



REQUEST FOR PROPOSAL (RFP) DOCUMENT

FOR

**Supply of Open Source based 3GPP/O-RAN Compliant
5G Radio Access Network Product**

**India Open Source for Mobile Communication
Network (IOS MCN) Project**

**Foundation for Innovation and Technology
Transfer**

IIT Delhi

Notice Inviting RFP

DOCUMENT VERSION 3.1

TWO-BID TENDER

NOTICE NO. RFP/FT/2023/11/13/IOS/01

Dated: 15th Feb 2024

BID SCHEDULE			
S.No.	Bid Activity	Date	Time
1	Notification	15/02/24	10:00 AM
2	Bid Query	19/02/24	5:00 PM
3	Answers to Bid Queries	22/02/24	10:00 AM
4	Submission of Bid	01/03/24	5:00 PM
5	Opening of Technical Bid	02/03/24	10:00 AM
6	Completion of Technical interaction and Demonstration of bidder's Technical Solution to the Technical Evaluation Committee	07/03/24	6:00 PM
7	Completion of Technical Evaluation	08/03/24	6:00 PM
8	Opening of financial Bid	09/03/24	10:00 AM

Pre-bid queries should be addressed to email: COO@fitt-iitd.in and Cc: Krishna Sirohi ksirohi@dbst.iitd.ac.in

Mode of Bid submission: Please refer to Para 10.5 for instructions.

Technical Bid: Can be submitted on email . In addition Hardcopy has to be sent at the address

Financial Bid: Hard copy has to be submitted.

Date: 15 Feb 2024



Chief Operations Officer
FITT

Address: MD FITT
Foundation for Innovation and technology Transfer
Deans Complex Main Building, IIT Delhi
Hauz Khas
New Delhi 110016

Request for Proposal

1. Introduction: FITT, invites proposals from bidders for the Supply of Open Source based 3GPP/O-RAN Compliant 5G Radio Access Network Product. The project would involve supply of equipment (Hardware and Software), installation and its operationalization in the lab of IIT Delhi. as defined in the RFP. The software of the Radio Access Network should be build using released codebase of any of the globally popular 5G open-source software initiative. The additional software as part of the supply of this product, will be made integral part of the India Open-Source platform for Mobile Communication Network (IOS MCN) delivery.

Indian Open-Source Mobile Communication Network (IOS MCN) project is a collaboration between industry, academia, and the Government, with a governance process based on global best practices. The mission of this Project shall be to facilitate the telecom ecosystem by building a common platform for providing a commercial grade, common and open software base to enable stakeholders to rapidly use, customize, make derivative works from, and thereby create Mobile Communication (5G and beyond) products and services

This Project aims to create a vibrant telecom ecosystem by building a membership-based partnership amongst start-ups, telecom operators, system integrators, equipment vendors, multinational corporations etc. This Project will provide the institutional mechanism to sustain this effort for the future with support from the Government as well as other sponsors.

In order to meet its deliverable objective of two-year project as funded by government of India, it is intended to acquire technology knowhow of 3GPP defined Radio Access Network based on any globally popular 5G open-source software initiatives and get benefit by continued association of technical strong organization supporting IOS-MCN project.

The acquired system (hardware and software) will be utilized as a development platform for carrying out the further development of the project and meeting goal of developing production grade deployable mobile network software.

2. Scope of work:

Scope of Delivery	<p>A. System: Two numbers of 5G Integrated gNB / (CU & DU) software running on suitable hardware. It includes:</p> <ul style="list-style-type: none"> a. One number of USRP (B210 - 40 MHz Bandwidth) Radio Unit b. One Number of Split 7.2 Compliant Radio Unit (integrated Antenna) supporting 100 MHz Bandwidth, a minimum 100 m-Watt radiated power and 4T-4R or 2T-2R antenna chain c. Grand-master Clock source to synchronize DU+CU with RU to support IEEE 1588 based clocking d. GNSS/GPS Based Stable clock for 5G Network <ul style="list-style-type: none"> i. GPS /GNSS Antenna ii. 1 PPS out and coherent iii. 1 programable frequency out, 10 MHz iv. Time of Day (TOD) v. 1PPS in vi. IEEE 1588 . SyncE vii. ITUT G.8265.1, G.8275.1 & G.8275.2 viii. Phase accuracy +100 ns ix. PTP slaves – 32 x. 2 x 1/2.5/10G (SFP+) <p>Integrated gNB/(DU+CU) should support single cell one at a time either with USRP (B210) or with 7.2 Split RU]</p>
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	<p>B. Documents:</p> <ol style="list-style-type: none">a. System Description Document of proposed RAN solutionb. Description of the Software changes incorporated over and above the released opensource codebase attributing to the additional differentiated product enhancement. Design description and the source code of the Software changes are mandatory part of the system delivery. Procedure for ‘Release build’ of the differentiated Software changes [<i>The same will be utilized for creating the new build (in presence of Technical Evaluation Committee) for system testing and evaluation</i>]c. Test-plan (with Test Results and logs to substantiate the results) for demonstrating all features/capabilities of RANd. Compliance to Specifications (As per Annexure-1)e. Compliance to RFP document <p>C. Software:</p> <ol style="list-style-type: none">a. Software (Source Code) of “differentiated product enhancements”b. Software upgrade (with design documents and source code) to include URLLC feature (as per 3GPP Rel 16). [The upgrade is required to be completed within the 6 months time, after the first system delivery] <u>Lower Latency ($\leq 5\text{ms}$) by supporting:</u><ul style="list-style-type: none">• Higher subcarrier spacing, with shorter transmission durations.• Frequent PDCCCH monitoring reducing the latency of the layer-1 control information.• Configured-grant, which allows the UE to autonomously transmit uplink data without having to send a scheduling request and wait for the uplink grant.• Downlink preemption.<u>Higher Reliability by supporting:</u><ul style="list-style-type: none">• Low spectral efficiency MCS/CQI tables.• PDCP duplication. <p>D. Technical Services (3 Resources) for 6 months for system integration and development activities. Additionally, bidder is also required to make an optional offer its Technical Services for Q3/Q4 after the Software upgrade delivery.</p>

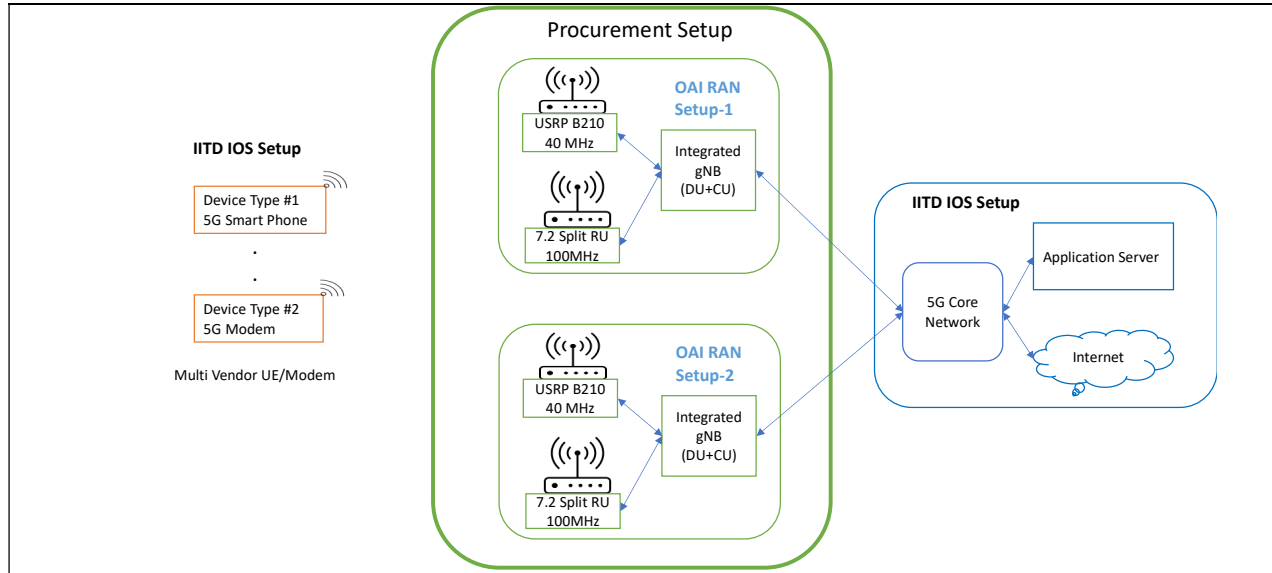


Figure-1: Block Diagram: Open Source 5G & Beyond Testbed

Technical Requirement	
Functional (Features) Requirement	As per Annexure-2
Stability Requirement	Real UE/Modem (Minimum 8#) for 24 Hours Continuous Operation
Performance Requirement	Data rate (DL + UL) in MIMO/SISO: 400 Mbps [Technical Evaluation with USRP 40/100 MHz or 7.2 Split RU]
	Latency for User & Control Plane: 15 ms or better
Capacity Requirement	32 Simultaneous Connected Users
Testing Requirement	
Testing Environment	<ol style="list-style-type: none"> i. The Procurement Setup will be tested and will undergo technical evaluation as per the Fig-1: Block Diagram. ii. Bidder will provide entire test setup for the technical verification. iii. Mix of 5G NR smartphone and Modems (with more than 2 vendors) are to be utilized simultaneously for demonstration. iv. In addition to the provided 5G UE and Modem for the testing RAN (system under test), available UE/Modems in IITD lab will also be utilized for generating more real UE traffic. It is not mandatory for ensuring interoperability of the RAN with all the UE/Modem available in IITD lab, provided bidder demonstrate interoperability with multi-vendor UE/Modems. v. Bidder may choose any Core Network for demonstrating all the requirements. If it helps him, bidder can use OAI based Core Network available at IITD lab for the demonstration of all features/capabilities of RAN. Bidder will ensure that his RAN solution is already interoperated with OAI Core Network. The selected supplier will also interoperate his RAN with the Core Network available at IIT Delhi. vi. The Test tools for demonstrating all the requirements will be provided by bidder.



	vii. Bidders need to clearly describe the testing procedure and the test tool utilized for demonstrating all features/capabilities in Test-plan.
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3. Description of the Software Changes for Product Enhancement: Bidder is required to submit the description, as per recommended format (below) of the software changes incorporated over and above the opensource codebase that has provided substantial enhancements in features, performance, capacity, and stability of the deployable 5G RAN Products:

Change Index	Change Description	Impact On			
		Functional	Performance	Capacity	Stability
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

This description will contribute to the technical evaluation with due weightage.

4. Bid Evaluation Model and Intermediate Steps:

4.1. Step-1: Document examination

- a) Verification of the company details
- b) Verification of Technical Bid Document
- c) Bidders will be notified about the Step-1 Assessment outcome. The assessment will be carried out based on the technical documentations provided as response to the technical bid and the subsequent responses received on technical queries, if required. The ‘Step-1’ Technical Evaluation Assessment will be done in accordance with the criteria mentioned in the following Table:

‘Step-1’ Technical Evaluation Summary (Documentation)						
Requirement Type	Functional	Performance	Capacity	Stability	“Differentiated Product Enhancement”	Total
Weightage	20	20	20	20	20	100
Bidder Name	Assessment					
Bidder#1						
Bidder#2						
Bidder#3						
Bidder#4						
Bidder#5						
Bidder#6						
Bidder#7						
Bidder#8						



*Bidder must ensure full availability of their internal resources to provide any clarification in Step-1.

4.2. Step-2: Technical Proof of Concept (PoC)

- a) The maximum four best selected bidders (in Step-1) will be chosen for PoC evaluation stage.
- b) Technical evaluation will be done on the real functional system in lab. All the “Technical Requirements” will be performed in the testing environment specified in “Scope of Work” Table.
- c) The summary of the technical evaluation will be captured in the following format:

‘Step-2’ Technical Evaluation Summary (PoC)						
Requirement Type	Functional	Performance	Capacity	Stability	“Differentiated Product Enhancement”	Total
Weightage	20	20	20	20	20	
Bidder Name	Assessment					
Bidders Qualified for PoC						
Bidder#1						
Bidder#2						
Bidder#3						
Bidder#4						

- d) Technical evaluation will also determine the usefulness to procure product from the two-bidder depending on the software based “differentiated product enhancement”. This will guide IOS-MCN project to establish suitable collaboration later for mutual benefit.

4.3. Step-3: Commercial Evaluation

- a) Only bidders with technically selected solutions (as per Step-2) will be considered for commercial evaluation.

4.4. Step-4: **Quality Cost Based Selection (QCBS): The** Final evaluation of the bid responses would be done based on QCBS Model. In this type of selection criteria, both quality and cost of the proposal are deciding factors for selection. The **weightage assigned for quality (technical proposal) will be 70% & 30% for financial Proposal**. First the technical proposal is evaluated, and scores are given to it as per the evaluation criteria. It is multiplied by the weightage and weighted technical score is determined. Similarly, the financial score is calculated as per the evaluation criteria and multiplied by the respective weightage to determine the weighted financial score.

Formula for calculating the financial score $S_f = 100 \times F_m / F$,

Where, S_f = financial score

F_m = Lowest Price

F = Price of the proposal under consideration

Formula for calculating final score:

$S = S_t \times T\% + S_f \times P\%$

Where T = the weights given to technical proposal,

P = the weights given to financial proposal

$T + P = 1$,

For example, if the weightage for technical proposal is 60% and for financial proposal 40%, then $T = 0.6$ and $P = 0.4$.

Both the weighted technical score and weighted financial scores are added together and the bidder having highest score is declared the winner and hence awarded the contract, as per following example:

Quality And Cost Based Selection (QCBS)												
S.No.	Name of Firm	Technical Weightage (T)			70%	Financial Price (F) in INR	Financial Weightage (F)		30%	Combined Evaluation		
		Technical Score (St) (Max.100)	Weighted Score (St*T)	Rank			Financial Score (Sf) (Max. 100)	Weighted Score (Sf*F)		Rank	Scores = (St*T + Sf*F)	Rank
1	Bidder-1	90	63	1	₹ 1,50,000.00	67	20	3	83	1		
2	Bidder-2	80	56	2	₹ 1,30,000.00	77	23	2	79	2		
3	Bidder-3	70	49	3	₹ 1,00,000.00	100	30	1	79	3		
4	Bidder-4	60	42	4	₹ 2,00,000.00	50	15	4	57	4		
					Fm Price ₹ 1,00,000.00							
Award recommended to the firm securing highest combined score												

4.5. Step-5: Award of contract to supply against the bid:

The project will be awarded to the highest combined score bidder as determined in Step-4.

5. Delivery Timeline and Payment Terms

Activity	Schedule	Date	Amount
Issue of PO	T0	11/03/24	
PBG Deposit (3% of Total Value) & Acceptance of PO	T1=T0+2D	13/03/24	
Advance	T2=T1+3D	16/03/24	40%
Delivery	T3=T1+3W	03/04/24	-
Installation & User Acceptance	T4=T3+1W	10/04/24	-
Technical Knowhow transfer on Software	T5=T4+1W	17/04/24	20%
Technical Services (Q1)	T5+ 1Q	31/07/24	20%
Software Upgrade + Technical Services (Q2)	T5 + 2Q	31/10/24	20%
<i>Technical Services (Q3) (Optional)</i>	<i>T5 + 3Q</i>	<i>31/01/25</i>	<i>Additional Amount</i>
<i>Technical Services (Q4) (Optional)</i>	<i>T5 + 4Q</i>	<i>30/04/25</i>	<i>Additional Amount</i>
* Performance bank Guarantee (PBG) for the total value of the PO is to be deposited within 2 days			

6. Acceptance and Warranty: The final acceptance certificate will be issued after acceptance of the system. Technical support for one year after the system delivery and acceptance without additional charge will be included in the bid price. Supplied Hardware will be required to replace or rectify without any additional cost during the warranty period.

7. Penalty Clauses:

@0.5% per week for delays in delivery. The maximum limit of penalty would be 10% for non-adherence to overall project timeline.

9. Non-Black listing Criteria for OEM and SI/bidder: -The Bidder and OEM should neither have been Debarred and / or blacklisted by any Central / State Govt. Department / Universities / schools

/Autonomous body etc. nor should have any litigation/ enquiry pending and / or initiated by any of these Department or Court of Law. (Self-Declaration required).

10. Conditions forming part of Notice Inviting Quotations (NIQ)

10.1. Price of the solution to be quoted for FITT IIT Delhi

10.2. The software code and related hardware **will be owned by FITT for further use as deemed fit. This will include all changes and development work done during the warranty period**

10.3. Contract base prices, taxes (including GST, duties and levies excepting octroi, which will be at actuals) as per Bill of material.

10.4. No Price Variations- The rates shall be on a fixed price basis valid for the period of the project. However, if there is any increase/reduction on account of government levies, taxes etc during the offer validity period, the same shall be passed on to the bidder.

10.5. The two bid systems should be followed for this NIQ. Under this system the bidder must submit their offer in two separate sealed envelopes marked clearly as Technical Bid and Commercial Bid on cover page of the envelope . The sealed envelopes should be placed in a third larger envelope. The main envelope which will contain both the bids should be super scribed with NIQ enquiry no. [RFP/FT/2023/11/13/IOS/01](#) and name of the item quoted for **(Request For Proposal (RFP) Supply of Open Source based Radio Access Network)**

10.6. The Successful bidder will have to submit Performance Bank Guarantee (PBG) @ 3% of the tender value in the form of DD drawn in favor of the MD FITT, payable at New Delhi within ten (2) days from the date of award of the contract. The submitted PBG should be valid for 12 months.

10.7. The Technical Bids will be opened in the presence of the bidders at the specified time and date. The bidder/their authorized agents who have responded to the quotation will be allowed to be present at the opening. ***The bidders are requested not to insert their quoted price in Technical Bid which will lead the quotation for summarily rejection.***

10.8. The Price Bids of only technically qualified bidders will be considered for further processing.

10.9. Bids would be rejected for award if it determines that the bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive or coercive practices in competing for the contract in question.

10.10. FITT may, at its discretion, extend the deadline for submission of bids by amending the bid documents in accordance with clause relating to Amendment of Bidding documents in which case all rights and obligations of the FITT and Bidders previously subject to the deadline will thereafter be subject to the deadline as extended. All the amendments will be updated through FITT website only.

10.11. The original and all copies of the bid shall be typed and shall be signed by the bidder, or a person or persons duly authorized to bind the bidder to the Contract. All pages of the bid, except for un- amended printed literature, shall be initialed by the person or persons signing the bid. Further, over-writings on documents, if any, should be supported by signatures.

10.12. FITT has the right to reject any bids on technical grounds without assigning any reason thereof.

10.13. The compliance sheet should indicate in details of meeting up of specifications required. The bidder can mention the additional features that exist in quoted products, if any, separately.

10.14. MD FITT shall be the final Authority for settlement of any dispute and his interpretation of any Clause/term/condition(s) of this document shall be final.

10.15. If any dispute arises out of or in connection with the contract, or in respect of any defined legal relationship associated therewith or derived there from, will be settled under the jurisdiction of Court of Law of New Delhi

10.16. FITT is not bound to accept the lowest bidder.

10.17. FITT can cancel the RFP and bid process at any point before award of order.

ANNEXURE-1

RAN Specifications for Bidder Compliance

Layers and Protocols	Features	Compliance(C/NC/PC) C=Compliant, NC=Not Compliant, PC=Partial Compliant	Remarks
General Parameters	Configurable TDD		
	Normal CP		
	Subcarrier spacings: 15 and 30kHz (FR1), 120kHz (FR2)		
	Bandwidths: 10, 20, 40, 60, 80, 100MHz		
	Intermediate downlink and uplink frequencies to interface with IF equipment		
	Procedures for 2-layer DL and UL MIMO		
	Slot format: 14 OFDM symbols in UL or DL		
	Highly efficient 3GPP compliant LDPC encoder and decoder (BG1 and BG2 supported)		
	Highly efficient 3GPP compliant polar encoder and decoder		
	Encoder and decoder for short blocks		
	Support for UL transform precoding (SC-FDMA)		
	Furthermore, the gNB and UE support		
	A) "noS1" mode (DL and UL): 1. Creates TUN interface to PDCP to inject and receive user-plane traffic 2. No connection to the core network		
B) Standalone (SA) mode: 1. UE can register with the 5G Core Network through the gNB, establish a PDU Session and exchange user-plane traffic			
gNB PHY 3GPP References :38.201 (Physical layer general descriptions), 38.202 (5G NR Physical layer services provided by the physical layer) 38.211 (Physical Channel and Modulation),38.212 (Multiplexing and channel coding), 38.213 (Physical layer procedures for control), 38.214 (Physical layer procedures for data)			
gNB PHY	15kHz and 30kHz SCS for FR1 and 120kHz SCS for FR2		
	Generation of NR-PSS/NR-SSS		
	NR-PBCH supports multiple SSBs and flexible periodicity		
	Generation of NR-PDCCH (including generation of DCI, polar encoding, scrambling, modulation, RB mapping, etc) 1. common search space 2. user-specific search space 3. DCI formats: 00, 10, 01 and 11		



	<p>Generation of NR-PDSCH (including Segmentation, LDPC encoding, rate matching, scrambling, modulation, RB mapping, etc).</p> <ol style="list-style-type: none"> 1. PDSCH mapping type A and B 2. DMRS configuration type 1 and 2 3. Single and multiple DMRS symbols 4. PTRS support 5. Support for 1, 2 and 4 TX antennas 6. Support for up to 2 layers (currently limited to DMRS configuration type 2) 7. Support for 256 QAM 		
	NR-CSIRS Generation of sequence at PHY		
	<p>NR-PUSCH (including Segmentation, LDPC encoding, rate matching, scrambling, modulation, RB mapping, etc).</p> <ol style="list-style-type: none"> 1. PUSCH mapping type A and B 2. DMRS configuration type 1 and 2 3. Single and multiple DMRS symbols 4. PTRS support 5. Support for up to 2 RX antenna 6. Support for up to 2 layers 7. Support for 256 QAM 		
	<p>NR-PUCCH</p> <ol style="list-style-type: none"> 1. Format 0 (2 bits, for ACK/NACK and SR) 2. Format 2 (mainly for CSI feedback) 		
	<p>NR-SRS</p> <ol style="list-style-type: none"> 1. SRS signal reception 2. Channel estimation (with T tracer real time monitoring) 3. Power noise estimation 		
	<p>NR-PRS</p> <ol style="list-style-type: none"> 1. Rel16 Positioning reference signal(PRS) generation and modulation 2. Multiple PRS resources, one per beam is supported in FR2 TDD mode 3. FR1 and FR2 support with config file 		
	<p>NR-PRACH</p> <ol style="list-style-type: none"> 1. Formats 0,1,2,3, A1-A3, B1-B3 		
	Highly efficient 3GPP compliant LDPC encoder and decoder (BG1 and BG2 are supported)		
	Highly efficient 3GPP compliant polar encoder and decoder		
	Encoder and decoder for short block		
	Code block segmentation and code block CRC attachment		
TS 38.321 Rel-15 MAC layer specifications			
gNB MAC	MAC -> PHY configuration using NR FAPI P5 interface		
	MAC <-> PHY data interface using FAPI P7 interface for BCH PDU, DCI PDU, PDSCH PDU		
	Scheduler procedures for SIB1		



	<p>Scheduler procedures for RA</p> <ol style="list-style-type: none"> 1. Contention Free RA procedure 2. Contention Based RA procedure <ol style="list-style-type: none"> i) Msg3 can transfer uplink CCCH, DTCH or DCCH messages ii) CBRA can be performed using MAC CE or C-RNTI 		
	Scheduler procedures for CSI-RS		
	<p>MAC downlink scheduler</p> <ol style="list-style-type: none"> 1. phy-test scheduler (fixed allocation and usable also without UE) 2. regular scheduler with dynamic proportionally-fair allocation 3. MCS adaptation from HARQ BLER 		
	MAC header generation (including timing advance)		
	ACK / NACK handling and HARQ procedures for downlink		
	<p>MAC uplink scheduler</p> <ol style="list-style-type: none"> 1. phy-test scheduler (fixed allocation) 2. regular scheduler with dynamic proportionally-fair allocation 3. HARQ procedures for uplink 		
	<p>Scheduler procedures for SRS reception</p> <ol style="list-style-type: none"> 1. Periodic SRS reception 2. Channel rank computation up to 2x2 scenario 3. TPMI computation based on SRS up 4 antenna ports and 2 layers 		
	<p>MAC procedures to handle CSI measurement report</p> <ol style="list-style-type: none"> 1. Evaluation of RSRP report 2. Evaluation of CQI report 		
	MAC scheduling of SR reception		
	<p>Bandwidth part (BWP) operation</p> <ol style="list-style-type: none"> 1. Handle multiple dedicated BWPs, supports one UE 2. BWP switching through RRC Reconfiguration method 		
gNB RLC	Send/Receive operations according to 38.322 Rel.16		
	Segmentation and reassembly procedures		
	RLC Acknowledged mode supporting PDU retransmissions		
	RLC Unacknowledged mode		
	DRBs and SRBs establishment/handling and association with RLC entities		
	Timers implementation		
	Interfaces with PDCP, MAC		
	Interfaces with gtp-u (data Tx/Rx over F1-U at the DU)		
gNB PDCP	Send/Receive operations according to 38.323 Rel.16		
	Integrity protection and ciphering procedures		
	Sequence number management, SDU discard and in-order delivery		

	Radio bearer establishment/handling and association with PDCP entities		
	Interfaces with RRC, RLC		
	Interfaces with gtp-u (data Tx/Rx over N3 and F1-U interfaces)		
gNB SDAP	Send/Receive operations according to 37.324 Rel.15		
	Establishment/Handling of SDAP entities.		
	Transfer of User Plane Data		
	Mapping between a QoS flow and a DRB for both DL and UL		
	Marking QoS flow ID in both DL and UL packets		
	Reflective QoS flow to DRB mapping for UL SDAP data PDUs		
gNB RRC	<u>LTE RRC (36.331) also updated to Rel 15</u>		
	Generation of CellGroupConfig (for gNB) and MIB		
	Generation of system information block 1 (SIB1)		
	Generation of system information block 2 (SIB2)		
	Application to read configuration file and program gNB RRC		
	RRC can configure PDCP, RLC, MAC		
	Interface with GTP-U (tunnel creation/handling for S1-U (NSA), N3 (SA) interfaces)		
	Integration of RRC messages and procedures supporting UE 5G SA connection 1. RRCSetupRequest/RRCSetup/RRCSetupComplete 2. RRC Uplink/Downlink Information transfer carrying NAS messages transparently 3. RRC Reconfiguration/Reconfiguration complete 4. RRC Reestablishment/Reestablishment complete 5. Support for master cell group configuration 6. Interface with NGAP for the interactions with the AMF 7. Interface with F1AP for CU/DU split deployment option 8. Periodic RRC measurements of serving cell (no A/B events)		
	UE timers		
	Cell reselection		
	RRC States		
	UE removal based on RLF, or any other reason?		
gNB XNAP	Integration of XNAP ASN1 definitions according to 38.423 Rel. 16.2.0		
gNB X2AP	Integration of X2AP messages and procedures for the exchanges with the eNB over X2 interface supporting the NSA setup according to 36.423 Rel. 15		
	X2 setup with eNB		
	Handling of SgNB Addition Request/Addition Request Acknowledge/Reconfiguration Complete		



gNB NGAP	Integration of NGAP messages and procedures for the exchanges with the AMF over N2 interface according to 38.413 Rel. 15.8		
	NGAP Setup request/response		
	NGAP Initial UE message		
	NGAP Initial context setup request/response		
	NGAP Downlink/Uplink NAS transfer		
	NGAP UE context release request/complete		
	NGAP UE radio capability info indication		
	NGAP Path Switch Request		
	NGAP PDU session resource setup request/response		
	Interface with RRC		
gNB F1AP	Integration of F1AP messages and procedures for the control plane exchanges between the CU and DU entities according to 38.473 Rel. 16		
	F1 Setup request/response		
	F1 DL/UL RRC message transfer		
	F1 Initial UL RRC message transfer		
	F1 UE Context setup request/response		
	F1 UE Context modification request/response		
	F1 UE Context release		
	F1 gNB CU configuration update		
	Interface with RRC		
Interface with gtp-u (tunnel creation/handling for F1-U interface)			
gNB E1AP	Integration of E1AP messages and procedures for exchange between CU-CP and CU-UP according to 38.463 Rel. 16		
	gNB-CU-UP E1 Setup Setup request/response		
	E1 Bearer Context Setup		
	Bearer Context Modification (gNB-CU-CP initiated)		
	Interface with RRC and PDCP		
gNB GTP-U	New GTP-U implementation supporting both N3 and F1-U interfaces according to 29.281 Rel.15		
	Interfaces with RRC, F1AP for tunnel creation		
	Interfaces with PDCP and RLC for data send/receive at the CU and DU respectively (F1-U interface)		
	Interface with SDAP for data send/receive, capture of GTP-U Optional Header, GTP-U Extension Header and PDU Session Container		
Base Station (BS) radio transmission and reception			
	Rx / Tx Spec per 3GPP TS 38.104		



O-RAN Fronthaul Working Group Control, User and Synchronization Plane Specification (ORAN-WG4.CUS.0-v04.00)			
gNB O-RAN FHI	RU Category		
	Beamforming		
	Bandwidth Saving		
	Energy Saving		
	O-DU - RU Timing		
	Synchronization		
	Transport Features		
	Other		
	O DU Low Project		
	Near-Real-time RIC X-APPs (RICAPP)		
	Near-Real-time RAN Intelligent Controller Platform (E2 Interface) (RICPLT)		
	Non-Real-time RIC (NONRTRIC)		
	Operations and Maintenance (OAM)		
	O-RAN Central Unit (OCU)		
	O-RAN Distributed Unit High Layers (ODUHIGH)		
	O-RAN Distributed Unit Low Layers (ODULOW)		
	Infrastructure (INF)		
	Simulations(SIM)		
	Integration and Testing (INT)		
	Service Management and Orchestration(SMO)		
AI/ML Framework			
3GPP Rel-15 Protocol supported	N3 per 3GPP Rel 15		
	NGAP per 3GPP Rel 15		
	NAS per 3GPP Rel 15		
	L3 per 3GPP Rel 15		
	SDAP per 3GPP Rel 15		
	PDCP per 3GPP Rel 15		
	RLC per 3GPP Rel 15		
	MAC per 3GPP Rel 15		
	PHY/L1 per 3GPP Rel 15		
Other E2E features	VoNR		
	Xn-Handover		
	N2-Handover		
	URLLC		
	TSN		

ANNEXURE-2

Features to be demonstrated in PoC

Seq. No.	Features/Use Cases/Test Cases	COMPLIANCE/ Observation/Remarks
1	USRP sub 6 GHz [Per Antenna 100 mW]	
2	RU (7.2x split) [Per Antenna 250 mW]	
3	TDD Sub-6 , Demo on n78 band	
4	40 Mhz for USRP	
5	100 Mhz for RU (7.2x split)	
6	SISO	
7	2x2 MIMO	
8	DL + UL >= 400Mbps	
9	Simultaneous >= 32 UE per Cell	
10	Single-Cell Support	
11	DL 256 QAM	
12	UL 64 QAM	
13	AES/SNOW Integrity - NIA1/2/3	
14	Cypher - NEA 1/2/3	
15	UE Admission control	
16	TDD Slot DDDSU	
17	TDD Slot DDDDDDDSUU	
18	IPV4 for UE	
19	Paging	
20	Radio Link Adaptation & Adaptive (HARQ)	
21	TCP UDP – AM/UM	
22	RLC AM 12/18 bit SN	
23	UE context setup/modification/release procedure	
24	Measurement reports	
25	Connect 5G device for Network access	
26	Initial Acquisition of the 5G SA mode cell by UE and decoding of MIB and SIB1 messages	
27	Validation of Contention Based RACH Procedure for initial access and UL synchronization	
28	RRC Establishment Procedure	
29	Registration Procedure with the Core	
30	Authentication Procedure for SIM card authentication with the UDM	
31	Non-Access Stratum (NAS) Security Mode Procedure	
32	UE Capability Exchange Procedure:	

33	PDU Session Establishment for the eMBB Data Services	
34	Tracing and debugging capability for NR-RRC, NR-MAC, NR-RLC	
35	Air interface traces by any debugging tool	
36	After connecting to 5G network, device should run some application to perform test e.g. 1. There is no video stalling even for 4K UHD video 2. Live Streaming content does not suffer from any stalls or lags. 3. HD Video Streaming can be streamed in uplink without any glitches or downgrade of resolution. 4. Video meeting experience is seamless with good video quality and real time meeting collaboration experience.	
37	Control plane Latency (≤ 15 ms)	
38	User plane Latency (≤ 15 ms)	



ANNEXURE-3

Self-Declaration to be given by the bidder

NIQ Reference No. &
Date: Bidder's Name &
Address: Person to be
contacted: Designation:
Telephone No:

Fax No:

Email:

To,
MD, FITT,
IIT Delhi
Hauz Khas
New Delhi

We, the undersigned Bidder, having carefully read and examined in detail the Terms and Conditions, specifications and all bidding document in regard to the supply Supply of Open Source based 3GPP/O-RAN Compliant 5G Radio Access Network Product at FITT and accept the same.

We also hereby declare that

1. We have not been blacklisted/debarred by any Government/Undertaking.
2. The rates quoted are not higher than the rates quoted for the same item to any Government/Undertaking.
3. The bid submitted by us is properly sealed and prepared so as to prevent any subsequent alteration and replacement.

For and on behalf of the firm
(Firms Name & Address)

(Signature of Authorized
Signatory)
Name:

Date: -----
Designation: Place: -----
Phone No:

Seal
:



ANNEXURE – 4

Bidder Organisation Details Format for RFP No. RFP/FT/2023/11/13/IOS/01 Dated 15/2/2024		
To FITT, IIT Delhi Hauz Khas, New Delhi-110 016 Date: Offer No:		
1	Bidder Name	
2	Website Address	
3	Email Address	
4	Address for Communication	
5	Telephone Number	
6	Fax/Telefax Number	
7	Authorised Person Name	
8	Designation:	
9	Mobile No.	
10	Email ID	
11	Alternate Person Name	
12	Designation:	
13	Mobile No.	
14	Email ID	
15	PAN Number	
16	GST Regn. No. with Address	
17	Beneficiary's complete Bank Details.	
18	Bank Account No.	
19	IFSC / NEFT Code	
20	Name of the Bank	
21	Address of the Branch	
22	Turnover of the Bidder in last 3 years	
23	2023	
24	2022	
25	2021	
26	Are you a MSME Unit. If yes, please furnish Registration Details, Name of the DIC/State.	
27	If you are MSME, is it owned by SC/ST Entrepreneurs or Women Entrepreneurs? If Yes, please specify the Name of the Owner who is SC or ST or Women Entrepreneur (as applicable)	
28	Following Documents are to be submitted	
29	Certificate of Incorporation	
30	PAN No	
31	GST Registration No.	



32	<p>DECLARATION</p> <p>1) We have read and understood the terms & conditions of the above-mentioned tender and comply to all Terms & Conditions of the Tender. (In case of any deviation, the Bidder must attach a separate sheet clearly mentioning the Clause No. of the Tender and Deviation thereto)</p> <p>2) We certify that the information mentioned above are true and correct to best of our knowledge.</p>	Signature of Authorised Signatory with Seal (Name)
33	Place	



ANNEXURE-5

BoQ

RFP No: RFP/FT/2023/11/13/IOS/01 Dt 15/2/24 for Supply of Open Source based 3GPP/O-RAN Compliant 5G Radio Access Network Product				
S.No	Equipment/Devices	HSN Code	Qty	Compliance (Yes/No)
1	Open Source based 3GPP/O-RAN Compliant 5G Radio Access Network Product		2	
2	Documents	Not Applicable		
	a) System Description Documents			
	b) Software Change Description & Procedure Document for "Differentiated Product Enhancement"			
	c) Test Plan (with Test result and Logs)			
	d) Compliance to Specifications			
	e) Compliance to RFP Document			
3	Software			
	a) Source Code Software for "Differentiated Product Enhancement"			
	b) Software Upgrade			
4	Technical Services			



ANNEXURE-6

Format: Letter of undertaking

(Company letter head)

To
The MD,
FITT, IIT Delhi.
Hauz Khas
New Delhi-110016

[Date]

Sir,

Sub: Undertaking on Non-disclosure of contract documents

I/We do hereby undertake that we shall not disclose the contract or any provision, specification, plan, design, pattern, sample or information to any third party for a period of three years from the termination of the contract.

I/We do hereby undertake that except with the written consent of the Buyer/Seller, other party shall not disclose the contract or any provision, specification, plan, design, pattern, sample or information to any third party.

I/We do hereby undertake not to copy the AS-IS documentation captured in this tender document in any form Xerox, electronic, or via DMS or any other physical/electronic means for any purpose but for the bidding process.

For and on behalf of the
Bidder

(Signature)
(Name of the Authorized Signatory)

Date:



ANNEXURE-7

Financial Bid Format

RFP No: RFP/FT/2023/11/13/IOS/01 Dt 15/2/24 for Supply of Open Source based 3GPP/O-RAN Compliant 5G Radio Access Network Product					
S.No	Equipment/Devices	Qty	Unit Rate in INR	GST in INR	Total with GST in INR
1	Two numbers of Open Source based 3GPP/O-RAN Compliant 5G Radio Access Network Product , Software and Technical Services (as per Section-2 scope of delivery)	1			
2,	OPTIONAL : Technical Services (3 resources) for 6 months post software upgrade delivery	1			

End of Document