	SESELIOSSEIS!	<u> </u>	
ŧυ	25851/2025/O/	Pour format for Implementation of IP-MPLS Technology for Unified Communication	Ver.: 2.0
	Title:	Backbone on Indian Railway	
	Page 1 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0	



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

PROOF OF CONCEPT (PoC) FORMAT

Implementation of IP-MPLS Technology for Unified Communication Backbone on Indian Railway

I. Amendment History

Sr. No.	Amendment	Version	Reason for Amendment
	Date		
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.

RDSO Official	Railway Official	Firm's Representative

10	25851/2025/O/	Politication Tele-1/RDSO of IP-MPLS Technology for Unified Communication	Ver.: 2.0
	Title:	Backbone on Indian Railway	
	Page 2 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0	

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).

${\bf 3.} \ \ {\bf Details\ of\ the\ official\ associated\ during\ POC:}$

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

RDSO Official	Railway Official	Firm's Representative

4 0	25251/2025/0/	A Director/Tolo-1/PDSO	
40	2000 unitent	Pour format for implementation of IP-MPLS Technology for Unified Communication	Ver.: 2.0
	Title:	Backbone on Indian Railway	
	Page 3 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0	

	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			

RDSO Official	Railway Official	Firm's Representative

1005051/0005101- Di				
40	2 <u>983 1/20</u> 23/0/	Pour format for implementation of IP-MPLS Technology for Unified Communication	Ver.: 2.0	
	Title:	Backbone on Indian Railway		
	Page 4 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0		

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.

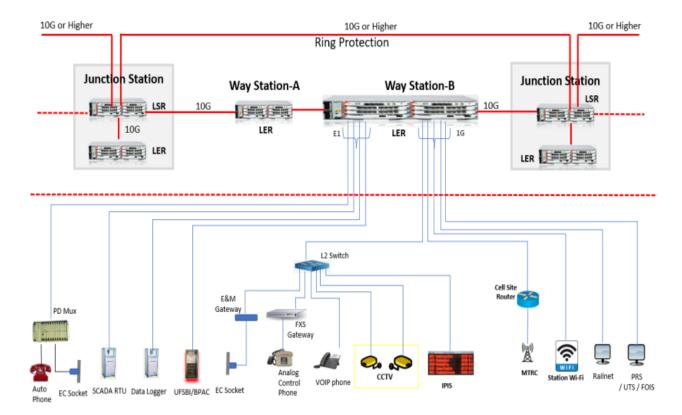


Fig. 1: Typical schematic diagram for implementation of IP-MPLS network

RDSO Official	Railway Official	Firm's Representative

	05054/0005/01 Pt				
łU	29851/2025/O/	Pour format for implementation of IP-MPLS Technology for Unified Communication	Ver.: 2.0		
	Title:	Backbone on Indian Railway			
	Page 5 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0			

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.

S.N.	Services	Test Scenario/ Procedure	Expected result	Observations
1.	VoIP Based TCCS	Connect with Railway network	Successful communication shall be established between controller and way station.	
2.	Railnet	through required port	Demonstrate the availability of Railnet.	
3.	PRS/UTS/FOIS	of LER	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.	

RDSO Official	Railway Official	Firm's Representative

40	400E0E4/000E/0/ D' / /T //DD00				
40	4025851/2025/O/O Director/Tele-1/RDSO of IP-MPLS Technology for Unified Communication				
	Title:	Backbone on Indian Railway			
	Page 6 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0			

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

RDSO Official	Railway Official	Firm's Representative

40	0 05054/0005/0/= Di-==4=-/T-I=-4/DDCO				
40	1025851/2025/O/O Director/Tele-1/RDSO				
	Title:	Backbone on Indian Railway	1		
	Page 7 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0			

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					

RDSO Official	Railway Official	Firm's Representative

40	400E0E4/000E/0/ D' / /T //DD00				
40	4025851/2025/O/O Director/Tele-1/RDSO of IP-MPLS Technology for Unified Communication				
	Title:	Backbone on Indian Railway			
	Page 8 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0			

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 Physically verify the individual power supply cards available and nominal power supply (with a voltage variation -40 V to -57 V Demonstrate: DC). Router should have 1+1 1. Router shall work on redundant, field replaceable DC 48VDC nominal power power supply units. In case of supply failure of one power supply 2. Router should have 1+1unit/card, other power supply redundant, field replaceable unit/card will take full load DC power supply units. any interruption of without 3. In case of failure of one services. 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. LER shall have the provision of 3.2 Physically verify the individual Port following minimum interfaces or Configuration cards available and to ensure that as per purchaser requirement: LER can support multiple cards. a) 4x10G (optical) interface a) 4x10G (optical) interface distributed equally in distributed equally in minimum two cards, to minimum two cards, to the adjacent connect to connect the adjacent to stations. stations. b) 8x1GbE (optical) interface b) 8x1GbE (optical) interface distributed equally in distributed equally in minimum two cards, minimum two cards, to connect various networks at connect various networks at stations optically. stations optically. c) 4x1GbE (copper) to connect c) 4x1GbE (copper) to connect various networks at stations. various networks at stations. This can be accommodated in This can be accommodated in 1G (Optical) Cards (Optical) Cards addition of ports or may be addition of ports or may be

RDSO Official	Railway Official	Firm's Representative

40	SECENTIANSEIO I	- Diverse Tele 4/DDCO	
40	Zagaillenda/Ol	Pour format for implementation of IP-MPLS Technology for Unified Communication	Ver.: 2.0
	Title:	Backbone on Indian Railway	
	Page 9 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0	

\

S.N.	Test Scenario	onal and Technical Requirements 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.	 Demonstrate the redundant feature of control plane. It shall able to take full load even with failure of one controller card. 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 availability and 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.	

RDSO Official	Railway Official	Firm's Representative

40	OFOF LIGARETA	D' (F 4/DD00		
40	29851/2025/O/	Pour format for implementation of IP-MPLS Technology for Unified Communication	Ver.: 2.0	1
	Title:	Backbone on Indian Railway		l
	Page 10 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0		l

4.0 FRS 04: Functional and Technical Requirements of LSR test cases **Expected Output/Values Observations** S.N. Test Scenario **Input Specification** 4.1 Power Supply Router shall work on -48VDC Physically verify the individual power supply cards available and nominal power supply (with a Demonstrate: voltage variation -40 V to -57 V 1. Router shall work on -48VDC DC). Router should have 1+1 nominal power supply redundant, field replaceable DC 2. Router should have power supply units. In case of redundant, field replaceable failure of one power supply DC power supply units. unit/card, other power supply 3. In case of failure of one power unit/card will take full load without supply unit/card, other power any interruption of services. 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. LSR shall have the provision of Physically verify the individual 4.2 **Port** Configuration cards available and to ensure that following interfaces or as per LSR can support multiple cards. purchaser requirement. 1. 8x10G (optical) ports, equally a) 8x10G (optical) ports, equally distributed in minimum two distributed in minimum two cards. cards. 2. Upgradable to 16 X 10 G b) Upgradable to 16 X 10 G (Optical) by way of (Optical) by way of adding/replacing the card. 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.

RDSO Official	Railway Official	Firm's Representative

Demonstrate

onboard

various

The router should have suitable

various functionalities/failures.

onboard visual indication

4.3

Alarm

provision

indication

and

for

failures

the

visual

available in the Router.

functionality of alarm option as

functionalities/

40	SECENISAS INC.	la Director/Tala 4/DDCO	
40	2985 11/20/23/01	Pour format for implementation of IP-MPLS Technology for Unified Communication	Ver.: 2.0
	Title:	Backbone on Indian Railway	
	Page 11 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0	

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

RDSO Official	Railway Official	Firm's Representative

40	SECEA ISSUE IS	- Di	
40	298311/2023/O/	Pour format for implementation of IP-MPLS Technology for Unified Communication	Ver.: 2.0
	Title:	Backbone on Indian Railway	
	Page 12 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0	

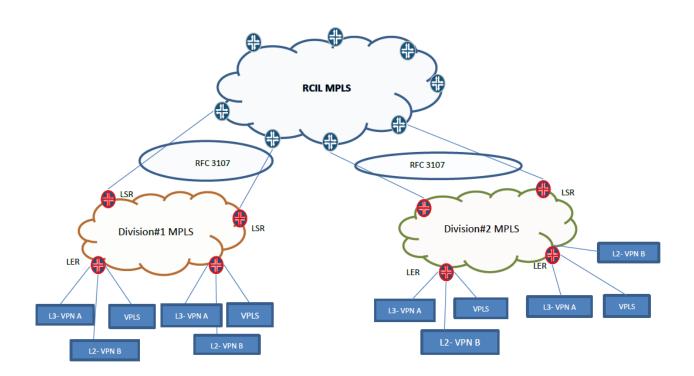
Per 05: Performance LER/LSR test cases 5.0 Note: The performance parameters given below shall be demonstrated during the PoC and Test report & Certificates shall also be submitted from the Govt. Lab/ NABL accredited Lab. S.N. Test Scenario **Input Specification Expected Output/Values** Observatio ns 5.1 Non-blocking Router shall support non-1. Support of non-blocking throughput of 60 Gbps throughput blocking throughput of 60 Gbps duplex for LER shall be full duplex for LER and or demonstrated. higher & 200Gbps switching 2. Support of non-blocking speed Full duplex for LSR or throughput of 200 Gbps as specified by the user. switching speed Full duplex for LSR shall be demonstrated. 5.2 No. of Routes 1. LER support for 10K IPv4 & 5K Router shall support 10K IPv4 Pv6 routes to be demonstrated. & 5K Pv6 routes (LER) & 2. LSR support for 64K IPV4 Shall support 64K IPV4 & 16K IPV₆ 16K Routes and IPV6 Routes and Multicast 1K to Multicast routes be routes 1K (LSR) demonstrated. 5.3 Multicast Router shall support 100 LER & LSR support 100 multicast multicast groups group shall be demonstrated. groups 5.4 Layer 3 VPN Minimum 100 MPLS layer-3 1. Minimum 100 MPLS layer-3 VPN's configuration for LER VPN's (LER) & 500 MPLS shall be demonstrated. layer - 3 VPN's (LSR) 2. Minimum 500 MPLS layer - 3 VPN's for LSR shall demonstrated. 5.5 **VPLS** Minimum 64 **MPLS VPLS** 1. LER is configurable Minimum 64 MPLS **VPLS** shall (LER) & 500 MPLS VPLS demonstrated. (LSR) 2. LSR is configurable minimum 500 MPLS VPLS shall demonstrated. PW's Minimum 500 MPLS Layer-2 1. LER is configurable Minimum 5.6 500 Layer-2 PWs shall **PWs** demonstrated. 2. LSR is configurable minimum 500 Layer-2 PWs shall be demonstrated. **BFD** 5.7 Router shall support min 64 Router support for min 64 BFD Session's BFD sessions. sessions shall be demonstrated.

RDSO Official	Railway Official	Firm's Representative

40	1005054/0005/0/ D' / /T I //DD00			
40	29851/2025/O/	Pour format for implementation of IP-MPLS Technology for Unified Communication	Ver.: 2.0	
	Title:	Backbone on Indian Railway		
	Page 13 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0		

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 CSC¹.
- 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).

RDSO Official	Railway Official	Firm's Representative

40	400E0E4/000E/0/- Di4/T-I4/DD00			
40	4025851/2025/O/o Director/Tele-1/RDSO Technology for Unified Communication		Ver.: 2.0	
	Title:	Backbone on Indian Railway		
	Page 14 of 14	Reference Document No.: STT/TAN/IP-MPLS/2020 Ver.: 3.0		

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.		

RDSO Official	Railway Official	Firm's Representative