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RESEARCH DESIGNS AND STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW-226011
(SIGNAL & TELECOM DIRECTORATE)

PROOF OF CONCEPT (PoC) FORMAT
for
Implementation of IP-MPLS Technology for Unified Communication Backbone on Indian Railway

I. Amendment History

Sr. No.	Amendment Date	Version	Reason for Amendment
1.	03-09-2024	1.0	First Issue
2.	04-07-2025	2.0	TAN was revised. Approved by PED/S&T at Note # 375 dated 04.07.2025 in e-Office file No. RDSO-TELE0LKO(TECH)/8/2020- Telecom Directorate/RDSO.

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1. Document Control Sheet:

Designation	Organization	Function	Level
SSE/Telecom	RDSO	Assistant	Assist/Prepare
DD/Telecom	RDSO	Member	Assist/Prepare, Check
Dir/Telecom-II	RDSO	Member Secretary	Prepare, Check, Review
ED/Telecom-I	RDSO	Reviewing Authority	Review
PED/ S&T	RDSO	Approving Authority	Approve

2. Prerequisite for the POC:

1.	Letter of Response to EoI with required documents
2.	Clause wise compliance of TAN
3.	MTCTE Certification: Vendor shall have integrated MTCTE certification for the product as per relevant TEC ER & ITSAR (Indian Telecom Security Assurance Requirements).
4.	Trusted Telecom Portal (TTP) Clearance: IPMPLS Router shall be cleared through the Trusted Telecom Portal (TTP) of National Security Council Secretariat (NSCS).

3. Details of the official associated during POC:

S. N.	From	Name of official	Designation
1.	Railway Officials		
2.	RDSO official		
3.	OEM Representative		

RDSO Official	Railway Official	Firm's Representative

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Test Definitions			
S.N.	**Test Case ID**	**Test Case**	**Description**
1.	Ser_01	Service Requirement	System (LER, LSR, NMS and application softwares etc.) shall be configured as per field requirements including components to be used for Railway Services intended to Run on the System.
2.	Gen_02	General requirement	General requirement of LER and LSR
3.	FRS_ 03	Functional and Technical requirements of Label Edge Router (LER)	Functionality of LER along with the integrated components for all the services used by Railways.
4.	FRS_04	Functional and Technical requirements of Label Switching Router (LSR)	Functionality of LSR along with the integrated components for all the services used by Railways.
5.	Per_05	Performance of LER/LSR	Performance of LER/LSR as per TAN.
6.	INT_06	Interoperability	Integration Of Divisional IP-MPLS Network With RailTel Network

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Ser_01-Service Requirement:

1.1 **System Architecture:** Typical schematic diagram is given in fig.1 below. However, actual architecture shall be as per purchaser requirements.

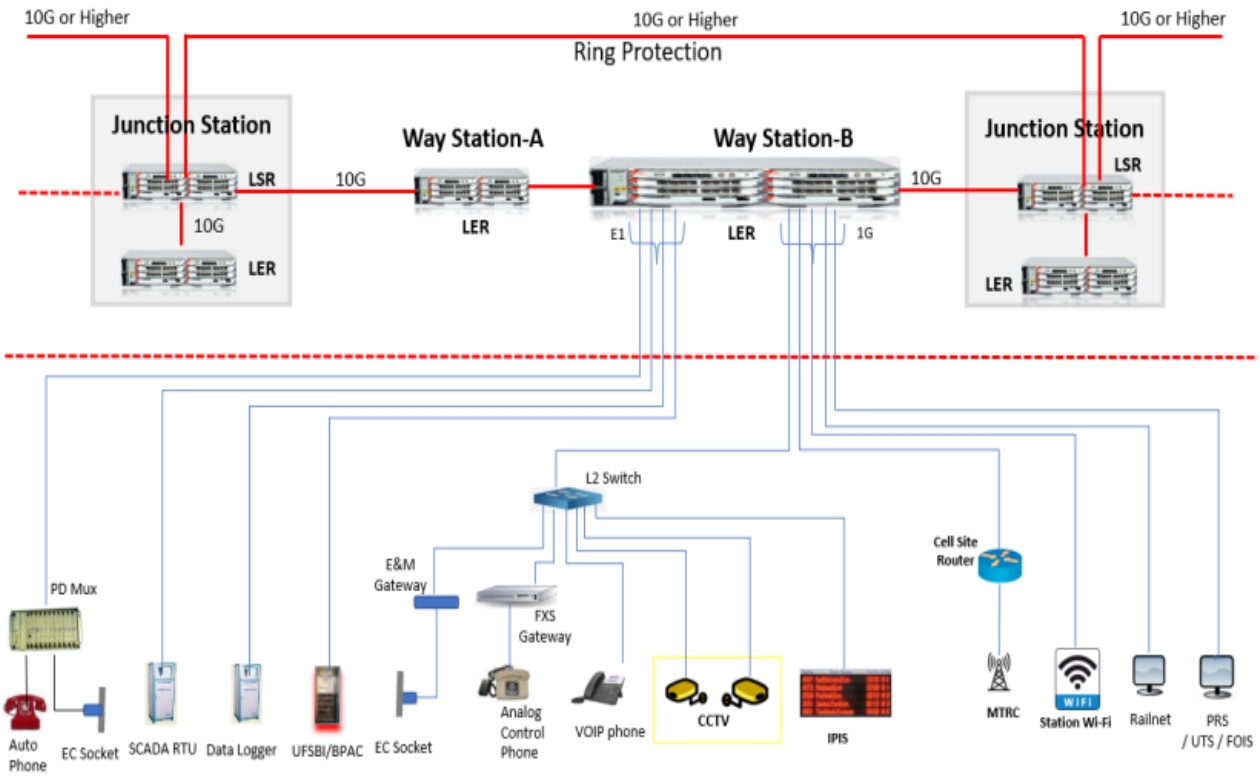

Fig. 1: Typical schematic diagram for implementation of IP-MPLS network

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1.2 **Services Proposed to be used:** Typically, following services are being used over IR. However, any additional services shall be connected & tested as per purchaser requirements.

Ser_01: Service Requirement Test Cases				
S.N.	**Services**	**Test Scenario/ Procedure**	**Expected result**	**Observations**
1.	VoIP Based TCCS	Connect with Railway network through required port of LER	Successful communication shall be established between controller and way station.	
2.	Railnet		Demonstrate the availability of Railnet.	
3.	PRS/UTS/FOIS		Demonstrate the availability of PRS/ UTS/ FOIS connection.	
4.	CCTV		Demonstrate the CCTV connectivity	
5.	Station Wi-Fi		Demonstrate the availability Wi-Fi network at Station.	
6.	IP Based IPIS		Demonstrate the availability of IP Based IPIS connectivity.	
7.	PDMux		Demonstrate the services running PDMux.	
8.	STM-1		Demonstrate the services running STM1	
9.	SCADA		Demonstrate the availability of SCADA network.	
10.	Data Logger		Demonstrate the availability of Data Logger connectivity	
11.	UFSBI		Demonstrate the availability of UFSBI connectivity.	
12.	BPAC		Demonstrate the availability of BPAC connectivity.	
13.	Any other services		As per purchaser requirements.	

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2.0	**Gen_02: General requirement of LER and LSR**				
SN	**Test Scenario**	**Input Specification**	**Expected Output/Values**		**Observations**
2.1	Design	The LER and LSR shall be chassis based. Chassis shall fit into a standard sized 19 inch rack mounting.	Verify the LER and LSR shall be chassis based. Chassis shall fit into a standard sized 19 inch rack mounting.		
2.2	Manufacturing details	Details of card configuration of LER and LSR Routers	Verify the following details in LER and LSR:		
			(i)	Make	
			(ii)	Model Number, Version No.	
			(iii)	Year of Manufacture	
			(iv)	Chassis serial number	
			(v)	Chassis Size	
			(vi)	No. of Slots in chassis with details for which slots are used.	
			(vii)	Details i.e. Make, Model, Version, Serial Number etc. of all type cards i.e. Power Supply, Controller, Fan and Interface cards etc.	
			(viii)	Number of spare slots (if any).	
			(ix)	All the cards i.e. Power Supply Card, Controller Card, Interface Card shall fit directly into the individual slots in the chassis to ensure redundancy and single point of failure.	
			(x)	Each type of Interfaces mentioned for LER and LSR shall be provided in separate modular cards.	
			(xi)	The performance parameters given in test case ID Per_05 shall be demonstrated during the PoC and Test Report & Certificates shall also be submitted from the Govt. Lab/ NABL accredited Lab.	

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2.3	**Details of Card configuration:**				
SN	**Details of cards**	**Make**	**Model No./Part No.**	**Version No.**	**S. No. of Cards**
a.	Power Supply Cards				
b.	Controller Cards				
c.	FAN Tray cards				
e.	Vacant Slot for Future Expansion				

2.4 Interface Card

SN	**Details of Interface**	**Make**	**Model No./Part No.**	**Version No.**	**S. No. of Cards**	**No. of Interface per card**
a.	10G (O)					
b.	1G (O)					
c.	1G (E)					
d.	STM-1					
e.	E1					
f.	Any Other type Interface					

3.0	FRS_3.0: Functional and Technical Requirements of LER test cases			
S.N.	**Test Scenario**	**Input Specification**	**Expected Output/Values**	**Observations**
3.1	Power Supply	Router shall work on -48VDC nominal power supply (with a voltage variation –40 V to –57 V DC). Router should have 1+1 redundant, field replaceable DC power supply units. In case of failure of one power supply unit/card, other power supply unit/card will take full load without any interruption of services.	Physically verify the individual power supply cards available and Demonstrate: 1. Router shall work on -48VDC nominal power supply 2. Router should have 1+1 redundant, field replaceable DC power supply units. 3. In case of failure of one power supply unit/card, other power supply unit/card will take full load without any interruption of services. 4. Power supply card shall fit directly into the individual slots in the chassis to ensure redundancy and avoid single point of failure.	
3.2	Port Configuration	LER shall have the provision of following minimum interfaces or as per purchaser requirement: a) 4x10G (optical) interface equally distributed in minimum two cards, to connect to the adjacent stations. b) 8x1GbE (optical) interface equally distributed in minimum two cards, to connect various networks at stations optically. c) 4x1GbE (copper) to connect various networks at stations. This can be accommodated in 1G (Optical) Cards by addition of ports or may be	Physically verify the individual cards available and to ensure that LER can support multiple cards. a) 4x10G (optical) interface equally distributed in minimum two cards, to connect to the adjacent stations. b) 8x1GbE (optical) interface equally distributed in minimum two cards, to connect various networks at stations optically. c) 4x1GbE (copper) to connect various networks at stations. This can be accommodated in 1G (Optical) Cards by addition of ports or may be	

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3.0	FRS_3.0: Functional and Technical Requirements of LER test cases			
S.N.	**Test Scenario**	**Input Specification**	**Expected Output/Values**	**Observations**
		provided as separate card. d) 8xE1 (G.703) for working various TDM circuits of stations utilising PD Mux as well as directly. e) 2xSTM1 (channelized, optical) ports.	provided as separate card. d) 8xE1 (G.703) for working various TDM circuits of stations utilising PD Mux as well as directly. e) 2xSTM1 (channelized, optical) ports. f) All interface cards shall fit directly into the individual slots in the chassis to ensure redundancy and avoid single point of failure.	
3.3	Alarm	The router should have suitable onboard visual indication for various functionalities/failures.	Demonstrate the provision and functionality of alarm option as onboard visual indication for various functionalities/failures available in the Router.	
3.4	Hot Swappable	Fan Tray, Controller cards, interface card should be hot - swappable and field replaceable unit (FRU)	Demonstrate the hot - swappable and field replaceable unit (FRU) feature for Fan Tray, Controller cards, interface card.	
3.5	Redundancy	Control plane should be redundant and should be able to take full load even with failure of one controller card.	1. Demonstrate the redundant feature of control plane. 2. It shall able to take full load even with failure of one controller card. 3. Test report and Certificates shall also be submitted from the Govt. Lab/ NABL accredited Lab for redundancy of control plane.	
3.6	Out of band Management port	The Router shall have provision for remote out-of-band management capability through Ethernet management port.	Demonstrate the availabilityand functionality of out of band Management port through Ethernet management port.	
3.7	Console Port	The Router shall have console management access, with the provision for console port.	Demonstrate the availability and functionality of Console port.	

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4.0	FRS_04: Functional and Technical Requirements of LSR test cases			
S.N.	**Test Scenario**	**Input Specification**	**Expected Output/Values**	**Observations**
4.1	Power Supply	Router shall work on -48VDC nominal power supply (with a voltage variation –40 V to –57 V DC). Router should have 1+1 redundant, field replaceable DC power supply units. In case of failure of one power supply unit/card, other power supply unit/card will take full load without any interruption of services.	Physically verify the individual power supply cards available and Demonstrate: 1. Router shall work on -48VDC nominal power supply 2. Router should have 1+1 redundant, field replaceable DC power supply units. 3. In case of failure of one power supply unit/card, other power supply unit/card will take full load without any interruption of services. 4. Power supply card shall fit directly into the individual slots in the chassis to ensure redundancy and avoid single point of failure.	
4.2	Port Configuration	LSR shall have the provision of following interfaces or as per purchaser requirement. a) 8x10G (optical) ports, equally distributed in minimum two cards. b) Upgradable to 16 X 10 G (Optical) by way of adding/replacing the card.	Physically verify the individual cards available and to ensure that LSR can support multiple cards. 1. 8x10G (optical) ports, equally distributed in minimum two cards. 2. Upgradable to 16 X 10 G (Optical) by way of adding/replacing the card. 3. All interface cards shall fit directly into the individual slots in the chassis to ensure redundancy and avoid single point of failure.	
4.3	Alarm	The router should have suitable onboard visual indication for various functionalities/failures.	Demonstrate the provision and functionality of alarm option as onboard visual indication for various functionalities/ failures available in the Router.	

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4.0	FRS_04: Functional and Technical Requirements of LSR test cases			
S.N.	**Test Scenario**	**Input Specification**	**Expected Output/Values**	**Observations**
4.4	Hot - swappable	Fan Tray, Controller cards, interface card should be hot - swappable and field replaceable unit FRU.	Demonstrate the hot - swappable and field replaceable unit (FRU) feature for Fan Tray, controller cards, interface card.	
4.5	Control plane redundancy	Control plane should be redundant and should be able to take full load even with failure of one controller card	1. Demonstrate the redundant feature of control plane. 2. It shall able to take full load even with failure of one controller card. 3. Test report and Certificates shall also be submitted from the Govt. Lab/ NABL accredited Lab for redundancy of control plane.	
4.6	Out of band Management port	The Router shall have provision for remote out-of-band management capability through Ethernet management port.	Demonstrate the out of band Management port with its functionality through Ethernet management port.	
4.7	Console port	The Router shall have console management access, with the provision for console port.	Demonstrate availability and functionality of Console Port.	

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5.0	**Per_05: Performance LER/LSR test cases** **Note:** The performance parameters given below shall be demonstrated during the PoC and Test report & Certificates shall also be submitted from the Govt. Lab/ NABL accredited Lab.			
S.N.	**Test Scenario**	**Input Specification**	**Expected Output/Values**	**Observations**
5.1	Non-blocking throughput	Router shall support non-blocking throughput of 60 Gbps full duplex for LER and or higher & 200Gbps switching speed Full duplex for LSR or as specified by the user.	1. Support of non-blocking throughput of 60 Gbps full duplex for LER shall be demonstrated. 2. Support of non-blocking throughput of 200 Gbps switching speed Full duplex for LSR shall be demonstrated.	
5.2	No. of Routes	Router shall support 10K IPv4 & 5K Pv6 routes (LER) & Shall support 64K IPV4 & 16K IPV6 Routes and Multicast routes 1K (LSR)	1. LER support for 10K IPv4 & 5K Pv6 routes to be demonstrated. 2. LSR support for 64K IPV4 & 16K IPV6 Routes and Multicast routes 1K to be demonstrated.	
5.3	Multicast groups	Router shall support 100 multicast groups	LER & LSR support 100 multicast group shall be demonstrated.	
5.4	Layer 3 VPN	Minimum 100 MPLS layer-3 VPN's (LER) & 500 MPLS layer - 3 VPN's (LSR)	1. Minimum 100 MPLS layer-3 VPN's configuration for LER shall be demonstrated. 2. Minimum 500 MPLS layer - 3 VPN's for LSR shall be demonstrated.	
5.5	VPLS	Minimum 64 MPLS VPLS (LER) & 500 MPLS VPLS (LSR)	1. LER is configurable Minimum 64 MPLS VPLS shall be demonstrated. 2. LSR is configurable minimum 500 MPLS VPLS shall be demonstrated.	
5.6	PW's	Minimum 500 MPLS Layer-2 PWs	1. LER is configurable Minimum 500 Layer-2 PWs shall be demonstrated. 2. LSR is configurable minimum 500 Layer-2 PWs shall be demonstrated.	
5.7	BFD Session's	Router shall support min 64 BFD sessions.	Router support for min 64 BFD sessions shall be demonstrated.	

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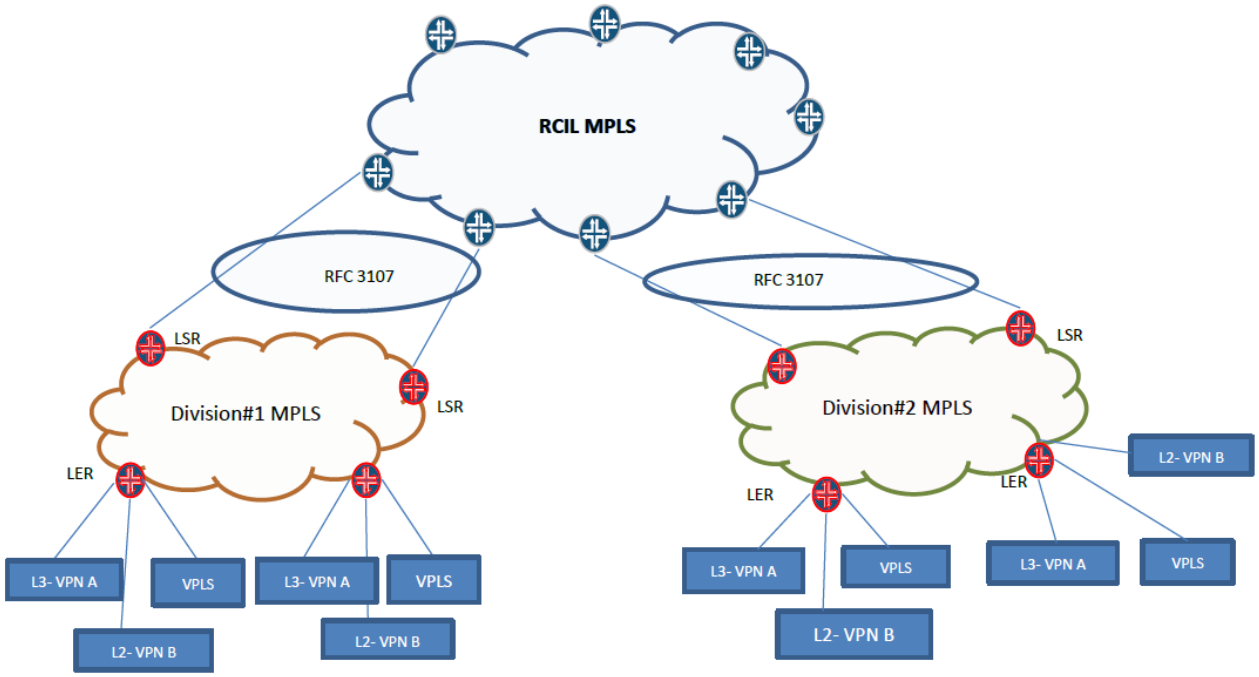
INT_06: INTEGRATION OF DIVISIONAL IPMPLS NETWORK WITH RAILTEL NETWORK

6.1 : Typical Schematic Overall Integration Scheme



6.2 Integration Design

1. The integration of the IP/MPLS network of the division will be done using MPLS VPN CSC[1].
2. Each Division will have its own MPLS domain with unique BGP AS numbers.
3. The IP/MPLS network of the division will be interconnected with RCIL IPMPLS PoP at two or more locations.
   BGP-LU session will be required at junction location (LSR) between Division and RCIL for exchanging labelled infrastructure routes among divisions.
4. The division will be able to create, extend and delete services on their own without any intervention from RCIL with this integration scheme.

6.3 Key Functionality to be tested for Integration

1. The CSC configuration should be completed between RCIL-LER and DIV-LSR router. It should be ensured that proper route exchange happens using BGP.
2. L3VPN, L2VPN, CES services feature testing within Division. These services shall be configured between two divisional setup and services to be configured and should work without any additional configuration from RailTel.
3. End-to-end QoS starting from Div-1 to RCIL and finally to Div-2 to be implemented and tested for ensuring proper marking, classification, and scheduling of respective service type(s).

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4. LAG, Load-balancing, redundancy between Div(s) and RCIL at NNI to be checked as the MPLS network of divisions will be connected to MPLS network of RailTel at two or more locations.
5. Latency measurement to be tested end-to-end (Div-1 to Div-2 over RCIL backbone) using Y.1731 and RFC 2544.
6. Verify Division 2 LER and LSR infra loopback labelled IP Prefixes are learnt via RCIL IPMPLS network over BGP and can be resolved in Division 1 LER routers via BGP over LDP.
7. Check if the BFD of fast failure detection works on BGP link established between the network of RCIL and Division.

[1] Carrier Support Carrier

6.4	**INT_06: Integration with RailTel Network Test cases**	
S.N.	**Details**	**Observation**
6.4.1	BGP over LDP	
	BGP in each Railway Division	
	Labeled E-BGP Session between LSR and RCIL PE	
6.4.2	Layer2 VPN	
	Layer3 VPN	
	Circuit-Emulation Service between Division-1 and Division-2	
6.4.3	Link Aggregation Group (LAG) & Load Balancing	
6.4.4	BFD for BGP session between LSR and RCIL PE	
6.4.5	Performance Monitoring for Layer-2 and layer-3 services	
6.4.6	End to end Quality of Service between Division-1, RCIL, and Division-2.	

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RDSO Official	Railway Official	Firm's Representative