

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

Reasoned document for revision of specification no. RDSO/SPN/TC/109/2023, Ver. 1.0 for the item
Integrated Communication system for Tunnels

SN	Clause No. of specification	Description/Parameters	Railways/ Firms	Feedback/Comments	RDSO View/ Comments	Proposed Revised Clause
1.	1.1	<p>Scope:</p> <p>This specification covers technical requirement of equipments for Integrated Communication System for Tunnels on Indian Railway network of varying lengths.</p>	NFR	<p>This specification covers technical requirement of equipments for Integrated Communication System for Tunnels on Indian Railway network of varying lengths.</p> <p>Integrated communication system shall cover following sub systems which are to be provided as per Railways requirements depends on local conditions of Railways on basis of length of tunnels in the section.:</p> <p>(i) Radio coverage system in Tunnels for various radio based communication systems</p> <p>(ii) CCTV surveillance system including Industrial grade switches suitable for harsh environment of tunnels especially high humidity.</p> <p>(iii) Emergency call point communication.</p> <p>(iv) Industrial grade IP based PA/speaker system.</p>	Not agreed. Already covered in Cl. 1.5.	No change.
2.	1.3	<p>VHF Simplex, LoeTrol DPWCS (Simplex), GSM-R/LTE-R (Duplex), TCAS KAVACH (Duplex) etc. Communication are to be extended as per Railway Requirement in Tunnels for</p>	NFR	<p>Radio network coverage in tunnels for VHF Simplex, DPWCS (Simplex), GSM-R/LTE-R (Duplex), KAVACH (Duplex) etc. Communication are to be extended as per Railway Requirement in Tunnels for communication during maintenance and constructional blocks, communication in the train between Guard & Driver,</p>	Agreed.	Cl. 1.3: Radio network coverage in tunnels for VHF Simplex, DPWCS (Simplex), GSM-R/LTE-R (Duplex), KAVACH (Duplex) etc. Communication are to be extended as per Railway Requirement in Tunnels for communication during

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		communication 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.		Emergency radio communication between driver, guard, station master Cabin & Train Controller etc.		maintenance and constructional blocks, communication in the train between Guard & Driver, Emergency radio communication between driver, guard, station master Cabin & Train Controller etc.
			Maven	VHF Simplex, DPWCS (Simplex), KAVACH (Simplex), GSMR/LTE-R (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 Controller etc. <i>Reason: KAVACH system uses spot frequencies for uplink, downlink and broadcast in simplex operation.</i>	Not agreed. Detail is it to be given as per note in cl 1.4.	No change
3.	1.4	The Frequency Band are allotted Frequency Band 146-163MHz for VHF Simplex communication, LocoTrol 406-407 MHz & 433-434 MHz, 876-915 MHz(Uplink) & 921-960 MHz(Downlink) for GSM-R communication and TCAS 405-512 MHz are allotted in Indian Railways. 700 MHz band are recommended to be allotted for LTE for Indian Railways. (Exact Bands and Channels authorized for use by Railways will be communicated at time of Order). VHF Simplex, LocoTrol DPWCS,	Maven	KAVACH: 405-512 427.5 – 430 MHz <i>Reason: As per WPC frequency allocation band for KAVACH</i>	Not agreed. Detail is it to be given as per note in cl 1.4.	No change
			Cellcomm	VHF Simplex, LocoTrol DPWCS, GSM-R/LTE-R, TCAS KAVACH communications shall be suitable to work within following frequency bands in Indian Railway network: 1. VHF Simplex - 143-163MHz 2. Distributed Power Wireless Control System (DPWCS) - 424 ~430Mhz 3. Global System for Mobile Communications –Railway (GSM-R) - 876-	Not agreed Detail is it to be given as per note in cl 1.4.	--

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		<p>GSM-R/LTE-R, TCAS KAVACH communications shall be suitable to work within following frequency bands in Indian Railway network: Very High Frequency (VHF) Simplex: 146-163MHz LoosTrol Distributed Power Wireless Control System (DPWCS): 406-407 MHz & 433-434 MHz 424 to 430 MHz Global System for Mobile Communications – Railway (GSM-R): 876-915 MHz(Uplink) 921-960 MHz(Downlink) Long-Term Evolution-Railway (LTE-R): 700 MHz band TCAS KAVACH: 405-512 MHz. ...</p>		<p>915 MHz(Uplink)& 921-960 MHz(Downlink) 4. Long-Term Evolution-Railway (LTE-R) - 700 MHz band 703 -748MHz (Uplink) &758-803MHz (Downlink) 5. KAVACH - ----- MHz(Uplink) & -----MHz (Downlink)</p> <p><i>Note: Exact Bands and Channels authorized for use by Railways will be communicated at time of Order</i></p> <p><i>Reason: Minimum information of Frequency band and the type of communication mode (Simplex /Semi duplex/Duplex) of all the network to be specified in the document so that the OEM can understand and develop the product or to understand the network requirement.</i></p> <p><i>1.LTE _R frequency band of Uplink and Downlink bifurcation is added in the document.</i> <i>2. KAVACH network is specified as a duplex system in the clause No-1.3 as part of the draft document and hence wour suggestion is to add the uplink & downlink frequency bands for a better clarity for product development.</i></p>		
4	1.5, SN-7	Emergency call point added	NFR	Emergency call points: Optional for less than 500 m and Yes for more than 500 m.	Agreed. New Sn-7 added in table.	Cl. 1.5 SN.-7: Emergency call points: Optional for less than 500 m and Yes for more than 500 m.
5	-	New Clause	NFR	All housing for equipments shall be minimum IP 65 for better protection of equipments.	Agreed. New Clause No. 2.9 added.	Cl. 2.9: All housing for equipments shall be minimum IP 65 for better protection of equipments.
6	-	New Clause	NFR	AC Power supply for equipments shall be provided by Electrical department, suitable UPS/battery backup suitable to work in	Power supply requirements are already defined in Cl.	No change.

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				High humidity area and harsh environment of tunnels.	No. 3.1.8 & 3.1.9.	
7	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 DPWCS, GSM-R/LTE-R, TCAS KAVACH, etc. Schematic diagram is mentioned at figure-1of specification.	Maven	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, DPWCS + KAVACH, GSM-R/LTE-R, KAVACH, etc. Schematic diagram is mentioned at figure-1of specification. <i>Reason: Frequency bands allocated by WPC of DPWCS and KAVACH are overlapping so same unit should Support both DPWCS and KAVACH.</i>	Not agreed. Detail is it to be given as per note in cl 1.4.	No change
8	1.7	For Tunnels more than 500 meters to less than 5000 meters per Bore, a Master/Remote Optical System is to be installed. This System consists of a VHF Simplex, LocoTrol DPWCS, GSM-R/LTE-R, TCAS KAVACH and 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-2of specification.	Maven	For Tunnels more than 500 meters to less than 5000 meters per Bore, a Master/Remote Optical System is to be installed. This System consists of a VHF Simplex, LocoTrol DPWCS + KAVACH, GSM-R/LTE-R, TCAS KAVACH and 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. <i>Reason: Frequency bands allocated by WPC of DPWCS and KAVACH are overlapping so same unit should Support both DPWCS and KAVACH.</i>	Not agreed. Detail is it to be given as per note in cl 1.4.	No change
			Cellcomm	For Tunnels more than 500 meters to less than 5000 meters per Bore or multiple small tunnels with in a cluster, a Master/Remote Optical System is to be installed. This	Not agreed Already covered in cl 1.2.	--

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				<p>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.</p> <p><i>Reason: In Ghat sections , there are multiple small tunnels in a cluster (even less than 500 meter)with in 5KM or lesser and will be in an uneven terrain where the RF signals from the nearest station controller may not reach to these tunnels. If we adopt the fibre Optical repeater for tunnels then it will be an ideal solution to meet the coverage requirement for small tunnels in ghat sections.</i></p>		
9	1.8	For Tunnels more than 5,000 meters per Bore, a Redundant Master Unit as per para 1.7 may also be deployed for complete Redundancy. Schematic diagram is mentioned at figure-3of specification.	Cellcomm	<p>For Tunnels more than 5,000 meters per Bore, a Redundant Master Unit as per para 1.7 may also be deployed for complete Redundancy. Schematic diagram is mentioned at figure-3 of specification. Figure-3 attached as annexure A</p> <p><i>Reason: Figure 3 need to be modified or to be kept with multiple options. To meet the diasy , ring topologies and communication objectives and for mulitple OEMs to participate with better or advance features such as minimum number of fibre core & ports with in the system. This will also help Railways to have multiple options with multiple technologies.</i></p> <p><i>Besides,</i></p> <p><i>1. VHF simplex can be extended in any combination or multiple stage of diasy</i></p>	Not agreed.	--

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				<p>chain.</p> <p>2. GSM & LTE coverage extension in Air Interface (Access Network) will have restrictions of fiber length considering the RTT (round trip time). Since the solution requires a combination of GSM & LTE in some cases, it is recommended to restrict the fibre link loss within the limit.</p> <p>3. Coverage overlapping from Both MU and parallel operation may degrade C/I, Multiple dominance, SNIR parameter and can impact the network performance.</p> <p>4. VHF Simplex network may not have above challenges.</p>		
10	2.1	Original Equipment Manufacturer (OEM) of Integrated Communication System for Tunnels or its authorized representative shall have service facility in India.	Cellcomm	<p>Original Equipment Manufacturer (OEM) of Integrated Communication System for Tunnels or its authorized representative shall have manufacturing and service facility in India.</p> <p><i>Reason:</i> Preference may be given to indigenous manufacturer as a minimum eligibility to support the MAKE IN INDIA policy</p>	Not agreed. The present clause suffices the requirement.	--
11	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.	Mobile Comm.	<p>This may please be deleted from the Tunnel Radio System. If required same is a must, may be considered as a separate project</p> <p><i>Reason:</i> The tunnel radio system is meant for extending wireless communication inside tunnel. The system processes communication at RF level. The same transparently extends the RF seamlessly through the remote units. The recording of the audio from the master unit requires complete demodulation system to extract the audio. The demodulation is much more complicated in case of GSM, LTE,</p>	Not agreed. Clause modified.	<p>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 as per user requirement.</p> <p>For this purpose voice recording arrangement as per RDSO specification RDSO/SPN/TC/38/2002 or latest or any other specification as per</p>

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				<i>LocoTrol (DPWCS) & KAVACH. In the scenario of LTE, GSM R, the communication is established through BTS. Since the communication is routed through BTS, the recording can be done at BTS level only which has nothing to do with tunnel radio System. Therefore, we request you to delete this clause.</i>		user may be used.
12	2.8	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.	Maven	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. However, It should not be possible for radios of two different block sections (track section between two stations) to communicate with one another. This block isolation must be achieved by digital software. <i>Reason: Suggesting to Including Railway working safety feature being asked in Railway tunnel works. Block isolation achieved by digital addressable means is safer than by analog methods.</i>	Not agreed Existing clause suffices the requirement	--
12	2.10	New Clause	NFR	All equipments shall be suitable for working in 25KV RE traction environment.	Agreed. New clause 2.10 added.	Cl. 2.10: All equipments shall be suitable for working in 25KV RE traction environment.
14	3.1 SN-7	Optic Fibre cable: 'No' for less than 500m and 'Yes' for more than 500m tunnel	NFR	No/Yes* * OFC may require in case of multiple tunnels or where off Air channel repeater may not have proper radio coverage for various services.	Covered in cl. 1.2	--

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	3.1	Following systems are required to extend VHF Simplex, Loeotrol DPWCS, GSM-R/LTE-R, TCAS KAVACH (As required) communication in Tunnels as per Table -2 below:	Maven	Following systems are required to extend VHF Simplex, DPWCS + KAVACH, GSMR/LTE-R, KAVACH (As required) communication in Tunnels as per Table - 2 below: <i>Reason: Frequency bands allocated by WPC of DPWCS and KAVACH are overlapping so same unit should Support both DPWCS and KAVACH.</i>		
16	3.1.1	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: i. Channelized VHF Simplex Off-Air Repeater and VHF Simplex Optical Master Unit. ii. GSM-R/LTE-R Off-Air Repeater and GSM-R/LTE-R Optical Master Unit. iii. Channelized DPWCS Loeotrol Off-Air Repeater and DPWCS Loeotrol Optical Master Unit. iv. Channelized TCAS KAVACH Off-Air Repeater and TCAS KAVACH Optical Master Unit.	NFR	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. However, it may be required in cases where station radio service signals is not available e.g, if tunnel is in between to hills and none of the station VHF or other radio signals is having coverage on portals of tunnels.	Agreed Footnote added	Master Unit with Power supply unit : No* * However, in cases where radio service signals are not available on portals of tunnel (s), Master Unit may be provided as decided by the user Railway.
			Maven	(iii) Channelized DPWCS + KAVACH Off-Air Repeater and DPWCS + KAVACH Optical Master Unit. (iv) Channelized KAVACH Off Air Repeater and KAVACH Optical Master Unit. <i>Reason: Frequency bands allocated by WPC of DPWCS and KAVACH are overlapping so same unit should Support both DPWCS and KAVACH.</i>	Not agreed. Detail is it to be given as per note in cl 1.4.	No change

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	3.1.1	Master Unit: Relative Humidity: Max 95%	NFR	Relative Humidity: Max 95% High Humidity, may be more than 100%.	Maximum humidity test criteria in standards are 95%.	No change.
		Number of Channels for each service: Normally 8 or user may specify their specific requirements. Channel Bandwidth: VHF Band: 25KHx Loeotrol DPWCS: 406-407 MHz & 433-434 MHz 424 – 430 MHz GSM-R: 907.8-914.8 MHz/ 952.8-959.8 MHz LTE-R: 700 MHz Band TCAS-KAVACH: 405-512 MHz	Maven	VHF Simplex: 8, DPWCS + KAVACH: 8 11 , GSM-R: 8, LTE-R: 8 <i>Reason: Suggesting to add reliability parameter of ORU and also for silent operation (<50dba sound level) being asked in Railway works. Moving parts fans etc. create sound and are more prone to failure, dust getting stuck etc. Failure of moving parts may result in expensive breakdown or reduced performance of overall ORU being used for vital application. Most of the DAS/Radio rebroadcast vendors have convection cooling even in the older higher power consuming analog version products.</i>	Not agreed. Detail is it to be given as per note in cl 1.4.	No change
				Channel Bandwidth: VHF Band: 25KHz Loeotrol DPWCS + KAVACH: 25KHz GSM-R: 200 KHz LTE-R: 40 KHz 5 MHz TCAS-KAVACH: 25 KHz <i>Reason: To match with 5MHz (Duplex pair) allocation by WPC for LTE-R</i>	Not agreed. Detail is it to be given as per note in cl 1.4.	No change
			Mobile Comm.	Normally 4- 8 or user may specify their specific requirements within this limit of 8 channels <i>Reason: A) The maximum number of channels in working system are 8 in chase</i>	It is 8	No change

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				<p>of VHF simplex. When this clause limit is left undefined, users may ask higher number of channels which adds to the cost and complexity considerably.</p> <p>B) The present Indian Railway communication is working in Analog mode. Therefore, the difference between 4 and 8 channels makes the hardware quantity double in 4 vs 8 channels. We therefore request to specify either 4 channels or 8 channels for more clarity.</p>		
		MU-ORU Fiber Link Protocol: Digital CPRI (Common packet Radio Interface)	Mobile Comm.	<p>This may please be deleted. Let it be open for solution provider.</p> <p><u>Reason:</u> This is a vendor specific. To the best of our knowledge, so far there is no working system installed successfully anywhere in the world for VHF simplex tunnel radio communication using this protocol. The only working system is in simplex RF to optical conversion in Analog. RDSO may draw specifications purely based on a working system or proven system.</p>	Not Agreed. Cl. Pertly modified	MU-ORU Fiber Link Protocol: Digital CPRI (Common packet Radio Interface)
18	3.1.1	New parameter	Maven	<p>UL output power: 33dBm or Better</p> <p><u>Reason:</u> Resuggesting to include missing parameter for MU, same parameter is mentioned as DL output power in RU.</p>	Agreed. New para UL output power added in table	UL output power: 33dBm or Better
19	3.1.1	System Gain (Master + Remote): 40±3dBm	CelComm	<p>System Gain (Master + Remote) - 40±3dBm 100±3dB</p> <p><u>Reason:</u> Since the Master unit is Off-Air type, to enhance the coverage at places with lower and higher input signal levels as receive signals strength shall vary from place to place due to terrain conditions. Hence, we recommend the System Gain of the Optical Master &</p>	Partly agreed	Cl. 3.1.1: system Gain (Master + Remote): Minimum 40±3dBm

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				<i>remote unit need to be designed with higher gain. It shall help to optimize the overall network efficiency.</i>		
20	3.1.1	Number of Optical Output Ports: Min 8	CelComm	<p>Number of Optical Output Ports -Min 4</p> <p><i>Reason: The objective of the optical system design should support the maximum number of remote units under a single master unit.</i></p> <p><i>The Master unit optical output port configuration to be designed inline with multiple connecting topology options to meet the daisy , ring topologies and communication objectives with better or advance features and options with minimum number of fibre core & ports with in the system.</i></p>	Not agreed	--
21	3.1.1	MU-ORU Fiber Link Protocol: Digital CPRI (Common packet Radio Interface)	CelComm	<p>MU-ORU Fiber Link - Digital</p> <p><i>Reason: Digital system design can achieve the feature requirement, multiple connection topologies and communication objectives in a better and flexible way.</i></p> <p><i>CPRI (Common packet Radio Interface) protocol is generally considered to bring the communication protocol in to a single platform where the ORAN (open radio access network) & MORAN (multiple Operator Radio access Networks). This protocol works or is used generally to share the Radio Access Network in Cellular Network and a Netral host solution for inbuilding coverage for Cellular Network. CPRI protocol need not be used for VHF, TETRA , GSM and a standalone LTE R</i></p>	Agreed	MU-ORU Fiber Link Protocol: Digital CPRI (Common packet Radio Interface)

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				<p>networks since it is not bringing any value additions to these system.</p> <p>Kindly consider the option only as digital for this requirement.</p>		
22	3.1.2	<p>Fibre Junction Box:</p> <p>Fibre Junction Box should be as per specification no. RDSO/SPN/TC/68/2014 or latest</p>	NFR	<p>Fibre Junction Box:</p> <p>Fibre Junction Box should be as per specification no. RDSO/SPN/TC/68/2014 or latest Or any other suitable IP 65 boxes may be used.</p>	Agreed	<p>Cl. 3.1.2: Fibre Junction Box:</p> <p>Fibre Junction Box should be as per specification no. RDSO/SPN/TC/68/2014 or latest Or any other suitable IP 65 boxes may be used.</p>
23	3.1.3	<p>Optical Remote Unit:</p> <p>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.</p> <p>Optical Remote Units to accept for VHF Simplex, Leaky Cable DPWCS, GSM-R/LTE-R, and TCAS KAVACH. 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> <p>Optical Remote unit shall be used to provide coverage in</p>	NFR	<p>Relative Humidity: Max 95% High Humidity more than 100%</p>	<p>Not agreed.</p> <p>Maximum humidity test criteria in standards is 95%.</p>	No change.
			Maven	<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.</p> <p>Optical Remote Units to accept for VHF Simplex, DPWCS + KAVACH, GSM-R/LTE-R, and KAVACH.</p> <p><i>Reason: Frequency bands allocated by WPC of DPWCS and KAVACH are overlapping so same unit should Support both DPWCS and KAVACH.</i></p>	<p>Not agreed.</p>	---

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		more than 500 meters lengths tunnels. Details of Remote unit are as under: ...				
24	3.1.3	New parameter	Maven	<p>Cooling: Convection</p> <p>Reason: <i>Reason: Frequency bands allocated by WPC of DPWCS and KAVACH are overlapping so same unit should Support both DPWCS and KAVACH.</i></p>	Partly agreed New parameter in table of 3.1.3	Cooling: Provision of cooling shall be there
25	3.1.3	<p>RF Input/ Output Configuration: —DL/UL combined</p> <p>DL/UL separate for Simplex Channels, Combined for Duplex Channels</p>	Mobile Comm.	<p>Separate DL / UL for VHF Simplex</p> <p>Reason: <i>Since VHF simplex a single frequency is used for transmit and receive, a single port cannot be used as this will not allow simplex communication.</i></p>	Agreed	<p>RF Input/ Output Configuration: —DL/UL combined</p> <p>DL/UL separate for Simplex Channels, Combined for Duplex Channels</p>
		<p>Number of ports: 4 ports (min) or as per user requirement.</p>	Mobile Comm.	<p>This should not be incorporated.</p> <p>Reason: <i>This is a vendor specific. So far, the working system is having only a single port and the system is functioning properly. This option should be left open for system designer.</i></p>	Not agreed	No change
26	3.1.3	Gain: 40±3dBm	Cellcom	<p>System Gain (Remote + Master) - 40±3dBm 100±3dBm</p> <p>Reason: <i>Since the Master unit is Off-Air type, to enhance the coverage at places with lower and higher input signal levels as receive signals strength shall vary from place to place due to terrain conditions. Hence, we recommend the System Gain of the Optical Master & remote unit need to be designed with higher gain. It shall help to optimize the overall</i></p>	Partly agreed	Cl. 3.1.1: system Gain: Minimum 40±3dBm

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				<i>network efficiency.</i>		
27		Number of ports: 4 ports (min) or as per user requirement	Cellcom	<p>Number of Optical Output Ports -Min 2</p> <p><i>Reason: The Remote unit optical output port configuration to be designed inline with multiple connecting topology options to meet the diasy , ring topologies and communication objectives with better or advance features and options with minimum number of fibre core & ports with in the system.</i></p> <p><i>The Number of optical ports and optical core requirement should be as minimum as possible. It is recommend to keep 2 Port as a minimum or as per user/project requirement.</i></p>	Not agreed	--
28	3.1.4	<p>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/DPWCS LocoTrol, GSM-R/LTE-R, and TCAS KAVACH communication per Bore.</p>	NFR	<p>Relative Humidity: Max 95% High Humidity more than 100%</p>	Not agreed.	--
			Maven	<p>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/DPWCS LocoTrol + KAVACH, GSM-R/LTE-R, and TCAS KAVACH communication per Bore.</p> <p><i>Reason: Frequency bands allocated by WPC of DPWCS and KAVACH are overlapping so same unit should Support both DPWCS and KAVACH.</i></p>	Not agreed	--
				<p>Note: Off-Air channelized repeater for less than 500m tunnels is applicable only when</p>	Footnote added in	Master Unit with Power supply

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				<p>RF signals from handhelds at station are available at the portal of the tunnel, else MU-ORU system as per user site requirements may be considered.</p> <p><i>Reason: Suggesting to add note for clarity that Off-air Repeater will be able to connect tunnel to station only if the RF signals from the station are available at the tunnel portal and signals from the off-air repeater are able to reach the station users.</i></p>	clause no. 3.1	<p>unit : No*</p> <p>* However, in cases where radio service signals are not available on portals of tunnel (s), Master Unit may be provided as decided by the user Railway.</p>
29	3.1.5	<p>For Wireless communication (VHF Simplex, LocoTrol DPWCS, GSM-R/LTE-R, and TCAS KAVACH) inside the tunnel Fire Retardant Low Smoking Zero Halogen (FRLS-ZH) rated Leaky cable shall be provided.</p> <p>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>....</p>	NFR	<p>For Wireless communication (VHF Simplex, DPWCS, GSM-R/LTE-R, and KAVACH) inside the tunnel Fire Retardant Low Smoking Zero Halogen (FRLS-ZH) rated Leaky cable shall be provided.</p> <p>Two 7/8” Leaky Cable shall runs per tunnel tube length for VHF Simplex, and DPWCS, however, one leaky cable is sufficient for GSM-R/LTE-R, and KAVACH communication.</p>	<p>Not agreed.</p> <p>It is as per overall system design.</p>	No change.
		<p>Fire Retardancy Test Method: IEC 60332-2</p> <p>Smoke Index Test Method: IEC 61034</p> <p>Toxicity Index Test Method: IEC 60754-1</p>	Eupen	<p>Fire Retardancy Test must be qualify as per standards international:</p> <p>IEC60332-2 (latest version) and add UL-1581, UL1666, BS4066, IEEE 1202, NEPA-262</p> <p>Smoke index test must be qualify as per</p>	Not agreed.	No change

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		Attenuation Test Method: IEC 61196-4 Coupling Loss Test Method: IEC 61196-4		standards international: BS 7622, UL 1685, IEEE-1202, ASTM E 662, NEPA-262 IEC 60754-2 (Latest Version), BS 6425 Fire Resistant: IEC60331, BS6387 Halogen Free: IEC 60754, BS 6425 Oxygen Index: ASTM D 2863 Attenuation Test Method: EN60332-1-2 Eka and EN50575 or EN50339 CPR clause Frequency: As per IEC- 61196-4 and measurement with "Ground level method"		
30	- 3.1.5.1	New Clause	NFR	Suitable clamps as per specification of manufacturer of leaky cable may be used for mounting leaky cables on walls.	Agreed. New clause 3.1.5.2 added	Cl. 3.1.5.2: Suitable clamps as per specification of manufacturer of leaky cable shall be provided for mounting leaky cables on walls.
31		Dimensions Diameter Over Jacket, maximum:27.7 mm Inner Conductor OD:9.50 mm ±0.2mm Cable Weight :0.42 kg/m ±0.02Kg/m Operating Temperature : -30 °C to +80 °C Operating Temperature : -30 °C to +80 °C	Cellcomm Eupen RDSO Review	Remove the dimensions from the specs. <i>Reason: The dimension of the cable varies slightly from OEM to OEM and request to remove the dimensions from the specs requirement document. All performance related parameters can be kept as it is so that all OEMs can participate in the project.</i> Diameter Over Jacket, maximum and Inner Conductor OD: This should not be specified; values are due to design and must be compatible to connectors. RDSO Review	Agreed To avoid limitation of vendor base due to this parameter . Aligned in line with category SD-QM-333	Dimensions Diameter Over Jacket, maximum:27.7 mm Inner Conductor OD:9.50 mm ±0.2mm Cable Weight :0.42 kg/m ±0.02Kg/m Operating Temperature : -30 °C to +80 °C -15 °C to +60 °C

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32	3.1.8	Power Supply unit for Master Unit:	ECR	AT supply must be made available for power supply of repeater/Tunnel control room.	Policy matter.	No change
	3.1.9	Power Supply unit for Optical Remote unit/Repeater in Tunnels:	ECR			
33	3.1.10	<p>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>	NFR	<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 (metallic) 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>	Agreed.	<p>Cl. 3.1.10: 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 (metallic) 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>
			ECR	Leakage cable should be connecting with earth in length to be notified	Partly agreed. Cl. 3.1.10.2 modified.	<p>Cl. 3.1.10.2: 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. However earthing should be provided at least at every ORU location.</p>
34	4.0	A Public address system shall be provided to inform/warn maintenance and service staff and give instructions to people	NFR	A Public address system shall be provided to inform/warn maintenance and service staff and give instructions to people in abnormal conditions during incident.	Agreed.	Cl. 4.0: A Public address system shall be provided to inform/warn maintenance and service staff and give instructions to people in

		<p>In 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/78-63/2008 2006 Rev. 0.0 1.0 or latest.</p>		<p>Therefore Industrial grade IP Speakers shall be installed in the tunnel as per user requirement.</p>		<p>abnormal conditions during incident. Therefore loudspeakers Industrial grade 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/78-63/2008 2006 Rev. 0.0 1.0 or latest.</p>	
35	5.0	<p>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>	NFR	<p>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/65/2021 Rev. 6.0 or latest. However, Railways may add specific latest parameters to suit tunnel environment especially high humidity. Switches and network shall use industrial grade devices.</p>	Agreed. modified	Clause	<p>Cl. 6.0: 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. However, Railways may add specific latest parameters to suite tunnel environment.</p>
36	7.1	<p>VISUAL INSPECTION: Each equipment of the system shall be visually inspected to ensure compliance with the</p>	Reviewed	Reviewed	PA system & CCTV cameras are included in visual inspection & marking is also		<p>VISUAL INSPECTION: Each equipment of the system shall be visually inspected to ensure compliance with the requirement</p>

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		requirement of clause 3 of this specification.			included.	of clause 3, 4, 5 & 10.1 of this specification.
37	7.2.2.1	NIL	Reviewed	Reviewed	Equipments on which Climatic test is to be carried out is defined.	Climatic and environmental test shall be carried out on following equipments: (i) Master unit (ii) Power supply unit (iii) Optical Remote Unit (iv) Off-Air Channelized Repeater (v) PA system (vi) Emergency call points
38	7.2.2.2	The above equipments shall meet the following climatic and environmental requirements: Note added for certificates & test reports to be submitted.	Reviewed	Reviewed	Note added for certificates & test reports to be submitted.	The above equipments shall meet the following climatic and environmental requirements: Note: A test certificate and test report shall be furnished by the supplier for the above tests. The test agency shall be an accredited agency as per RDSO norms and details of accreditation shall be submitted by the firm to Purchaser.
39	7.2.2.3	New Clause for certificate and test reports for Leaky Cable and CCTV cameras and fiber junction box.	Reviewed	Reviewed	New Clause for certificate and test reports for Leaky Cable and CCTV cameras and fiber junction box.	7.2.2.3: Test certificate and reports for items i.e. Leaky cable, Fiber Junction box etc. shall be submitted by supplier.
40	Other	--	ECR	For proper monitoring of working of repeater, there should be arrangement for online monitoring of repeater status in divisional NMS	Not part of specification. May be decided by concerned Railway.	--
41	Other	--	ECR	Provision of POC should available before start of installation at site	Not part of	--

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					specification. May be decided by concerned Railway.	
42	Other	--	ECR	OEM should provide a certificate about distance of working of tunnel communication system for specific distance without any distortion.	Not part of specification. May be decided by concerned Railway.	--
43	4.0	A Public address system shall be provided to inform/warn maintenance and service staff and give instructions to people in abnormal conditions during incident. Therefore loudspeakers Industrial grade 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/78-63/2008 2006 Rev. 0.0 1.0 or latest.	Axis video	Specification of PA System: Speaker Characteristics Audio streaming: One-way, Built-in microphone (option to disable), built-in web server Audio compression: G.711 PCM 8 kHz, G.726 ADPCM 8 kHz, Sampling rate from 8 kHz up to 48 kHz Max sound pressure level & Coverage: 121 db or better, 65° horizontal by 95° vertical or better, Frequency response : 280 Hz – 12.5 kHz or better Amplifier: Built-in 7 W Class D amplifier or better Security: Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control, Digest authentication, User access log Supported protocols:IPv4/v6, HTTP, HTTPSb , SIP, SSL/TLSb , QoS Layer 3 DiffServ, FTP, CIFS/SMB, SMTP, SNMP DNS, DynDNS, NTP, TCP, UDP, IGMPv1/v2/v3, ICMP, DHCP, ARP, SOCKS, SSH. Voice announcement:Support Voice announcement using SIP phone , Support for Session Initiation protocol (SIP) for integration with Voice over IP (VoIP) systems.	Not agreed. As per user requirement	--

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			<p>Event actions File upload: HTTP, network share and email Notification: email, HTTP and TCP Play audio clip ,Perform Auto Speaker Test Send SNMP trap ,Status LED</p> <p>Power: Power over Ethernet (PoE) IEEE 802.3af/802.3af Type 1 Class 3 (max 13 W)</p> <p>Connectors I/O: terminal block for one input and one output</p> <p>Casing: Impact-resistant aluminum, IP66-, IP67-, NEMA 4X-rated.</p> <p>Operating conditions: -30°C to 60 °C ,Humidity 10-100% RH (condensing) or better</p> <p>Certifications:EN 55032 Class B, EN 50121-4, IEC 62236-4, EN 55024, EN 61000-6-1, EN 61000-6-2, FCC Part 15 ,IEC/EN/UL 62368-1, IEC/EN/UL 60950-22 Railway environment:a. EN 50121-4 b. IEC 62236-4</p> <p>Warranty:5-year warranty</p> <p>Speaker: should be powered by direct POE .No other extenal convertor or amplifier to be used.</p> <p>Audio Software : Software requirements</p> <p>1.The audio software shall provide full functionality for the supported number of audio devices (1000 or more) and 100 Zones.</p> <p>2.Assign/link a microphone to a defined audio speaker or group of speaker for live paging or to play pre-recorded annoucement</p> <p>3.System log, syslog server support</p> <p>4.The unit shall support SIP for integration</p>		
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			<p>with VoIP, peer-to-peer or integrated into SIP/PBX</p> <p>5 Support overview and management of all connected devices</p> <p>6 Provide real-time or scheduled management of session events</p> <p>7 Schedule-music</p> <p>8 Software should support SIP trunk intergration</p> <p>9 Priority between Paging Sources</p> <p>10 Two way talk back with selected speaker</p> <p>11 Calibration of Volumes of different music zone as individually</p> <p>12 Backup and restore database</p> <p>13 Audio streaming Opus 48 kHz stereo with 64, 192 or 320 kbps</p> <p>14 Audio files Supported audio file formats: mp3, mp4, mpeg, aac, wma, ogg, flac, wav</p> <p>15 Supported protocols IPv4, HTTP, HTTPS, DNS, NTP, RTP, RTSP, TCP, UDP, DHCP, SIP, mDNS, M3U</p> <p>16 Support for internet radio by URL</p> <p>17 Calender Support for to shedule the annocument</p> <p>18 Dashboard for health monitoring of connected speakers</p> <p>Minimum Hardware specifications: Processor: Intel® Core™ i3 Memory:8 GB Storage:128 GB SDD Operating system:Microsoft Windows 10, Windows 10 IoT 2016 LTSC, Windows Server 2016, 2019 Virtual machine support: VMware ESXi, Microsoft Hyper-V, and Microsoft Windows Datacenter with configuration</p>		
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				<p>and resources allocated similar to the minimum hardware requirements. Network All devices must be connected to the same multicast domain as the server that Audio software</p> <p>MIC:IP based MIC Support min 10 paging buttons that can be configured individually Power: POE Protocol: IPv4,SIP and other necessary protocol</p>		
	V	Reference	RDSO Review	RDSO Review	Table of reference standards has been included.	Table of reference standards has been included.

Tunnel communication system for more than 5000 meters with Master unit Redundancy

