# Notice Inviting EOI for Selection of System Integrator for eNodeB Trials of 4G LTE-R systems

Ref: CORP/MKTG/RDSO/4G/2023/14/01

Date: 16/09/2023



# ITI LIMITED Corporate Marketing, F-100, II Floor, Dooravaninagar, Bangalore-560016 CIN No: L32202KA1950GOI000640

Website: www.itiltd.in

#### 1. Introduction

ITI Limited, a Public Sector Undertaking under the Department of Telecommunications, Ministry of Communications, is a leading Telecom equipment manufacturer and solution provider in India. The major customers are BSNL, BBNL, MTNL, Defense, Paramilitary forces, Railways, Banks, Central & State Govt departments, Institutions and research organizations like ISRO.

ITI Limited has been undertaking various projects in all fields of telecommunications and information technology and also continuously deploying new technologies in the field of Telecom, ICT, Networking, e-Governance etc. ITI Ltd has diversified its operation and has been executing projects in the field of Smart Infrastructure (Smart Cities, Safe Cities, Smart Energy Meters, Smart Classrooms, Smart Poles etc), Bharatnet etc. ITI Ltd has been executing projects in latest technologies like GPON, OLT, ONT, OFC, HDPE etc.

ITI Limited has addressed the "Expression of Interest for Shortlisting of firms for Trials of 4G LTE-R systems in 500RKM in SCR". RDSO has allocated ITI Limited Ex Secundrabad (SC) to BB Nagar (BN) ie from Km 195.36 to Km 228.59) in Secundrabad-Raghunathpali section.

In this connection ITI Limited, invites sealed Expression of Interest (EOI)from eligible bidders to work with ITI Ltd as a System Integrator (SI) on back to back basis for implementing the above work ie survey, installation, commissioning & PoC (Proof of Concept) of eNodeB for Trials of eNodeB for 4G LTE-R System as per their scope of work finalized with ITI Ltd.

Date of EOI Upload	16-09-2023
Pre-bid Queries	Pre-bid queries if any can be send by email.
Due Date for Submission of EOI	22-09-2023, 11 AM
Technical Bid Opening	22-09-2023, 11.30 AM
ITI Ltd Contact Person	Chief Manager- Product Mktg,
	F-100, II Floor, East Wing, ITI Limited,
	Corporate Marketing,
	Dooravaninagar, Bengaluru– 560016
	email: shethy_bbsr@itiltd.co.in,
	vrsakum_crp@itiltd.co.in
	Mob: 9337892230 / 9535325537
Mode of submission	The Technical Bid and financial bid shall be
	uploaded in e-procurement site of ITI Limited
	(https://itilimited.euniwizarde.com/). For
	submission of online bid and procedure to be
	followed,
	visit https://itilimited.euniwizarde.com/

#### 2. Important Dates

#### 3. Scope of Work

The EOI is intended for Selection of SI for Survey, Installation, Commissioning and PoC of eNodeB for Trials of 4G LTE-R systems in 500RKM in South Central Railways for Voice, Data, MCX capability in 4G LTE-R technology. The 4G LTE-R network set up during trials will work as bearer network for Indian Railway's Nation Automatic Train Protection System (KAVACH).

For detailed scope of work & Bill of Material pl. refer RDSO EOI documents, amendments & corrigendum;

EoI details references are as below: EOI Ref No: RDSO/TELE/EOI/01/2023 dated 24.03.2023

ITI Limited has been allocated Ex Secundrabad (SC) to BB Nagar (BN) ie from Km 195.36 to Km 228.59) in Secundrabad-Raghunathpali section. The RDSO EOI and clarifications are attached at Annexure VI, allocation letter is attached at Annexure VII and Design Inputs for Radio Network Planning is attached at Annexure VIII. Interested bidders can write to the email IDs mentioned in this EOI in case of any clarifications.

<b>4(i)</b>	Eligibility Criteria	Criteria of Applicants			
	a	Company Profile:			
		The Bidder/Consortium shall be Company incorporated /registered			
		in India under Companies Act 1956/2013/ proprietorship/			
		partnership firm/ Limited Liability Partnership (LLP).			
	b	<u>Turnover</u>			
		The Bidder shall have an average annual Turnover of INR 30			
		Lakhs for the past 3 financial years from their Indian operations/			
		services (F. Y. 2019-20, 2020-21 & 2021-22).			
	С	Projects Experience			
		a) Experience in System Integration of 4G Telecom Products,			
		preferably in Railways			
		b) Providing and handling of Testing & Measurement equipment			
		for the survey drive test, functional testing and field trials of			
		the equipment.			
		manpower			
	d	The bidder should have positive Net worth as on 31st March, 2022.			
	e	Undertaking for willingness to work with ITI Ltd as per EOI /			
		RDSOterms and conditions			

f	Blacklisting
	Bidder shall submit self-declaration(s) that
	• they are not ineligible / banned / blacklisted in any manner whatsoever by any of the State or UT and or Central Government in India on any ground including but not limited to indulgence in corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice or convicted of economic offence in India for any reason as on last date of bid submission.
	• they don't have any ongoing litigation/cases/arbitration which will have any impact on our ability to provide services under the proposed EOI/tender.
	• their bid is made in good faith, without collusion or fraud and the information contained in the bid is true and correct to the best of our knowledge and belief.
	• In regard to matters relating to the security and integrity of the country, no charge sheet has been filed by an agency of the Government / conviction by a Court of Law for an offence committed by the
	Undertaking in this regard to be submitted
g	response
h	Undertaking to submit requisite PBG when work is awarded (5% of PO value)
i	Bidder should undertake to comply all the EOI/tender requirements
j	Bidder should submit <b>write up</b> on Implementation Plan and capability (how the technical and financial requirement of the project will be met) on how the project will be executed by the bidder

k	Bidder shall submit a list of Key technical personnel with the required domain experience who will be associated in this project.
1	Bidder should submit <b>self-certificate</b> with proper contact detail of clients along with PO reference and amount supplied (Details of End User - Firm Name, Contact person, Designation, Telephone Number, Fax, Official mail id etc.). The same should be issued by authorized signatory of bidder.
	ITI Ltd reserves the right to verify the correctness of the client certificates (PO Copies/Work orders) and any other information submitted by the bidder in his offer.
	In case of any wrong information submitted by bidder, the bid will be rejected and subsequently the bidder will be blacklisted from doing any business with ITI Limited.
m	For start-up and MSME companies, terms and conditions will be as per the latest GoI guidelines. A copy of the latest GoI guidelines may be uploaded along with the technical bid.

<b>4(ii)</b>	Please provide compliance for the following clauses	Compliance
Gen		Yes / No
eral		
1	ITI Ltd reserves the right to quote & supply ITI Ltd manufactured p partial quantity) if BOM of EOI/Tender/Project contains ITI Ltd manu ( <i>Not applicable</i> )	products (in full or affactured products.
2	ITI Ltd reserves the right to undertake the supplies up to 50% of the <i>(Notapplicable)</i>	e order quantity.
3	ITI Ltd reserves the right to undertake services likes installation and activities, Annual Maintenance Contract (AMC) etc. up to 50%.(Not ap	commissioning oplicable)
4	ITI Ltd reserves the rights to split the balance orders (after taking out 70%: 30% ratio between H1 and H2 (Highest margin bidders) for spec provided H2 bidder matches H1 margins offered, and wherever technic Applicable for this EOI)	the ITI portion) in eding up the work, cally feasible. (Not
5	All activities like Proof of concept/demo/presentation on "No Cost (NCNC) basis wherever applicable will be the responsibility of bidde for this EOI)	No Commitment" ers (Not applicable
6	Bidder should be willing to impart required training to ITI Ltd engi undertakingservices & execution of project	neers for

7	Bidder will be responsible for any shortcoming in the BOM and the same should be rectified free of cost
8	Bidder should be willing to provide ToT for manufacture of offered products in ITI Ltd if
	the bidder is an OEM. Bidder/OEM shall give an undertaking for doing contract
	manufacturing of their proposed product at ITI Ltd manufacturing plant. (Not
	Applicable forthis EOI) (Not applicable)
9	Bidder should be willing to sign an exclusive agreement with ITI Ltd for smooth
	execution of the project
10	All commercial terms will be as per the customer EOI/Tender/PO.
11	Earnest Money Deposit (EMD) required for submitting the bid will be borne by the
	selected bidder. Bid security Declaration to be submitted along with the EOI response
12	Performance Bank Guarantee (PBG) will be shared among all the work executing
	bidders depending upon the ratio of order value (as above)
13	Del'errore Cale della
10	Delivery Schedule is not the systemer EQU/Tender/ PQ on healt to healt have
	Derivery Schedule as per the customer EOI/Tender/ PO on back to back basis
14	LD Clause: LD shall be as per ITI Ltd Clauses (@ 0.5% of order value per week or part
	thereof subject to a maximum of 10% of the undelivered portion/ the order value (if the
	item(s) cannot be used unless full supply is made) or to cancel the order and purchase
	the materials from alternative source at the risk and cost of the supplier) OR as per
15	the customer EOI/PO/tender clause whichever is higher.
15	Payment Terms:
	a) The payment terms can be 60% on 1&C, 35% on A1 and remaining 5% after one
	year. b) The quote shall be given separately for Survey and $I&C$
	b) The quote shall be given separately for Survey and tec
16	The bidder shall give an undertaking for the following:
	a. To support ITI Ltd as a SI partner
	b. To make all arrangements and carry out Proof of Concept (PoC) at bidder's cost
	c. To submit PBG when the work is awarded
	a. For survey all the required test & Measuring equipment shall be brought by SI
	c. For survey an me required test & weasuring equipment shall be brought by SI

<b>4(iii)</b>	Checkli	klist of documents/information to be submitted:		
	a.	Company Profile		
	b.	Certificate of Incorporation		
	c. Memorandum & Articles of Association			
	d. Audited financial statements for the last 3 years. FY 2019-20, 2020-21 & 2021-22 CA certificate			
	e. Auditors Net worth certificate			
	f.	PO & Successful completion certificates in this regard shall be submitted for		
		proof of experience		
		Self-certificate with proper contact detail of clients		
	g.	All required Undertaking in company letter head		
	i.	GST Registration Certificate or valid exemption certificate		
	j.	Copy of PAN Card		
	k.	CIN (Corporate Identity Number), if applicable		
	1.	Authorization letter in the company letterhead authorizing the person signing the bid for this EOI and Power of Attorney (POA)		
	m.	Undertaking in letter head to indemnify ITI Ltd from any claims / penalties / statutory charges, liquidated damages, with legal expenses etc.		
	n.	Undertakings in Company letter head as per Annexure I		
	0.	Bidders Details as per Annexure II		
	р.	Clause by clause compliance of all EOI terms and conditions with references to supporting documents as per Annexure III		
	q.	Pre-Contract Integrity Pact as per Annexure-IV a) "Bidders participating in the EOI have to agree to sign Integrity Pact on placement of order / contract"		
		<ul><li>b) "Those bidders who are not willing to sign Integrity Pact will not be considered for bid opening"</li></ul>		
	r.	Bid security Declaration format as per Annexure – V		
	s.	Write up on Implementation Plan and capability		
	t.	List of Key technical personnel		

4(iv)	Financi	al Bid
		A. Cost for carrying our Survey in INR Lumpsum. (Inclusive of all taxes)
		B. Cost for I&C and POC integration in INR per enode B (Inclusive of all
		taxes)

#### **5** Special Conditions of EOI:

No advance will be paid to the selected back-to-back partner, even though ITI Ltd is eligible to get advance from the customer being a front end bidder.

#### Note:

1. ITI Ltd's Tender document can be downloaded from ITI Ltd web site www.itiltd.in. For uploading the bid proposal, all vendors have to register in our eProcurement portal (https://itilimited.euniwizarde.com/)

Any clarifications regarding the EOI/tender can be obtained from

CMR- Product Mktg, F-100, II Floor, East Wing, ITI Limited,Corporate Marketing, Dooravaninagar, Bengaluru– 560016 email: shethy\_bbsr@itiltd.co.in, vrsakum\_crp@itiltd.co.inMob: 9337892230 / 9535325537

- 2. Technical bids will be opened at 11.30 AM on 22/09/2023
- 3. Financial Bid opening will be done after the evaluation of Technical bid (Only for technically qualified bidders).
- 4. Bid should be valid for a period of 180 Days from the date of opening of EOI response.
- 5. Conditional offers are liable for rejection.
- 6. The Bidders should give Clause by clause compliance (as per Annexure III) of all EOI terms and conditions with references to supporting documents; otherwise the offers are liable for rejection.
- 7. Payment to the successful bidder shall be made after deducting the offered margin and the statutory taxes payable to the Govt (Penalties if any levied by the customer will be passed on to the Successful bidder), only after the receipt of payment from the customer.
- 8. Prices offered should be firm throughout the contract irrespective of reason, what so ever, including the exchange rate fluctuation.
- 9. Evaluation: SI will be selected on the basis of his offer as per financial bid format. Selected SI shall submit the PBG when the work is awarded.
- 10. Indemnity: The vendor to indemnify ITI Ltd from any claims / penalties / statuary charges, liquidated damages, with legal expenses etc as charged by the customer. LD/ Penalties incurred on account of delay in supply, product failure during warranty if any and deficiency in Warranty and AMC services attributable to the partner shall be borne by the partner
- 11. Arbitration: Any dispute arising out of this Agreement shall be settled and resolved as per the dispute resolution and arbitrations clause agreed between the Parties under the main Contract.
- 12. Set Off: Any Sum of money due and payable to the supplier under this contract may be appropriated by the purchaser or any other person contracting through the ITI Ltd and set off the same against any claim of the purchaser for payment of a sum of money arising out of this contract or under any other contract made by the supplier with the purchaser.
- 13. The interested SI may like to discuss the customer EOI/tender related information, EOI Bidding Conditions, Bidding Process and clarifications, if any with the Chief Manager Marketing and obtain the complete EOI/tender document from customer website.
- 14. Consortium bids are not allowed
- 15. Companies interested to associate with ITI Ltd for this project shall have specialization and experience in Supply, Installation and maintenance of IT Projects. The details of the projects executed by the company shall be given in the EOI response.

- 16. ITI Ltd will not consider any or all of the bids if they are not meeting EOI requirements.
- 17. Bidders participating in the EOI have to agree to sign Integrity Pact on placement of order / contract.
- 18. Those bidders not willing to sign Integrity Pact will not be considered for bid opening.

19. Intellectual Property Rights:

- All deliverable, outputs, plans, drawings, specifications, designs, reports and other documents and software submitted by the contractor under this contract shall become and remain the property of the procuring entity and subject to laws of copyright and must not be shared with third parties or reproduced, whether in whole or part, without: the procuring entity's prior written consent.
- The contractor shall, not later than upon termination or expiration of this contract, deliver all such documents and software to the procuring entity, together with a detailed inventory thereof.
- The contractor may retain a copy of such documents and software but shall not use it for any commercial purpose.
- 20. Late offer: Any offer received after the prescribed timeline shall be rejected and shall be returned unopened to the Companies.
- 21. Language of offers: The offers prepared by the Company and all the correspondences and documents relating to the offers exchanged by the companies shall be written in English language.
- 22. In the event that ITI Ltd is required to provide demonstration or working of the product to their buyers, the same shall be arranged by the system integrator at latter's cost and expenditure.
- 23. Cost of EOI: The bidder shall bear all costs associated with the preparation and submission of his offer against this EOI, including cost of presentation for the purposes of clarification of the offer, if so desired by ITI Ltd. ITI Ltd will, in no case be responsible or liable for those costs, regardless of the conduct or outcome of the EOI process.
- 24. Purchaser's **Right to accept any bid or to reject any or All Bids or to cancel the EOI:** ITI Limited reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids, at any time prior to award of contract without assigning any reason whatsoever and without thereby incurring any liability to the affected bidder or bidders on the grounds of purchaser's action.
- 25. Amendment **of EOI:** At any time prior to the last date for receipt of offers, ITI Ltd, may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify the EOI document by an amendment. In order to provide prospective bidder reasonable time in which to take the amendment into account in preparing their offers, ITI Ltd may, at their discretion, extend the last date for the receipt of offers and/or make other changes in the requirements set out in the Invitation for EOI.
- 26. Disclaimer: ITI Ltd and/or its officers, employees disclaim all liability from any loss or damage, whether foreseeable or not, suffered by any person acting on or refraining from acting because of any information including statements, information, forecasts, estimates or projections contained in this document or conduct ancillary to it whether or not the loss or damage arises in connection with any omission, negligence, default, lack of care or misrepresentation on the part of ITI Ltd and/or any of its officers, employees.

#### Annexure-I

#### Undertakings (To be in Bidder's Letter Head)

M/s..... do here by undertake the following

- 1. are not blacklisted by Central Govt./ any State or UT Govt/ PSU/ organized sector in India
- 2. to work with ITI Ltd as per this EOI and Customer EOI/Tender terms and conditions. Also, we agree to implement the project (scope of work as per EOI/Tender terms and conditions including investment) covering Warranty & post-warranty services, maintenance etc, in the event of ITI Ltd winning the contract on back-to- back basis.
- 3. to submit bid security declaration and Performance Bank Guarantee (...... % of contract value) to customer/ITI Ltd (as decided by ITI Ltd) as per Customer EOI/Tender terms & conditions.
- 4. that we will be equipped with the required manpower with qualifications, certifications and experience as mentioned in the customer EOI/tender.
- 5. to get required certificate& support (warranty & post-warranty/maintenance) in the name of ITI Ltd from the OEM as per customer EOI/tender requirement.
- 6. to obtain relevant statutory licenses for operational activities.
- 7. to sign MoU/Teaming Agreement, Integrity Pact with ITI Ltd for addressing the customer EOI/tender as per customer's EOI/tender terms and conditions.
- 8. to indemnify ITI Ltd from any claims / penalties / statuary charges, liquidated damages, with legalexpenses etc as charged by the customer.
- 9. to support the offered equipment for a minimum period of 7 years including warranty and AMC
- 10. to supply equipment/components which conform to the latest year of manufacture.
- 11. The bidder should give certificate stating that all the hardware/ software supplied under the contract shall not contain any embedded malicious codes that could inhibit the desired functions of the equipment or cause the network to malfunction in any manner.

#### **Bidders Profile**

1.	Name and address of the company			
2.	Contact Details of the Bidder (Contact person name with designation, Telephone Number, FAX, E- mail and Web site)			
3.	Area of business			
4.	Annual Turnover for 3 financial years (Rs in Cr)	2019-20	2020-21	2021-22
5.	Net worth as on <b>31st March</b> , <b>2022</b>			
6.	Date of Incorporation			
7.	GST Registration number			
8.	PAN Number			
9.	CIN Number, if applicable			
10.	Number of technical manpower in company's rolls			

#### Annexure-III

#### **Compliance Statement**

S.No	Clause No.	Clause	Compliance (Complied/ Complied)	Not	Remarks Reference	with	Documentary

Note: Bidders are requested to comply every clause as per EOI, Corrigendum, Addenda which is published along with the EOI. The relevant supporting documents need to be referred with respective clauses mentioned.



#### Annexure - IV

#### PRE-CONTRACT INTEGRITY PACT

(To be executed on plain paper and submitted along with Technical Bid/ EOI Documents. To be signed by the bidder and same signatory Competent/ Authorized to sign the relevant contract on behalf of the ITI Ltd).

EOI No.....

This Integrity Pact is made on .....day of 2023

BETWEEN:

ITI Limited, ...... having its Registered & corporate office at ITI Bhavan, Dooravani Nagar, Bangalore – 560016 India, and established under the Ministry of Communications & IT, Government of India (hereinafter called the Principal), which term shall unless excluded by or is repugnant to the context, be deemed to include its Chairman & Managing Director, Directors, Officers or any of them specified by the Chairman & Managing Director in this behalf and shall include its successors and assigns) ON THE ONE PART AND

M/s .....Chief Executive Officer (hereinafter called the bidder(s)/Contractor(s)), which term shall unless excluded by or is repugnant to the context be deemed to include its heirs, representatives, successors and assigns of the bidder/contract ON THE SECOND PART.

Preamble

WHEREAS the Principal intends to enter into an MOU of partnering business opportunities of common interest and able to generate synergies in execution of such business for ....

(name of the Stores / equipment / items). The Principal, values full compliance with all relevant laws of the land, regulations, economic use of resources and of fairness/ transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal has appointed an Independent External Monitor (IEM), who will monitor the EOI process and the execution of the contract for compliance with the principles as mentioned herein this agreement.

WHEREAS, to meet the purpose aforesaid, both the parties have agreed to enter into this Integrity Pact the terms and conditions of which shall also be read as integral part and parcel of the EOI Documents and contract between the parties.

NOW THEREFORE, IN CONSIDERATION OF MUTUAL COVENANTS STIPULATED IN THIS PACT THE PARTIES HEREBY AGREE AS FOLLOWS AND THIS PACT WITHNESSETH AS UNDER:

#### SECTION 1 – COMMITMENTS OF THE PRINCIPAL

The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:

- a. No employee of the Principal, personally or through family members, will in connection with the EOI for or the execution of the contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the personal is not legally entitled to.
- b. The Principal will, during the EOI process treat all bidder(s) with equity and reason. The Principal will in particular, before and during the EOI process, provide to all bidder(s) the same information and will not provide to any bidder(s) confidential/ additional information through which the bidder(s) could obtain an advantage in relation to the EOI process or the contract execution.
- c. The Principal will exclude from the process all known prejudiced persons. If the principal obtains information on the conduct of any of its employee, which is a criminal offence under IPC/PC Actor if there be a substantive suspicion in this regard, the Principal will inform the Chief Vigilance Officer and in addition can initiate disciplinary action as per its internal laid down Rules/ Regulations.

#### SECTION 2 – COMMITMENTS OF THE BIDDER / CONTRACTOR

- 2.1 The Bidder(s)/Contractor(s) commits himself to take all measures necessary to prevent corruption. He commits himself observe the following principles during the participation in the EOI process and during the execution of the contract.
- a. The bidder(s)/contractor(s) will not, directly or through any other person or firm offer, promise or give to any of the Principal's employees involved in the EOI process or the execution of the contract or to any third person any material or other benefit which he/ she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever (during the EOI process or during the execution of the contract.
- b. The bidder(s)/contractor(s) will not enter with other bidders/ contractors into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices,

specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

- c. The bidder(s)/contractor(s) will not commit any offence under IPC/PC Act, further the bidder(s)/contractor(s) will not use improperly, for purposes of competition of personal gain, or pass onto others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
- d. The Bidder(s)/Contractor(s) of foreign original shall disclose the name and address of the Agents /representatives in India, if any. Similarly, the Bidder(s)/Contractor(s) of Indian Nationality shall furnish the name and address of the foreign principals, if any.
- e. The Bidder(s) f Contractor(s) will, when presenting the bid, disclose any and all payments made, are committed to or intend to make to agents, brokers or any other intermediaries in connection with the award of the contract.
- f. The Bidder(s)/Contractor(s) will not bring any outside influence and Govt bodies directly or indirectly on the bidding process in furtherance to his bid.
- g. The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or to be an accessory to such offences.

# SECTION 3 – DISQUALIFICATION FROM EOI PROCESS & EXCLUSION FROM FUTURE CONTRACTS

If the Bidder(s)/Contractor(s), during EOI process or before the award of the contract or during execution has committed a transgression in violation of Section 2, above or in any other form such as to put his reliability or credibility in question the Principal is entitled to disqualify Bidder(s)/Contractor(s) from the EOI process.

If the Bidder(s)/Contractor(s), has committed a transgression through a violation of Section 2 of the above, such as to put his reliability or credibility into question, the Principal shall be entitled exclude including blacklisting for future EOI/contract award process. The imposition and duration of the exclusion will be determined by the severity of the transgression. The severity will be determined by the Principal taking into consideration the full facts and circumstances of each case, particularly taking into account the number of transgression, the position of the transgressor within the company hierarchy of the Bidder(s)/Contractor(s) and the amount of the damage. The exclusion will be imposed for a period of minimum one year.

The Bidder(s)/Contractor(s) with its free consent and without any influence agrees and undertakes to respect and uphold the Principal's absolute right to resort to and impose such exclusion and further accepts and undertakes not to challenge or question such exclusion on any ground including the lack

of any hearing before the decision to resort to such exclusion is taken. The undertaking is given freely and after obtaining independent legal advice.

A transgression is considered to have occurred if the Principal after due consideration of the available evidence concludes that on the basis of facts available there are no material doubts.

The decision of the Principal to the effect that breach of the provisions of this Integrity Pact has been committed by the Bidder@)/ Contractor(s) shall be final and binding on the Bidder(sj/ Contractor(s), however the Bidder(s)/Contractor(8) can approach IEM(s) appointed for the purpose of this Pact.

On occurrence of any sanctions/ disqualifications etc arising out from violation of integrity pact Bidder(s)/ Contractor(s) shall not entitled for any compensation on this account.

Subject to full satisfaction of the Principal, the exclusion of the Bidder(s)/Contractor(s) could be revoked by the Principal if the Bidder (\$)/ Contractor(s) can prove that he has restored/ recouped the damage caused by him and has installed a suitable corruption preventative system in his organization.

#### SECTION 4 – PREVIOUS TRANSGRESSION

- 4.1 The Bidder(s)/ Contractor(s) declares that no previous transgression occurred in the last 3 years immediately before signing of this Integrity Pact with any other company in any country conforming to the anti-corruption/ transparency International (TI) approach or with any other Public Sector Enterprises/ Undertaking in India of any Government Department in India that could justify his exclusion from the EOI process.
- 4.2 If the Bidder(s)/ Contractor(s) makes incorrect statement on this subject, he can be disqualified from the EOI process or action for his exclusion can be taken as mentioned under Section-3 of the above for transgressions of Section-2 of the above and shall be liable for compensation for damages as per Section- 5 of this Pact.

#### SECTION 5 – COMPENSATION FOR DAMAGE

- 5.1 If the Principal has disqualified the Bidder(s)/Contractor(s) from the EOI process prior to the award according to Section 3 the Principal is entitled to forfeit the Earnest Money Deposit/Bid Security/ or demand and recover the damages equitant to Earnest Money Deposit/Bid Security apart from any other legal that may have accrued to the Principal.
- 5.2 In addition to 5.1 above the Principal shall be entitled to take recourse to the relevant provision of the contract related to termination of Contract due to Contractor default. In such case, the Principal shall be entitled to forfeit the Performance Bank Guarantee of the Contractor or demand and recover liquidate and all damages as per the provisions of the contract agreement against termination.

#### SECTION 6 – EQUAL TREATEMENT OF ALL BIDDERS/CONTRACTORS

6.1 The Principal will enter into Integrity Pact on all identical terms with all bidders and contractors for identical cases.

- 6.2 The Bidder(s)/Contractor(s) undertakes to get this Pact signed by its subcontractor(s)/subvendor(s)/ associate(s), if spy, and to submit the same to the Principal along with the EOI document/contract before signing the contract. The Bidder(s)/Contractor(s) shall be responsible for any violation(s) of the provisions laid down in the Integrity Pact Agreement by any of its subcontractors/ sub-vendors / associates.
- 6.3 The Principal will disqualify from the EOI process all bidders who do not sign this Integrity Pact or violate its provisions.

#### SECTION 7 – CRIMINAL CHARGES AGAINST VIOLATIG BIDDER(S)/CONTRACTORS

7.1 If the Principal receives any information of conduct of a Bidder(s)/Contractor(s) or subcontractor/ sub-vendor/associates of the Bidder(s)/Contractor(s) which constitutes corruption or if the principal has substantive suspicion in this regard, the principal will inform the same to the Chief Vigilance Officer of the Principal for appropriate action.

#### SECTION 8 – INDEPENDENT EXTERNAL MONITOR(S)

8.1 The Principal appoints competent and credible Independent External Monitor(s) for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extend the parties comply with the obligations under this pact.

#### Details of IEM appointed by IT1 are as under:

Shri Javeed Ahmad, IPS(Retd.) M-1101, Shalimar Gallant Apartment Vigyanpuri, Mahanagar, Lucknow-226006

- 8.2 The Monitor is not subject to any instructions by the representatives of the parties and performs his functions neutrally and independently. He will report to the Chairman and Managing Director of the Principal.
- 8.3 The Bidder(s)/Contractor(s) accepts that the Monitor has the right to access without restriction to all product documentation of the Principal including that provided by the Bidder(s)/Contractor(s). The Bidder(s)/Contractor(s) will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The Monitor is under contractual obligation to treat the information and documents Bidder(s)/Contractor(s) with confidentiality.

- 8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the project provided such meeting could have an impact on the contractual relations between the Principal and the Bidder(s)/Contractor(s). As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or take corrective action, or to take other relevant action. The monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in specific manner, refrain from action or tolerate action.
- 8.6 If the Monitor has reported to the Chairman & Managing Director of the Principal a substantiated suspicion of an offence under relevant IPC/PC Act, and the Chairman & Managing Director of the principal has not, within the reasonable time taken visible action to proceed against such offence or reported it to the Chief Vigilance Officer, the Monitor may also transmit this information directly to the Central Vigilance Commissioner.
- 8.7 The word 'Monitor' would include both singular and plural.

#### SECTION 9 - FACILITATION OF INVESTIGATION

9.1 In case of any allegation of violation of any provisions of this Pact or payment of commission, the Principal or its agencies shall be entitled to examine all the documents including the Books of Accounts of the Bidder(s)/Contractor(s) and the Bidder(s)/Contractor(s) shall provide necessary information and documents in English and shall extend aII help to the Principal for the purpose of verification of the documents.

#### SECTION 10 - LAW AND JURISDICTION

- 10.1 The Pact is subject to the Law as applicable in Indian Territory. The place of performance and jurisdiction shall the seat of the Principal.
- 10.2 The actions stipulated in this Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extent law in force relating to any civil or criminal proceedings.

#### SECTION 11 – PACT DURATION

This Pact begins when both the parties have legally signed it. It expires after 12 months on completion of the warranty/ guarantee period of the project /work awarded, to the fullest satisfaction of the Principal.

If the Bidder(s)/Contractor(s) is unsuccessful, the Pact will automatically become invalid after three months on evidence of failure on the part of the Bidder(s)/Contractor(s).

If any claim is lodged/made during the validity of the Pact, the same shall be binding and continue to be valid despite the lapse of the Pact unless it is discharged/determined by the Chairman and Managing Director of the Principal.

#### SECTION 12 - OTHER PROVISIONS

- 12.1 This pact is subject to Indian Law, place of performance and jurisdiction is the Registered & Corporate office of the Principal at Bengaluru.
- 12.2 Changes and supplements as well as termination notices need to be made in writing by both the parties. Side agreements have not been made.
- 12.3 If the Bidder(s)/Contractor(s) or a partnership, the pact must be signed by all consortium members and partners.
- 12.4 Should one or several provisions of this pact turn out to be invalid, the remainder of this pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
- 12.3 Any disputes/ difference arising between the parties with regard to term of this Pact, any action taken by the Principal in accordance with interpretation thereof shall not be subject to any Arbitration.
- 12.4 The action stipulates in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.

In witness whereof the parties have signed and executed this Pact at the place date first done mentioned in the presence of the witnesses:

For BIDDER(S)/CONTRACTOR(S)

.....

For PRINCIPAL

.....

Page 19 of 25

Name Designation

Name Designation

Witness

1. .....

2. ....

1. .....

2. ....

#### Annexure-V

#### **Bid Security declaration letter**

Date: [insert date (as day, month and year)

Bid No: [.....]

То

ITI Limited F- 100, East Wing Corporate Marketing Dooravaninagar Bangalore- 560016

We, the undersigned, declare that:

We understand that, according to your conditions, bids must be supported by a Bid Securing Declaration

We accept that we will automatically be suspended from being eligible for bidding in any contract with the ITI Limited for a period of 3 years, if we are in breach of obligation (s) under the bid conditions, because we:

a) Have withdrawn our bid during the period of bid validity specified in the Letter of Bid; or

b) Having been notified of the acceptance of our bid by the ITI Limited during the period of bid validity.

(1) fail of refuse to execute the contract, if required, or (2) fail or refuse to furnish the Performance Security

We understand the Bid-Securing Declaration shall expire if we are not the successful bidder, upon the earlier of (1) our receipt of your notification to us of the name of the successful bidder; or (2) twenty-eight days after the expiration of our bid

Signed: [insert signature of person whose name and capacity are shown].

In the capacity of [insert legal capacity of person signing the Bid-Securing Declaration]

Name: [insert complete name of person signing the Bid-

Annexure – VI RDSO EOI and Clarifications





# भारत सरकार / Government of India रेऱ मंत्राऱय / Ministry of Railways अन**ुसन**्ध**ान अभभकल**्न एव**ं म**ानक स**ंगठन / Research Designs & Standards** Organization

मानकनगर, रखनऊ – 226011 / Manak Nagar, Lucknow – 226 011

# Expression of Interest for Shortlisting of firms for Trials of 4G LTE-R systems in 500RKM in SCR.

## Eol reference no. RDSO/TELE/EOI/01/2023

Issued by:

Principal Executive Director/ S&T, Room No: 202, Annexe I Building Research Designs & Standards Organization, Ministry of Railways, Manak Nagar, Lucknow, INDIA 226011

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5	Eligibility & Qualification Criteria	10
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10	Annexure-III (FRS)	(53 pages)

#### NOTICE FOR EXPRESSION OF INTEREST

#### (Eol reference no. RDSO/TELE/EOI/01/2023)

Ministry of Railways, Research Designs & Standards Organization (RDSO), Lucknow India is interested in shortlisting of firms for "Trials of 4G LTE-R systems in 500RKM in SCR". The firms, who have enough experience and capabilities in the above field and are interested in trials of 4G LTE-R system may submit the Expression of Interest. Firms interested in trials of 4G LTE-R system and supply of the equipment along with necessary engineering support, are requested to see the details on RDSO website www.rdso.indianrailways.gov.in at Home page in Vendor Interface tab under "Expression of Interest (EOI)".

The interested firms are requested to submit details in the prescribed format to the concerned officer as mentioned in the "Expression of Interest (EOI)".

#### **Availing Eol Documents**

The EoI Document can be downloaded free of cost from the RDSO website www.rdso.indianrailways.gov.in at Home page in Vendor Interface tab under "Expression of Interest (EOI)"

#### **Important Dates**

- 1. Eol document available on website 24.03.2023 at 11:30 hrs onwards.
- 2. Pre-Eol meeting on 12.04.2023 at 10:00 hrs at RDSO as well as on-line through video conference.
- 3. Last date and time for submission of response up to 24.04.2023 at 15:00 hrs.

#### Mode of submitting response to EOI

Interested firms are requested to submit their response in the prescribed "Format for Letter of Response" attached as Annexure – I along with requisite details. Response may be sent to PED/S&T, RDSO, Manak Nagar, Lucknow - 226011.

## Disclaimer

- 1. The purpose of this Eol document is to provide the firms with information to assist the formulation of their response.
- 2. RDSO, its employees make no representation or warranty and shall incur no liability under any law, statute, rules or regulations as to the accuracy, reliability or completeness of the Eol document.
- 3. RDSO may, in its absolute discretion, but without being under any obligation to do so, modify, amend or supplement the information in this Eol document.
- 4. The issue of this Eol does not imply that RDSO is bound to shortlist any or all the firms. Even after short-listing of suitable firms, RDSO is not bound to proceed ahead with the firms and in no case be responsible or liable for any commercial and consequential liabilities in any manner whatsoever.
- 5. The firms shall bear all costs associated with the preparation, technical discussion/presentation and submission of response to EoI. RDSO shall in no case be responsible or liable for these costs regardless of the conduct or outcome of the EoI process.
- 6. Canvassing in any form by the firms or by any other agency on their behalf shall lead to disqualification of their response to Eol.
- 7. RDSO reserves the right to accept or reject any or all the Eol responses received against this notice without assigning any reasons and without prejudice.

## Details of Eol

- 1. Indian Railways intend to engage with the OEMs, authorized representatives of OEMs, firms who have developed product/s in 4G/5G technology area or in other similar technology field such as GSM/GSM-R, TETRA etc. to participate in Expression of Interest for Trials of 4G LTE-R systems in 500RKM under jurisdiction of South Central Railway (SCR) for Voice, Data, MCX capability in 4G LTE-R technology. The EOI is also intended that 4G LTE-R network set up during trials will work as bearer network for Indian Railway"s Nation Automatic Train Protection System (KAVACH).
- 2. EOI is being called by RDSO for shortlisting of firms for "Trials of 4G LTE-R systems in 500RKM in SCR". The sections where trials are planned in full or in part along with details of KAVACH make in that section are given below.

Section	Kms	KAVACH make
Secunderabad-Vikarabad-Bidar	163	HBL
Bidar-Parbhani	240	KERNEX
Secunderabad-Gadwal	188	MEDHA
Vikarabad-Wadi	112	MEDHA
Secunderabad-Raghunathpalli	94	Kavach of Quadrant and
		GGTronics under installation

- 3. For the trials Functional Requirements Specifications (FRS) of LTE for Proof of Concept for Indian Railways issued vide RDSO-TELE-LKO(TECH)/3/2019-0/o ED/Tele-I/ RDSO Date:01.06.2022 with latest amendments to be used for the Trials. Supplementary FRS and Test Plans for the trials may be issued by RDSO in due course. The FRS document is attached as Annexure-III.
- 4. EOI is being called for shortlisting of firms for 4G LTE-R trials in the following categories-
  - eNodeB
  - LTE Router
  - Cab Communication system
  - MCX handset
  - Dispatcher/Station Radio

A firm can apply to EOI for one/more than one or all of the above category of items.

- 5. Considering migration to 5G in future, firm may offer 4G equipment which could be upgraded to 5G with minimal change. The PoC Test/Trials will include testing of not only 4G RANs but also 4G upgradable to 5G RANs.
- 6. During the trial it is expected that the software of the hardware like eNodeB, cab communication system, LTE routers etc. will need changes. Railway will not fund the development/modification of software. Only the hardware cost is to be funded in this project.

- 7. In the trials, firm shall develop/engineer the product as per Functional Requirement Specification (FRS) attached with EOI, supply, install, test and commission their offered equipment under each category in the allotted section of South Central Railway. Each Section shall be of 30-50 KM in continuous stretch based on Site conditions.
- 8. Similar POC for 4G LTE-R is under way with C-DOT in 21 Km of Secunderabad-Lingampalli section of South-Central Railway wherein EPC Core has been provided by C-DOT. C-DOT shall provide EPC Core (same or Upgraded) for this trial also. Mission Critical Application (Voice, Video and Data), (MCX), KAVACH application server (KAS), Loco Exchange Server (LES), Centralized Network Monitoring System (e-NMS to be made part of CNMS) will be part of EPC Core provided by C-DOT.
- 9. Shortlisted Firm will be awarded a section for Trial under each category of items. Brief Details of the work involved in each category is given below.

#### (A) eNodeB:

- i. One make of eNodeB shall be used to cover minimum 30-50 km continuous stretch so that performance of a particular make is established in terms of coverage, cell-edge throughput, call handing over to same as well as other makes of eNodeBs, interoperability, checking call handing over at maximum permissible speed on IR.
- ii. The supplier of eNodeB shall also be responsible for supply of associated equipment of Radio Access Network (RAN) such as antennas, feeder cable and other accessories, integrate, test and commission the RAN with CORE and MCX server of C-DoT
- iii. Firms which are applying for eNodeB category shall carryout RF survey.
- iv. eNodeB of each make shall be able to make functional all type of Cab Communication System, MCX handsets, LTE Router and Dispatcher/Station Radio on its RAN.

#### (B) LTE Router:

- i. LTE Router shall be installed in Locomotive/EMU/Trainset cabs along with external antenna at the roof of the cab.
- ii. LTE Router shall support Mission Critical QCIs as per 3GPP.
- iii. LTE router shall be ruggedized to meet the stringent environmental condition of the locomotive.
- iv. Cab Communication System, onboard Kavach system and any other system shall be connected to LTE Router on ethernet ports.
- v. Installation of LTE Router modem on Locomotives along with antenna for use in Loco/EMU/Train Set and Cab Communications System and interface with KAVACH and Cab radio.

#### (C) Cab Communication System:

- i. Cab Communication system shall be used for Voice functionalities as stipulated in FRS.
- ii. Cab Communication System shall be installed in each cab of locomotive/EMU/Trainset designated for trial purpose.
- iii. Cab Communication system shall be able to work in RAN of all the makes who are participating in the trials.
- iv. Installation of Cab Communication system on Locomotives along with antenna for use in Loco/EMU/Train Set and interface with LTE Router to be done by the firm supplying the Cab Communication system.

#### (D) MCX Handsets:

- i. The MCX handset will be ruggedized UE and shall be given to Loco Pilots having mission critical application as specified in FRS.
- ii. MCX handsets shall be able to work on all type RAN makes who are participating in the trails and able to communicate to EPC Core and MCX application server for its functionality.

#### (E) Dispatcher/Station Radio:

- i. Dispatcher will be provided in Control office and fulfiil the requirements as stipulated in FRS.
- ii. Station Radio is a form of ruggedized dispatcher and shall be provided with station Master and fulfill the requirements as stipulated in FRS.
- iii. Dispatcher and Station radio of one make (in one section) shall be interoperable to other makes of RAN (in other section), Cab Communication System and MCX handsets of all makes who are participating in the trial and should be able to communicate to EPC Core and MCX application server for its functionality.
- 10. Expected Outcome of trials:
  - a) Firming up the FRS for 4G LTE-R along with the system configuration to be deployed on IR.
  - b) Enabling manufacturers of eNodeBs to test and fine tune their equipment with CDoT CORE, MCX applications and Kavach.
  - c) Development of multiple port LTE Router suitable to be deployed on Locomotives along with antenna for use in Loco/EMU/Train Set and Cab Communications System.

- d) Development of hardware and software for MCX applications for Railways as per FRS for MCX client for Railways.
- e) Undertake small developmental works/projects like IoT Sensors, Central Data Bank for recording and retrieving Sensor Data using LTE-R.
- f) Expected coverage distance for each eNodeB shall be >= 5km in open field with minimum cell edge throughput of 1 Mbps.

# Process of EoI and tentative Timeline for completion of trials

Process of Eol

- a) Interested firms shall submit the detailed technical proposal for the trials of 4G LTE-R along with required documents as per EOI document.
- b) Shortlisting of firms for different categories of equipment for trials of 4G LTE-R will be done by a committee nominated to evaluate the offers based on the shortlisting criteria given in the Eol document.
- c) After shortlisting of eligible firms, shortlisted firms shall submit the cost estimation within one week. Based on the cost estimates in different categories, it is intended to award the work to the shortlisted firms through tendering process.
- d) Further payments to these firms shall be given by the South Central Railway as per terms and conditions given in the letter of award.

Tentative timeline for the trials

Milestone	Description	Timeline
Meeting functional requirement	Firm shall carry out the testing of equipment based on Functional test format of RDSO, jointly with C-DoT and RDSO at specified location to their satisfaction.	D+60 days
Supply of material	After meeting the compliance of FRS in step 1, the firm shall supply the full quantity as proposed.	D+90 days
Installation and commissioning	Firm shall carry out installation and commissioning of the equipment at finalized locations in the allotted section/locomotives/stations.	D+120 days
Field trial of Equipment	<ul> <li>The trial would be declared as successful if:</li> <li>(a) Track side equipment functions for a period of 2500 equipment hours without failure of equipment.</li> <li>(b) Onboard equipment functions for a period of 1000 Km without failure of equipment.</li> </ul>	D+180 days

Note – D is date of award of work to shortlisted firm.

 Firm, who are participating, having office in India shall either be an Original Equipment Manufacturer (OEM) of the product or have developed product of similar field. Firm can also be an authorized representative of OEM of the product. In that case the firm shall submit the Manufacturer Authorization Form (MAF) along with its offer.

Items Similar Field Radio/BTS/BSC of GSM-R/GSM, Radio/eNodeB of 4G- LTE, eNodeB 5G Radio/ eNodeB of 5G Routers. Ethernet Switches, LTE Router Modems. **Broadband Routers** PTT handset, UHF/VHF handsets. Cab Communication device Cab Radio of GSM-R/TETRA, MCX Handset, **Dispatcher/Station Radio** PTT handset, UHF/VHF handsets. Cab Radio of GSM-R/TETRA, MCX handsets Ruggedized handsets of GSM-R/TETRA, Dispatcher/Station Radio, Mobile handsets Train Control Communication System Dispatcher, **Dispatcher/Station Radio** Dispatcher of GSM-R/TETRA, Dispatcher of LTE, LTE-R

Similar field for items for each categories are as under:

# **Shortlisting Criteria**

1. Shortlisting of firms for trials in various categories will be considered based on design and development experience, Financial capabilities and availability of technical experts and other resources. RDSO shall examine the details submitted by the applicant as mentioned in Annexure-I along with the offer.

S. No.	Item	Marks	Remarks
1.	Turnover of the firm during last 3 financial years	20	Firm having maximum be given full marks and other as percentile.
2.	Details of supplies made in the field/similar field of item under Eol	30	The firm which has made maximum number of supplies in that particular category shall be given full marks & other as percentile.
3.	Experience & expertise for item proposed under Eol or items in similar field		It is based on years of experience in such products & firm having maximum year of experience shall be given full marks & other as percentile.
4.	Manpower & their qualification	20	No. of technical experts with professional qualification on firms direct role and percentile. Base reference 10 nos.
5.	Details of patent held & MoU/agreement with OEM	10	Number of such items & percentile thereof. Base reference 5 nos.

2. Selection Criteria for short listing of firm:

Note – The above selection criteria shall be fulfilled either by OEM or its authorized representative for each category of item.

#### 1. Role of SCR

- a) SCR shall provide basic infrastructure for trials and also provide required permission to execute the work in the Railway premises.
- b) SCR shall provide following :
  - (i) Providing towers for installation of antenna and equipment based on RF survey.
  - (ii) Last mile OFC connectivity for each radio with requisite bandwidth between eNodeB and EPC.
  - (iii) Stable power supply of required load for these equipments.
  - (iv) Locomotives for installation of onboard equipment.
- c) Verification, Measurement of works and disbursement of funds to the participating firms.
- d) Extend any other assistance required for the trials.

#### 2. Role of C-DOT

- a) CDOT shall ensure integration of RAN and other equipment provided by the Industry partners and their performance shall be made available on CNMS.
- b) CDOT shall develop MCX Server, KAS Server, LES Server, CNMS, KMS to suit for various end user equipment on Indian Railways.
- c) CDoT CORE is to be used for the PoC trial as is being done now in the SC
   LPI section and the system and features should conform to relevant requirements of IR as per 3GPP standards release 14/15. These relevant Railway requirements shall be identified jointly by CDOT and RDSO.

#### 3. Role of Industry Partners/Firm's

- a) Shall liaison with CDOT and develop/supply, install, test and commission the equipment, including all peripherals and accessories, for meeting the operational requirements of Railways.
- b) Firms supplying the eNodeB and associated equipment for RAN shall be required to do Radio Survey for locating Towers and take clearances from Railway authorities.
- c) Installation and testing of eNodeB, Antennas to work with CORE and MCX server of C-DoT.
- d) Necessary requisite test and measurement equipment for the survey drive test, functional testing and field trials of the equipment shall be provided by the firm.

#### FORMAT FOR LETTER OF RESPONSE

Respondents Ref No.:

Date:

Principal Executive Director/ S&T, Room No: 202, Annexe I Building Research Designs & Standards Organization, Ministry of Railways, Manak Nagar, Lucknow, INDIA 226011

(Email-pedsnt@rdso.railnet.gov.in & edtele@rdso.railnet.gov.in)

Dear Sir,

# Subject: Submission of Response to Eol for "Shortlisting of firms for Trials of 4G LTE-R systems in 500RKM in SCR".

- 1. We, the undersigned, offer the following information in response to the Expression of Interest sought by you vide your Notification No.\_\_\_\_\_, dated\_\_\_\_\_.
- We are duly authorized to represent and act on behalf of \_\_\_\_\_\_\_ (hereinafter the "respondent")
- 3. We have examined and have no reservations to the EOI Document including Addenda No(s)\_\_\_\_\_.
- 4. We are attaching with this letter, the copies of original documents defining:
  - a) the Respondent"s legal status;
  - b) its principal place of business;
  - c) its place of incorporation (if respondents are corporations); or its place of registration (if respondents are cooperative institutions, partnerships or individually owned firms);
  - d) Self-certified financial statements of Last three years, clearly indicating the financial turn over and net worth.
  - e) Copies of any market research, business studies, feasibility reports and the like sponsored by the respondent, relevant to the item under consideration

- 5. We shall assist MoR and/or its authorized representatives to obtain further clarification from us, if needed.
  - a) RDSO and/or its authorized representatives may contact the following nodal persons for further information on any aspects of the Response:

S. No.	Contact Name	Address	Telephone	E Mail
1				
2				

- 6. This application is made in the full understanding that:
  - a) Information furnished in response to EOI shall be used confidentially by RDSO for the purpose of development of the project.
  - b) RDSO reserves the right to reject or accept any or all applications, cancel the EOI and subsequent bidding process without any obligation to inform the respondent about the grounds of same.
  - c) We confirm that we are interested in participating in development of the item
- 7. We certify that our turnover and net worth in the last three years is as under:

Financial Year	Turn over	Net worth

- 8. In response to the EOI we hereby submit the following additional details annexed to this application.
- 8.1. Details of various items being manufactured/consultancy undertaken.
- 8.2. Details of customer(s) and supplies made in the field of item under Eol.
- 8.3. Experience and expertise for the items proposed in EOI.
- 8.4. Details of man-power with their qualification and experience.
- 8.5. Detailed proposal for items proposed in EOI including alternative proposal, if any.
- 8.6. Details of Intellectual Property Rights (IPR) held, patent filed/held and MoU/agreement signed.
- 8.7. Details of ISO certification
- 8.8 Undertaking as per Annexure-II
- The undersigned declare that the statements made and the information provided in the duly completed application are complete, true, and correct in every detail. We also understand that in the event of any information furnished by us being
found later on to be incorrect or any material information having been suppressed, RDSO may delete our name from the list of qualified Respondents. We further understand that RDSO will give first preference to the applicants considered relevant for the purpose. Our response is valid for a period of 90 days from the date of submission.

Signature of Authorized Signatory (with official stamp) Name of Authorized Signatory: Designation of Authorized Signatory: Address of the Respondent: Telephone & Fax of the Respondent: E-mail address of the Respondent: (To be taken on non-judicial stamp paper of appropriate value as applicable in the respective state and dully notarized & witnessed)

# **UNDERTAKING**

I, son of ..... aged about ...... Years resident of ..... do hereby solemnly affirm as under

- 1. That the deponent is the Authorised signatory of (*Name of the Sole* Proprietorship Concern/Partnership Firm/ Registered Company/ Joint Venture).
- 2. That the deponent declares on behalf of (Name of the Sole Proprietorship Concern/ Partnership Firm/ Registered Company/Joint Venture) that:

# DEPONENT

#### VERIFICATION

I declare that the contents of para 1 to 2 above are true as per my knowledge and nothing hasbeen hidden.

# <u>DEPONENT</u>

 ISO 9001: 2015
 Effective from 31.05.2022
 FRS/LTE
 Version 0 d0

Document Title: Functional Requirements Specifications of LTE for Proof of Concept for Indian Railways.



सत्यमेव जयते

GOVERNMENT OF INDIA (भारत सरकार)

MINISTRY OF RAILWAYS (र**ेऱ म**ंत्र**ाऱय)** 

# Functional Requirements Specifications of LTE for Proof of Concept for Indian Railways.

FRS No.

Version 0 d0

May-2022

Issued by

SIGNAL & TELECOM DIRECTORATE RESEARCH, DESIGNS & STANDARDS ORGANISATION MINISTRY OF RAILWAYS MANAK NAGAR LUCKNOW - 226 011



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(Govind Pandey)	(C.S. Mahoviya)	(Vijay Garg)	(G. Pavan Kumar)	Page 1 of 53
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Document Title: Functional	l Requirements Specification	s of LTE for Proof of	Concept for Indian Rail-
ways.			

DOCUMENT DATA SHEET				
FRS/LTE		Version 0.0		
Title of Document				
Functional Requirements Specifications of				
LTE for Proof of Concept for Indian Railways.				
Authors				
See Document Control Sheet				
Approved by RDSO				
Name: Shri Rajendra Dhambel Designation: Prin	ncipal Executive Dire	ector/S&T/RDSO		
Abstract This document covers Functional Requirements Specifications of LTE for Proof of Con- cept for Indian Railways.				

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(Govind Pandey)	(C.S. Mahoviya)	(Vijay Garg)	(G. Pavan Kumar)	Page 2 of 53
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ways.			

# DOCUMENT CONTROL SHEET

Name	Organiza-	Function	Level
	tion		
Shri Govind Pandey,	RDSO	Member	Prepare
JRE/Tele			
Shri C.S. Mahoviya	RDSO	Member	Prepare
SSE/Tele			
Shri Vijay Garg	RDSO	Member	Verification
Director Tele-I			
Shri G. Pavan	RDSO	Member Secretary	Recommend
ED/Tele-II			
Shri Rajendra Dhambel	RDSO	Approving Authority	Approve
PED/S&T/RDSO			

				Printed :
(Govind Pandey)	(C.S. Mahoviya)	(Vijay Garg)	(G. Pavan Kumar)	Page 2 of 53
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ways.			

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ListofAbbreviations: 3GPP	Third Generation Partnership Project			
AC	Alternating Current			
СА	Carrier Aggregation			
CAT6	Category 6			
CDoT	Centre for Development of Telematics			
CISPR	International Special Committee on Radio Interference			
DoS	Deniel of Service			
CR	Cab Radio			
CRC	Cyclic Redundancy Check			
CTC	Centralized Traffic Control			
dBm	decibel-milliwatts			
DC	Direct Current			
DEMU	Diesel Electrical Multiple Unit			
DoT	Department Of Telecommunication			
DPWCS	Distributed Power Wireless Control System			
EIRENE	European Integrated Railway Radio Enhanced Network			
EMC	Electromagnetic Compatibility			
EMU	Electrical Multiple Unit			
EoTT	End of Train Telemetry			
EPC	Evolved Packet Core			
EPS	Evolved Packet System			
ESS	Environmental Stress Screening			
ETCS	European Train Control System			
ETSI	European Telecommunications Standards Institute			
E-UTRAN	Evolved Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access Network			
FA	Functional Addressing			
FDD	Frequency Division Duplexing			
FRS	Functional Requirement Specification			
GBR	Guranteed Bit Rate			
GPS	Global Positioning System			
GSM	Global System for Mobile communications			
GSM-R	GSM – Railway			
GW	Gateway			

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Hq	Head Quarter
HLR	Home Location Register
HSS	Home Subscriber Server
ID	Identity Number
IEC	International Electrotechnical Commission
IMS	IP multimedia subsystem
IMSI	International Mobile Subscriber Identity
IP	Ingress Protection/Internet Protocol
IP-MPLS	Internet protocol Multi-protocol label switching
IPv4	Internet Protocol Version 4
IPv6	Internet Protocol Version 6
IRNSS	Indian Regional Navigation Satellite System
IR	Indian Railway
IS	Indian Standard
KAS	KAVACH Application Server
KHz	Kilohertz
KMS	Key Management System
KV	Kilovolt
LDA	Location Dependent Addressing
LES	Loco Exchange Server
LTE	Long Term Evolution
М	Mandatory
MAC	Media Access control
MC	Mission Critical
MCData	Mission Critical Data
MCPTT	Mission Critical Push To Talk
MCVideo	Mission Critical Video
MCX	Mission Critical X, with $X = PTT$ or $X = Video$ or $X = Data$
MCX Service	Mission Critical Service
MEMU	Mainline Electric Multiple Unit
MHz	Mega Hertz
MME	Mobility Management Entity
MMI	Man-Machine Interface
MSB	Most Significant Bit
MSISDN	Mobile Station International Subscriber Directory Number.
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ways.	
MSN	Mobile Subscriber Number
MVB	Multifunction Vehicle Bus
NB-IoT	Narrow Band Internet of Things
NMS	Network Management System
Non-GBR	Non Guranteed Bit Rate
NSS	Network Sub-System
OFC	Optical Fibre Cable
OTT	Over the Top
OVK	Onboard Vital Kavach
PCRF	Policy and Charging Rules Function
PDN	Packed Data Network
PoC	Proof of concept
QCI	QoS Class Identifier
QoS	Quality of Service
RAN	Radio Access Network
REC	Railway Emergency Call
RH	Relative Humidity
RMS	Root Mean Square
SDF	Service Data Flow
SCR	South Central Railway
SIP	Session Initiation Protocol
SIM	Subscriber Identity Module
SM	Station Master
SNMP	Simple Network Management Protocol
SVK	Stationary Vital Kavach
SOF	Start Of Frame
TEC	Telecommunication Engineering Centre
TSR	Train Speed Restriction
TSRMS	Train Speed Restriction Management System
UE	User Equipment
UHF	Ultra High Frequency
URL	Uniform Resource Locator
V2V	Vehicle-to-Vehicle
V2X VDS	Vehicle-to-Everything
VDS VGCS	voice Group Call Service
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#### List of Definitions

- i. **Acceptance Tests**: Tests carried out on the equipment/ system for the purpose of acceptance of the equipment/ system.
- ii. **Active Cab**: The active cab is the cab associated with an onboard KAVACH, from which the traction is controlled.
- iii. **Broadcast call**: A call made to all members of a pre-defined group within a local geographical area. Only the initiator of the call may talk, with all other group members listening only.
- iv. **Carrer Aggregation:** Carrier aggregation is a technique that is used in wireless communication to increase the data rate per user, whereby multiple frequency blocks (called component carriers) are assigned to the same user.
- v. **Emergency Call**: A call of highest priority for warning a dangerous situation in a pre defined area
- vi. **Frequency division Duplexing (FDD):** Frequency-division duplexing (FDD) is a method for establishing a full-duplex communications link that uses two different radio frequencies for transmitter and receiver operation.
- vii. **Functional Acceptance Tests**: Tests carried out by installing some equipment in the field to prove that the system performs in accordance with this specification & the local configuration data is acceptable.
- viii. **Functional Addressing**: An addressing scheme shall be provided which permits users to be identified by numbers corresponding to their functional roles rather than by numbers tied to the terminal equipment that they are using.
- ix. **GBR bearer**: An EPS bearer with reserved (guaranteed) bitrate resources. GBR SDF aggregates are typically authorized "on demand" which requires dynamic policy and charging control
- x. **Group call:** A call made to all members of a pre-defined group within a local geographical area. Only one member of the group may talk at any instant, with all other group members listening only.
- xi. **KAVACH:** It is the brand name of Automatic TrainProtection System developed for Indian Railways.
- xii. **Location Dependent Addressing**: Location dependent addressing shall be provided to route calls for a given function to a destination number that is dependent upon the user's location
- xiii. **Multi-party call**: A voice communication method whereby a number of parties defined by the call initiator may participate in the call. All parties may talk simultaneously.
- xiv. **Non-GBR bearer:** An EPS bearer with no reserved (guaranteed) bitrate resources. A Non GBR SDF aggregate may be pre-authorized through static policy and charging control.
- xv. **Public emergency call:** A point-to-point voice call which is used to notify nonrailway authorities (such as Police, Fire, Disaster Management and Ambulance services) of an emergency situation.

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xvi. **Shunting mode:** A radio is considered in "Shunting Mode" when it is prepared to receive shunting emergency calls but cannot receive train emergency calls.

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# 1. Executive Summary

This document covers the functional requirements of LTE (Long Term Evolution) for Indian Railways. (Ref. Railway board letter for PoC no. 2020/Tele dev/Implementation of LTE dated 29.01.2022).

## 2. Forward

This Functional Requirements Specification for Long Term Evolution (LTE) is released to address the requirements that are relevant for field trials to be conducted in Secunderabad – Lingampalli automatic section of South Central Railway with the objective to conduct following tests:

- (i) Voice, Video & Data Communication.
- (ii) Interface requirements of KAVACH over LTE.
- (iii) Mission Critical applications pertaining to Railways.

## **3.** Section proposed for proof of concept

Secunderabad – Lingampalli section of Secunderabad Division in South Central Railway is proposed for the Proof of Concept. The section is a part of the automatic signalling territory carrying major sub-urban traffic of SCR. The section has been proposed to cover varied aspects of KAVACH and telecommunication needs of Indian Railways. The characteristics of the section are briefly reproduced below:

Station	Secunderabad Jn	Hussain Sagar Jn	Sanatnagar	Hafizpet	Lingampalli
KM	182.27	180.1	175.18	166.2	161.06
No. of Platforms	Ten	Nil	Three	Two	Six
KAVACH Equipped	No*	No	Yes	Yes	Yes
Make of KAVACH	Medha	-	Medha	Kernex	HBL
Tower available	Yes	No	Yes	Yes	Yes
Height of Tower	40 m	-	30 m	30 m	30 m
Type of Tower	Lattice	-	Lattice	Monopole	Lattice
Shunting Needs	High	Low	High	Medium	Medium
No. of Station Radio at station	3	1	1	1	1
No. of Handheld PTT Sets Required <sup>#</sup>	2	1	1	1	1
No. of Cab Radios	6 Nos. to be installed in loco of 3 trains				

\*Will be commissioned shortly

# Six numbers of Handheld PTT Sets Required for locos in 3 trains

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In addition to above, there are several halt stations with two platforms in this section. Three KAVACH equipped EMUs will be nominated for the Proof of Concept by SCR. These are to be equipped with six LTE router, six cab radios and six MCPTT sets.

#### 4. Scope

- 4.1 LTE for Railways consists of User Equipment, Evolved Universal Terrestrial Radio Access Network, Evolved Packet Core with MCX capabilities for Mission-Critical Push To Talk (MCPTT), Mission Critical Data (MC Data) and Mission Critical Video (MC Video) application, normal voice communications.
- 4.2 The LTE Functional Requirements Specification defines the requirements of a radio system satisfying the mobile communications needs of the Indian railways. It encompasses ground-train voice and data communications, together with the ground-based mobile communications needs of trackside workers, station, depot staff and railway administrative and managerial personnel.
- 4.3 All voice call services shall be able to operate between any combination of fixed and mobile equipment users.
- 4.4 To meet the functionality and performance requirements of LTE, the following system services are required:
- 4.4.1 The system shall be designed to work in 700 MHz spectrum (703-748 MHz Uplink & 758-803 MHz Downlink, 3GPP/ETSI Band 28) with 5 MHz (paired) spectrum in the spectrum

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block 713-718/768-773 MHz Carrier bandwidth allocated to Indian Railways as per Ministry of Communication, Department of Telecommunication Letter No. L-14001/01/2019-NTG (pt.) dated 22.10.2021.

- 4.4.2 LTE shall be able to support Frequency Division Duplexing (FDD). The system shall support minimum channel bandwidth of 5 MHz and 25 Transmission Bandwidth configurations (Ref. Doc. No. ETSI TS 136 101 V13).
- 4.4.3 The system shall also support Carrier Aggregation (CA) as per 3GPP/ETSI specification(O).
- 4.4.4 The LTE Radio Network shall be planned with double radio coverage (100% Coverage Overlap) where in case of one eNode-B failure; the adjacent eNode-Bs will cover the requirements.
- 4.4.5 The System shall support broadcast based V2V application. V2X application is preferable (Ref. Doc. No. ETSI TS 122 185 V14). These applications are required for Collision prevention by KAVACH, DPWCS and EoTT.
- 4.4.6 MCX should be a completely integrated solution or OTT solution (whichever C-DoT is comfortable with) and support to define MCX aliases for functional addressing (FA) and location dependent addressing (LDA).
- 4.5 The EPC is composed of network elements: the Serving Gateway (Serving GW), the PDN Gateway (PDN GW), the MME, PCRF and the HSS.
  - (i) PCRF: It shall apply Gating control, QoS control and Usage monitoring control.
  - (ii) Serving Gateway & PDN Gateway: The control plane shall reside near EPC. User planes shall be provided at the Secunderabad and Lingampalli stations in a georedundant manner.
- 4.6 MCX Solution shall provide voice, data and video capabilities to the LTE system by using LTE terminals.
- 4.7 Interoperability with GSM-R is not covered in the scope of PoC.
- 4.8 Software update of any part of the LTE system should be possible with minimal disruption to operations and should not lead to undesired situations.

#### 5. LTE system requirements

- (i) Frequency of operation: 700MHZ.
- (ii) OFC Backbone: IPMPLS
- (iii) Radio network planning with 30m of coverage on either side of railway track.
- (iv) SIP/IMS server for which C-DOT is Comfortable.
- (v) Onboard LTE router modems.
- (vi) Interface development with KAVACH at EPC end.
- (vii) MCPTT handsets and Dispatcher terminals.
- (viii) SIM cards- Approx 50.
- (ix) V2V Communication (Preferable)
- (x) LTE shall support in band and guard operational modes of NB-IoT (O).

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# 6. Test related to voice, MC voice, MC Data & MC Video

- 6.1 The following Voice services are to be tested:
  - (i) Voice broadcast service.
  - (ii) Voice group call service.
  - (iii) Point to point voice calls.
  - (iv) The system shall support multi-party voice communications. Any of the parties involved in a multi-party voice call shall be able to talk simultaneously.
- 6.2 Railway specific applications to be tested:
  - (i) Support for functional addressing by train, engine or driving coach number<sup>1</sup> or functional number.<sup>1</sup>
  - (ii) Call specific persons depending upon user location.
    - a) Location dependent addressing: Location dependent addressing shall be provided to route calls for a given function to a destination number that is dependent upon the user's location.
    - b) The functions to which calls shall be routed based upon the location of the mobile shall include:
      - Primary controller
      - -Secondary controller
      - -Station Master
    - c) For Location dependent addressing, the jurisdiction of Station Master will be from Distant Signal of his station to Distant Signal of Next Station.
    - d) In Location dependent addressing, during ongoing call, if the train crosses the jurisdiction of existing station master/controller, the call should not get disconnected until user deliberately disconnects the call. However once disconnected, the next call should be connected as per new jurisdiction.
  - (iii) Specific mode for shunting operations providing a link assurance signal.
  - (iv) Multiple Loco Pilot communications within the same train.
  - (v) Railway operational emergency calls.
- 6.3 Mission Critical Voice Services to be tested:
  - (i) Priority MCPTT Point to Point Calls.
  - (ii) Priority MCPTT Group Calls.
  - (iii) Broadcast Group Calls from authorized MCPTT Group Members.
  - (iv) Private call and Private Call (with Floor control).
  - (v) MCPTT Emergency Group Calls with highest priority over all other MCPTT Group transmissions.
  - (vi) Support the confidentiality and integrity of all user traffic and signalling at the application layer.

<sup>&</sup>lt;sup>1</sup> Train no. is 5 digit, Engine/driving coach no. varies from 5 to 6 digits.

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- 6.4 The Following Data Services to be tested:
- 6.4.1 Data Services:
  - (i) Text Messages point-to-point and point-to-multipoint text messages.
  - (ii) General data application timetable information, maintenance and diagnostic information, email, remote database access.
- 6.4.2 Mission Critical Data Services:
  - (i) Train Control applications such as KAVACH etc.
- 6.5 Mission Critical Video Services to be tested:
  - (i) Video Surveillance;
  - (ii) Emergency Alert;
  - (iii) The MCVideo service shall support MCVideo UEs that are capable of only transmitting, only receiving and both transmitting and receiving videos;
  - (iv) Remote camera control;
  - (v) Video Conferencing;
  - (vi) The MCVideo Service shall enable MCVideo Service Administrator to create a hierarchy for determining which Participants, Participant types, and urgent transmission types, if any, shall be granted a request to override an active MCVideo Service transmission.

# 7. Call related services

- 7.1 The network shall support as a minimum following call related services:
  - (i) Display of identity of called/calling user;
  - (ii) Restriction of display of called/calling user; (O)
  - (iii) Priority and pre-emption;
  - (iv) Call forwarding unconditional(M), busy(M), no reply (O), not reachable (O)
  - (v) Call hold;
  - (vi) Callwaiting;
  - (vii) Callbarring (O).

Note:- (O) : Optional requirement as given in EIRENE standards. (M) : Mandatory requirement as givenin EIRENE standards

- 7.2 Railway specific features:
  - (i) Set-up of urgent or frequent calls through single keystroke or similar.
  - (ii) Display of functional identity of calling/called party in case of Functional Addressing.
  - (iii) Fast and guaranteed call set-up.
  - (iv) Seamless communication support for train speeds up to 250 Kmph (Design). To be tested up to the maximum permissible speed of the trial section.
  - (v) Automatic and manual test modes with fault indications.
  - (vi) Control over mobile network selection.
  - (vii) Control over system configuration.

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Autorized person shall be able to configure software (i.e. numbering scheme, user related services etc.) and hardware components of the network system according to the requirement.

7.3 High Priority point to point call connectivity should be as shown in table below (O) :-

	Receiving Party										
		Primary Controller	Secondary Controller	Approaching SM	Rear SM	Ahead SM	Cabin	Loco Pilot	Assistant Loco	Guard	Other Train
									Pilot		Loco Pilot
	Primary Controller		Yes	Yes	Yes	Yes	No	Yes		Yes	
۲.	Secondary Controller	Yes		Yes	Yes	Yes	No	Yes		Yes	
ıg Part	Approaching SM	Yes	Yes		Yes	Yes	Yes	Yes		Yes	
atir	Rear SM	Yes	Yes	Yes							
liti	Ahead SM	Yes	Yes	Yes							
	Cabin	No	No	Yes				Yes		Yes	
	Loco Pilot	Yes	Yes	Yes			Yes		Yes	Yes	Yes
	Assistant			Yes			Yes	Yes		Yes	Yes
	Loco Pilot										
	Guard	Yes	Yes	Yes			Yes	Yes	Yes		
	Other Train Loco Pilot							Yes	Yes		

#### 8. Bearer service for external applications

Other applications for which LTE shall provide the bearer service may include public address system and on-train intercom.

# 9. Network Configuration

- (i) The LTE radio network shall have double radio coverage (100 % overlap), so that if one eNode-B fails, the requirements will be fulfilled by the adjacent eNode-Bs.
- (ii) The E-UTRAN shall provide coverage up to a distance of 30 meters from the nearest running rail in all the directions.
- (iii) The level of coverage should be at least 95% of the time over 95% of the designated coverage area for a radio installed in a vehicle with an external antenna.
- (iv) Call set up Requirements:
  - a) Call set-up time shall be less than two seconds for normal call and less than one second for emergency calls. The required call set-up times shall be achieved in 95% of cases.
  - b) The handover success rate should be at least 99.5% over train routes under design load conditions.

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# **10.** Services and Facilities

10.1 The following voice telephony services are to be supported for each type of mobile radio:

Features	Cab Radio	UE	Dis- patcher	Station Radio
Point-to-point voice calls	М	М	М	М
Public emergency voice calls	0	0	М	М
Broadcast voice calls	М	М	М	М
Group voice calls	М	М	М	М
Multi-party voice calls	М	0	М	М

Note:- M = Mandatory requirement.

O = Optional requirement.

N/A = Not Applicable.

10.2 The following data applications are to be supported for each type of mobile radio:

Features	Cab Radio	UE	Dis- patcher	Station Radio
Text message service	М	М	М	М
General data applications	М	Ο	М	М

10.3 The following call related services are to be supported for each type of radio:

Features	Cab Radio	UE	Dis- patcher	Station Radio
Display of calling user identi- ty	М	М	М	М
Display of called user identity	М	М	М	М
Restriction of display of user identity	0	0	0	Ο
Call forwarding	-	-	-	-
(a) Unconditional	М	Ο	0	Ο
(b) If user busy	0	0	0	0
(c) If no reply	0	0	0	0

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Features	Cab Radio	UE	Dis- patcher	Station Radio
(d) If not reachable	0	0	0	0
Call Hold	М	0	М	М
Call Waiting	М	М	М	М
Call Barring	М	0	М	М
Auto answer service	М	0	М	М
Call supervisory information	0	0	0	0

10.4 The following features are to be supported for each type of radio:

Features	Cab Radio	UE	Dis- patcher	Station Radio
Functional addressing	М	М	М	М
Location dependent address- ing	М	0	М	М
Shunting Mode	М	М	М	М
Multiple Loco Pilot Commu- nications with the same train	М	N/A	М	М
Railway Emergency Calls	М	М	М	М

**11. Environmental Requirements** (The equipment used in PoC need not be tested, but they shall be certified preferably)

11.1 Environmental Requirements:

Sr.	Test Type	Equipment Condition	Severity	Specification
1	Dry heat test (Operation)	Operating	For functional trials: Temp. 70 °C Duration: 16 hrs.	IS: 9000 Pt.
1	Dry heat test (Storage)	Non-operating	Temp. 75°C Duration: 16 hrs.	Section: V
2	Cold Test (Operation)	Operating	Temp. $-10^{\circ}$ C +/- $3^{\circ}$ C, Duration: 2 hrs.	IS: 9000, Pt. II
3	Rapid variation temperature test	Operating	-10 to +70°C, Duration: 7 hrs at each temperature. Rate of change: 1°C per Minute. No. of cycle: 03	IS: 9000 Pt. XIV Section: II
4	Damp heat test (steady state stor- age)	Operating	RH 95% @ 40°C Duration = 4 days	IS: 9000 Pt. IV

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5	Damp heat test (Cyclic)	Operating	RH 95% @ 40°C (high) , 25°C (low) Duration: 12 + 12 = 24 hrs cyclic No. of cycles = 6	IS: 9000 Pt. V Section-II
6	Bump Test (Package)	Non-operating	40g peak, 4000 bumps per axis Duration: 6 milliseconds No. of axes: 03	IS: 9000 Pt. VII Section II
7	Mechanical Shock Stationary and Loco unit	Power off Condition	11 millisecond (half sign pulse), 20g peak.	IS: 9000 Pt. VII ,Section-I
8	Vibration test			
(i)	Onboard	Non-operating	5 Hz to 150 Hz Acceleration A: 3g 20 sweep cycles on 3 axes	IS: 9001 Pt.
(ii)	Stationary	Non-operating	5 Hz to 35 Hz Acceleration A: 2g 20 sweep cycles on 3 axes	
9	Salt Mist test			
(i)	On Board (inside cab)	Non-operating	Procedure 3: Salt: 2hrs, Mist Duration =22 hours 35(+/- )3°C, RH: 95% No. of cycles: 03	
(ii)	On Board (outside cab)	Non-operating	Procedure 2: Salt: 2hrs, Mist: Duration=7 days 35(+/-)3°C, RH: 95% No. of cycles: 04	IS: 9000 Pt. XI
(iii)	In door	Non-operating	Procedure 3: Salt: 2hrs, Mist Duration =22 hours 35(+/-)3°C, RH: 95% No. of cycles: 03	
(iv)	Out door (On Track /Track side)	Non-operating	Procedure 2: Salt: 2hrs, Mist: Duration=7 days 35(+/- )3°C, RH: 95% No. of cycles: 04	
10	Dust test	Non-operating	1 hour only	IS: 9000 Pt. XII
11	7 KV discharge Test	Non opera- tional		RDSO/SPN/1 44/2006: Clause 9.4.1.
12	Environmental Stress Screening (ESS) test	(PCB Cards)		RDSO/SPN/1 44/2006: Clause 9.3
(i)	Thermal Cycling	Non opera- tional		serial no.13

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(ii)	Power Cycling	Non tional	opera-		
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- 11.2 Other type tests :( Only Applicable for Rolling stock equipment)
  - (i) Variation and interruption of voltage supply (Class: S2) to equipment tests as per clause 5.1.1.2 and 5.1.1.3 of IEC 60571 -2012 or relevant clause of latest amend-ment / issue.
  - (ii) Supply over-voltage and surges tests as per clause 5.2 & 12.2.7 of IEC 60571 -2012 or relevant clause of latest amendment / issue. Electrostatic discharge tests shall be carried out as per Clause 9.4.1 of RDSO/SPN/144/2006 or relevant clause of latest amendment.
  - (iii) Transient burst and susceptibility test as per clause 5.5 of IEC 60571-2012 or relevant clause of latest amendment / issue.
  - (iv) Radio interference test as per clause 5.5 & 12.2.8 of IEC 60571-2012 or relevant clause of latest amendment / issue.
  - (v) Insulation test as per clause 12.2.10 of IEC 60571 -2012 or relevant clause of latest amendment / issue.

#	Parameter	Standard
i)	Conducted and Radiated Emission	CISPR 22 (2008) OR
		CISPR 32 Class-A
ii)	Immunity to Electrostatic discharge:	IEC-61000-4-2
	Contact discharge level 2 $\{\pm 4 \text{ kV}\}$	Performance Criteria-B, Clause 9
iii)	Immunity to Electrostatic discharge:	IEC-61000-4-2
	Air discharge level 3 $\{\pm 8 \text{ kV}\}$	Performance Criteria-B, Clause 9
iv)	Immunity to radiated RF:	IEC 61000-4-3 (2010);
	(a) Radio Frequency: 80 MHz to 1	Performance Criteria-A, Clause 9
	GHz, Electromagnetic field: 3V/m	
	(b) Radio Frequency: 800 MHz to	
	960 MHz, Electromagnetic field:	
	10V/m	
	(c) Radio Frequency: 1.4 GHz to 6	
	GHz, Electromagnetic field: 10V/m	
v)	Immunity to fast transients (burst):	IEC 61000- 4- 4 {2012);
	Test Level 2:	Performance Criteria-B, Clause 9
	(a) 1 kV for AC/DC power port	
	(b) 0. 5 kV for signal / control / data	
	/ telecom lines.	
vi)	Immunity to surges: AC/DC ports	IEC 61000-4-5 (2014)
	a. 2 kV peak open circuit voltage for	Performance Criteria-B, Clause 9
	line to ground	
	b. 1kV peak open circuit voltage for	
	line to line	

#### 11.3 EMI/ EMC requirements for LTE base Station shall be as below as applicable:-

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#	Parameter	Standard
vii)	<ul> <li>Immunity to surges: Telecom ports</li> <li>(a) 2 kV peak open circuit voltage</li> <li>for line to ground coupling.</li> <li>(b) 2 kV peak open circuit voltage</li> <li>for line to line coupling.</li> </ul>	IEC 61000-4-5 (2014) Performance Criteria-C, Clause 9
viii)	Immunity to conducted disturbance induced by Radio frequency fields: Under the test level 2 {3 V r.m.s.} in the frequency range 150 kHz-80 MHz for AC / DC lines and Signal /Control/telecom lines.	IEC 61000-4-6 (2013) Performance Criteria-A, Clause 9
ix)	Immunity to voltage dips & short interruptions (applicable to only ac mains power input ports, if any): Limits: - (a) a voltage dip corresponding to a reduction of the supply voltage of 30% for 500ms (i.e. 70% supply voltage for 500ms) (b) a voltage dip corresponding to a reduction of the supply voltage of 60% for 200ms; (i.e.40% supply voltage for 200ms) (c) a voltage interruption corre- sponding to a reduction of supply voltage of >95% for 5s. (d) a voltage interruption corre- sponding to a reduction of supply voltage of >95% for 10ms.	IEC 61000-4-11 (2004): a. Performance Criteria B for Reduc- tion of Supply 30% for 500ms or Dip to reduction of 60% for 100ms b. Performance Criteria C for Reduc- tion of 60% for 200ms c. Performance criteria C for Voltage Interruption>95% for 5 s (Note: In case of Battery back-up per- formance criteria A is applicable). d. Performance Criteria B for Voltage Interruption >95% duration :10ms (Note: In case of Battery back-up Per- formance Criteria A is applicable for above conditions.)

11.4 Safety requirements for LTE base Station may be as below as applicable:-

S. No.	Parameter	Standard
i)	The equipment shall conform to IS	IS 13252 part 1:2010 / IEC
	13252 part 1:2010- "Information Tech-	60950-1 {2005} part 1;
	nology Equipment – Safety- Part 1:	or IEC 62368-I:2014
	General Requirements" [equivalent to	
	IEC 60950-1 {2005} "Information	
	Technology Equipment –Safety- Part 1:	
	General Requirements"]	
	Or IEC 62368-I:2014	

- 11.5 Electromagnetic Radiation: The LTE shall meet Department of Telecom (DoT) latest guidelines and regulations for Electromagnetic Radiation from Antennae (LTE Base station).
- 11.6 As per DoT, "Licensee shall conduct audit and provide self certificates after every two year as per procedure prescribed by Telecommunication Engineering Centre (TEC)/ or any other agency authorised by Licensor from time to time for conforming

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to limits/levels for Antennae (Base Station) Emissions for general public exposure as prescribed by the Licensor from time to time. The present limits/levels\* are reproduced as below:-

Frequency Range 400 MHz to 2000 MHz	E-Field Strength (Volt/Meter (V/m)) 0.434 f <sup>1/2</sup>	H Field Strength (Amp/Meter (A/m)) 0.0011 f <sup>1/2</sup>	Power Density (Watts/Sq. Me- ter (W/Sq.m)) <b>f</b> / 2000
3 GHZ to 300 GHz	19.29	0.05	1

( $\mathbf{f}$  = frequency in MHz)" (\*as per DoT letter no. 800-15/ 2010-V AS, dated 26/06/2013)

11.7 The typical requirement for Temperature and Humidity and Ingress Protection is mentioned below:-

Equipment	Ingress Protection (IP)
Indoor Installation	IP 54 or higher
Outdoor Installation	IP 67 or higher

- 11.8 For indoor installations, provision of Air Conditioning is mandatory.
- 11.9 In case, equipment is housed in an enclosure then the enclosure shall meet IP requirements.

# 12. Functional Requirement of Mobile Equipment

#### 12.1 Cab Radio System

- 12.1.1 Each Train Engine (Loco) shall be provided with 2 nos. of Cab Radio Systems in for Indian Railways front and Rear Loco compartments. The Cab Radio System shall provide mission critical Voice and Data communication for train operational requirements.
- 12.1.2 The Cab Radio System shall work on the spectrum assigned for LTE to Indian Railways.
- 12.1.3 The equipment shall work on DC supply source normally consisting of accumulator battery and / or an auxiliary generator. The nominal and limits of voltage in which the equipment shall operate satisfactorily are as under:

Type of Locomotive	Nominal Voltage	Limits of voltage
Diesel-Electric	72 Volts DC	50 to 90 Volts DC

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Electric,	EMUs,	DEMUs,	110 Volts DC	79 to 136 Volts
MEMUs, 7	Frain Set etc	c.,		DC

- 12.1.4 Cab Radio shall boot when the supply voltage is applied. The Cab Radio shall be activated by inserting BL key (Electric Locos) or placing Reverser handle in the forward position (in Diesel Locos).
- 12.1.5 It shall give an audible and visual indication is given that connection to a LTE network was not possible.
- 12.1.6 It shall have facility to adjust brightness and contrast.
- 12.1.7 It shall have facility to register/deregister the train number and Engine or Driving Coach number. Engine or driving coach number shall not get erased until; they are authenticated by the authorized personnel.
- 12.1.8 The Engine or Driving Coach number is to be transmitted as functional number if no train number is registered by the Cab Radio. The engine number shall be displayed to the called party. This also facilitates ease of shunting.
- 12.1.9 It shall have facility to register/deregister the functional address to other Loco Pilot, (non-leading Loco Pilot) and guard.
- 12.1.10 It shall have facility for point to point call, voice group call and emergency call.
- 12.1.11 It shall have automatic answering of call from primary controller.
- 12.1.12 A point-to-point call can be placed on hold and a second point-to-point call can then be initiated.
- 12.1.13 It shall handover during incoming and outgoing point to point or group call (cell change in the same or different location area).
- 12.1.14 The Cab Radio shall be capable to initiate a Voice Group Call Service by selecting the number from a phonebook.
- 12.1.15 It shall be possible for multiple Loco Pilot communications within the same train by the leading Loco Pilot. The call from the controller (primary or secondary) shall be automatically accepted and added to the "Multi Loco Pilot Communication" established by the leading Loco Pilot.
- 12.1.16 Cab Radio automatically receives an ongoing group call after switching-on. The ongoing group call will be joined automatically if automatic answering applies.
- 12.1.17 Group call "other LPs in the area" is initiated and managed by the Cab Radio.
- 12.1.18 Cab Radio shall have provision to mute / unmute the speech in order to listen to the talking controller and avoid unintelligible echo.
- 12.1.19 The Cab Radio shall be able to receive and join an incoming train emergency call any time. The ongoing multi Loco Pilots' conference call is pre-empted.
- 12.1.20 The Cab Radio shall initiate a train emergency call at any time i.e. also during an ongoing point to point/multi Loco Pilot call.
- 12.1.21 Shunting: Entering shunting mode is supported by the CR..
- 12.1.22 The Cab Radio shall have the following minimum functions/features:-

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- (a) Loco Pilot call related functions:
  - i. Call controller.
  - ii. Call other Loco Pilot in the area.
  - iii. Send railway emergency call.
  - iv. Confirm receipt of railway emergency calls.
  - v. Communicate with other Loco Pilots on the same train.
  - vi. Call train staff.
  - vii. Call other authorized users.
  - viii. Receive incoming voice calls.
  - ix. Terminate calls.
  - x. Receive text messages.
  - xi. Enter/leave shunting mode.
  - xii. Monitor calls to other on train users/devices.
  - xiii. Forward calls/cancel call forwarding to/from Loco Pilot hand held.
- (b) Other Loco Pilot related functions:
  - i. Powering up radio.
  - ii. Switch radio MMI on and off.
  - iii. Adjust loud speaker volume.
  - iv. Select mobile radio network.
  - v. Register and deregister train number.
  - vi. Register and deregister on train users.
  - vii. Register and deregister stock numbers.
  - viii. Store/retrieve numbers and their details.
  - ix. Invoke supplementary services-Call Deflection, Calling Line Identification Presentation, Calling Line Identification Restriction, Connected Line Identification Presentation, Connected Line Identification Restriction, Call Forwarding-unconditional, user busy, no reply, not reachable.
  - x. Invoke tests.
  - (c) Other Cab Radio functions:
    - i. Automatic connection of incoming calls to appropriate on-train users or devices (conductor, public address system, data systems, etc).
    - ii. Automatic establishment of outgoing calls initiated by on-train users or devices.
    - iii. Automatic handling of calls of varying priorities.
    - iv. Transmit Railway emergency call event indication to train-borne recorder.
    - v. Run time diagnostics:
      - a. Upon the request of the Loco Pilot, the Cab Radio should be able to perform a suite of run-time diagnostic tests on all physical interfaces (O).
        - b. If run-time diagnostics are implemented, failure of an interface shall be reported to the Loco Pilot via the display.
      - c. If run-time diagnostics are implemented, diagnostic tests shall not interfere with normal operation of the Cab Radio.
      - d. If run-time diagnostics are implemented, all failures should be available to be recorded (O).

12.1.23 The Cab Radio System may include the following sub systems:-

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- i. LTE Router/ Modem (Central Control Unit)
- ii. Control Panel (MMI) & Display Unit
- iii. Microphone & Speaker and MC PTT Handset and Cradle
- iv. Rail Rooftop Low Profile Antenna
- v. Dual Redundant Power Supply
- 12.1.24 One Cab Radio System shall consist of at least two Mobile network terminations, in active/ standby configuration i.e. comprising of minimum two mobile equipments and SIM cards.
- 12.1.25 The SIM cards shall be physically integrated with the Cab Radio set and shall not be able to be removed except by maintenance staff.
- 12.1.26 The Control Panel shall consist of capacitive touch screen display unit of day light readable type for displaying information. Control panel shall have dedicated hard buttons configurable for specific functions.
- 12.1.27 Cab Radio System shall receive remote software upgrades via a ground-based management terminal. Cab Radio System shall also support software updates via USB Stick. There shall be provision for retrieving system logs from USB/Ethernet ports.Also periodically, Cab Radio shall be able to send the system log to central server.
- 12.1.28 The Speakers in the Loco Pilot Cab shall be loud enough to be audible in the running Train. The radio should be able to provide five levels of adjustment (numbered 1 to 5) for each volume range setting. The following table details the levels of adjustment and the three (Quiet, Normal and Noisy cab) loudspeaker ranges to be provided.

Levels of		Loco Pilot adjustment			
adju	istment	Quiet cab	Normal cab	Noisy cab	
250 mW	24 dBm	1	1		
355 mW	25.5 dBm	2			
500 mW	27 dBm	3 (Default)	2	1	
1 W	30 dBm	4	3 (Default)	2	
2 W	33 dBm	5	4	3 (Default)	
4 W	36 dBm		5	4	
8.5 W	39 dBm			5	

- 12.2 Roof top Antenna
- 12.2.1 Separate Rail Rooftop Low Profile Antenna shall be provided for each Cab Radio System
- 12.3 LTE Router modem equipment
- 12.3.1 LTE Router modem equipment shall provide interface for the following applications:
  - (i) KAVACH
  - (ii) Cab Radio
  - (iii) IoT
  - (iv) Survelliance

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- 12.3.2 The equipment in the Cab and their redundant equipment shall be connected over Optical Fibre Media or any other media of industry standard in Ring Arrangement.
- 12.3.3 The various systems/sub systems in the Cab Radio System for voice and data shall be connected with suitable cables and wires complying with relevant specifications and standards for Rolling Stock Application.
- 12.3.4 The Ethernet interface between Cab Radio and client application shall be on industrial grade fibre or CAT6 cable with suitable M12/M23 connectors.
- 12.3.5 An emergency power supply should be provided for Cab Radio Systems which will enable the Loco Pilot"s radio to continue to operate for a period of at least 2 hour in the event of failure of the train"s main power supply.

## 13. Radio Jamming

- 13.1 Radio jamming could be an act of an illegitimate radio device attempting to disrupt radio communication between a legitimate sender and a legitimate receiver.
- 13.2 Undetected or un-prevented radio jamming could potentially have following impacts in some cases:
  - DoS attack on UE
  - DoS attack on network
- 13.3 Radio jamming should not be feasible in the LTE network of Railways.

# 14. Time Synchronization

- 14.1 LTE shall provide time synchronization facility to all the elements in its network.
- 14.2 The time sync shall be from GPS or IRNSS.

#### **15.** Quality of Service (QoS) Requirements:

The one-to-one mapping of standardized QCI values to standardized characteristics for the tentative services shall be as per **Annexure-A**.

#### 16. Numbering Plan

- 16.1 Numbering Scheme for Mobile Communication Network for Indian Railways is given in Annexure-B of this document.
- 16.2 This section addresses the following:
  - i. Numbering plan requirements.
  - ii. Standardized telephone numbers.
  - iii. Group numbers.
- 16.3 Numbering plan requirements
- 16.3.1 The LTE system shall enable users to originate and receive calls by functional number.
- 16.3.2 Each mobile shall be identified by a unique telephonenumber.
- 16.4 Use of train number
- 16.4.1 The use of train numbers to address trains must not result in any ambiguities.
- 16.4.2 Every on-train function shall be identified by a unique standard number.

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- 16.5 Use of engine/coach number
- 16.5.1 The use of engine/coach numbers to address trains must not result in any ambiguities.
- 16.5.2 Every on-engine/coach function shall be identified by a unique standard number.
- 16.6 Use of shunting team, maintenance team or controller number
- 16.6.1 Every shunting team number shall be based on an association of:
  - i. Service area identifier.
  - ii. Shunting team identifier.
- 16.6.2 Every maintenance team number shall be based on an association of:
  - i. Service area identifier.
  - ii. Type of maintenance team (specialty code).
  - iii. Maintenance team identifier.
- 16.6.3 Every controller number shall be based on an association of:
  - i. Controller location.
  - ii. Controller identifier.
- 16.6.4 The numbering for other teams shall be treated in the same way as maintenance teams.
- 16.7 Use of group calls
- 16.7.1 Group call service areas are freely configurable within the operational responsibility of each railway network.
- 16.8 Telephone numbers
- 16.8.1 For certain functions, standardized telephone numbers shall be implemented. These functions are:
  - i. Railway emergency call.
  - ii. Route call to primary controller.
  - iii. Route call to secondary controller.
  - iv. Route call to power supply controller.
  - v. Public emergency call

# 17. Onboard LTE Router

Indian Railways requires a modem-router to interface between the KAVACH system and the LTE radio system. It shall also have facility to provide Onboard to other Onboard and Front end to Rear end communication preferably without the involvement of EPC.

- 17.1 Over the Air Requirements of Onboard LTE router
  - i. QoS on Uplink shall be on QCI 69 for KAVACH.
  - ii. Operating system Shall not be from land border sharing countries.
  - iii. Support MVB, RS-422, RS-485 (O)
  - iv. Support reception of GPS and IRNSS(O).
  - v. Support Software defined LAN (Virtual LAN).
  - vi. Support SNMP v3

#### 18. KAVACH Interface Requirements (Extract of Annexure E of KAVACH specification)

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- 18.1 Each stationary KAVACH (SVK) shall be connected to the PGW of EPC through Railways L3 VPN implemented using IPMPLS existing OFC network. This OFC network shall be of redundant architecture.
- 18.2 Each loco shall have provision of redundant LTE radio modems, to which the Onboard KAVACH (OVK) system is connected via IP interface.
- 18.3 EPC shall generate dynamic IP addresses to the OVK which are accessing request to stabilise communication.
- 18.4 OVK shall have the URL of KAVACH Application Server (KAS) and Loco Exchange Server (LES).
- 18.5 The LTE modem of loco communicates with eNodeB on the wayside over RF.
- 18.6 KAS shall consist of a lookup table as shown below:

Field Description	Field Width	Comment
	(Bytes)	
Station ID	2	Station ID (MSB in first byte)
Station IP Status	1	0: Not Available
		1: IPv4 Station
		2: IPv6 Station
		3: UHF Station
Station IP Number 1	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -
		16Bytes)
Station Port Number	2	MSB in first byte
1		
Station IP Number 2	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -
		16Bytes)
Station Port Number	2	MSB in first byte
2		
NMS IP Status	1	0: Not Available
		1: IPv4 Station
		2: IPv6 Station
		3: UHF Station
NMS IP Number 1	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -
		16Bytes)
NMS Port Number 1	2	MSB in first byte
NMS IP Number 2	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -
		16Bytes)
NMS Port Number 2	2	MSB in first byte
TSR IP Status	1	0: Not Available
		1: IPv4 Station
		2: IPv6 Station
		3: UHF Station
TSR IP Number 1	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -
		16Bytes)
TSR Port Number 1	2	MSB in first byte
TSR IP Number 2	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -
		16Bytes)
TSR Port Number 2	2	MSB in first byte

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Field Description	Field Width	Comment	
	(Bytes)		
CTC IP Status	1	0: Not Available	
		1: IPv4 Station	
		2: IPv6 Station	
		3: UHF Station	
CTC IP Number 1	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -	
		16Bytes)	
CTC Port Number 1	2	MSB in first byte	
CTC IP Number 2	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -	
		16Bytes)	
CTC Port Number 2	2	MSB in first byte	

Server random number of two bytes shall be generated whenever the information is passed on by the KAS to OVK. KAS shall be capable of handling IPV4 and IPV6 address.

- 18.7 Flow of data from OVK to SVKis detailed below:
  - a. EPC shall allot IP address to OVK dynamically on registration.
  - b. OVK shall have the URL of KAVACH Application Server.
  - c. On entering to KAVACH territory, OVK shall communicate its Loco ID and approaching SVK ID to KAS.
  - d. Based on the approaching SVK ID communicated by OVK, KAS shall communicate applicable IP addresses of Stationary KAVACH, NMS, TSRMS and CTC from the lookup table to OVK.
  - e. Based on the SVK IP address received, the OVK shall request access from the Stationary KAVACH.
  - f. The SVK shall establish communication with OVK based on the access request packet request received from OVK.
  - g. With the communication established between SVK and Onboard KAVACH, the communication between them shall take place with SVK to OVK and OVK to SVK regular packets.
  - h. OVK shall obtain IP address from KAS for establishing communication with next SVK or restoration of a communication failure.
  - i. The same procedure is to be followed for NMS, TSRMS and CTC.
- 18.8 KAS shall pass on the Driving unit/loco ID, its IP addresses and the location details to Loco Exchange Server.
- 18.9 Loco Exchange Server<sup>2</sup> shall populate a dynamic lookup table of loco IDs and their

<sup>&</sup>lt;sup>2</sup> Application servers were used for enabling OVK to OVK communication as intermediary approach as the V2V and V2X communication is not readily available with C-DOT as on date. V2V communication is required for handling collision prevention in KAVACH. V2X communication is required for handling operations of DPWCS and EOTT. If this communication is not possible through LTE, then the frequency spots used for these applications cannot be surrendered. Hence, CDOT may get the V2V and V2X communication scheme as prescribed in 3GPP, as the LTE is developed indigenously by them and they posses total control of the development. However, the FRS for PoC includes both V2V and V2X communication and use of application server (look up table) to facilitate C-DOT.

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IP addresses within a geographical region. This geographical region shall cover all the locos with a distance of 5000 m (configurable).

- 18.10 Flow of data from OVK to OVK in its vicinity is detailed below:
  - a. Loco Exchange Server shall populate a dynamic lookup table of loco IDs and their IP address within the vicinity of the loco based on the data received from KAVACH Application Server.
  - b. OVK shall have the URL of Loco Exchange Server.
  - c. OVK shall communicate its Access Request Packet to Loco Exchange Server through Onboard KAVACH to Loco Exchange Server packet.
  - d. Loco Exchange Server shall aggregate the OVK access request packets received from all the locos in the geographical area and send Onboard access request packets to each loco in the geographical area through Loco Exchange Server to OVK packet.
  - e. OVK shall decode the above information and validate it for SoS and collision scenarios.
- 18.11 Protocols for compatibility of KAVACH and LTE are enclosed as Annexure -C.
- 18.12 **IP Address Management:** The IP address of Stationary KAVACH is dynamic and shall be as follows:

Primary station IP address	xxx.yyy.aaa.bbb/ppppp aaa:bbb – Station ID (0xAABB)
Secondary station IP address	xxx.yyy.aaa.bbb/ppppp aaa:bbb – Station ID (0xAABB)

18.12.1 Sample IP address allocation for IPv4 with inclusion of Stationary KAVACH Id in IP addresses is given in below table.

Stationary KAVACH – ID	Stationary KAVACH – IP Address
500 (01.244)	172.16.01.244/60000
500 (01.244)	172.16.01.244/60001

18.13 A parallel KMS server shall also be got installed in PoC. SVK and OVK are required to do Key Management using this server.

Annexure-A

#### Quality of services (QOS) Requirements:-

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This table is extract of Table 6.1.7 of ETSI TS 123 203 V 14.6.0. For further clarification, may please refer to this document.

QCI	Resource Type	Priority Level	Packet Delay Budget (ms)	Packet Error Loss Rate	Example Ser- vices	Mapping of Indi- an Railway appli- cations (Tenta- tive)
1		2	100	10 <sup>-2</sup>	Conversational Voice	Voice Mobile Communication
2		4	150	10 <sup>-3</sup>	Conversational Video (Live Streaming)	Live Video Streaming from Accident Site (ART) or similar
3		3	50	10-3	V2X messages	V2X messages
4		5	300	10 <sup>-6</sup>	Non- Conversational Video (Buffered Streaming)	Live Video Streaming from Accident Site (ART)
65	GBR	0.7	75	10-2	Mission Critical user plane Push To Talk voice (e.g., MCPTT)	Mission Critical Services
66		2	100	10-2	Non-Mission- Critical user plane Push To Talk voice	Voice Mobile Communication
67		1.5	100	10-3	Mission Critical Video user plane	Mission Critical Video user plane

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ways.			

QCI	Resource Type	Priority Level	Packet Delay Budget (ms)	Packet Error Loss Rate	Example Ser- vices	Mapping of Indi- an Railway appli- cations (Tenta- tive)
5		1	100	10 <sup>-6</sup>	IMS Signalling	
6		6 (If net- work support muli- media priority services)	300	10 <sup>-6</sup>	Video (Buffered Streaming) (e.g., www, e- mail, chat, ftp, p2p file sharing, progressive vid- eo, etc.)	Video Surveillance System (CCTV), Passenger Infor- mation System and Real Time Train Information Sys- tem, IoT Services etc
7	Non-GBR	7	100	10-3	Voice, Video (Live Streaming)	Voice Mobile Communication, Streaming from Accident Site (ART) & Video Surveillance Sys- tem (CCTV)
8		8 (For premium bearer)			Video (Buffered Streaming)	Video Surveillance System (CCTV), Passenger Infor-
9		9 (For default bearer)	300	10 <sup>-6</sup>	TCP-based (e.g., www, e-mail, chat, ftp, p2p file sharing, progres- sive video, etc.)	mation System and Real Time Train Information Sys- tem, IoT Services etc
69		0.5	60	10-6	Mission Critical delay sensitive signalling (e.g., MC-PTT signal- ling)	Train Automation and Protection Ser- vices i.e. KA- VACH, ETCS and other services
70		5.5		10 <sup>-6</sup>	Mission Critical Data (e.g. exam- ple services are the same as QCI 6/8/9)	Mission Critical Services
79		6.5	50	10-2	V2X messages	V2X messages

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Annexure-B

# **Numbering scheme for mobile communication network for Indian Railways:-**The IMSI and MSISDN for Indian Railways shall be as below:-



						~	Fixe	ed for Indian Railway
	MCC		+91	l (India)	/	7	2 digit o Kolkata	ode for identification of Zones Metro/ DFCCIL etc.
		AC		AC 99		/	Digit	CT- Call Type
м		NDC	Zone	2 Dig	2 Digit Code		1	LDA & ICA
S		СТ				-	2	Train fn No.
1				1 Dig	it Code -		3	Engine fn. No.
S	S MSN D	HC		HQ/ 1 Digit		4	Coach fn Call	
N		Subscriber No.	Divn.	Code		50	Group Call	
			scriber No.		1 Digit		51	Broadcast Call
				Dept.	Code		6	Maintenance and Shunting Team
				0000	0000 to 9999		7	FSN & Train Controller
						- /	8	Voice Call
						7	Diali	Zanal HO/ Dive
Digit	Dept.		Digit	Dept.			Digit	Zonal HQ/ Divn.
0	General M	Manager	5	Operating		1	0	
1	Personal	& Commercia	al 6	Mechanical			2	20d Divp
2	Security a	& Medical	7	S&T			2	2rd Dive
3	Electrical		8	Stores		1	5	Next Dive
	Engineer	ina	9	Accounts	() ()		****	Next Divn.

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ways.			

# Annexure – C

# Compatibility Scheme for LTE and KAVACH

# 1. OVK to KAS IP Look Up request Packet Structure

Field No	Field Description	Field	Comment
		Width	
1	Start of English	(Bytes)	0
1	(SOF)	2	UXASCC
2	Packet Version	1	1
3	Message Type	1	<ul> <li>0: Not used</li> <li>1: OVK to KAS IP Look Up request Packet</li> <li>2: KAS to OVK IP Look Up response Packet</li> <li>3: OVK to LES Access Request Packet</li> <li>4: LES to OVK Access Request Packet Structure</li> <li>5: Onboard KAVACH to Stationary KAVACH</li> <li>6: Stationary KAVACH to Onboard KAVACH</li> <li>7: Onboard KAVACH to NMS Event</li> <li>8: Onboard KAVACH to NMS Fault</li> <li>9: NMS Acknowledgement</li> <li>10: Onboard KAVACH to TSR Server</li> </ul>
4	Message Length	2	In Bytes from field "Message Type" to "CRC" (inclusive of both) 22 Bytes
5	Message Se- quence	2	0-65535
6	Date	3	DD/MM/YY 00-99: official year, 100-126: not used, 127: year unknown 01-12: official month, 0,13,14: not used, 15: month unknown 01-31: official day, 0: month unknown Eg: $27/04/18 \rightarrow 0x1B-0x04-0x12$

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Field No	<b>Field Description</b>	Field	Comment
		Width	
		(Bytes)	
7	Time	3	HH:MM:SS (IST time)
			00-99: official year, 100-126: not used,
			127: year unknown
			01-12: official month, 0,13,14: not used,
			15: month unknown
			01-31: official day, 0: month unknown
			Eg: $06:36:10 \rightarrow 0x06-0x24-0x0A$
8	Loco ID	3	Loco ID (MSB in first byte)
9	Station ID	2	Station ID (MSB in first byte)
10	Loco Random	2	MSB in first byte
	Number		

# 2. KAS to OVK IP Look Up response Packet Structure

Field No	Field Description	Field	Con	nment	
		Width			
		(Bytes)			
1	Start of Frame (SOF)	2	0xA5CC		
2	Packet Version	1	1		
3	Message Type		0: Not used 1: OVK to KAS I Packet 2: KAS to OVK I sponse Packet 3: OVK to LES A Packet 4: LES to OVK A Packet Structure 5: Onboard KAV KAVACH 6: Stationary KAV KAVACH 7: Onboard KAV Event 8: Onboard KAV Fault 9: NMS Acknowl 10: Onboard KAV Server 12: TSR server to VACH	P Look Up reque P Look Up re- access Request access Request ACH to Stational VACH to Onboar ACH to NMS ACH to NMS edgement VACH to CTC VACH to TSR	ry rd
4	Message Length	2	In Bytes from fiel " to "CRC"	d "Message Typ	e
			(inclusive of both	)	
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Field No	Field Description	Field Width (Bytes)	Comment
5	Message Se- quence	2	0-65535
6	Date	3	DD/MM/YY 00-99: official year, 100-126: not used, 127: year unknown 01-12: official month, 0,13,14: not used, 15: month unknown 01-31: official day, 0: month un- known Eg: 27/04/18 $\rightarrow$ 0x1B-0x04-0x12
7	Time	3	HH:MM:SS (IST time) 00-99: official year, 100-126: not used, 127: year unknown 01-12: official month, 0,13,14: not used, 15: month unknown 01-31: official day, 0: month un- known Eg: 06:36:10 $\rightarrow$ 0x06-0x24-0x0A
8	Loco ID	3	Loco ID (MSB in first byte)
9	Station ID	2	Station ID (MSB in first byte)
10	Station IP Status	1	0: Not Available 1: IPv4 Station 2: IPv6 Station 3: UHF Station
11	Station IP Num- ber 1	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -16Bytes)
12	StationPortNumber 1	2	MSB in first byte
13	Station IP Num- ber 2	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -16Bytes)
14	StationPortNumber 2	2	MSB in first byte
15	NMS IP Status	1	0: Not Available 1: IPv4 Station 2: IPv6 Station 3: UHF Station
16	NMS IP Number 1	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -16Bytes)
17	NMS Port Num- ber 1	2	MSB in first byte
18	NMS IP Number 2	4/16	MSB in first byte (IPv4-4Bytes, IPv6 -16Bytes)
19	NMS Port Num- ber 2	2	MSB in first byte

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Field No	Field Description	Field Width	Comment
20		(Bytes)	
20	TSR IP Status	1	0: Not Available
			1: IPv4 Station
			2: IPv6 Station
			3: UHF Station
21	TSR IP Number 1	4/16	MSB in first byte (IPv4-4Bytes,
			IPv6 -16Bytes)
22	TSR Port Number	2	MSB in first byte
	1		
23	TSR IP Number 2	4/16	MSB in first byte (IPv4-4Bytes,
			IPv6 -16Bytes)
24	TSR Port Number	2	MSB in first byte
	2		5
25	CTC IP Status	1	0: Not Available
			1: IPv4 Station
			2: IPv6 Station
			3: UHF Station
26	CTC IP Number 1	4/16	MSB in first byte (IPv4-4Bytes,
			IPv6 -16Bvtes)
27	CTC Port Num-	2	MSB in first byte
	ber 1	_	
28	CTC IP Number 2	4/16	MSB in first byte (IPv4-4Bytes
-0		1/10	IPv6 -16Bytes)
29	CTC Port Num-	2	MSB in first byte
27	ber 2	-	
30	Server Random	2	MSB in first byte
50	Number	2	Wish in first byte
31	MAC	2	MSB in first byte Message type to
51		2	Server Random Number Additional
			fill zeros to make block multiple of
			128 hits
32	CPC	4	CPC 32 hit (Polynomial
52		<del></del>	EER88320 (Massage type to
			MAC)
			MAC)

### 3. OVK to LES Access Request Packet Structure

Field No	Field Descrip-	Field Width	Comment
	tion	(Bytes)	
1	Start of Frame	2	0xA5CC
2	Packet Version	1	1

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Field No	Field Descrip- tion	Field Width (Bytes)	Comment
3	Message Type	1	<ul> <li>0: Not used</li> <li>1: OVK to KAS IP Look Up request Packet</li> <li>2: KAS to OVK IP Look Up response Packet</li> <li>3: OVK to LES Access Request Packet</li> <li>4: LES to OVK Access Request Packet Structure</li> <li>5: Onboard KAVACH to Stationary KAVACH</li> <li>6: Stationary KAVACH to Onboard KAVACH to NMS Event</li> <li>8: Onboard KAVACH to NMS Fault</li> <li>9: NMS Acknowledgement</li> <li>10: Onboard KAVACH to TSR Server</li> <li>12: TSR server to Onboard KAVACH</li> </ul>
4	Message Length	2	In Bytes from field "Message Type " to "CRC" (inclusive of both)
5	Message Se- quence	2	0-65535
6	Date	3	DD/MM/YY 00-99: official year, 100-126: not used, 127: year unknown 01-12: official month, 0,13,14: not used, 15: month unknown 01-31: official day, 0: month un- known Eg: 27/04/18 $\rightarrow$ 0x1B-0x04- 0x12
7	Time	3 uest Packet	HH:MM:SS (IST time) 00-99: official year, 100-126: not used, 127: year unknown 01-12: official month, 0,13,14: not used, 15: month unknown 01-31: official day, 0: month un- known Eg: 06:36:10 $\rightarrow$ 0x06-0x24- 0x0A

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ways.			

Field No	Field Descrip- tion	Field Width (Bytes)	Comment
9	CRC	4	CRC 32 bit (Polynomial EEB88320) (Message type to
			MAC)

### 4. LES to OVK Access Request Packet Structure

Field No	Field Descrip-	Field Width	Comment
1		(Bytes)	
1	Start of Frame	Z	$0 \times 15 CC$
2	(SUP) Dealest Version	1	1
2	Packet version	1	1 Or Net ment
3	Message Type	1	U: NOT USED 1: OVK to $K \land S$ ID L ook Up ro
			1: OVK to KAS IP LOOK UP IE-
			Quest Packet
			2: KAS to OVK IP LOOK UP IE-
			sponse Packet
			5. OVK to LES Access Request Dacket
			A: LES to OVK Access Pequest
			4. LES to OVK Access Request Dacket Structure
			5: Loco to Stationary KAVACH
			6: Stationary KAVACH to Loco
			7: Loco to NMS Event
			8: Loco to NMS Fault
			9: NMS Acknowledgement
			10: Loco to CTC
			11: Loco to TSR Server
			12: TSR server to Loco
4	Message	2	In Bytes from field "Message Type
	Length		" to "CRC"
	6		(inclusive of both)
5	Message Se-	2	
	quence		0-65535
6	Date	3	DD/MM/YY
			00-99: official year, 100-126: not
			used, 127: year unknown
			01-12: official month, 0,13,14: not
			used, 15: month unknown
			01-31: official day, 0: month un-
			known
			Eg: $27/04/18 \rightarrow 0x1B-0x04-0x12$

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Field No	Field Descrip-	Field Width	Comment	
	tion	(Bytes)		
7	Time	3	HH:MM:SS (IST time)	
			00-99: official year, 100-126: not	
			used, 127: year unknown	
			01-12: official month, 0,13,14: not	
			used, 15: month unknown	
			01-31: official day, 0: month un-	
			known	
			Eg: $06:36:10 \rightarrow 0x06-0x24-0x0A$	
8	Number of Lo-	1	Indicate number of Loco Packets	
	co Packets		below (Max 20)	
9	Loco Access Request Packet1			
10	Loco Access Request Packet2			
	-			
		-		
28		Loco Access F	Request Packet 20	
29	MAC	2	MSB in first byte, Message type to	
			Server Random Number, Addition-	
			al fill zeros to make block multiple	
			of 128 bits	
30	CRC	4	CRC 32 bit (Polynomial	
			EEB88320), (Message type to	
			MAC)	

### 5. Onboard KAVACH to Stationary KAVACH Packet Structure

Field No	Field Descrip	- Field Wid	lth C	omment	
	tion	(Bytes)			
1	Start of Frame	2			
	(SOF)		0xA5CC		
2	Packet Version	n 1	1		
3	Message Type	2 1	0: Not used		
			1: OVK to K.	AS IP Look Up re-	-
			quest Packet		
			2: KAS to OV	/K IP Look Up re-	-
			sponse Packe	t	
			3: OVK to LI	ES Access Request	t
			Packet		
			4: LES to OV	K Access Request	t
			Packet Struct	ure	
			5: Loco to Sta	ationary KAVACH	Η
			6: Stationary	KAVACH to Loc	0
			7: Loco to NI	MS Event	
			8: Loco to NI	MS Fault	
			9: NMS Ack	nowledgement	
			10: Loco to C	CTC	
			11: Loco to T	SR Server	
			12: TSR serv	er to Loco	
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Field No	Field Descrip-	Field Width	Comment
	tion	(Bytes)	
4	Message Length	2	In Bytes from field "Message
			Type " to "CRC"
			(inclusive of both)
5	Message Se-	2	
	quence		0-65535
6	Date	3	DD/MM/YY
			00-99: official year, 100-126: not
			used, 127: year unknown
			01-12: official month, 0,13,14:
			not used, 15: month unknown
			01-31: official day, 0: month un-
			known
			Eg: $27/04/18 \rightarrow 0x1B-0x04-0x12$
7	Time	3	HH:MM:SS (IST time)
			00-99: official year, 100-126: not
			used, 127: year unknown
			01-12: official month, 0,13,14:
			not used, 15: month unknown
			01-31: official day, 0: month un-
			known
			Eg: $06:36:10 \rightarrow 0x06-0x24-0x0A$
	Onboard K	AVACH access r	equest packet/Regular packet
9	CRC	4	CRC 32 bit (Polynomial
			EEB88320), (Message type to
			End of Loco Packet)

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ways.			

Field No	Field Description	Field	Comment
		Width	
		(Bytes)	
1	Start of Frame (SOF)	2	0xA5CC
2	Packet Version	1	1
3	Message Type	1	0: Not used
			1: OVK to KAS IP Look Up
			request Packet
			2: KAS to OVK IP Look Up
			response Packet
			3: OVK to LES Access Request
			Packet
			4: LES to OVK Access Request
			Packet Structure
			5: Onboard KAVACH to Sta-
			tionary KAVACH
			6: Stationary KAVACH to
			Onboard KAVACH
			7: Onboard KAVACH to NMS
			Event
			8: Onboard KAVACH to NMS
			Fault
			9: NMS Acknowledgement
			10: Onboard KAVACH to CTC
			11: Onboard KAVACH to TSR
			Server
			12: TSR server to Onboard
			KAVACH
4	Message Length	2	In Bytes from field "Message
			Type " to "CRC"
			(inclusive of both)
5	Message Sequence	2	0-65535
6	Date	3	DD/MM/YY
			00-99: official year, 100-126:
			not used, 127: year unknown
			01-12: official month, 0,13,14:
			not used, 15: month unknown
			01-31: official day, 0: month
			unknown
			Eg: $27/04/18 \rightarrow 0x1B-0x04-$
			0x12

#### 6. Stationary KAVACH to Onboard KAVACH Packet Structure

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Field No	Field Description	Field Width (Bytes)		Comment
7	Time	3	HH:1 00-9 not u 01-1 not u 01-3 unkn Eg: ( 0x0A	MM:SS (IST time) 9: official year, 100-126: used, 127: year unknown 2: official month, 0,13,14: used, 15: month unknown 1: official day, 0: month 1: official day, 0: month 1: official day, 0: month 1: official day, 0: month 1: official day, 0: month
8	Station Access Response PROFILE Packet / TSR	Packet / Stat Packet	ion Re	egular Packet & TRACK
9	CRC	4		CRC 32 bit (Polynomial EEB88320), (Message type to End of Station Packet)

### 7. Onboard KAVACH to NMS Packet Structure

Field No	Field Description	Field Width (Bytes)	Comment
1	Start of Frame (SOF)	2	0xA5CC
2	Packet Version	1	1
2 3	Packet Version Message Type	1	1 0: Not used 1: OVK to KAS IP Look Up re- quest Packet 2: KAS to OVK IP Look Up re- sponse Packet 3: OVK to LES Access Request Packet 4: LES to OVK Access Request Packet Structure 5: Onboard KAVACH to Station- ary KAVACH 6: Stationary KAVACH to Station- ary KAVACH 6: Stationary KAVACH to Onboard KAVACH 7: Onboard KAVACH to NMS Event 8: Onboard KAVACH to NMS Fault 9: NMS Acknowledgement 10: Onboard KAVACH to TSR Server 12: TSR server to Onboard KA- VACH

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Field No	Field Description	Field Width (Bytes)	Comment
4	Message Length	2	In Bytes from field "Message Type
			" to "CRC"
			(inclusive of both)
5	Message Sequence	2	0-65535
6	Date	3	DD/MM/YY
			00-99: official year, 100-126: not
			01 12: official month 0 13 14: not
			used 15: month unknown
			01-31: official day, 0: month un-
			known
			Eg: $27/04/18 \rightarrow 0x1B-0x04-0x12$
7	Time	3	HH:MM:SS (IST time)
			00-99: official year, 100-126: not
			used, 127: year unknown
			01-12: official month, 0,13,14: not
			used, 15: month unknown
			known
			Eg: $06:36:10 \rightarrow 0x06-0x24-0x0A$
8	ONBOARDKAVACH	3	
	ID		
9	System Version	1	1
10	Event Count	1	
11	Event Id	2	
12	Event Data		
13	CRC	4	CRC 32 bit (Polynomial EEP88220) (Massage type to End
			of Loco Packet)
	Onboard	KAVACH Ever	nt Table
Event ID	Field	Field Width	Description
		(Bytes) – m	1
1	Radio-1 Health	1	1: OK
			2: Diagnostic Link Fail
			3: Radio Fail
2	Radio-2 Health	1	1: OK
			2: Diagnostic Link Fail
2	Dadia 1 Innut augul-	1	5: Kadio Fall Value: 10V 20V
5	Radio-1 input supply	1	- On change of voltage by 1V
Δ	Radio-2 Input supply	1	Value: 10V-30V
-	Natio-2 input supply	1	- On change of voltage by 1V
5	Radio-1 Temperature	1	Value: -30°C to 70°C (1 byte
-	······································	-	Signed)
			- On change of temperature by 3°C

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Field No	Field Description	Field Width (Bytes)	Comment
6	Radio-2 Temperature	1	Value: -30°C to 70°C (1 byte Signed) - On change of temperature by 3°C
7	Radio-1 PA Tempera- ture	1	Value:20°C to 100°C - On change of temperature by 3°C
8	Radio-2 PA Tempera- ture	1	Value:20°C to 100°C - On change of temperature by 3°C
9	Radio-1 PA Supply Voltage	1	Value: 11V-13V - On change of voltage by 1V
10	Radio-2 PA Supply Voltage	1	Value: 11V-13V - On change of voltage by 1V
11	Radio-1 Tx PA Current	1	Value: 1.5A to 3.2A - On change of current
12	Radio-2 Tx PA Current	1	Value: 1.5A to 3.2A - On change of current
13	Radio-1 Reverse Power	1	Value received from Radio Eg: Value received from Radio is 0x01 = 0.1W (Value: 0x01)
14	Radio-2 Reverse Power	1	Value received from Radio Eg: Value received from Radio is 0x0F = 1.5W (Value: $0x0F$ )
15	Radio-1 Forward Pow- er	1	Value received from Radio Eg: Value received from Radio is 0x36 = 5.4W (Value: 0x36)
16	Radio-2 Forward Pow- er	1	Value received from Radio Eg: Value received from Radio is 0x78 = 12W (Value: 0x78)
17	Radio-1 RSSI	2	Value received from Radio Eg: Value received from Radio is 0xBDBF = -132.5dBm (Value: 0xBDBF)
18	Radio-2 RSSI	2	Value received from Radio Eg: Value received from Radio is 0xBDBF = -132.5dBm (Value: 0xBDBF)
19	Stationary Regular packet received time offset	2	0-2000 ms
20	Active GPS Number	1	GPS used for frame number calcu- lation 0 – No Active GPS 1 – GPS 1 2 – GPS 2 3 – Both GPS - on change of GPS

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Field No	]	Field Description	n	Field Wi (Bytes	dth )	(	Comment	
21	(	GPS-1 View Statu	IS	1	-	0 – No Data		
						1 - V		
						2 - A		
						- on detectior	n of change of ev	ent
22	(	GPS-2 View Statu	IS	1		0 - No Data		
						1 - V		
						2 – A		
						- on detectior	n of change of ev	ent
23		<b>GPS-1</b> Seconds		1		0 to 59 secon	ds	
						- on change o	of value	
24		GPS-2 Seconds		1		0 to 59 secon	ds	
						- on change o	of value	
25	(	GPS-1 Satellites i	n	1		Value receive	ed from GPS rece	eiver
		View				- On change	of value	
26	(	GPS-1 CNO (Max	()	1		Maximum Cl	NO Value receive	ed
						from GPS rec	ceiver	
						- On change	of value	
27	(	GPS-2 Satellites i	n	1		Value receive	ed from GPS rece	eiver
		View				- On change	of value	
28	(	GPS-2 CNO (Max	()	1		Maximum Cl	NO Value receive	ed
						from GPS rec	ceiver	
						- On change	of value	
29		GPS-1 link status	5	2		0-Both GPS 1	ink and PPS fail	
						1- GPS link f	ail and PPS ok	
						2- GPS link o	ok and PPS fail	
						3- GPS link of	ok and PPS ok	
30		GPS-2 link status	5	2		0-Both GPS 1	ink and PPS fail	
						1- GPS link f	ail and PPS ok	
						2- GPS link o	ok and PPS fail	
						3- GPS link of	ok and PPS ok	
31		GSM-1 RSSI		1		Value receive	ed from GSM mo	odule
						- On change	of value	
32		GSM-2 RSSI		1		Value receive	ed from GSM mo	odule
						- On change	of value	
33	C	urrent Running K	ey	1		0: Default ke	y set,	
		-	·			1-30: KMS k	ey set	
						- on change o	of Key Set	
34	Re	emaining Number	of	1		0: No keys,		
		Keys				1-30: Remain	ning KMS key se	ts
		-				- on change o	of value	
35	Ses	ssion Key Checks	um	2		Checksum of	16 bytes session	n key
		-				- for every 2s	at the time of A	u-
						thentication of	only	
36		DMI-1 link status	S	2		0-NOT OK	-	
						1-OK		
37		DMI-2 link status	5	2		0-NOT OK		
						1-OK		
L. L							Detect	
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Field No	Field Description	Field Width (Bytes)	Comment
38	RFID Reader-1 link	2	0-NOT OK
	status		1-OK
39	RFID Reader-2 link	2	0-NOT OK
	status		1-OK
40	Duplicate Missing RFID Tag	2	RFID Tag Number
41	Missing linked RFID Tag	4	B3-B1: Linked RFID Tag B0: Linking direction
42	Computed TLM Status	4	B3-B1: Station Id
	-		B0: TLM Status
			Values:
			1 – TLM Updated
			2 – TLM Timeout
43	Train Configuration	1	0 – No Change
	C C		1 – Updated
44	Train Brakes Test	1	0 – Brake Test failed
			1 – Brake Test Successful
45	Selected Train for-	1	TBD
	mation		
46	Selected Cab	1	1 – Cab1 Selected
			2 – Cab2 Selected
47	Brake application rea-	1	0-Not used
	son		1-Reverse movement detected
			2-Unusual stopage detected
			3-Overspeed
			4-Rollback detected
			5-MBT selected
			6- No LP Acknowledge
			7- MA Shortened
			8-Headon collision detected
			9-Rearend collision detected
			10-Loco Specific SoS received
			11-Station General SoS received
48	Station General SoS	3	B2-B1: Station Id
			B0: General SoS status (1 – Re-
			ceived, 2 – Cancelled)
49	Station Loco Specific	3	B2-B1: Station Id
	SoS		B0: Specific SoS status (1 – Re-
			ceived, 2 – Cancelled)

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Field No	Field Description	Field Width (Bytes)	Comment
50	Collision Detection	4	B3-B1: Loco Id
			B0: SoS code
			Values:
			1 – Manual SoS received
			2 – Manual SoS cancelled
			3 – Unusual stopage detected
			4 – Unusual stopage end
			5 – Head-on collision detected
			6 – Head-on collision end
			7 – Rear-end collision detected
			8 – Rear-end collision end
51	Loco Self SoS	1	1 – Manual SoS
			2 – Manual SoS end
			3 – Unusual stopage start
			4 – Unusual stopage end
52	KAVACH Connection	1	1 – KAVACH Isolated
			2 – KAVACH Connected
53	BIU Isolated	1	1 – BIU Isolated
			2 – BIU Connected
54	EB Bypassed	1	1 – EB Connected
			2 – EB Bypassed
55	KAVACH Territory	1	1 – KAVACH Entry
			2 – KAVACH Exit
56-199	Reserved		
200-254	Firm specific events	2	This field Information is specific
			to KAVACH firm
255	Specific value		Not to be used

### 8. Onboard KAVACH to NMS Fault Packet Structure

Field No	Field Description	Field Width (Bytes)	Comment
1	Start of Frame (SOF)	2	0xA5CC
2	Packet Version	1	1

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Field No	Field Description	Field Width	Comment
3	Message Type	(Bytes)	0: Not used
5	Wiessage Type	1	1: OVK to KAS IP Look Up re-
			quest Packet
			2: KAS to OVK IP Look Up re-
			sponse Packet
			3: OVK to LES Access Request
			Packet
			4: LES to OVK Access Request
			Packet Structure
			5: Onboard KAVACH to Sta-
			tionary KAVACH
			0: Stationary KAVACH to
			7: Onboard KAVACH to NMS
			Event
			8: Onboard KAVACH to NMS
			Fault
			9: NMS Acknowledgement
			10: Onboard KAVACH to CTC
			11: Onboard KAVACH to TSR
			Server
			12: TSR server to Onboard KA-
4			VACH
4	Message Length	2	In Bytes from field "Message
			Type " to "CRC" (inclusive of both)
5	Message Sequence	2	0-65535
6	Date	3	DD/MM/YY
0	Dute	5	00-99: official year. 100-126:
			not used, 127: year unknown
			01-12: official month, 0,13,14:
			not used, 15: month unknown
			01-31: official day, 0: month un-
			known
			Eg: $27/04/18 \rightarrow 0x1B-0x04-$
			0x12
7	Time	3	HH:MM:SS (IST time)
			00-99: official year, 100-126:
			not used, 12/: year unknown
			not used 15: month unknown
			01-31: official day 0: month un-
			known
			Eg: $06:36:10 \rightarrow 0x06-0x24$ -
			0x0A

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ways.			

Field No	Field Description	Field Width (Bytes)	Comment
8	KAVACH subsystem	1	0x11 – Stationary KAVACH
	type		0x33 – TSRMS
9	KAVACH Subsystem ID	3	
10	System Version	1	1
11	Total Fault Codes (F)	1	Max number of faults shall be 10
12	Fault Code	2*F	Firm specific code to be decoded by NMS
13	CRC	4	CRC 32 bit (Polynomial EEB88320), (Message type to
			End of Loco Packet)

9. NMS Acknowledgment Packet Structure

Field No	Field Descrip-	Field Width	Comment
1	Start of Frame (SOF)	2	0xA5CC
2	Packet Version	1	1
3	Message Type	1	0: Not used 1: OVK to KAS IP Look Up re- quest Packet 2: KAS to OVK IP Look Up re- sponse Packet 3: OVK to LES Access Request Packet 4: LES to OVK Access Request Packet Structure 5: Onboard KAVACH to Station- ary KAVACH 6: Stationary KAVACH to Station- ary KAVACH 7: Onboard KAVACH to NMS Event 8: Onboard KAVACH to NMS Fault 9: NMS Acknowledgement 10: Onboard KAVACH to TSR Server 12: TSR server to Onboard KA- VACH
4	Message Length	2	In Bytes from field "Message Type " to "CRC" (inclusive of both)

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Field No	Field Descrip-	Field Width	Comment
5		(Dytes)	
5	allence	2	0-65535
6	Date	3	DD/MM/YY
0	Dute	5	00-99 official year 100-126 not
			used. 127: year unknown
			01-12: official month. 0.13.14:
			not used, 15: month unknown
			01-31: official day, 0: month un-
			known
			Eg: $27/04/18 \rightarrow 0x1B-0x04-0x12$
7	Time	3	HH:MM:SS (IST time)
			00-99: official year, 100-126: not
			used, 127: year unknown
			01-12: official month, 0,13,14:
			not used, 15: month unknown
			01-31: official day, 0: month un-
			known
			Eg: $06:36:10 \rightarrow 0x06-0x24-0x0A$
8	KAVACH	1	0x11 – Stationary KAVACH
	subsystem type		0x22 – OnboardKAVACH
			0x33 – TSRMS
9	KAVACH	3	
10	Subsystem ID	1	1
10	System ver-	1	1
11	SIOII Total Fault	1	
11	Codes (F)	1	Max number of faults shall be 10
12	Eault Code	2*F	Firm specific code to be decoded by
12		21	NMS
13	CRC	4	CRC 32 bit (Polynomial
			EEB88320), (Message type to
			End of Loco Packet)

### 10. Onboard KAVACH to CTC Packet Structure

Field No	Field Descrip- tion	Field Width (Bytes)	Comment
1	Start of Frame	2	
	(SOF)		0xA5CC
2	Packet Ver-	1	
	sion		1

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Field No	Field Descrip- tion	Field Width (Bytes)	Comment
3	Message Type	1	0: Not used 1: OVK to KAS IP Look Up request Packet 2: KAS to OVK IP Look Up response Packet 3: OVK to LES Access Request Packet 4: LES to OVK Access Request Packet Structure 5: Onboard KAVACH to Sta- tionary KAVACH 6: Stationary KAVACH to Sta- tionary KAVACH 7: Onboard KAVACH to NMS Event 8: Onboard KAVACH to NMS Fault 9: NMS Acknowledgement 10: Onboard KAVACH to TSR Server 12: TSR server to Onboard Vet Vet CU
4	Message Length	2	In Bytes from field "Message Type " to "CRC" (inclusive of both)
5	Message Se- quence	2	0-65535
6	Date	3	DD/MM/YY 00-99: official year, 100-126: not used, 127: year unknown 01-12: official month, 0,13,14: not used, 15: month unknown 01-31: official day, 0: month unknown Eg: $27/04/18 \rightarrow 0x1B-0x04-0x12$
	Time	3	HH:MM:SS (IST time) 00-99: official year, 100-126: not used, 127: year unknown 01-12: official month, 0,13,14: not used, 15: month unknown 01-31: official day, 0: month unknown Eg: 06:36:10 $\rightarrow$ 0x06-0x24- 0x0A
8		Train Posit	ion to CTC

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ways.			

Field No	Field Descrip- tion	Field Width (Bytes)	Comment
9	CRC	4	CRC 32 bit (Polynomial
			EEB88320), (Message type to
			End of Loco Packet)

#### 11. Onboard KAVACH to TSR Server

Field No	Field Descrip-	Field Width	n Comment	
	tion	(Bytes)		
1	Start of Frame (SOF)	2	0xA5CC	
2	Packet Version	1	1	
3	Message Type		<ul> <li>0: Not used</li> <li>1: OVK to KAS IP Look Up request Packet</li> <li>2: KAS to OVK IP Look Up response Packet</li> <li>3: OVK to LES Access Request Packet</li> <li>4: LES to OVK Access Request Packet Structure</li> <li>5: Onboard KAVACH to Stationary KAVACH</li> <li>6: Stationary KAVACH to Onboard KAVACH</li> <li>7: Onboard KAVACH to NMS Event</li> <li>8: Onboard KAVACH to NMS Fault</li> <li>9: NMS Acknowledgement</li> <li>10: Onboard KAVACH to TSR Server</li> <li>12: TSR server to Onboard KA-</li> </ul>	
4	Message Length	2	In Bytes from field "Message Type " to "CRC" (inclusive of both)	
5	Message Se- quence	2	0-65535	
6	Date	3	DD/MM/YY 00-99: official year, 100-126: not used, 127: year unknown 01-12: official month, 0,13,14: not used, 15: month unknown 01-31: official day, 0: month un- known Eg: 27/04/18 $\rightarrow$ 0x1B-0x04-0x12	
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Field No	Field Descrip-	Field Width	Comment
	tion	(Bytes)	
7	Time	3	HH:MM:SS (IST time)
			00-99: official year, 100-126: not
			used, 127: year unknown
			01-12: official month, 0,13,14:
			not used, 15: month unknown
			01-31: official day, 0: month un-
			known
			Eg: $06:36:10 \rightarrow 0x06-0x24-0x0A$
8	Loco to TSR	Server Access Requ	est / Regular Packet / Link Check
		Pac	cket
9	CRC	4	CRC 32 bit (Polynomial
			EEB88320), (Message type to End
			of Loco Packet)

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S.N.	Section	Page No.	Clause No.	Description	Query (ITI)	RDSO Comments
1	Details of Eol	5	1	1. Indian Railways intend to engage with the OEMs, authorized representatives of OEMs, firms who have developed product/s in 4G/5G technology area or in other similar technology field such as GSM/GSM-R, TETRA etc.	Can Bidder Participate taking up OEMs as Consortium Partner without providing MAF. Please clarify	As per Eol document clause no. 1 (of page no.10 of 16).
2	Shortlisting Criteria	11	2.2	Details of supplies made in the field/similar field of item under Eol	Can Experience Certificate submitted by OEMs as a consortium partner on behalf of Bidder be valid? Please clarify	Yes.
3	Role of Various agencies	12	1.b.i	(i) Providing towers for installation of antenna and equipment based on RF survey.	1.Whether Pole mount, Mount Bracket, Cable Tray will be made available by SCR for each site? 2.Civil,Electrical Infrastructure readiness to radiate eNodeB will be provided by SCR? Please clarify	<ul> <li>South Central Railway will provide basic infrastructure only i.e.:</li> <li>1. Towers.</li> <li>2. 230VAC power supply upto the base of the towers.</li> <li>3. OFC connectivity upto the base of the towers.</li> </ul>

S.N.	Section	Page No.	Clause No.	Description	Query (ITI)	RDSO Comments
4	Role of Various agencies	12	1.b.ii	(ii) Last mile OFC connectivity for each radio with requisite bandwidth between eNodeB and EPC.	If BBU(may be at RR) & RRU are kept apart due to any reason, Whether Digging & Trenching of Power cables & OFC will be done by SCR? Please clarify	OFC will be provided upto the foot of the tower.
5	Role of Various agencies	12	1.b.iii	(iii) Stable power supply of required load for these equipment's.	<ol> <li>Whether SMPS &amp; DCDB         <ul> <li>Stable - 48V DC) supply</li> <li>eNodeB Tower will be</li> <li>provided by SCR</li> <li>AC Power Supply to</li> <li>DCDB will be Single Feed                  <ul></ul></li></ul></li></ol>	<ul> <li>South Central Railway will provide basic infrastructure only i.e.:</li> <li>1. Towers.</li> <li>2. 230VAC power supply upto the base of the towers.</li> <li>3. OFC connectivity upto the base of the towers.</li> </ul>
6	Role of Various agencies	12	1.d	d) Extend any other assistance required for the trials.	Physical Security of e NodeB installed? Will it be the responsibility of SCR? Please clarify	Till the commissioning and handing over, the equipments will remain under custody of firms.

S.N.	Section	Page No.	Clause No.	Description	Query (ITI)	RDSO Comments
7	Functional Requirements Specifications	26	3	Section proposed for proof of concept	Please provide us the Tentative number of e NodeBs and LTE router	To be finalized after shortlisting of firms.
8	Functional Requirements Specifications	26	3	Section proposed for proof of concept	Please provide us with the Proposed Network Diagram & Technical Architecture	Technical part will be discussed after shortlisting of firms.
9	Functional Requirements Specifications	26	3	Section proposed for proof of concept	Existing N/w Elements details of POC solution (like VAS Servers, Metering & charging equipment, USSD/SMSC,GPS) to check Interoperability may kindly be provided.	Technical part will be discussed after shortlisting of firms.
10	Functional Requirements Specifications	26	3	Section proposed for proof of concept	Towers are not available at Hussain Sagar Jn. Whether Bidder is required to erect Physical Towers for E NodeB at any stage of POC or Rollout? Please clarify	South Central Railway will provide the facility as per clause no.1 (page 12 of 16) of Eol document.
11	Functional Requirements Specifications	26	3	Section proposed for proof of concept	Is there any tunnel in POC section to serve by the eNODE B coverages? Please clarify	Section Details will be provided after shortlisting of the firms.
12	Functional Requirements Specifications	27	4.4.1	The system shall be designed to work in 700 MHz spectrum	SACFA need to be applied by SCR or Bidder? Please clarify	This will be discussed after shortlisting of firms.

S.N.	Section	Page No.	Clause No.	Description	Query (ITI)	RDSO Comments
13	Functional Requirements Specifications	30	7.2.iv	(iv) Seamless communication support for train speeds up to 250 Kmph (Design). To be tested up to the maximum permissible speed of the trial section.	Is 250 Kmph Speed testing is Mandatory during POC or Rollout? Please clarify	This will be discussed after shortlisting of firms.

Annexure – VII Allocation Letter Phone : 0522 - 2459886 Fax : 0522 - 2462635 E-mail : vijay.garg79@gov.in



मारत सरकार, रेल मंत्रालय अनुसंधान अमिकल्प और मानक संगठन लखनऊ—226 011 Government of India - Ministry of Railways Research Designs & Standards Organisation LUCKNOW – 226011



NO. RDSO-TELELKO (TECH)/6/2023

Dated: 24.08.2023

M/s ITI Limited, Bangaluru

Sub: Section allotment to shortlisted firms for enodeB for Trials of 4G LTE-R systems in 500RKM in SCR.

Ref: (i) Eol reference no. RDSO/TELE/EOI/01/2023 dated 24.03.2023. (ii) This office letter of even No. dated 02.08.2023 & 04.08.2023.

- (iii) Your letter No. CORP/MKTG/RDSO/4G/2023/12 dated
  - 11.08.2023.

Vide this office letter at reference (ii) above regarding submission of trial section preference, it is to be informed that your firm has been allotted **Ex. Secunderabad (SC)** to Bibinagar (BN) (from Km. 195.36 to Km.228.59) in Secunderabad -Raghunathpalli (SC-RGP) section as per the preference submitted and availability of trial section.

You are advised to carry out RF survey in the allotted section. The Design Inputs for Radio Network Planning is attached as Annexure-I. The RF survey report shall be submitted to this office by **15.09.2023**. No payment will be done by the Railway/RDSO for RF Survey.

You are also requested to make necessary preparation for the LAB testing at Secunderabad. The test plan has already been to you vide this office letter even No. dated 04.08.2023. Date of start of testing will be intimated to you shortly.

This is for your kind information and further necessary action.

Kindly acknowledge the acceptance of the section.

DA : Annexure-I.

121/08/2023

(Vijay Garg) Director / Telecom-1 For Director General/ S&T

Annexure – VIII Design Inputs for Radio Network Planning

Annexure-I

### Design Inputs for Radio Network Planning

Sr.	Parameters	Value
No.	<del>-</del> · · · · ·	
1.	I errain Model	Rural, Suburban and Urban
2.	Path Loss Model	3GPP/ITU-R M.2135-1 or Okumara Hata or
		Ray Tracing Model
3.	Cell Edge Throughput (DL)	2 Mbps
4.	Cell Edge Throughput (UL)	1 Mbps
5.	Cell Area Coverage probability	The system shall meet the following.
	and Minimum Coverage Level	1. Coverage probability of 95% based on
		minimum coverage level of -95 dBm and
		remaining 5% based on minimum level
		of -100 dBm, for speeds lower than or
		equal to 220 km/h.
		2. Cell edge throughput for Uplink and Downlink.
6.	Frequency Band	Band 28
		Uplink : 713-718 MHz
		Downlink : 768 - 773 MHz
7.	Channel Bandwidth	5 MHz
8.	Duplex Method	FDD
9.	Modulation	Uplink : SC-FDMA,
		Downlink : OFDMA
10.	UE Antenna Height	1.5 m outdoor UEs
11.	eNodeB Tx-Rx antenna Path	2 Tx-2 Rx (2X2 MIMO)
12.	UE Tx - Rx Antenna Path	1 Tx-2 Rx
13.	UE Category	Class 2 or higher
14.	eNodeB Transmit Power	43 to 46 dBm
15.	eNodeB Cable and Connector	0 dBm
10	loss	
16.	eNodeB Antenna Gain	16 -21 dBi
17.	eNodeB Noise Figure	5 dB
18.	UE Transmit Power (max)	23.0 dBm
19.	UE Antenna Gain	0.0 dBi
20.	UE Body Loss	0.0 dB
21.	UE Noise Figure	7 dB
22.	UE Cable and Connector loss	0.5 dB
23.	Noise Spectral Density	-174 dBm/Hz
24.	SINR Target (DL)	$0 \text{ dB} \le \text{SINR} \le 40 \text{ dB}$
25.	SINR Target (UL)	$0 \text{ dB} \le \text{SINR} \le 40 \text{ dB}$
26.	Cell Load (DL& UL) %	50% for Urban, Suburban and Rural
27.	Interference Margin	2.1 dB
28.	Penetration Loss	11 dB

### 2160232/2023/O/o Director/Tele-1/RDSO

- 1. Field Survey shall be carried out by the firms for the respective section allotted. Suitable software tool along with mapping on professional digital map may be used. All required tools/resources i.e. digital map, software tools etc. to be arranged by firms.
- 2. Permissible Tx power shall be as per regulatory norms (i.e. 63 dBm for 5 MHz Bandwidth etc.).
- 3. For penetration loss measurement, Continuous Wave (CW) test may be carried out by the firms as per site requirements.
- 4. The towers (Cell Sites) shall be planned to have continuous Radio Signal Coverage with RF Coverage redundancy considering UE at 1.5 meter height from ground level. Coverage redundancy implies that if any cell site goes down then continuous coverage is made good from its adjacent Cell sites.
- 5. While planning cell sites, towers should invariably be planned at stations. The existing towers (as already communicated) or upcoming towers should be taken into consideration for Cell site planning. The rest of the gap to be filled by additional towers (cell sites) considering existing installations such as IBHs, Auto Huts, LC gates as preferred locations.
- 6. The height of the existing towers is already provided in the section details communicated. The additional towers are proposed of height 40 meters.

### **Requirement of Survey Report**

After survey, the desktop survey report shall be submitted to RDSO including the following details:

- 1. Details of latitude and longitude of stations, IB huts and Level Crossings Gates etc.
- 2. Prediction of requirement of additional towers so as to meet the requirements of given design inputs for radio planning.
- 3. Details of latitude and longitude of new towers proposed.
- 4. Details of heights of proposed antennae and their azimuth.
- 5. Heat map of Radio Strength in the vicinity of Railway track with colour code on a geographical map.
- 6. Marking of existing tower locations and proposed tower locations on the map.
- 7. Marking of Railway track on the map.

All radio Survey to be provided in Hard copies (02 Nos.) alongwith soft copies (PenDrive, CD).