	IS 13252/IEC 60950	Information Technology Equipment -Safety
7.	SD-QM-333	TEC Standard For Environmental Testing of Telecommunication Equipment
8.	IEC 62133	Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications
9.	TEC: 13016	Specific Absorption Rate (SAR) for Wireless Communication Devices used in close proximity to human body
10.	ITU-T G.652	Transmission media and optical systems characteristics – Optical fibre cables

IV. Abbreviation

S.N.	**Abbreviation**	Details
1.	EIDS	Elephant Intrusion Detection System
2.	RDAS	Remote Distributed Acoustic Sensing
3.	CPS	Central Processing Sever
4.	GUI	Graphical User Interface
5.	OFC	Optical Fiber Cable
6.	RE	Railway Electrified
7.	NFR	Northeast Frontier Railway
8.	RDSO	Research Designs & Standards Organisation
9.	IP	Ingress Protection
10.	API	Application Programming Interface
11.	SOAP	Simple Object Access Protocol
12.	MQTT	Message Queuing Telemetry Transport
13.	SDK	Software Development Kit
14.	URL	Uniform Resource Locator

IV. Table of Contents

1.0 FOREWORD

1.1 Elephant Intrusion in various parts over Indian Railways has been a cause of safety concern for a long time. They result in train derailments, causing human fatalities, huge loss to Indian Railways and disruption in train operations and loss to wild life.

Various preventive measures have been taken by Indian Railways to deal with such situations. This system is designed to provide additional Aid to warn about Elephant Intrusion so that necessary preventive action may be taken. However, the existing administrative preventive actions being taken by user Railways shall continue to be followed.

1.2 Trials of Distributed Acoustic Optical Fiber Sensing based "Elephant Intrusion Detection System" is ongoing in Northeast Frontier Railway (NFR) with the objective of development of an effective system for detection of Elephant Intrusion near Railway Track over Indian Railways.

1.3 This Specification for Elephant Intrusion Detection System is prepared as per directives of Railway Board vide letter No.2020/Tele/9(1)/1(33266798) dated 14th July, 2023.

2.0 SCOPE

This document covers the functional, technical and system requirements of equipment/system working on the principle of "Distributed Acoustic Optical Fiber Sensing" for real time detection of Elephant Intrusions near Railway Tracks and generating necessary alarms.

3.0 Applications of System

Primary application of the system is Elephant Intrusions detection near Railway Track alongwith Real Time Train Tracking and display.

The system may be used for any additional application i.e. digging activity in vicinity of track, warning at LC gate etc. of Indian Railways, if required and proven to be capable of.

4.0 Working Principle and Technology Used

The system shall use the "Distributed acoustic sensing over Optical Fiber and Rayleigh Scattering" as the core of the technology. The working principle of the system depends on the change in light illumination properties of reflected light in the Optical Fiber. Measurement of time delay between sent and received laser light pulse decides the location of the event. Identification of any event is done by measuring the modulation in the back

scattered light signal.

5.0 General Requirements

5.1 The system shall be capable of meeting specified functional requirements in Existing Indian Railway working Conditions.

5.2 The system shall detect and display the enroute trains in real time for the entire area covered by Elephant intrusion detection system.

5.3 The system shall be non-intrusive type.

5.4 The system shall be capable of working satisfactorily on different Terrains of Indian Railways having Single Line, Multiple Line, Electrified, Non-Electrified sections etc.

5.5 The system shall be capable of successfully detecting events (as specified in clause 3.0) on various railway structures such as Culverts, Yards, Curves, Tunnels, LC gates etc. Limitation of detection in these zones, if any, shall be clearly indicated by the system provider.

5.6 The system shall neither be affected nor cause any effect on normal working of Signaling/Telecom or any other working system of Indian Railways.

5.7 The installation of system shall not require changes to the existing infrastructure of Indian Railways.

5.8 Upon installation of system on IR, the system provider shall carry out necessary modifications to system as required for customization on IR conditions.

5.9 It shall be the responsibility of system provider to comply with all Statutory & Regulatory Compliance Requirements in India. However, OFC laying and conducting trials will require permission from forest department and same shall be ensured by Zonal Railway.

5.10 Network connectivity for communication of events/alarms at identified remote location (Loco, Station, control office etc.) will be provided by Railways.

6.0 System Components: Typical system may consist of the following components

6.1 Optical Fiber Cable

6.1.1 The system is expected to work using optical fiber cable as per Indian Railways Standard Specification No. IRS: TC 55-2006 latest version/amendments for 24 Fibre Armoured Optical Fibre Cable and RDSO Specification No. RDSO/SPN/TC/110/2020 Rev-0 latest version/amendments for 24/48 Fibre Armoured Optical Fibre Cable.

However, for additional laying of OFC required for identified elephant corridors, Optical Fiber Cable as per Indian Railways Standard Specification mentioned above shall be laid.

6.1.2 Indian Railways have Optical Fiber Cable laid throughout the track side out of which two dark fibers to be used for the application. Additional laying of Optical Fiber cable to be decided as per Railway requirements & site survey, if any.

6.1.3 The system shall be capable of detecting events as indicated in clause 3.0 (Applications of System) using fibers of OFC laid along the track.

6.1.4 The system shall be capable of working satisfactorily despite losses on account of additional splicing in OFC during the service, subject to maximum optical loss of 12 dB on one side.

6.1.5 The left over fibers of the laid down OFC shall be available to Railways for use.

6.2 HARDWARE

Hardware shall include all the components required for the system. Typical system may consist of minimum following units.

6.2.1 Remote Distributed Acoustic Sensing Unit (RDAS)

This unit will be installed at station in OFC room or as decided by user railway. This unit consists of optical interface unit with optical source generator, Signal Processing Unit, Controller and communication unit, Power Supply Unit etc. This unit is primarily responsible for sending laser source into optical fiber cable and receiving backscattered signal. The signal processing unit processes backscattered signal to identify pattern in signal.

The System shall have a minimum of four channels as single RDAS unit (Two main channels and two hot standby channels) for connecting the OFC cable. The RDAS unit shall be capable of handling the detection for an optical distance of minimum 40 km per channel.

6.2.2 Central Processing Server (CPS)

This is main processing unit with high performance computing server, storage, centralized database. This unit shall have features as per requirements of Cl. 8 and GUI for CPS as per Cl. No. 10.1. This unit shall be capable to handle multiple remote DAS units. This unit is located at central location as defined by user railway. This unit will receive the processed pattern data file from remote DAS, further analyses this data to detect the events accurately. Detected real time patterns/signatures of events received from remote units are compared with the reference signatures captured during the initial measurements and stored in the signature library. After comparison, the analyzed data is used to generate appropriate alert of intrusion. These alert data will be transmitted to relevant ASM units, Locomotive units etc. based on location of events, for information and necessary action, over railway communication network decided by user Railway. These events are also locally displayed on a LED screen of appropriate size installed as defined by user railway and will generate audio/visual alarm.

This unit will host analysis software, various application software, database, Geo location application, dispatcher application etc.

This unit shall also detect and display the enroute trains in real time for the area controlled by a particular Central Processing Server. Further Details are given in GUI for CPS.

6.2.3 ASM Unit

The ASM Unit is installed for real time audio visual alarm along with OHE pole kilometer (in case of RE area) and Engineering/Hectometer Post (In case of Non-RE Area) when elephant movement is identified. This unit shall be capable to view real time dashboard of the section. The ASM unit is connected to Central Processing server and shall be able to receive input from Central Processing server. In case of elephant intrusion, it triggers the audio visual alarm at respective station which is acknowledged by the station master. Further details are given in GUI for ASM unit.

6.2.4 Loco Pilot Unit

This unit will provide audio visual alarm to train driver/guard over available network. This will be either a mobile phone or portable tablet both with touch screen as per Clause No. 7.4

of the specification. Necessary application software shall be installed in this unit to work as per functional requirements.

Loco Pilot unit shall display Train Location, Train movement, Train movement direction, Event Location, Pole or OHE km post (In case of RE area) and Engineering/Hectometer Post (In case of Non-RE Area), Date of event, Time of event, acknowledgement etc.

6.3 Software

System provider shall provide complete software module with the system including required updates.

6.4 Power Supply

The System shall work properly with Nominal -48 V (within the range of -44V to -56 V) DC and/or 230V (within the range of 165V to 260V) AC power supply as input as specified in the respective sub-system's specifications and other supplies required for system shall be derived from these Inputs. Railways will provide -48V DC/230V AC supplies as available at site.

6.4.1 The UPS (wherever required) with at least 4 hours power back-up or as per user requirement shall be provided by the System provider.

6.4.2 The required Earthing/Surge protection arrangement shall be provided by the System provider.

7.0 Technical Specification

7.1 Remote DAS: Minimum Specification of Remote DAS is specified below:

SN	Parameter	Minimum Specification
1.	Remote DAS Hardware	The Remote DAS Server Hardware shall be Industrial grade and suitable to run 24 x 7
2.	Sensing Element /standard fiber type	As per ITU-T G.652 or latest
3.	Number of Channel	Minimum 4 nos. (Two main channels and two hot standby channels)
4.	Event Detection Sensitivity	The system shall be capable of detecting Elephant movement from a minimum of 20 meters on either side (longitudinal i.e. perpendicular to fiber) away from existing OFC.
5.	Total Range per channel	The RDAS unit shall be capable of handling the detection for an optical distance of minimum 40 km per channel.
6.	Processer transfer rate	64 bit or better
7.	Fiber loss	0.25 dB/Km
8.	Laser Wave length	1550nm
9.	Laser Stability	±5 ppm
10.	Laser Class	Class 1M
11.	Operating System	64 Bit, OS Linux Output or Similar.
12.	Data Storage	2x1TB HDD or better

	(Removable)	
13.	Data Storage (Internal)	128 GB or better
14.	Location Accuracy	±10 meter
15.	Power Supply	The system shall work on Input power supply of -48V DC (within the range of -44V to -56V). It shall have Redundant Hot-swappable power supply. If one fails, the other takes care of system functioning without any interruption.
16.	Mounting	19" inch rack mountable.
17.	LAN/ Ethernet	Onboard/ on slot Gigabit Ethernet (4x1 Gbe RJ45) with Load Balancing and Fail over Support, IPv6 Compliant.

7.2 Central Processing Server (CPS): Minimum Specification of Central Processing Server is specified below:

SN	Parameter	Minimum Specification
1.	Central Processing Server Hardware	The Central Processing Server Hardware shall be of Industrial grade, suitable to run 24 x 7
2.	Processor	Intel Xeon Processor or similar
3.	No. of Cores	Minimum 8 Cores in Single Processor or 2 Nos. of 4 Core Processors (Dual Socket)
4.	Frequency	2.1 GHz or more
5.	Cache	20 MB
6.	Memory	32 GB or higher, DDR3/DDR4 SDRAM or latest
7.	Operating System	Windows Server 2016 or latest or Linux
8.	LAN/ Ethernet	Onboard/ on slot Gigabit Ethernet ((4x1 Gbe RJ45) with Load Balancing and Fail over Support, IPv6 Compliant.
9.	Hard Disk Drive	Hot Pluggable SAS HDD, 2 TB & Minimum 30 days storage capacity, 7200RPM
10.	RAID Controller	SAS RAID Controller with RAID 1 configuration or better
11.	Communication	4G/LTE
12.	USB	Minimum 4 Nos.
13.	Keyboard & Mouse	Required
14.	Power Supply	The system shall work on Input power supply of -48V DC (within the range of -44V to -56V). It shall have Redundant Hot-swappable power supply. If one fails, the other takes care of system functioning without any interruption.
15.	Fan Configuration	Redundant Hot-swappable Fan
16.	Display	LED Display of appropriate size as per user requirements
17.	Chassis Type	19" Rack mountable with sliding rails and fittings to install into a Rack.

7.3 ASM Unit: Minimum Specification of ASM unit is specified below:

SN	Parameter	Minimum Specification
1.	Hardware	Tablet based device or similar as per user requirement,

		Industrial grade, suitable to run 24 x 7
2.	Operating System	Linux or similar
3.	Processor	Quad-Core, 64-bit Processor, 1.5 GHz
4.	RAM	Minimum 4 GB
5.	Internal Storage	Minimum 512 GB, Minimum 10,000 Events
6.	Display	10'' Touchscreen or better
7.	Audio/Sound	Inbuilt Speaker for audio alarm 5W, 8 ohms
8.	Audio Channels	2 channels
9.	USB	USB 3.0 or better, Minimum 02 Nos.
10.	LAN	10/100/1000 Mbit (Gigabit LAN over USB 3.0)
11.	Power Supply	230V (within the range of 165V to 260V) AC/ -48 V DC (within the range of -44V to -56V) DC.
12.	Local Storage of Historical events	As defined by user railway
13.	Hard & Soft Button	Push buttons for • Power ON/OFF • Audio Alarm • Acknowledgement • Reset button
14.	Network	Available Network
15.	Communication	Ethernet
16.	Interface	RJ-45 interface for Ethernet Communication RS-485 Quad Cable Interface (If Required)
17.	Relay Out	Potential Free Contact
18.	MAC ID	Unique MAC ID
19.	Accessories	Keyboard and mouse

7.4 Loco Pilot Unit: Minimum specification of Android based portable device to be used as Loco Pilot Unit is specified below:

S. N.	Parameter	Minimum Specification
1.	Device type	Either a mobile phone or portable tablet both with touch screen as per user requirements.
2.	Display	(a) Display size- Minimum 10 inch (b) HD (1280 x 720p) or Higher (c) Capacitive, touch-screen with Gorilla Glass
3.	Processor	Quad-Core, 64-bit Processor, 1.5 GHz
4.	RAM	Minimum 8 GB
5.	Internal Storage	Minimum 128 GB
6.	Communication	Available Network
7.	Power Supply	Battery Operated with charger 230V (within the range of 165V to 260V) AC
8.	Battery Capacity/Backup	5100mAh or more, Minimum 12 Hrs battery backup
9.	Speaker	Internal Speaker
10.	Interfaces	(a) Wi-Fi (2.4 GHz and 5 GHz, Standards 802.11 a/b/g/n/ac)

		(b) USB type C (c) Bluetooth (Bluetooth 5.0 or higher)
11.	Operating System	Android 12 or latest
12.	Hard Buttons	Power ON/OFF etc.
13.	**6.** Application Software	**7.** Shall be equipped with Elephant Intrusion Alarm Monitoring Application Software
14.	Soft Buttons	Acknowledgment, Alarm Indicator (Flashing RED for alert and Green Normally), RESET etc.
15.	Specific Absorption Rate (SAR)	TEC 13016-2020 or equivalent

8.0 Application Software Requirement

System provider shall provide complete application software module for Remote DAS Unit, Central Processing Server, ASM Unit and Loco pilot unit including required updates. These software modules shall include all driver software, operating systems and application software modules.

The Central Processing Server application Software shall have the following main Features:

8.1 It shall provide GIS map-based real-time visualization of the entire section covered under all DAS connected to the CPS for intrusion detection system.

8.2 The dashboard shall be customizable for Event/Alarm viewing of multiple remote DAS devices. Dashboard shall be responsive and user friendly. Various charts and graphs shall be available on dashboard.

8.3 There shall be possibilities of multiple dashboards for various Remote DAS units in main dashboard.

8.4 It shall have dispatcher module for sending alarm/events to Mobile / users via SMS, email, or application notification.

8.5 It shall have provision to provide audio visual alarm.

8.6 The history of all reference traces/signature of events shall be stored and dynamic signatures shall be captured and time stamped for future analysis.

8.7 If applicable, it shall have provision to update analysis based on feedback received as supervised learning for better classification and accuracy of alarm with due course of time.

8.8 **Reporting:** There shall be various reporting option available for all the data. Custom reporting shall be able to generate reports in Excel, csv, pdf, Json formats. It shall be able to generate standard report as:

8.8.1 Daily/Weekly/Monthly Elephant movement detected in a specified section over the division.

8.8.2 Frequently event generated zone.

8.8.3 Acknowledged detection history

8.8.4 Other customized reports as per user requirements

8.9 **Alarms Management**- Application shall have web-based/CPS configurable alarms managements for alarms created from Rule Engine. The details of alarm management are

defined in respective section Cl. No. 10.

8.10 **Geo location server**- This shall store all latitude and longitude information of entire OFC route. Mapping of Railway track along with landmarks and Satellite Map/Image. (GIS Survey shall be done by the system provided for the section where system will be installed).

8.10.1 The Central Processing server shall correlate optical location received from remote DAS servers with geo location information (already stored in Geo location Server) and send to Event dispatcher for alarm/information notification to end users.

8.11 Event Dispatcher– The role of event dispatcher is to send real time information/alarm/event received from Central Processing Server to field users via SMS, application notification, email etc.

9.0 Functional Requirements of the System:

9.1 The system shall be capable of detecting identified events as indicated in clause no. 3.0 (Applications of System).

9.2 The system shall generate an audio visual alarm for detected events at designated location. The System shall be capable for generating SMS alerts.

9.3 The system shall clearly indicate the location of detected event and provide relevant record in reproducible electronic form.

9.4 The monitoring/ scanning of the events and generating alarms shall be on real time basis. There shall not be any undue delay between detection of event and generation of audio/visual alarm at designated location.

9.5 The system is expected to be capable of detecting the primary events (clause 3) without fail (100% success rate of detection). The system preferably shall not generate false alarm. The alarms if found false in physical verification shall not exceed 5% of all the alarms being generated per section per month or as defined by user Railway.

9.6 It is desirable that system covers the continuous stretch of corridor without any portion of corridor left uncovered/unmonitored in between.

9.7 The system shall be capable of self-diagnosis of system failure, breakdown, fiber cut etc. and an alarm and information shall be generated in real time at a designated location. The alarm signal shall be different from that generated in case of detected events (Elephant Intrusion etc.). Audio alarm of events shall continue until it is acknowledged.

9.8 The system shall be capable to detect and identify simultaneously occurring events at different locations as different isolated events. Simultaneous events occurring at a distance of 50 m and above shall be shown as separate isolated events.

9.9 The system design shall be capable of detecting the events in all soil conditions i.e. dry, wet etc. The System design shall be such that it is able to detect the following:

9.9.1 Continuous longitudinal (i.e. perpendicular to laid fiber) detection of Elephant Intrusion with detection sensitivity of minimum 20 meters on either side of laid optical fiber.

9.9.2 In Elephant Corridors, the detection shall be 150-200 meter from center of track or as defined by user railway. Additional optical fiber cable, if required, may be laid by the supplier to meet this requirement.

9.10 The system shall be capable of accurately detecting the location of occurrence of any event with a spatial accuracy of +- 10 meter or better.

9.11 The system shall be capable of storage/backup for the generated events/alarms.

9.12 The system may require capturing of Signatures of various events for analysis & detectionof events using Software algorithm. It shall be the responsibility of System provider to initially capture the signatures for all type of events, if required.

9.13 The System provider shall clearly indicate the requirements from Indian Railways for capturing signatures for different events. If any simulated conditions are required to be created by Railways for capturing of signatures, the same shall be clearly defined by the system provider duly indicating the number of iterations for different events for covering the full spectrum of Elephant intrusion events.

9.14 The functions of individual system/sub-system as defined in various clauses are indicative. The actual functionality of individual system/sub-system may differ as per specific system design. However, the complete system shall be capable of achieving all the required functions and desired output.

9.15 Interoperability between EIDS Equipment of different OEMs

Interoperability between systems of different vendors shall be ensured so that same application & GUI of ASM & Loco Pilot is able to accept inputs from systems of various vendors available in the section/division/ZR. For this, vendors have to provide necessary interfaces like SOAP, APIs, MQTT, other standard application protocol and also provide support for future modifications/installations.

9.15.1 The Remote DAS and CPS shall have in-built APIs/SDKs to integrate EIDS system with third party applications.

9.15.2 The APIs/SDKs shall contain URLs for fetching the following:

i. Number of DAS devices connected in the network
ii. Health status of DAS Unit
iii. Type of Deployment
iv. Event Date & Time Stamp
v. Intrusion/Event Type
vi. Location of Intrusion in meters
vii. Location of Intrusion in latitude & longitude
viii. Threat Level
ix. History of events
x. All signatures stored for elephant and trains
xi. Any other requirement as specified by user railway

10.0 Graphical User Interfaces (GUI) of Various Devices

The minimum GUI for various devices is defined below. However, any specific requirements as per user railway shall be incorporated by the system provider.

10.1 GUI for Central Processing Server (CPS)

10.1.1 A Central Server will handle multiple remote DAS Units based on server configuration and

software licenses. The Central sever will be located and its output displayed in Divisional or Zonal Head Quarters according to requirement of Indian Railway. The Remote DAS units at various block sections of the divisions will be displayed together in Divisional central Display and multiple divisions will be displayed together in Zonal Level.

The Major Details of CPS GUI are as follows:

SN	Features
1.	The GUI will be capable of displaying real-time monitoring of alarms, events, etc.
2.	Divisional display will show the data of the specific division only and Zonal Display will show all divisions data coming under the zone. Whenever controlling area of particular DAS needs to be monitored, same shall be displayed in separate window by clicking the DAS. Required masking in the software will be done for Divisional and Zonal level usage. Power to control the masking feature for the same will be given to the administrator of the central server dashboard.
3.	It will display status of all Devices in the network such as Remote DAS units, ASM Units, Server etc.
4.	Division, Control Stations, ASM Stations and Elephant corridors will be specifically marked in Railway terminology in the GUI.
5.	It shall provide GIS map-based real-time visualization of the entire section covered under all DAS connected to the CPS for intrusion detection system.
6.	The Dashboard shall be customizable for Event/Alarm viewing of multiple remote DAS devices. Dashboard shall be responsive and various charts and graphs as desired by user railway shall be available.
7.	It shall have a provision to provide audio visual alarm.
8.	The History of all events/alarms shall be stored and time-stamped for future analysis for a period of 1 year or as specified by user railway in tabular structure with following broad applications: • Easy to access, no configuration required-once collected, data can be accessed by any client as per user access permissions defined by administrator. • Historical data can be accessed by many predefined reports in web with formats like hourly, daily, monthly and yearly. Provision shall be there for fast retrieval of data.
9.	Feedback provided by Loco Pilots, including remarks and comments on elephant sightings shall be stored and time-stamped for future analysis.
10.	**System Health and Status:** • Remote DAS /Controller, ASM Workstation communication status. • Server status, including CPU and memory usage. • Network connectivity status. • Status of communication with Loco Pilot Tablets. Fiber health status monitoring including fiber cut, unusual losses etc.
11.	**Real-time Elephant and Train Location Data:** • GPS coordinates of elephants and Train within the monitored corridor/ Division/Zone as per user railway requirements.

	• Time stamps of the last known elephant locations. Historical elephant movement patterns.
12.	**Reporting:** There shall be various reporting options available for all the data. Custom reports shall be available in formats such as Excel, csv, pdf, Json etc. It shall also be able to generate standard reports based on: a. Daily/Weekly/Monthly Elephant movement detected in a specified section over the division b. Frequently event-generated zone c. Acknowledged detection history. Customized report.

10.1.2 Alarms Management: GUI should have a web-based alarms management:

SN	Features
1.	Alarm Monitoring - GUI shall have the capability to display and monitor alarms/events in real time.
2.	Provision to cater alarms and events generated by the rule engine.
3.	Alarm History – Provision to provide a facility to find the previous occurrences (with respective time of occurrence) of a particular alarm.
4.	All Events should be included with details such as Event type, Status, Station, KP /Pole numbers, Duration of event and acknowledgement status.
5.	User Access - Access to alarm views shall be controllable based on username and rights configurable by the administrator based on the predefined profiles.
6.	Administrator shall have the right to define the above profiles.
7.	Geo Location – Geo Location with all latitude and longitude information of entire OFC route shall be calibrated and configured for each remote DAS unit. Mapping of Railway track along with landmark and Satellite Map/Image shall be done.
8.	The Application shall correlate optical location received from remote DAS to geolocation information.

10.2 GUI for ASM Unit: ASM GUI shall have following minimum features:

SN	Features	Description
1.	Proper Visibility	The GUI shall be such that it is easily readable by ASM
2.	Should display active/inactive status	Flashing Indication to indicate healthy condition of ASM Unit and Communication Channel. Alert the user in the events of a system failure or network outage leading to no notifications.
3.	Should have acknowledgement option for alarms	Continuous Buzzer till alarm is acknowledged. Red flashing indication until train crosses the intrusion location.

4.	GPS location of Elephant corridors	Yes
5.	Station code	Yes
6.	Alert on presence of elephant in the corridors with location details	Audio and Visual alert in terms of buzzer and Red Indication
7.	Historic data visualization	As defined by user railway
8.	Receives and stores feedback from ground true feedback.	Required
9.	Acknowledgement and Feedback option for received confirmation of intrusion to CPS	In case of detection of elephant intrusion
10.	Storage and Display of historic alert information	As defined by user railway
11.	Provide information with location of Train and elephant at the same time (tabular and GIS mapped)	Distance between Train & Elephant, OHE Pole KM (In case of RE Area) and Engineering/Hectometer Post in case of Non-RE Area shall be shown on GIS map and Tabular Form. Also, Section from Previous station Advance Starter to Next Station Home signal shall be visible on every ASM Unit.
12.	Current date and time should be displayed	Yes

10.3 GUI for Loco Pilot Unit: Loco Pilot GUI shall have following minimum features:

SN	Features	Description
1.	Proper Visibility	The GUI shall be such that it is easily readable by Loco Pilot
2.	Should display active/inactive status	Flashing Indication to indicate healthy condition of Loco Unit and Communication Channel. Alerts the user in the events of a system failure or network outage leading to no notifications.
3.	Should display network status	Green Indication for Presence and Red for absence.
4.	Real time Alert on presence of elephant in the corridors with location details	Audio and Visual alert in terms of buzzer and Red Indication
5.	Update historic alerts in network if out of network for some duration	After network restoration, only active alarms based on train location in terms of Audio and Visual alert shall be indicated.
6.	Provide information with location of Train and elephant at the same time (tabular and GIS mapped)	Distance between Train & Elephant, OHE Pole KM (In case of RE Area) and Engineering/Hectometer Post in case of Non-RE Area shall be shown on GIS map and Tabular Form. Also, continuous 10 KM section ahead shall be visible on Loco Pilot Unit.

7.	Date & time shall be displayed	Yes
8.	Option to add feedback on acknowledging the alarm for True positive & False Negative.	Yes (True Positive means elephant was present and properly detected. False Negative means elephant was present but not detected.
9.	Alarm status display (acknowledged or Not)	Continuous Buzzer till alarm is acknowledged. Red flashing indication until train crosses the intrusion location.
10.	Storage and Display of historic alert information	As defined by user railway

11.0 Environmental/Climatic Requirements:

Note:

1. Equivalent IS/EN/IEC/MIL standards are acceptable.
2. A test certificate and test report shall be furnished by the supplier. The test agency conducting the environmental tests shall be an accredited agency as per existing RDSO norms and details of accreditation shall be submitted by the firm.

11.1 Climatic Test

11.1.1 Remote DAS Unit ASM Unit & Loco Pilot Unit shall meet the climatic requirements (Temperature & Humidity) as per SD-QM-333 in category B2 issued by TEC, Department of Telecommunication, Govt. of India (or Equivalent IS/IEC/EN standards).

11.1.2 Central Processing Server (CPS) shall meet the climatic requirements (Temperature & Humidity) as per SD-QM-333 in category A issued by TEC, Department of Telecommunication, Govt. of India (or Equivalent IS/IEC/EN standards).

Note: The recommended sequence for climatic testing shall consist of the following tests as applicable in the order given below:

(i) Cold (Low Temperature)
(ii) Dry Heat (High Temperature
(iii) Damp Heat cyclic (Tropical exposure)
(iv) Rapid Temperature Cyclic
(v) Damp Heat Steady State

11.2 Vibration, shock and bump test:

11.2.1 Remote DAS Unit, Central Processing Server & ASM Unit shall meet the following tests:

SN	Test Type	Equipment Condition	Severity	Specification
1.	Vibration	Non-operating	5 Hz to 350 Hz Acceleration A: 2g 20 sweep cycles on 3 axes	IS: 9001 Part XIII
2.	Bump Test (Package) (Except	Non-operating	400 m/s^2 peak, 4000 bumps per axis Duration: 6 milliseconds	IS: 9000 Part VII Section 2

	Central Processing Server)		No. of axes: 03	

11.2.2 Loco Pilot Unit shall meet the following tests:

SN	Test Type	Equipment Condition	Severity	Specification
1.	Vibration	Non-operating	5 Hz to 350 Hz Acceleration A: 2g 20 sweep cycles on 3 axes	IS: 9001 Part XIII
2.	Drop Test	Non-operating	Height- 1000 mm	Standard-QM-333/IS 9000 Part VII/ (Section 4) or equivalent.

11.3 Dust: Remote DAS Unit & ASM Unit shall meet the following requirements:

S.N.	Test Type	Equipment Condition	Severity	Standard Specification
1.	Dust	Non-Operating	1 hour only	IS: 9000 Part XII

Note: Equivalent EN/IEC/MIL standards is acceptable

12.0 EMI/EMC Requirement

12.1 Remote DAS Unit, Central Processing Server and ASM Unit shall meet the following EMI/EMC requirements:

S. N.	Parameter	Standard
i)	Conducted and Radiated Emission- Class A or Class B	TEC EMI EMC Standard CISPR 22/32, EN 55022/32. Class A or Class B as applicable as defined in Notes to Annexure-B
ii)	Immunity to AC voltage dips, short interruptions and voltage variations	TEC EMI EMC Standard EN/IEC 61000-4-11, Annexure-B
iii)	Immunity to DC voltage dips, short interruptions and voltage variations	TEC EMI EMC Standard EN/IEC 61000-4-29, Annexure-B
iv)	Immunity to Electrostatic discharge	TEC EMI EMC Standard EN/IEC-61000-4-2 , Annexure-B
v)	Immunity to fast transients (Burst)	TEC EMI EMC Standard EN/IEC-61000-4-4, Annexure-B
vi)	Immunity to radiated RF	TEC EMI EMC Standard EN/IEC-61000-4-3, Annexure-B
vii)	Immunity to RF field induced conducted disturbance	TEC EMI EMC Standard EN/IEC 61000-4-6 , Annexure-B
viii)	Immunity to Surges	TEC EMI EMC Standard IEC 61000-4-5, Annexure-B

12.2 Loco Pilot unit shall meet EMI/EMC requirements as per regulatory norms.

13.0 Device Safety

Remote DAS Unit, Central Processing Server, ASM Unit and Loco Pilot unit shall meet the following safety requirements:

SN	Parameter	Standard
1.	Device Safety	IS 13252-1 or IEC 60950-1 or IEC 62368-1
2.	Battery Safety (For Loco Pilot Unit only)	IS 16046. EN/IEC 62133 or equivalent

14.0 Ingress Protection

14.1 Remote DAS Unit, Central Processing Server and ASM Unit: IP 50 or higher.

14.2 Loco Pilot Unit :IP 67(Battery IP level shall be same as device IP)

15.0 Marking & Packing

15.1 The following information shall be clearly embossed / engraved / screen printed at a conspicuous places.

i. Item Name
ii. RDSO Specification Number
iii. Make & Model
iv. Name or monogram of the manufacturer
v. Year of manufacture.
vi. Serial Number

15.2 **Packing:** The equipment shall be suitably packed so as to avoid any damage or deterioration during storage and transit.

16.0 POC Trial

POC trial shall be conducted by the concerned Zonal Railway indenting the EIDS as per guidelines issued by RDSO before issuing the Letter of Acceptance (LoA)/Purchase Order (PO).

17.0 Test and Performance Requirements

17.1 Type Test

For type test, one complete system shall be subjected to following tests:

1. Visual Inspection

a) General workmanship and any physical damage-The equipment shall be free from any physical defects or any other imperfection including marking and painting etc.

b) Marking & Packing: As per Clause No. 15.

2. Verification of Technical Specification for Hardware as per clause 7.0 (i.e. Remote DAS, CPS, ASM Unit, Loco Pilot Unit etc.)

3. **Functional Test:** As per Clause No. 9 (except clauses 9.5, 9.6, 9.8, 9.9, 9.10).

The functional test shall be carried out with the help of simulation. Those functional

requirements which are not possible to be tested in simulated conditions, shall also be demonstrated during field trials. Verification of GUI/Alerts etc. as per relevant clauses.

4. Environmental/Climatic tests as per Clause No. 11
5. EMI/EMC as per Clause No. 12
6. Device Safety as per clause No. 13
7. Ingress Protection (IP) as per Clause No. 14

Note:

1. For Loco Pilot Unit, parameters specified in Cl. No. 7.4 shall be verified from data sheet and/or firmware during type test.
2. A test certificate along with test report shall be submitted by the supplier from a Govt. Lab/NABL Accredited Lab or an Accredited Lab as defined in RDSO ISO document No. QO-D-8.1-10 Cl. No. 4.3.5.1 sub-clause 3 and 4.3.5.1.1 or latest.

17.2 Acceptance Test

Following shall constitute the acceptance test. The acceptance test shall be carried out on all Central Processing Server (CPS), Remote Distributed Acoustic Sensing (RDAS) Unit. On remaining equipment, test shall be carried out on 30% of items randomly selected from the lot offered for inspection by the supplier.

1. Verification of Type Test report & PoC report
2. Physical verification of the system as per PO/CA
3. Visual Inspection
   a) General workmanship and any physical damage-The equipment shall be free from any physical defects or any other imperfection including marking and painting etc.
   b) **Marking & Packing** as per Clause No. 15
4. Verification of Technical Specification for Hardware as per clause 7.0 (i.e. Remote DAS, CPS, ASM Unit, Loco Pilot Unit etc.)
5. **Functional Test**: As per Clause No. 9 (except clauses 9.5, 9.6, 9.8, 9.9, 9.10).
   The functional test shall be carried out with the help of simulation. Those functional requirements which are not possible to be tested in simulated conditions, shall also be demonstrated during field trials. Verification of GUI/Alerts etc. as per relevant clauses.

17.3 Routine Test

The following shall comprise the routine tests and shall be conducted by manufacturer on every equipment and the test results will be submitted to the inspection authority before inspection.

17.3.1 General workmanship and any physical damage-The equipment shall be free from any physical defects or any other imperfection including marking and painting etc.

17.3.2 **Marking & Packing:** As per Clause No. 15

17.3.3 Verification of Technical Specification for Hardware as per clause 7.0 (i.e. Remote DAS, CPS, ASM Unit, Loco Pilot Unit etc.)

17.3.4 **Functional Test**: As per internal procedure of supplier but at least as per Cl. No. 9 (except clauses 9.5, 9.6, 9.8, 9.9, 9.10). Verification of GUI/Alerts etc. as per relevant clauses.

18.0 System Acceptance Test

After complete installation of the system in the Railway, system acceptance test shall be carried out by consignee to the effect to comply with the functional and technical requirements of the specification, as per the procedure/scheme/format proposed by System provider and dully approved by competent authority of user Railway. Also, field trials for a period of minimum 6 months including rainy season shall be carried out by consignee, officer in charge and the system provider. Final commissioning certificate shall be issued by competent authority of user Railway after successful field trials.

19.0 Training and Documentation

19.1 The system provider shall provide training to sufficient number of Indian Railway official to operate the system/ equipment.

19.2 The system provider shall provide the following documents

19.3 Working principle of the System/equipment.

19.4 Detailed description, function and weight/dimension of each unit of the system/equipment.

19.5 Technical literature, drawing and specification of each unit of the equipment along with details of relevant software, if applicable.

19.6 Method of calibration of system and detailed methodology for validation of the system/equipment during service.

19.7 User Manual and Maintenance Manual.

20.0 Ordering Information

S.N.	Item Name	Clause No.	User Requirements (To be specified by user, if other than as mentioned in relevant clause)
1.	UPS	6.4.1	
2.	LED Display for Central Processing Server	7.2, S.N. 16	Size to be specified by user
4.	Interoperability	9.15	Interoperability shall be ensured by Supplier between all the vendors.

21.0 Warranty

Warranty for a minimum period of 2 years from the date of commissioning or completion of field trials whichever is later or as per user Railway requirement shall be provided by the supplier.

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