REQUEST FOR PROPOSAL

This is a Request for Proposal (RFP) for procurement of equipment for setting-up a cellular network at the IISc campus. Our requirements include eNBs (2 nos), a gateway core, and multiple UEs to provide cellular connectivity for autonomous control experiments on a 2 km stretch. In addition to the equipment, the requirements include network setup, manpower training for use of the equipment, and access to the software through API and/or source codes to enable implementation and testing of new algorithms.

In this document, we will provide the background of the project, details of requirements, technical specifications of the equipment, and the vendor shortlisting and procurement procedure. All interested vendors shall submit a response proposal demonstrating their capabilities to produce the requested equipment and meet other requirements to the primary point of contact listed below.

Direct all questions concerning the acquisition to **Dr. Himanshu Tyagi** at **htyagi@iisc.ac.in.**

1. BACKGROUND

The Department of Electrical and Communication Engineering at the Indian Institute of Science is participating in the 5G Testbed Project sponsored by the Department of Telecommunications, Government of the India. There are four components of our research project: algorithms for sub 6-GHz PHY, mmWave antenna design, high bandwidth visible light communication link, and demonstrating a use-case of 5G technology in control of autonomous vehicles. This RFP addresses the fourth component in the list above. In this part, we are setting up a campus-wide, multimodal communication network to enable coordinated tasks by multiple robotic nodes. We are building the mobile robotic nodes, equipped with their radios and local processing power, and setting-up a communication network comprising WiFi APs (including 802.11p APs), UWB links, and Telemetry links, all supported by a campus-wide cellular backbone.

In this RFP, we are seeking vendors who can provide cellular base-station (BS) equipment, with ability to communicate to LTE Release 10 (upgradable to release 15 option 3a) COTS UEs, and custom UEs to serve local fixed-wireless access network. We will be developing our own scheduling and handover algorithms and the vendors should enable this via either providing access to full source code or proving access to various APIs for modifying the necessary parameters in the protocol stack. Along with the equipment, we seek vendors to setup the network, provide training for using equipment, provide certain enhancements to suite our requirements, and provide support for our R&D effort. The procurement procedure, evaluation criteria, the technical details of requirement, and clauses are specified below.

2. PROCEDURE

1. The vendor will be required to submit a technical proposal and a commercial proposal in two separate sealed envelopes.

2. We shall follow the following schedule:

Release of RFP	Thursday, November 22, 2018
Pre-bid clarification meeting	Thursday, November 29, 2018
Deadline for submission of bids	Thursday, December 13, 2018

A pre-bid clarification meeting will be held on Thursday, November 29 at the ECE Department, IISc. Vendors can participate in this meeting and clarify their doubts about the RFP. The deadline for submission of proposals is two weeks after the pre-bid clarification meeting, namely Thursday, December 13. Proposals should arrive by this deadline at the office of **Dr. Himanshu Tyagi, Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore, Karnataka 560012, India.**

3. The technical proposal should contain a compliance table that should describe your compliance in a "yes" or "no" response against each of the items in the technical requirements table listed in this RFQ. If the response is "no," please provide a description of the extent of deviation and the reason for the deviation in separate columns. Also, please include an additional column comparing your equipment with those of your competitors.
4. Also, please provide evidence to indicate your eligibility. Note that if eligibility is not met, the proposal will not be considered further in the evaluation process and no final score will be assigned. The committee may decide to obtain additional information from the vendors to get further clarification on eligibility.
5. The evaluation of the eligible vendor proposal will follow a techno-commercial evaluation process in accordance with the scheme highlighted below. The vendor with the highest score will be granted the tender.
6. An itemized list of prices of items should be given. For eNBs, the vendor should quote per unit prices for BBU and RRH separately. Similarly, a per unit cost for COTS UE and custom UE should be specified. The cost of EPC software, interconnection equipment and other peripherals must be given. Finally, the budget for training and maintenance support should be included separately.

3. EVALUATION CRITERIA

1. ELIGIBILITY:
    i. The vendor should have a proven track record of being a supplier for RAN equipment. Please include references for any past order consisting of LTE RAN equipment (eNB or EPC) fulfilled.
    ii. The performance of RAN equipment should be evaluated and self-certified using 3GPP recommended tools. The vendor should either have license for these tools to demonstrate compliance at its own premises or should have access to a lab facility where this can be done.

iii. The vendor should propose in the response a list of performance evaluation and compliance tests using tools in the previous point. The list should be sufficient to evaluate the promised performance of the equipment. The list of proposed conformance tests should be based on 3GPP recommendations for Multi-Radio Base Stations including those specified in 37 series specification documents.

iv. The vendor should also include a list of certificates that will be shown for Environmental and EMI-EMC requirements for transmission. This can be based on certification obtained in the past for similar use-cases.

2. EVALUATION OF THE PROPOSAL

i. The proposal will be evaluated using a techno-commercial bid evaluation process, where separate points will be assigned to technical and commercial components.

ii. The winner will be selected based on the score according to the following point scheme:

Technical score (max 200)

- Proposed solution summary and technical presentation: 20
- Functional capabilities: 100
  - Includes compliance to all the requirements
  - Includes compliance to necessary certificates
  - Includes technical readiness and maturity of product
  - Includes ownership of the protocol stack software
- Non-functional capabilities: 40
  - Includes points for giving access to the source codes
  - Includes points for API access to different layers of the stack (especially high MAC and RRM)
  - Includes training/maintenance support
  - Includes proposed co-development model
- Solution case studies and references: 40
  - Includes points for previously delivered solutions

Commercial score (max 100)

Commercial score of vendor A = 30 + 70*(lowest price bid/price bid of A)

Total score = Technical score + commercial score

4. TECHNICAL REQUIREMENTS

4.1 eNB General Requirements

4.1.1 Hardware Interface Requirements

No.	Parameter	Specification	Comments
4.1.1.1	eNB should have atleast one Ethernet	1G Ethernet is minimum and 10G	To study and develop hand-off algorithms, we

	interface to external world	Ethernet is desirable via RJ45 connector	would like to be able to interconnect multiple eNBs
4.1.1.2	eNB can optionally have optical fiber connection	One or more optical SFP/SFP+ connection along with the Ethernet connection via RJ45 connection	
4.1.1.3	BBU and RRH should be physically separated, with BBU enabled to support more than 3 RRHs	CPRI connection between BBU and RRH	We would like to set up a campus wide network - hence we would like a single BBU be capable of supporting multiple RRHs that are physically spaced apart from the BBU.
4.1.1.4	eNB should support X2 and S1 interface		

4.1.4. 3GPP Protocol Requirements

No.	Parameter	Specification	Comments
4.1.4.1	3GPP Release number	eNB should support Release 9 or later (with option to upgrade to Release 15 option 3a)	The vendor should provide a path for upgradation in the proposal.
4.1.4.2	Multi-sector support	It should support 3 sector cells	
4.1.4.3	UE category	It should support Category 4 UE or better	
4.1.4.4	Band of operation	3.3-3.6 GHz	
4.1.4.5	Bandwidth	Must support 5,10, and 20 MHz bandwidths	
4.1.4.6	Tx power control	20 to 40 dBm in steps of 1 dB	
4.1.4.7	Interoperability	It should work with Release 9 complaint LTE-UE from multiple vendors	
4.1.4.8	No. of UEs	It should support > 50 users per eNB/cell	
4.1.4.9	QoS provisioning: The platform shall provide support for Dedicated and Default bearers with different QoS and traffic characteristics	For example, 1. GBR and Non-GBB 2. Real time and Non-Real time e.g.: VoIP, video, web	

		browsing sessions etc.	
4.1.4.10	Test compliance	Conformance to TS 36.523-x tests	

NOTE: Provide detailed conformance test results of TS 36.523-x.

4.1.5 Software Requirements

No.	Parameter	Specification	Comments
4.1.5.1	UL and DL L2 scheduler	It shall be possible to plug-in third-party DL and UL scheduling algorithms and RRM into the eNB. Specify the Operating System on which the software can be written	API interface should be well-specified to enable incorporation of new schedulers. Demonstration of this capability in prior deployments will be a plus.
4.1.5.2	eNB OS	The eNB should support opensource OS such as Linux, eCOS. If some other proprietary OS is used, then it must support C/C++ programming language for making changes in the scheduler.	Our strong preference is for Linux. We also want the software capability to remotely upgrade software modules. This is needed to ensure that the testbed is remotely configurable, upgradeable and accessible for experiments.
4.1.5.3	Throughput over 20MHz and MIMO	1. For 4x4 MIMO, DL throughput shall be >= 250Mbps and UL throughput shall be >= 50Mbps 2. For 2x2 MIMO, DL throughput shall be >= 150Mbps	

4.1.5.4	Latency: Average RTT of an IP packet of 64 bytes	1. < 15ms for pre-allocated resources 2. < 20ms with scheduling with Sch Req/Sch Grant sequence	Vendor may point-out L1 latency separately and propose an upgradation path for sub 5ms latency.
4.1.5.5	eNB-eNB communication delay	< 2 msec	

4.2 Core Network Requirements

No.	Parameter	Specification	Comments
4.2.1	CN QoS implementation compliance	3GPP TS 23.401	
4.2.2	CN Packet Classification	DiffServ (DSCP) and 802.1p/Q	
4.2.3	CN Queueing discipline support	Strict priority, WRR, WFQ, and the likes.	
4.2.4	Software EPC		

4.3. UE Requirements

4.3.1 Interface, Mechanical and Electrical Requirements

No.	Parameter	Specification	Comments
4.3.1.1	Mounting for non-dongle UE	Small form factor and light weight. Should be mountable on a human driven vehicle or an UV (e.g. robot, drone)	Ideally, this should be less than 500g.
4.3.1.2	Battery operated UE	The UE should be battery operated.	
4.3.1.3	UE-WiFi hotspot/tethering	Interface details that enable the feature	We prefer the UEs to support WiFi.

4.4. Performance Requirements

No.	Parameter	Specification	Comments
4.4.1	Throughput over 20MHz and MIMO	1. For 4x4 MIMO, DL throughput shall be >= 250Mbps and UL throughput shall be >= 50Mbps	

		2. For 2x2 MIMO, DL throughput shall be >= 150Mbps	
4.4.2	Latency: Average RTT of an IP packet of 64 bytes	1. < 15ms for pre-allocated resources 2. < 20ms with scheduling with Sch Req/Sch Grant sequence	
4.4.3	eNB-eNB communication delay	< 2 msec	

NOTE: Attach comprehensive lab test report that shows practically achievable performance on your system.

4.5. Configuration and OAM

No.	Parameter	Specification	Comments
4.5.1	Configuration	It should be possible to easily configure the system locally and remotely. The back-end configuration software should be easy to use and provide support for both basic and advanced configuration.	Should support industry standard protocols for management and configuration.
4.5.2	GUI	The GUI should provide detailed system level statistics in real-time, including LTE specific information. Application traffic usage, UE, and more.	Enumerate the list of monitorable parameters in your proposal.

4.5.3	Operational Telemetry Data	Should support accessing the run-time statistics of eNB remotely and API based access of all telemetry data using industry standard protocols.	Give a list of methods by which your system supports this requirement. SNMP MIB support is desirable.

4.6 Training and Setup Requirements

No.	Parameter	Specification	Comments
4.6.1	Training for use of equipment and software	The vendor should provide training for usage of software and hardware	Provide a plan for training/tutorial at least once a year and preferable twice a year.
4.6.2	Engineering support	Engineering support to deploy, configure, and upgrade the equipment. An engineer should be made available specifically to help interfacing of the equipment with the local setup at IISc	Support to help incorporate IISc developed algorithms into the software stack and help with the experiments will be added bonus.
4.6.3	Maintenance and warranty	A three years warranty is required. Besides that, a model for future maintenance should be proposed	
4.6.4	Co-development and enhancement	A model for further enhancement of the equipment to include enhancements compliant with LTE	

		Release 15 option 3(a) should be included	