

Research Design & Standard Organization
Telecom Department (Signal & Telecom Directorate)

Reasoned document for review of specification no. RDSO/SPN/TC/109/2019, Rev. 0 for the item
Integrated Communication system for Tunnels

SN	Clause No. of current specification	Description/Parameters	Railways/ Firms	Feedback/Comments	RDSO View/ Comments	Proposed Revised Clause
1.	1.3	VHF Simplex, LocoTrol, GSM-R/LTE, TCAS etc. Communication are to be extended as per Railway Requirement in Tunnels for communication during maintenance and constructional blocks, communication in the train in between Guard & Driver, Emergency radio communication between driver, guard, station master & Cabin, Train Control etc.	NFR	<p>Cl. 1.3 & 3.1 mandates provision of VHF simplex, LocoTrol, GSM-R/LTE, TCAS etc. as required. However, NFR open line issued policy guidelines which mandates that all 4 services to be provided in tunnels of new lines projects.</p> <p>As per manufacturers, One OMU/ORU cannot accommodate all frequency bands specially simplex and duplex communication. VHF & LocoTrol are simplex whereas TCAS & LTE are duplex.</p> <p>One ORU cost 30-35 lakhs to be provided at each 500 m distance, providing 2 boxes may increase capital cost.</p>	<p>No change</p> <p>Requirement to extend one or more service to be decided by Railway as per Cl. 13.2.</p> <p>Separate Master Unit will be required for each service i.e. VHF Simplex, LocoTrol, GSM-R/LTE, TCAS.</p>	--
			Maven	<p>.. 'Locotrol'... change to 'DPWCS' LTE change to LTE-R</p> <p><i>Reason: Locotrol is trademark of GE. Indian railways is using 'DPWCS'</i></p>	<p>Agreed.</p> <p>Cl. 1.3 modified for further clarification.</p> <p><i>Remark: LocoTrol is Patent name of US. Indian Railway use</i></p>	<p>Cl. 1.3:</p> <p>VHF Simplex, LocoTrol DPWCS (Simplex), GSM-R/LTE-R (Duplex), TCAS KAVACH (Duplex) etc. Communication are to be extended as per Railway Requirement in Tunnels for communication</p>

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					<i>Distributed Power Wireless Control System (DPWCS).</i>	during maintenance and constructional blocks, communication in the train in between Guard & Driver, Emergency radio communication between driver, guard, station master & Cabin, & Train Controller etc.
			Innovatrix Wireless	VHF Simplex, LocoTrol (simplex way), GSM-R/LTE (semi Duplex) , TCAS (simplex /Semi Duplex) etc. communication are to be extended as per Railway Requirement in Tunnels for communication during maintenance and constructional blocks, communication in the train in between Guard & Driver, Emergency radio communication between driver, guard, station master & Cabin, Train Control etc. <i>Reason: RDSO should define the technology type against each technology</i>	Agreed. However, Semi duplex is not there.	
2.	1.6	For Tunnels less than 500 meters per Bore are to be covered with High Gain Off-Air Channelized Repeaters feeding Dual Radiating Cable Systems. The Repeaters cover VHF Simplex, LocoTrol, GSM-R/LTE, TCAS etc. Schematic diagram is mentioned at figure-1of specification.	Maven	For Tunnels less than 500 meters per Bore where strong RF signals from station is available at the portal of the tunnel are to be covered with off-air re repeaters... <i>Reason: To clarify that off-air repeater can be used only when there is RF signal available at the tunnel portal</i>	Not agreed May be decided by Railways during Site Survey.	--
3.	1.7	For Tunnels more than 500 meters to less than 5000 meters per Bore, a Master/Remote Optical System	Innovatrix Wireless	For Tunnels more than 500 meters to less than 5000 meters per Bore, a Master/Remote	Not agreed Generic	--

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		is to be installed. This System consists of a VHF Simplex, LocoTrol®, GSM-R/LTE and TCAS Master Unit, feeding Optical Remote Units. These Remote Units are housed in an IP65 Case. Appropriate Antennas and Leaky Cables are to be deployed. Schematic diagram is mentioned at figure-2 of specification.		Optical System is to be installed. This System consists of a VHF Simplex, LocoTrol®, GSM-R/LTE and TCAS Master Unit, feeding Optical Remote Units. These Remote Units ideally a single unit for all technology are housed in an IP65 Case. Appropriate Antennas and Leaky Cables are to be deployed. Schematic diagram is mentioned at figure-2 of specification. <i>Reason: All the technologies (VHF Simplex/GSM-R/LTE-TCAS and Locotrol should be accommodated in a single ORU unit. We have a solution which is getting built in India and will be on air on one of the Railway site very soon. Any technology can be upgraded at site without adding or changing any hardware.</i>	Specification.	
4.	2.3	The integrated communication system shall be connected to centralized tunnel control room which shall be either at adjacent Railway station or Divisional Control HQ controlling 2 or more tunnels.	NFR	In NFR, ASM will act as tunnel controller and hence all communication equipments controls need to be brought in ASM room because of which requirement of OFC, network switches, CCTV controls, etc., will change, RDSO spec, is silent whether these are to be provided at ASM room or Tunnel Portals.	Not agreed Already define in this clause.	--
5.	2.4	The Tunnel Radio System shall	Maven	The Tunnel Radio System shall provide an uninterrupted radio	Agreed	Cl. 2.4: The Tunnel Radio System shall

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		provide an uninterrupted radio communication inside tunnel with the headquarters and operation centers and handheld devices of the tunnel operator's staff, emergency staff and trains which pass the tunnel.		communication inside tunnel with the headquarters and operation centers and handheld devices of adjacent stations(s) and handheld devices of the tunnel operator's staff, emergency staff and trains which pass the tunnel. <i>Reason: Added adjacent Station communication for clarity.</i>	Cl. 2.4 modified	provide an uninterrupted radio communication inside tunnel with the headquarters and operation centers and handheld devices of adjacent station(s) , handheld devices of the tunnel operator's staff, emergency staff and trains which pass the tunnel.
			Innovatrix Wireless	Need to be rephrased by railways accordingly. <i>Reason: Each tender should accompany and provision of coverage in between tunnels. Same is currently not being provisioned but asked by railways in their tender.</i>	No changes	
6.	2.5	The communication of all channels in the tunnel shall be independent, simultaneous and failure-free.	Innovatrix Wireless	The communication of all channels (as per requirement of individual railway zone for their tender) in the tunnel shall be independent, simultaneous and failure-free. <i>Reason: Ideally each railway zone for their individual tender should define channels required for their work.</i>	Not agreed Already Covered in Clause 13.2	--
7.	2.7	Voice recording arrangement as per RDSO/SPN/TC/38/2002 or latest for all communication through the Master unit should be provided at the location of the Master unit for analysis and accountability.	Innovatrix Wireless	Voice recording arrangement with xxxx of channels along with radio as per RDSO/SPN/TC/38/2002 or latest for all communication through the Master unit should be provided at the location of the Master unit for analysis and	Not agreed Already Covered in Clause 13.2	

				<p>accountability.</p> <p><i>Reason: Each tender must define how many channels they require for voice recording and must include the corresponding radio required</i></p>		
8.	2.8	<p>The VHF simplex communication being the lifeline of train operation, Tunnel Radio System should be able to provide an uninterrupted radio communication between the radios located anywhere inside a tunnel (inner tunnel) and also between radios of other tunnels/ master unit location (inter tunnel) of the same network.</p>	Maven	<p>The VHF simplex communication being the lifeline of train operation, Tunnel Radio System should be able to provide an uninterrupted radio communication between the radios located anywhere inside a tunnel (inner tunnel) and also between radios of other tunnels / master unit location (inter tunnel) of the same network. It should also be able to provide uninterruptable radio connectivity between the following:</p> <p>a) Between (i) handheld radios inside the tunnel, (ii) between handheld radios inside tunnel and handheld radios in adjacent tunnels of same section and (iii) handheld radios inside the tunnel and handheld and base radios of adjacent stations of the concerned block section. However, it should not be possible for radios of two different block sections to communicate with one another.</p> <p>(b) Communications between adjacent stations.</p>	<p>Not agreed</p> <p>This is generic requirement.</p> <p>Specific requirement decided by user.</p>	--

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				<i>Reason: To incorporate user requirements as some recent past tendes.</i>		
9.	3.1, SN-4	<p>System Description: 4. Off-Air Channelized Repeater</p> <p>Tunnels less than 500 meters length : 4. Yes</p>	Maven	<p>4. 'Off-Air Repeater'</p> <p>4. Yes*</p> <p><i>*Note -Only if strong RF signals from station are available outside the tunnel portal, else MU/ORU system connecting to adjacent station should be implemented.</i></p>	Not agreed	--
10.	3.1.1	<p>Master Unit: The Master Unit is used to convert signals from RF to light when fibre fed repeaters is used at the remote end of the optical link. Master Unit shall be used in more than 500 meters lengths tunnels. Master Unit system may consist of following sub-system:</p> <p>(i) Channelized VHF Simplex Off-Air Repeater and VHF Simplex Optical Master Unit. (ii) GSM-R/LTE Off-Air Repeater and GSM-R/LTE Optical Master Unit. (iii) Channelized TCAS/LocoTrol Off-Air Repeater and TCAS/LocoTrol Optical Master Unit.</p> <p>Frequency Range(Customized): LocoTrol:</p>	Maven	<p>Master Unit shall be used in more than 500 meters lengths tunnels and for less than 500 meters tunnels where RF signals from the nearby station are not available at the tunnel portal.</p> <p>(i) Channelized VHF Simplex Off-Air Repeater and VHF Simplex Optical Master sub-unit.</p> <p>(ii) GSM-R/LTE-R Off-Air Repeater (if required) and GSM-R/LTE-R Optical Master sub-unit.</p> <p>(iii) Channelized TCAS/DPWCS Off-Air Repeater and TCAS/DPWCS Optical Master sub-unit.</p> <p><i>Reason: (i) For clarity of implementation. (ii) Added the word 'sub-unit' to avoid confusion, many time</i></p>	<p>Not agreed</p> <p>However, LocoTrol replaced with DPWCS and frequency is change to 424 – 430 MHz in table.</p> <p><i>The frequency identified by IR for operation of distributed wireless Control system of Locomotive is from 424 to 430 MHz in UHF band (Cl. 3.1.1 modified accordingly)</i></p> <p><i>Refer to Electrical Department spec no. RDSO/2019/EL</i></p>	<p>Frequency Range(Customized): LocoTrol : 406-407 MHz & 433-434 MHz DPWCS: 424 – 430 MHz</p>

		406-407 MHz & 433-434 MHz		<p><i>Master unit and Optical Master unit are used interchangeably.</i></p> <p><i>(iii) In case GSM-R/LTE-R signals are taken by physically connecting to BTS the off-air repeater will not be required. Added the word 'sub-unit' to avoid confusion ,and clarity on GSM-R/LTE-R requirement of off-air repeater subsystem.</i></p> <p><i>(iv) Added the word 'sub-unit' to avoid confusion and 'DPWCS' in place of Locotrol.</i></p>	/RDSO/0142 Rev. 0	
11.	3.1.1	Number of Channels for each service should be normally 4 or user may specify their specific requirements – 4 channels	Maven	<p>'Minimum number of Channels' VHF Simplex – 16 Channels</p> <p>Reason: 11+2 (spare) =13 VHF Simplex frequencies are being asked by IR users in recent tenders.</p> <p>Now out of 22 frequencies, IR has surrendered 6 frequencies, so only 16 remain frequencies remain with IR.</p> <p>Support of all 16 will make the System seamless, uniform and cover the all present and future IR requirements.</p>	Partially agreed Cl. 3.1.1 modified	Cl. 3.1.1: Number of Channels for each service: Normally 4 8 or user may specify their specific requirements.
			NFR	<p>Cl. 3.1.1 & 3.1.4: Master Unit: No. of Channel-4:</p> <p>Highly inadequate as 16 spot frequencies are for VHF simplex, more than 70 spots for Loco troll, more than 6 pairs for others.</p> <p>Normally 8 optical channels in OMU/ORU are there which can</p>	Partially agreed Cl. 3.1.1 modified Min 8 ports are define	

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				<p>be increased further by adding additional modules, Hence optical channels may be increased to minimum 8 per system expandable to 64 channels</p> <p>Minimum number of Optical channels in ORU and OMUs to be increased to minimum 8 expandable to 64. These optical channels are deciding factors for covering number of spot frequencies.</p>	No of ports in ORU clarified in clause no. 3.1.3	
12.	3.1.1	Number of Optical Output Ports: Min 8	NFR	For Connectivity of OMU with ORUs, 8 ports are being offered which are not sufficient for long tunnels if connected on star OFC connectivity.	<p>Not agreed</p> <p>Minimum 8 ports are defined as per clause no. 3.1.1 however requirement of more port may be specified by purchaser.</p> <p>For long tunnel ring connection shall be deployed.</p>	--
13.	3.1.1	New parameter	Maven	<p>UL output power: 33dBm or better'</p> <p><i>Reason: Adding missing parameter for MU</i></p>	Not agreed	--
14.	3.1.1	New parameter	Maven	<p>MU-ORU Fiber Link Protocol: Digital CPRI</p> <p><i>Reason: Digital CPRI (Common packet Radio Interface) is a</i></p>	<p>Agreed</p> <p>New parameter "MU-ORU Fiber Link Protocol" added in table.</p>	MU-ORU Fiber Link Protocol: Digital CPRI (Common packet Radio Interface)

				<p><i>standard protocol used in the telecom industry to connect Base band Unit and Radio Head Units of BTSs'. This protocol is adopted by most of the DAS/Radio rebroadcast vendors in their latest product family. To specify this will ensure that IR gets the latest digital platforms. Digital transports of signals over fiber has many inherent advantages over older analog system sincluding no fiber loss, support of cascade, mesh, ring topology for saving of fibers and multi-level redundancy for reliability of lifeline communications, future scalability and upgradability to other bands etc.</i></p>		
15.	3.1.3	<p>Optical Remote Unit: Optical Remote unit is used at the remote end to convert Optical Signal to RF Signal and then transmit it into Leaky cable in the particular area to cover the tunnel for the wireless communication. It is connected to Master Unit. Optical Remote Units to accept for VHF Simplex, LocoTrol, GSM-R/LTE and TCAS. The Case is an IP65 rating construction Housing. Remote unit are Monitored, Controlled and Alarmed Remotely from the Master Unit over Fibre and Remotely using an Ethernet Modem.</p>	Maven	<p>Optical Remote unit shall be used to provide coverage in more than 500 meters lengths tunnels and in less than 500m tunnels where RF signals from station are not present at the tunnel portal. Details of Remote unit are as under:</p> <p>Optical Remote Units to accept for VHF Simplex, DPWCS, GSM-R/LTE, TCAS as required.</p> <p>Optical remote unit should support Master Unit redundancy, fiber ring redundancy with both master</p>	Not agreed	--

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		Optical Remote unit shall be used to provide coverage in more than 500 meters lengths tunnels. Details of Remote unit are as under: ..		units and connectivity to additional ORU of same or other band simultaneously. <i>Reason: (i) For clarity (ii) DPWCS term used. (iii) Adding reliability feature vital for emergency and lifeline Communications and feature for Future upgradability without requiring new fiber.</i>		
			NFR	Optical Remote Unit: No. of optical channels not specified to decide spot frequencies in different bands. It should be minimum 8 expandable to 64 as per requirement. Number of ports for connecting OFC from both ends not specified. Minimum 2 ports are required if scheme 3 is implemented. However, 4 ports should be there to have better redundant OFC ring protection.	Agreed New parameter "Number of ports" added	New parameter: Number of ports: 4 ports (min) or as per user requirement.
16.	3.1.3	RF Input/ Output Configuration: DL/UL combined	Maven	RF Input/ Output Configuration: DL/UL separate for Simplex Channels, Combined for Duplex Channels	Agreed In clause 3.1.3 RF Input/ Output Configuration modified.	RF Input/ Output Configuration: DL/UL separate for Simplex Channels, Combined for Duplex Channels
17.	3.1.4	Off-Air Channelized Repeater: For less than 500 meters Tunnels are to be covered with High Gain Off-Air Channelized Repeaters feeding Dual Radiating Cable Systems. The Repeaters cover VHF Simplex/LocoTrol, GSM-R/LTE and TCAS communication per Bore.	Maven	Off-Air repeater <i>Reason: More generic terminology.</i>	Not agreed	--

18.	3.1.4	Number of Channels for each service should be normally 4 or user may specify their specific requirements: 4 Channel	Maven	<p>‘Minimum number of Channels’ VHF Simplex – 16 Channels</p> <p>Reason: 11+2 (spare) =13 VHF Simplex frequencies are being asked by IR users in recent tenders.</p> <p>Now out of 22 frequencies, IR has surrendered 6 frequencies, so only 16 remain frequencies remain with IR.</p> <p>Support of all 16 will make the System seamless, uniform and cover the all present and future IR requirements.</p>	Partly agreed	<p>Cl. 3.1.4:</p> <p>Number of Channels for each service: Normally 4-8 or user may specify their specific requirements.</p>
19.	3.1.5	<p>Leaky Cable: For Wireless communication (VHF Simplex, LocoTrol, GSM-R/LTE and TCAS) inside the tunnel FRLS-0H rated Leaky cable shall be provided. Two 7/8” Leaky Cable shall runs per tunnel tube length for VHF Simplex, LocoTrol, GSM-R/LTE and TCAS communication.</p> <p><u>Construction Materials:</u> Jacket: LSZH Polyolefin or PE Dielectric: Foam PE Inner Conductor: Smooth/Corrugated copper tube Jacket Colour: Black Outer Conductor: Copper foil <u>Dimensions:</u> Diameter Over Jacket, maximum: 27.7 mm Inner Conductor OD: 9.50 mm ±0.2mm</p>	NFR	<p>Leaky Cable: Only LSZH has been mentioned, it should be fire retardant LSZH cable.</p> <p>All cables used by electrical & S&T in tunnels are fire retardant. Also in case of fire, all holes of leaky cable will be filled/blocked and it will become unusable. If fire retardant layer is used, this can be prevented.</p> <p>Propagation polarization: Horizontal/vertical</p> <p>It should be both Horizontal & vertical to get better signal. No. of ORU can be reduced as range will increase.</p> <p>Also angular propagation will further increase the range. Thus</p>	Partly Agreed for FRLSZH cable	<p>Cl. 3.1.5: Leaky Cable: For Wireless communication (VHF Simplex, LocoTrol DPWCS, GSM-R/LTE-R and TCAS KAVACH) inside the tunnel Fire Retardant Low Smoking Zero Halogen (FRLS-0 ZH) rated Leaky cable shall be provided. Two 7/8” Leaky Cable shall runs per tunnel tube length for VHF Simplex, LocoTrol DPWCS, GSM-R/LTE-R and TCAS KAVACH communication.</p> <p><u>Construction Materials:</u> Jacket: FRLSZH Polyolefin or PE</p> <p>Polarization: Vertical/Horizontal/Angular as per site requirement</p>

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<p>Cable Weight: 0.42 kg/m ±0.02Kg/m</p> <p>Electrical: Operating Frequency Band: 75 – 2700 MHz</p> <p>Polarization: Vertical/Horizontal</p> <p>Velocity: 89 %</p> <p>Cable Impedance: 50 ohm ±2 ohm</p> <p>DC Resistance, Inner Conductor(Max): 1.69 ohms/km</p> <p>DC Resistance, Outer Conductor(Max) : 3.5 ohms/km</p> <p>Insulation Resistance(Min): 10000 MΩkm</p> <p>Jacket Spark Test Voltage (rms): 8000 V</p> <p>Peak Power: 91.0 kW</p> <p>Environmental: Operating Temperature: -30 °C to +80 °C</p> <p>Mechanical: Tensile Strength(Min): 215 kg /2100N</p> <p>Fire Retardancy Test Method: IEC 60332-1</p> <p>Smoke Index Test Method: IEC 61034</p> <p>Toxicity Index Test Method: IEC 60754-1</p> <p>Standard Conditions: Attenuation Test Method: IEC 61196-4</p> <p>Attenuation Tolerance: ±10%</p> <p>Attenuation, Ambient Temperature: 20 °C</p> <p>Coupling Loss Test Method:</p>		cost saving by saving number of ORUs.		
	Eupen	<p>Jacket: Cable Must be FRLSZH for Tunnel Application</p> <p><i>Reason: Halogen Free, Low Smoke, Flame Retardant (HLFR) FR is must</i></p>	Agreed for FRLSZH cable	
		<p>Polarization: Linear</p> <p><i>Reason: not relevant as such (see attached presentation EUCARAY cable Orientation)</i></p>	Partially agreed	
		<p>Diameter Over Jacket, maximum and Inner Conductor OD: This should not be specified; values are due to design and must be compatible to connectors.</p>	Not agreed	--
		<p>Operating Frequency Band: 30 – 2400 MHz</p> <p><i>Reason: The highest frequency requested is 900MHz. What does it change if range is up to 2400MHz or 2700MHz?</i></p>	Partially agreed	Operating Frequency Band: 75 – 2700 2400 MHz
		<p>DC Resistance, Inner Conductor(Max): 1.63 ohms/km</p>	Not agreed	--
			Inner Conductor (Max):1.69 ohms/km already mentioned in this specification	

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IEC 61196-4

Coupling Loss Tolerance:
±5 dB
Electrical Performance

DC Resistance, Outer Conductor (Max): 2.5 hms/km

Not agreed

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DC Resistance, Outer Conductor (Max): 3.5 ohms/km already mentioned in this specification

Operating Temperature:

-40 °C to +85 °C

Reason: due to high allititude usage in Mountain area of JK and northeast.

Not agreed

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Fire Retardancy Test Method:

IEC60332-2, UL-1581 ,
UL1666, BS4066 , IEEE 1202 ,
NEPA-262

Smoke Index Test Method:

BS 7622 , UL 1685, IEEE-1202,
ASTME 662 , NEPA-262

Toxicity Index Test Method:

IEC-60754-2 , BS 6425

Fire Resistant: IEC60331 ,
BS6387

Halogen Free: IEC 60754, BS
6425

Oxygen Index: ASTM D 2863

Temp Index: ASTM D 2863

Reason: Must for Tunnel and used by Delhi Metro and globally

Not agreed

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Attenuation Tolerance: ±5%

Electrical Performance:

EN60332-1-2 Eka and
EN50575 or EN50339 CPR
Classes

Not agreed

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Attenuation Test Method:

As per IEC -61196-4 and
measurement with "Ground

Not agreed

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				level method".		
			NFR	Leaky cable specification is not covering frequency bands of cellular networks which means that separate cable will be required in future for extending public networks.	Not agreed Frequency range of leaky cable covers cellular networks bands	--
			Innovatrix Wireless	The specs defined currently need to be reviewed once with standard manufacturers as currently some of the specs are not in line as we feel	Noted	--
20.	3.1.5 3.1.5.1	Antenna and its arrangement: For Tunnels less than 500 meters, Antenna shall be installed at tunnel site for VHF Simplex, LocoTrol, GSM-R/LTE, TCAS etc. Antenna arrangement consists of: a) RG217 Coaxial cable with proper connectors b) RF Lightning & Surge Protector c) Tower at Tunnel for fixing antenna.	Maven	RG217 or suitable <i>Reason: To allow better choice of RF cable such as LMR etc.</i>	Agreed Cl. 3.1.5.1 modified	Antenna and its arrangement: For Tunnels less than 500 meters, Antenna shall be installed at tunnel site for VHF Simplex, LocoTrol DPWCS, GSM-R/LTE-R, TCAS KAVACH etc. Antenna arrangement consists of: a) RG217 (or better) Coaxial cable with proper connectors b) RF Lightning & Surge Protector c) Tower at Tunnel for fixing antenna.
21.	3.1.7	Optical Fibre: Master Unit at Base station shall be connected to the tunnel optical remote unit through Fibre Junction Box. Video Surveillance System and PA Systems shall be also connected though same Optic Fibre system as per Railway requirement in para 13.2.	Maven	Fiber loop redundancy: Must support fiber ring redundancy in case of fiber cut. Fiber connection topology: Must support Star, cascade (at-least 10 on one optical port) and mesh topologies <i>Reason: (i) Adding reliability Parameter already shown in Fig -2</i>	Agreed. Fibre loop redundancy & fibre connection topology added.	Cl. 3.1.7: Optical Fibre: Master Unit at Base station shall be connected to the tunnel optical remote unit through Fibre Junction Box. Video Surveillance System and PA Systems shall be also connected though same Optic Fibre system as per Railway requirement in para 13.2. System shall support fibre loop redundancy

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				(ii) Adding parameter for feature support. Cascade and mesh topology allow for saving of fiber and infield expandability without requirement of new fiber cores.		as shown in fig.2 & 3. System shall support Star, cascade & Ring, mesh topologies for fibre connection.
			NFR	Connectivity of OMU to ORUs are not specified in RDSO specification, presently star connectivity is being implemented in all tunnels of J&K , SWR, CR and other places which is not cheaper on life cycle basis and increasing work load on maintenance of OFC cables. Presently one fiber is used to connect one ORU which increased OFC requirement in section by 72 to 96 fibers depending on overall length of tunnels in alignment. The length of tunnels are in range of 60 to 80% of alignment in NFR projects of Manipur, Sikkim, Kohima, etc. laying of 3-4 OFC cables is challenge in section. Thus user requirement of daidy chain connectivity from OMU to ORS on one or 2 fibers must be included. 3 OEMs are already providing Digital system working on one fibers including Maven, Vista and Cellcom. Thus additional of this requirement will reduce complaints in tenders and will	Agreed Fibre connection topology is cleared in relevant modified Cl. 3.1.7 for Star, cascade & Ring, mesh topologies.	--

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				case future maintenance and reduced capital cost.		
			Innovatrix Wireless	There should be provision for 24 / 48 core fibre LSZH type for projects and should be clearly defined in the booklet.	Not agreed Type of OFC cable should be decided by user.	--
22.	3.1.8	Power Supply unit for Master Unit: For Integrated Communication System in Tunnel, power supply unit with 12 Hrs. battery backup (230VAC 50Hz or -48 VDC) for Master Unit should be provided by supplier. For installing of system Railway shall ensure that 230V AC, 50Hz is available at the location of the Master Unit at base station site.	Innovatrix Wireless	Each tender from railway zone should add this as a separate line item	No Change	--
23.	3.1.9	Power Supply unit for Optical Remote unit/Repeater in Tunnels: For Integrated Communication System in Tunnel, power supply unit with 12 Hrs. battery backup (230VAC 50Hz or -48 VDC) for Optical Remote unit/Repeater in Tunnels should be provided by supplier. For installing of system Railway shall ensure that 230V AC, 50Hz is available at the entrance of Tunnel.	Innovatrix Wireless	Each tender from railway zone should add this as a separate line item	No Change	--
24.	4.0	PA system: A Public address system shall be provided to inform/warn maintenance and service staff and	NFR	PA System: As per various consultants reports on tunnels in NFR & J&K projects, all consultants	Partly agreed RDSO specification no. RDSO/SPN/TC/78/2	Cl. 4.0: PA system: A Public address system shall be provided to inform/warn maintenance and service staff and give instructions to people in

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		<p>give instructions to people in abnormal conditions during incident. Therefore loudspeakers shall be installed every 100 m in the tunnel. Purchaser should list out the items required to be installed in tunnels as per RDSO specification no. RDSO/SPN/TC/78/2008 Rev. 0.0 or latest.</p>		<p>suggested speakers at 25-30 meter to avoid humming, echo & noise.</p> <p>High power speakers create lot of reflection & echo in absence of proper acoustics in tunnels thus low power speakers need to be used for clarity in voice.</p> <p>Further, referred RDSO specification no. RDSO/SPN/TC/78/2008 for PA system in coaches is not suitable for tunnel applications. Hence spec. should add provision of industrial grade IP speakers. Same are being used worldwide including all Metros and J&K tunnels.</p>	<p>008 has been withdrawn. For PA system.</p> <p>Note: Some firms made IP Speakers i.e Zenital, Norden etc.</p>	<p>abnormal conditions during incident. Therefore loudspeakers IP Speakers shall be installed every 100 m in the tunnel as per user requirement. Purchaser should list out the items required to be installed in tunnels as per RDSO specification no. RDSO/SPN/TC/78/2008 Rev. 0.0 or latest.</p>
25.	5.0	<p>IP Based Video Surveillance System: IP based Video Surveillance System shall be provided inside tunnels to ensure that there are no blank spots over the tunnels. All the camera feed will be transferred to Tunnel Control Center/Divisional Control Room for viewing, recording and monitoring of tunnels through cameras. Purchaser should list out the items required to be installed in tunnels as per RDSO specification no. RDSO/SPN/TC/65/2019 Rev. 5.0 or latest.</p>	NFR	<p>IP Based Video Surveillance System: The referred RDSO specification is not suitable for tunnel applications. The environment, humidity & light conditions inside tunnels are not good as suggested in RDSO spec. Further smaller range of IR source will require more number of cameras in tunnels.</p> <p>All consultants prescribed industrial grade cameras with complete system at interval of 50 meters on both side of walls to monitor both side of trains in</p>	<p>Not agreed</p> <p>Note: As per clause no. 3.8 of RDSO specification no. RDSO/SPN/TC/65/2019 Rev. 6.0 or latest The equipments shall be able to work in the temperature range and humidity as specified in the corresponding clauses of the specification. Purchaser may specify any other</p>	<p>Cl. 5.0: IP Based Video Surveillance System: IP based Video Surveillance System shall be provided inside tunnels to ensure that there are no blank spots over the tunnels. All the camera feed will be transferred to Tunnel Control Center/Divisional Control Room for viewing, recording and monitoring of tunnels through cameras. Purchaser should list out the items required to be installed in tunnels as per RDSO specification no. RDSO/SPN/TC/65/2019 2021 Rev. 5.0 6.0 or latest.</p>

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				case of train accident. Range can be increased by using powerful IR source of 80-100 meter range and thus number of cameras can be reduced.	temperature requirement and humidity as per site requirement as per cl no. 3... of specification of VSS.	
26.	--	Other parameters	NFR	Provision of industrial grade network: For SCADA of Electrical department, for monitoring power supply, Gas sensors, jet ventilation fans and their automatic operations, Fire alarms and Fire Hydrant with Auto operations, Auto control of power supply in case of fire etc. were required to be connected on robust 10G network based on Industrial grade 10G network which is required for CCTV surveillance system and IP speaker system and IP speaker system inside tunnels.	No Change Note: Networking is not a part of this RDSO specification	--
27.	--	Other parameters	NFR	Industrial grade Emergency call point communication: All consultants suggested provision of all-weather proof, vandalism prof, fire proof call point audio/video phones like talk back as emergency communication system. Electrical department already provided LED lit signages showing position of such phones. IRCON is already providing Henrich make PA and call point phone system designed for such type of	New clause 3.1.11 for Emergency call point added.	New clause 3.1.11: Emergency call point: Industrial grade SIP based emergency call point phones for public/staff which will be connected to Railway network shall be available in tunnel as per user requirement.

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				tunnels. All Metro Railways are providing these systems. Thus Specification should include this requirement of provision of SIP based emergency call point phones for public/staff which will be connected to Railway network.		
28.	--	Other parameters	NFR	In case of accident, first duty of S&T staff is to provide telephone connectivity for passengers. This requirement is totally absent in RDSO specification. Provision of SIP phones and Wi-Fi system can eliminate this problem. Railnet can be extended in case of emergency to permit WhatsApp call to passengers in tunnels or cellular network extension requirement shall be added in RDSO specification.	Not agreed For SIP based Emergency call point phone added in cl. 3.1.11	--
29.	--	Other parameters	NFR	Cellular Network extension: The Hilly terrain of new line of NFR are not having public cellular network coverage not only in Railway track peripheries but also in tunnels. There is absolute need for provision of same. However, RDSO is silent on this requirement. This need to be added.	Not agreed	--
30.	--	Other parameters	NFR	Intrusion detection system: OFC based intrusion detection system need to be included in these projects as per site	Not agreed	--

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				requirements which includes predictive alarms generated through AI/MI Engine for tunnel instrumentation, gas conditions, human trespassing etc.		
31.	--	Other parameters	NFR	<p>RDSO specification is silent on effect of RE on Leady cables, armoured fibers and other cables. Some cables are laid in wire mesh channels in absence of concrete ducts, thus electrostatic induce effect will come in picture. For human safety, protection of staff while working on armored Leaky and OFC need to be taken care of or else unarmoured, anti rodent, fire retarded OFC Cables to be used.</p> <p>RDSO specification provides requirement of Earth at every 500m. Provision of earth pits in tunnels concrete lining is not permitted by Engineers due to fear of increase in water seepage from earthling pit holes. It is better to have Earth pits in escape tunnels or Adits or at end of tunnels and connecting through GI strip. Else GRID earth of tunnel lining should be brought out in consultation with civil Engineering.</p> <p>Arrangement of earthling of leaky cables needs to be</p>	New Cl. 3.1.10 for Earthing for telecom equipment has been added	<p>Cl. 3.1.10: Earthing:</p> <p>Proper earthing arrangement shall be provided for telecom equipment's ($\leq 1\Omega$) in tunnels by providing an earth grid at both ends of the tunnel and running copper earth bus bar across the tunnel and grounding it at regular intervals inside tunnels by providing ring earth of four electrodes in maintenance niche.</p> <p>Earthing of cable armour and trays at regular intervals to be ensured as per standard practice of RE area to ensure the safety of working staff.</p>

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				suggested by RDSO for human safety due to induce voltages.		
32.	13.1 (12)	Leaky Cable accessories kit, connectors & installation kit for Leaky cables	NFR	Clamps of leaky cables are very costly items and RDSO specification is silent on them. Some parameters need to be added in RDSO specification of SS & FRP clamps require for mounting of Leaky cables.	No Change Clamps to be proved as per site requirement	--
33.	Fig-3	Tunnel Communication system for more than 5000 meters with Master unit redundancy	RDSO	Tunnel Communication system for more than 5000 meters with Master unit redundancy	Fig-3 modified	Fig-3: ORU redundancy has also been provided and attached as Annexure-A
34.	13.1	Supply, Installation, Testing and Commissioning of following item by the supplier for Tunnel communication: 3. Optical Remote Unit: 01 No. at every interval of 500 meters length.	RDSO	Cl. No. 13.1 sn-3 modified. Location of optical remote unit shall be decided as per site requirement based on radio survey.		Cl. 13.1: Optical Remote Unit: Supply, Installation, Testing and Commissioning of following item by the supplier for Tunnel communication: 3. 01 No. at every interval of 500 meters length As per site requirement. 19. Emergency call point: As per purchaser requirement for more than 500 meter tunnels. 20. Voice Recording arrangement: As per purchaser requirement for all type of Tunnels
35.	13.2	Details to be furnished by Purchaser: 5. Single mode OFC connectivity for Master Unit (from base station site to Fibre junction box) and for Video Surveillance System & PA System at the entrance of tunnel to be provided by purchaser. 8. List out the item and quantity required to be installed in tunnels	RDSO	Cl. No. 13.2 SN-5 & 8 modified and SN-12 added.		Details to be furnished by Purchaser: 5. Single mode OFC connectivity for Master Unit (from base station site to Fibre junction box) and for Video Surveillance System & PA System at the entrance of tunnel to be provided by purchaser. 8. List out the item and quantity required to be installed in tunnels for PA System as per RDSO specification no.

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		for PA System as per RDSO specification no. RDSO/SPN/TC/78/2008 Rev. 0.0 or latest.		<p>RDSO/SPN/TC/78/2008 Rev. 0.0 or latest user requirement.</p> <p>11. Number of Earthing arrangement required ($\leq 1\Omega$) (Earthing arrangement should normally be provided at every 500 meters Optical Remote unit inside of Tunnel)</p>
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Annexure-A





