REMMLLOT: PART-0
(OVERVIEW)

<table>
<thead>
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<th>Specification Number</th>
<th>MP.0.04.02.04</th>
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<tr>
<td>Revision</td>
<td>5</td>
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<td>Date of Issue</td>
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**Brief Description**

This is a part of a four part specification numbered 0 through to 3 describing the requirements for setting up systems for Remote Monitoring and Management of Locomotives and Trains (REMMLLOT).
FOREWORD

REMMLOT Enables remote monitoring of Diesel Locomotives. It creates a complete IT enabled ecosystem which provides a platform for remotely monitoring health and operational characteristics of diesel electric locomotives.

It also enables monitoring of performance of crew and helps in identifying lapses, e.g. when he passes a signal at danger. This will enable focused counselling and training of such crew, who are prone to unsafe working.

REMMLOT also monitors condition of locomotive and makes preventive maintenance of locomotives more effective. REMMLOT monitors shutting down of locomotives when idle for a long time and generates management information to ensure this.

The complete specification for REMMLOT is split over four parts numbered from 0 to 3. Together these parts specify the requirements for setting up the complete system.

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## LIST OF AMENDMENTS

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<td>1.</td>
<td>Sep 2007</td>
<td>0</td>
<td>First issue</td>
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<td>Jul 2008</td>
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<td>First revision</td>
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<td>3.</td>
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<td>Merged and made common specification for ALCo and EMD design of locomotives.</td>
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<td>MP.0.24.00.43 Specification of MBCS Systems for EMD locomotives</td>
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<tr>
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<td>4.</td>
<td>MP-MOD-EC-05-27-10-March-10</td>
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0 Introduction

This document is part of set of documents specifying equipment and services for the deployment of REMMLOT. Kindly see the list of referenced documents for locating other documents of the set.

Diesel locomotives of IR are now fitted with Microprocessor based control, which have fault diagnostic and locomotive health monitoring system. These systems capture the operational and performance data of locomotive continuously.

This document provides the overview of a set of specifications that aim to capture, relay, analyze and present this data to maintainers for improving maintenance by applying condition monitoring strategies.

The specifications of this set of equipment / service requirements are detailed in their respective specification. The relationships of the different specifications included in this set are as given in the diagram below:

Figure 1: Hierarchy of Specifications

1 Objectives and Scope

This document outlines the scope of requirements and the inter-relationships for setting up REMMLOT systems. The complete deployment of REMMLOT requires the following sub-systems:

- Locomotive Remote Monitoring System (LRMS) consisting of the on board equipment
- Locomotive & Train Management System (LTMS) consisting of datacentre, internet portal and 24x7 Technical Helpdesk.
- Facilities for access at Diesel Shed's

The implementation of REMMLOT will require equipment and services to be procured. The related specifications contain the technical details for the procurement and equipment and services. A model document for implementing a Service Level Agreement is also provided for ensuring that the quality of outsource services are monitored and measured ensuring acceptable level of service and taking appropriate corrective and preventive action.

2 Terminology / Abbreviations

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Term / Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>APM</td>
<td>Application Performance Management (Measurement)</td>
</tr>
<tr>
<td>2.</td>
<td>DIADEM</td>
<td>DIAdem is software specifically designed to help engineers and scientists quickly locate, inspect, analyze, and report on measurement data using one software tool.</td>
</tr>
<tr>
<td>3.</td>
<td>DIALS</td>
<td>Digital Into Analog LCD based System</td>
</tr>
<tr>
<td>4.</td>
<td>DLW</td>
<td>Diesel Locomotive Works</td>
</tr>
<tr>
<td>5.</td>
<td>DMW, DLMW</td>
<td>Diesel Loco Modernization Works, Patiala</td>
</tr>
<tr>
<td>6.</td>
<td>EDGE</td>
<td>Enhanced Data rates for GSM Evolution (EDGE) is a digital mobile phone technology that allows improved data transmission rates as a backward-compatible extension of GSM</td>
</tr>
<tr>
<td>7.</td>
<td>FTP</td>
<td>File Transfer Protocol</td>
</tr>
<tr>
<td>8.</td>
<td>GPRS</td>
<td>General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications</td>
</tr>
</tbody>
</table>
9. GPS | Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites.

10. IR | Indian Railways
11. ITS | Issue Tracking System
12. LRMS | Locomotive Remote Monitoring System
13. LTMS | Locomotive and Train Management System
14. MBCS | Microprocessor Based Control System
15. MMD | Maximum Moving Dimensions. The maximum size of rolling stock that can be safely moved on Indian Railways without infringement.
16. NI | National Instruments
17. RDBMS | Relational Database Management System
18. RDSO | Research Designs & Standards Organization
20. RTC | Real Time Clock
21. SADS | Situation Awareness Display System
22. TDMS | Technical Data Management System
23. XML | Extensible Markup Language (XML) is a set of rules for encoding documents in machine-readable form. It is defined in the XML 1.0 Specification produced by the W3C, and several other related specifications, all gratis open standards

Table 1: Abbreviations

3 Definitions

3.1 SADS
Situation Awareness Display System (SADS) is a network of PCs connected to multiple large-screen LCD monitors which displays real-time information.

3.2 Geo-fence
A geo-fence is a virtual perimeter for a real-world geographic area. This is developed using GPS sensing and referencing with a set of coordinates stored in a database that define the virtual fence.

4 Brief description of the system/equipment/components
The overall aim of the project is to provide an intelligent, time saving infrastructure that provides capability to identify and grade locomotives in real-time for proper planning of maintenance and prevention of line failures.

The complete REMMLOT system shall consists of locomotive on-board equipment, communication interface, data logging server, data analysis engine, data presentation application, user client (both PC and cellphone based). A 24x7 helpdesk is specified for providing assistance for maintenance of system and also for troubleshooting of the locomotives.

The data shall be collected from the locomotive computer, relayed to the remote server via a GPRS link. The data shall be stored on the server, analyzed as per pre-defined or user defined rules and presented via simple and easy to use web interfaces.

The following figures provide the overview of the equipment and services that are required for implementation of REMMLOT.
General requirements

The equipment supplied against this specification shall meet the following general requirements.

- The equipment supplied shall be of good quality, rugged and reliable and capable to withstand environmental and use conditions. The individual components shall meet the lifecycle for that category of equipment.
- Wherever outsourced equipment is used care shall be taken to ensure that the equipment is sourced from reputed manufacturers.
- The supplier of equipment supplied under this specification shall ensure proper interfacing and connectivity between equipment / software.

Functional Requirements

The expected functional requirements of the system components are provided briefly as under.

6.1 Overview of functional requirements

6.1.1 Locomotive on board equipment:

The onboard equipment shall interface to the locomotive Vehicle Computer in a manner such that all parameters acquired by the vehicle computer are available for further processing. This equipment shall have its own independent GPS system for getting the geographical location.

6.1.2 Communication system:

Locomotive on-board equipment shall be equipped with GPRS/EDGE/CDMA based communication system for relaying of acquired data.

6.1.3 Data logging servers:

These servers shall be located at the data centre of the supplier / service provider. These servers shall log data relayed by the locomotive on-board devices.
6.1.4 Data analysis and presentation systems:
These shall be server side applications running at the data centre of the provider and shall analyze the data as per predefined / user defined rules. This software shall also prepare the information generated for display on the internet portal.

6.1.5 Internet Portal:
A secure internet portal shall form the user interface of the REMMLOT system. All users shall interact through the portal.

6.1.6 Client applications:
PC and mobile applications shall form the applications for interaction for users. Additionally data analysis and visualization application shall be provided on the PC for further analysis as required by the user.

6.1.7 Geo-fence development:
The LTMS provider shall be required to develop geo-fences for identification of locomotive location. These fences shall demarcate boundaries of railway zones and divisions.

6.1.8 24x7 technical helpdesk:
This helpdesk shall provide support for running of the system.

6.1.9 Training:
Training of users shall be an inherent part of service to be delivered. The users shall be trained for use of different applications and software provide.

6.2 Overview of REMMLOT Dataflow
The following figure depicts the overview of the dataflow for REMMLOT data.

Figure 4: REMMLOT Data Flow
1. The data is generated in the Locomotive control computer.
2. Data is stored in the system data logger, long and short term event recorder and fault data packs.
3. The REMMLOT-LRMS equipment shall acquire this data and add GPS location and RTC time.
4. And transmit the same wirelessly to the remote data-logging servers.
5. Data shall be received and assembled at the data-logging servers
6. Data shall be stored in TDMS files
7. And RDBMS.
8. Data stored in the RDBMS shall be made available through http on web pages designed using the SADS concept.

9. The information shall be viewed using clients running on PC / laptops and phones.

10. The TDMS files shall be available for download using FTP.

11. The TDMS files shall be analysed using NI DIADem. It shall also be possible for the DIADem application to connect to data from the RDBMS using ODBC.

12. It shall be possible to download data directly from the LRMS / MBCS using laptops.

13. The downloading programme shall convert the data to TDMS file.

14. The TDMS file so generated in (13) shall be uploaded to LTMS server if required.

15. The TDMS file generated shall also be available for local data analysis using DIADem if required.

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Application Note

The complete system has purchased components and outsourced services. The purchased components shall be tested as per requirement of the specifications. The outsourced services shall be tested and monitored as per service level agreements for the same.

The detailed functional requirements, specifications, testing criteria of the subsystems indicated the figures are listed in the respective system specifications.

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7 Technical Requirements

Detailed technical requirements for each component of the REMMLOT systems are provided in the relevant part of the specification.

8 Applicable drawings

Applicable drawings (if any) for each component of the REMMLOT systems are provided in the relevant part of the specification.

9 Safety Requirements

All equipment provided under this specification shall meet the existing safety norms as applicable for the respective environment. The applicable norms are listed in the relevant part of the specification.

10 Environmental / climatic requirements

All equipment provided under this specification shall meet the prescribed environmental requirements as prescribed in the relevant part of the specification.

11 Referred standards

The following standards are referred by this specification. It is requested to kindly ensure operational understanding of all the referred standards.

- AAR-S-5702 for testing for affect of working environmental conditions
- CMMI-SVC for service provision
- IEC 60571 for rail road electronics
- IS 2500 for sampling plans
- ISO 27001 for information security management systems
- ISO 9001 for Quality Management System
- ISO 9421 guidelines for user interface development
- NMEA 2000 (IEC61162-3) for sharing of GPS Data
- TIA-942 for server uptime
UL 60950 for safety of mains powered equipment.

12 Maintenance and diagnostic aid
As listed in the relevant part of the specification.

13 Documents to be supplied by the equipment supplier
As listed in the relevant part of the specification.

14 Accessories
As listed in the relevant part of the specification.

15 Training
As listed in the relevant part of the specification.

16 Tests and verification
As listed in the relevant part of the specification.

17 Types of tests
As listed in the relevant part of the specification.

18 Painting labeling and marking
As listed in the relevant part of the specification.

19 Packing and delivery
As listed in the relevant part of the specification.

20 Guarantee / Warrantee
The IRS conditions for guarantee / warrantee shall be applicable.

21 Intellectual Property Rights

21.1 Undertaking by equipment manufacturer
All the specifications issued by RDSO shall include a requirement of undertaking to be signed by Vendors on “INFRINGEMENT OF PATENT RIGHTS”. The undertaking can be as under:

Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/matters lies with the manufacturer/supplier.

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21.2 Declaration of confidentiality of submitted documents by manufacturers
While submitting a new proposal/design, manufacturer must classify their documents confidentiality declaration, such as

This document and its contents are the property of M/s XYZ (Name of the vendor) or its subsidiaries. This document contains confidential proprietary information. The reproduction, distribution, utilization or the communication of this...
22 Information to be supplied by supplier
As listed in the relevant part of the specification.

23 Information to be supplied by purchaser
As listed in the relevant part of the specification.
### ANNEXURE 1: REMMLOT Performance Parameters

The following services shall be provided and monitored as part of this agreement.

<table>
<thead>
<tr>
<th>S. No.</th>
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<th>Performance Parameter</th>
<th>Desired Value</th>
<th>Remarks</th>
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<tr>
<td>1.</td>
<td>GPRS/EDGE service for data transfer from locomotives</td>
<td>Ability to send data at rate better than once every 10 minutes.</td>
<td>Compliance better than 95%</td>
<td>This requirement shall be adhered to by the LRMS provider. The measurements shall be done at server side by using software tools developed by LTMS provider or by use of 3rd party APM tools.</td>
</tr>
<tr>
<td>2.</td>
<td>Data centre</td>
<td>Uptime of internet site</td>
<td>As per TIA 942 Tier III</td>
<td>This requirement shall be adhered to by the LTMS provider. The measurements shall be done at server side by using 3rd party APM tools.</td>
</tr>
<tr>
<td>3.</td>
<td>Data centre</td>
<td>Time to login to the site</td>
<td>Less than 10 seconds for 95% of login requests.</td>
<td>This requirement shall be adhered to by the LTMS provider. The measurements shall be done at server side by using 3rd party APM tools.</td>
</tr>
<tr>
<td>4.</td>
<td>Data centre</td>
<td>Guaranteed minimum data transfer rate from site to client</td>
<td>128 kbps</td>
<td>This requirement shall be adhered to by the LTMS provider. The measurements shall be done at server side by using 3rd party APM tools.</td>
</tr>
<tr>
<td>5.</td>
<td>Data centre</td>
<td>Time to respond to service request. (All types HTTP, FTP ODBC etc)</td>
<td>Less than 5 seconds for 95% of requests.</td>
<td>This requirement shall be adhered to by the LTMS provider. The measurements shall be done at server side by using 3rd party APM tools.</td>
</tr>
<tr>
<td>6.</td>
<td>Operation of SADS and DAWS at control offices.</td>
<td>Equipment uptime including connectivity</td>
<td>Better than 95% of demand.</td>
<td>This requirement shall be adhered to by the LTMS provider. The measurements shall be done at client side by using 3rd party APM tools.</td>
</tr>
<tr>
<td>7.</td>
<td>Operation of software only clients.</td>
<td>Software uptime.</td>
<td>Better than 95% of demand.</td>
<td>This requirement shall be adhered to by the LTMS provider. The measurements shall be done at client side by using 3rd party APM tools.</td>
</tr>
<tr>
<td>8.</td>
<td>Technical Support</td>
<td>Queries sent by email, letter, SMS</td>
<td>For 95% of cases, within 24hrs and problem resolution in 72 hrs</td>
<td>Measured on the ITS implemented by the LTMS service provider. Cases where response time is mutually agreed to be longer shall not be considered.</td>
</tr>
</tbody>
</table>
Note: These performance parameters are highly dependent on the bandwidth available to the internet data servers. The following table shall be used as a guide for calculation of bandwidth requirements. It is recommended that the bandwidth calculated from the data given below should be used as an estimate and correct bandwidth requirement shall be based on actual requirements for meeting the performance metrics as given the table above.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Data server interface</th>
<th>Estimated load for Calculation of Internet data bandwidth</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>1.</td>
<td>Communication with Locos (FTP)</td>
<td>All locomotives. Appropriate distribution factor to be calculated to meet the data transfer requirements.</td>
<td>Since the exact amount of data transfer from the locomotive is not known and depends on the fault frequency this requirement can be determined empirically. However a first estimate can be made once the data to be transferred is finalized for each type of locomotive.</td>
</tr>
<tr>
<td>2.</td>
<td>HTTP</td>
<td>75% of all ordered clients and 10% of all additional clients (created by personnel downloading client software) shall be taken as simultaneous connections.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>FTP (for downloading TDMS files for DIADem)</td>
<td>20% of all DIADem clients shall be considered for simultaneous access</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>ODBC</td>
<td>10% of all DIADem clients shall be considered for simultaneous access</td>
<td></td>
</tr>
</tbody>
</table>