



EXPRESSION OF INTEREST (EOI)

FOR

PROVIDING DESIGN AND DEVELOPMENT SERVICES AND ToT

FOR

SOFTWARE DEFINED RADIO (SDR).

R&D, ITI Limited

Bangalore Plant

Benaluru-560016

Global Expression of Interest (Eoi) for short listing of a Design Partner for Design and Development of Software Defined Radio (SDR) and Solutions.

ITI Limited, a Central Public Sector Undertaking under the Department of Telecommunications, Ministry of Communications & IT, is a Leading Telecom equipment manufacturer and Turnkey solution provider in India. The Bangalore unit of ITI Limited is ISO 9001:2015 and ISO 14001:2015 certified, and is in the process of empanelling a Design Technology Partner for Design and Development of Software Defined Radio (SDR) solutions and provide technical support for the system integration.

ITI Ltd invites responses through sealed Expression Of Interest (Eoi) from reputed design and development entities, having experience in the area of Design, Development, Test, Conduct field trials, help to obtain relevant product certifications and Transfer the Technology and it's IPR for the bulk manufacturing of the product at ITI Limited.

Schedule of this EOI & Address for submitting the Eoi: -

Sl. No	Schedule	Date
1	EOI Issue Date	05/05/2022
2	Last Date for Pre-bid Queries to be raised by Probable Developers in writing (by email)	19/05/2022
3	Tentative date of Pre-bid meeting of Probable developers at ITI Bangalore	26/05/2022
4	Response to Pre-bid Clarifications by ITI to Probable developers	02/06/2022
5	Address at which proposal in response to EOI is to be submitted	Asst. Executive Engineer Material Management Dept. R&D, Bangalore Plant, ITI limited, Dooravaninagar Bangalore - 560 016. Phone No.: 080-28503675 E-Mail: mmr_bgp@itilttd.co.in
6	Due date for submission of EOI by Email & Hard Copy by Post	30/06/2022@4PM(IST)
7	Opening of Eoi bids	01/07/2022 @ 11:00 A.M(IST)

Submission of response to this notice inviting EOI shall be deemed to have been done after careful study and examination of this document with full understanding of its Scope, Terms, and Conditions & Implications. **Interested parties from Indian firms and international firms may please contact the following official to raise Pre-bid Queries and any related information pertaining to this Expression of Interest:**

The Contact details:

Name : C P Dwivedi

Desig. : Dy. Manager (R&D)

Mobile : +91 9483009259

E-Mail : cpdwivedi_bgp@itilttd.co.in

Selection of Interested Parties: The Interested Parties fulfilling the eligibility criteria and all other terms & conditions of this EOI shall be shortlisted as per the recommendation of the EOI evaluation committee of ITI Ltd. The shortlisted Interested Parties would be required to participate in the RFP to be floated by ITI ltd. upon completion of the short listing process.

PART - 1

INTRODUCTION

ITI Limited (herein after referred to as ITI in this document), a Public Sector Undertaking under the Department of Telecommunications, Ministry of Communications & IT, is a leading Telecom equipment manufacturer and solution provider in India. The major customers of ITI are BBNL, BSNL, Indian Defence, Paramilitary forces, Railways and Central & State govt bodies of India etc.

ITI intends to participate in upcoming tenders / RFPs for the design, Manufacturing & supply of Software Defined Radio (SDR) as per requirement of customers. Considering the bulk market requirement of the product, ITI is planning to empanel Design and Development Technology Partner who can undertake the total design of Software Defined Radio (SDR) solutions including hardware, firmware and application software, supporting and mentor the R&D team of ITI Limited to enable such design and engineering on its own. This EOI is released to seek interested technology Partner, who can design and develop Software Defined Radio (SDR) solutions of various types / Form factors required by end customer etc.

Prospective design partners need to respond to this EOI by providing detailed inputs with respect to the scope of this EOI.

This Expression of Interest (EOI) aimed at short-listing the eligible bidders. The shortlisted parties will be participating in RFP to be released later (after completing the EOI Process). The Request for Proposal (RFP) will be released only to the shortlisted bidders for feasibility study, preparation of detailed project report (DPR), and undertake total design of Software Defined Radio (SDR) solution with a standard (free) warranty of 2 years from the date of completion of development, Customer certification including hardware & Software paid maintenance for period of 05 years after the completion of Standard (free) warranty of 2 years. During the above period of 5 years, the selected developer of SDR Solutions will take up any of the Upgrades and Hardware & Firmware modifications as desired by ITI.

PART-2

SCOPE OF WORK

As per Scope of work, interested parties shall undertake and complete the following activities:

- (a) Development of Hardware and Software Design for Software Defined Radio (SDR) (i.e all variants such as Handheld (HH), Manpack, Manpack HF, Truck Ground, Truck Ground HF, AFV (Armoured Fighting Vehicles), AFV HF, Airborne SDRs, Hepr Configuration-1, Hepr Configuration-2, Air Traffic Controller (ATC), Ground Data Terminal (GTD) for SDR etc) as per applicable relevant standards.
- (b) Development of the SDR products and help ITI Ltd., getting it type approved with defence accredited laboratories & certifications.
- (c) Supporting ITI in the Coordination with customer for the field integration and testing of the product in their network.

- (d) Identify the Requirement of tools and Test instruments for manufacturing the product for bulk manufacturing.
- (e) Complete Transfer of Technology (ToT) without any royalty, so as to enable ITI Ltd. to manufacture the product at ITI with transfer of IPR. **International Firms may indicate their willingness for full transfer (Design ToT) to ITI; however, Manufacturing ToT is must for both Indian & International developers**
- (f) Technical support in getting the clients / ITI's customer approval and Product acceptance.
- (g) Mentoring /Training of resources (ITI Manpower as well as Lab setup) to create the Design and Development Infrastructure for self-supporting of the product.

PART - 3

ELIGIBILITY CRITERIA

- 1) The Interested Parties shall have a minimum annual turnover of Rs.15 Crores (average) from the EOI specified/related services during the last three financial years preceding the current FY of 2021-22.
- 2) The Interested Parties shall have experience for minimum of 03 years in providing technological design and development services for Software Defined Radio. (Satisfactory completion certificates from customers for the projects taken-up shall be submitted).
- 3) The Interested Parties should be the Original Design Manufacturer (ODM) and not a licensee. The Company should possess the entire IPR, Source Codes, Design and Documentation of the SDR.
- 4) The Interested Parties should be unconditionally willing to assign the entire existing IPR held by it to ITI and further all the IPR developed under the present Project of SDR by the Company should be exclusively owned and held by ITI.
- 5) The Interested Parties should demonstrate at least ONE fully formed and operational SDR in either V/UHF or HF Frequency Band with entire technical specifications on one Radio Link.
- 6) The Interested Parties shall have valid ISO certificate relevant to the services being offered.

EoI should consist of following information and documents duly signed as per format given in Annexure - I.

- (a) Brief description of Bidders organization specific to the scope of EOI.
- (b) Contributions in the field Software Defined Radio (SDR) solution with verifiable references.
- (c) Development work in the SDR products/services in the defence segment
- (d) Design Lab Infrastructure with the Developer and certifications obtained by them.
- (e) Hardware and Software design capability.

- (f) Details of any patents and IPRs(Proof of Patents shall be provided with EoI)
- (g) Awards/Accolades.
- (h) Publications on the subject matter of Software Defined Radio (SDR) solutions.
- (i) Collaboration if any with leading technological institutions in India and Abroad
- (j) A write-up of having understood the purpose and scope of EOI, with proposal to undertake with the time lines from the day of Go-ahead.

PART 4

GENERAL CONDITIONS:

1. Interested Parties shall send their proposal in single sealed cover to the following address: Research and Development, Bangalore Plant, ITI limited, Dooravaninagar Bangalore - 560 016.Phone No.: 080-28503670E-Mail: mmr_bgp@itilttd.co.in
2. The last date for receiving the EoI is Date: 30/06/2022, 16.00 hrs (IST).
3. In case the date of submission of bid is declared to be a holiday, the EoI may be submitted on the next working day of ITI.
4. In case there are any clarifications on this notification, please contact Mr. C P Dwivedi at cpdwivedi_bgp@itilttd.co.in.
5. Late offer: Any offer received after the prescribed timeline shall be rejected and shall be returned unopened to the vendor.
6. Language of offers: The offers prepared by the vendor and all the correspondence and documents relating to the offers exchanged by the vendor, shall be in English language.
7. Authorized Signatory: All certificates and documents received as part of the offer shall be signed by the Authorized Representative (signing is not mandatory for technical manuals or documentation). The power or authorization, or any other document consisting of adequate proof of the ability of the signatory to bind the vendor shall be submitted if demanded by ITI.
8. ITI reserves the right to suspend or cancel the EOI process at any stage, to accept, or reject any, or all offers at any stage of the process and / or to modify the process, or any part thereof, at any time without assigning any reason, without any obligation or liability whatsoever.
9. Cost of EOI: The vendor shall bear all costs associated with the preparation and submission of its EOI, including cost of presentation for the purposes of clarification of the offer, if so desired by ITI. ITI in any case will not be responsible or liable for those costs, regardless of the conduct or outcome of the EOI process.
- 10.The Vendor shall be ready to give clarifications on any part of the offer to ITI Ltd.
- 11.Amendment of EOI: At any time prior to the last date for receipt of offers, ITI,

may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective vendor, modify the EOI document by an amendment. In order to provide prospective vendor reasonable time in which to take the amendment into account in preparing their offers, ITI 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.

12. Disclaimer: ITI 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 mis-representation on the part of ITI and/or any of its officers, employees.

PART - 5

EOI DOCUMENTS

The Response to EOI shall be submitted online (e-tender) on website and also hard copy in a single cover (clearly marked as “EOI for Providing services for Design and Development and supply of Software Defined Radio (SDR)” which shall contain one-sealed cover with the following documents:

- a) Clause-by-clause compliance to this EOI (all parts).
- b) Supporting Documents for EOI technical requirements and guide line.
- c) Proposed Design Approach along with Architecture of each type of SDR with Block Schematic stated in Technical specifications
- d) Brochures
- e) Technical writeup/paper on the development done in the field of SDR

PART-6

EVALUATION PROCESS

1. The ITI shall evaluate the responses of the EOI and all supporting documents & documentary evidence. ITI may seek additional documents as it deems necessary during the process of Evaluation of Offers pertaining this EOI.
2. The responses shall be evaluated to validate competence of the applicant according to the supporting documents specified in this document.
3. The decision of ITI Evaluation Committee in the evaluation of responses to the EOI shall be final. No correspondence will be entertained outside the evaluation process of the Committee.
4. The Evaluation Committee reserves the right to reject the proposal.
5. As part of clarification, discussion and presentation (if required) on technical documents to be submitted. Technical write-up /paper on what has been developed by vendors.

PART-7**Presentation with Approach & Methodology**

- a) The Interested Parties shall give a presentation on the proposed scope of work mentioned. The presentation will be mandatory and any Interested Parties who does not fulfill the condition will be summarily rejected.
- b) The presentation will form part of the evaluation process. The date and venue of the presentation would be intimated by ITI soon after the EoI opening date.
- c) The presentation should provide a representative solution to integrate various aspects of the project as per the scope.
- d) Presentation shall be given in English.

PART - 8**QUERIES**

1. All queries may be sent to the ITI Limited by post, or e-mail on or before Date: 17/05/2022.
2. All enquiries/clarifications from the Applicants, related to this EOI, must be directed in writing exclusively to the contact person. Enquiries received after the due date shall not be entertained.
3. The preferred mode of delivering questions is through e-mail. The queries by the applicants shall be raised in the following format.

Sl. NO.	Page No.	Clause of The EOI	Clarification needed

- 4 The corrigendum (if any) shall be intimated to vendors by email.
- 5 In order to provide prospective applicants reasonable time for taking the corrigendum into account, ITI may, at its discretion, extend the last date for the receipt of EOI proposals which shall be notified.

Annexure – I**Documents in support of meeting the eligibility conditions**

(Please fill details and enclose supporting documents wherever required & applicable.)

Sl. No.	Description	Remarks	Page No.
1.	Name of the Company		
2.	Contact Details (Name, Designation, Landline / Mobile No. , Email id, FAX No. , website etc.)		
3.	Organization Profile		
4.	Certificate of Incorporation / Registration details		
5.	Articles & Memorandum of Association with CIN No.		
6.	Area of Business for which firm is registered		
7.	Audited Annual Report / Accounts of P&L statements for the financial years (FY 2018-19 FY 2019-20, FY 2020-21)		
8.	Annual turnover for the Financial years as per audited Accounts (FY 2018-19 FY 2019-20, FY 2020-21)		
9.	Net worth as per Audited Accounts for the Financial Year (FY 2018-19 FY 2019-20, FY 2020-21)		
10.	GST Registration certificate		
11.	Copy of PAN certificate		
12.	Copy of IT returns filed during the past three years		
13.	Solvency Certificate issued by any scheduled bank during the last 6 months		
14.	Previous experience of handling similar projects/ works in the preceding four financial years (FY 2018-19, FY 2019-20, FY 2020-21, FY 2021-22)		
(a)	Details of POs (Purchase Orders) / Contracts Executed (Sample PO copies to be enclosed) in the field of SDRs		
(b)	Copy of Performance / Completion Certificates issued by Customer, if any		
15.	Previous Experience with ITI Limited, if any		
16.	Man Power Details (Total of 100 Persons Min)		
(a)	Technical (Min of 80)		
(b)	Non-Technical		
17.	Not Black listed certificate (undertaking).		

18.	ISO or equivalent certificate		
19.	Any legal cases pending against the company? If any, details to be furnished.		

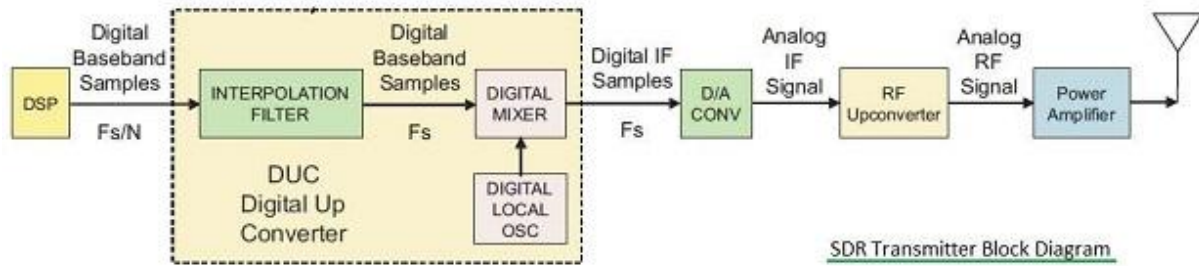
ANNEXURE-C**Specification for Software Defined Radio (SDR)****Project Background:**

R&D ITI Ltd. intends to take up the development of Software Defined Radio (SDR). It is a special kind of advance Radio system in which, the physical layer functions are defined as software functionality i.e. a software code executes the role of a Circuit Board of the conventional radio and software-based filtering algorithms are used for frequency selection. The software generates the communication signal waveform, which is equivalent to a modulated signal, making SDR capable of communicating over a large portion of the spectrum, whilst supporting multiple protocols. The SDR is a multimode, multi-band and multi-functional radio requiring only a software upgrade for improvements. SDR operates in the HF, VHF, UHF, L-Band & S-Band frequency spectrum ranges using multiple protocols to provide secure interconnected network for communication. SDR is compatible with the legacy Military radio systems for feature enhancement. The SDR is also, a multi-channel radio, instantiated with software-defined waveforms capable of secure & jam-resistant, networked voice, data and video communication. It operates through a receiver, transmitter, software application and various other auxiliary systems and performs the functions of amplifiers, filters, mixers, modulators/ demodulators, and detectors. It has a broad frequency range by default and can be programmed to work at a specific frequency within the range. It can also be re-configured, thereby replacing multiple radios with a single unit and offers enhanced flexibility, cost-effectiveness, and interoperability to the user. The SDR is designed to provide communication in multi modes such as Air-to Air, Air-to-Ground and Ground-to-Air configuration. The functionality and expandability is built upon an open architecture framework called the Software Communications Architecture (SCA).

ITI looks forward to develop Handheld SDR, Manpack SDR, Manpack HF, Truck Ground SDR, Truck Ground HF, AFV (Armoured Fighting Vehicles) SDR, AFV HF, Heptr Configuration 1, Heptr Configuration 2, Air Traffic Controller (ATC) and Ground Data Terminal (GDT).

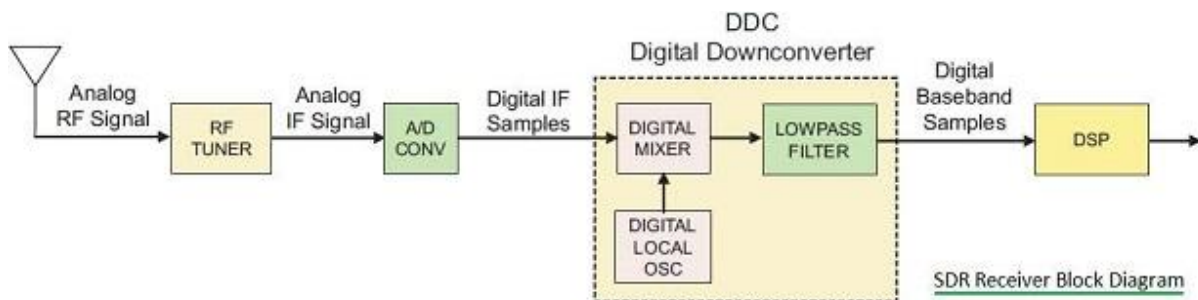
Software Defined Radio (SDR) Architecture:

Transmitter:



SDR transmitter part consists of DSP, DUC (Digital Up Conversion), D/A converter, analog RF Up converter and power amplifier. The digital baseband part is coded in DSP which provides I/Q data as per different transmitter need. This is digitally up converted using DUC (Digital Up Conversion) with the use of digital LO (Local Oscillator) and digital mixer. The digital IF (Intermediate Frequency) samples are converted to analog IF. This analog IF is converted to analog RF using RF up converter. The RF signal is amplified before being transmitted over the air using respective antenna.

Receiver:



SDR receiver part consists of RF tuner, which converts RF signal to amplified IF signal, A/D converter converts analog IF into digital IF samples. The digital samples are passed to the DDC (Digital Down Conversion), which converts digital IF samples into digital baseband samples (Referred as I/Q data). DDC consists of digital mixer, digital Local Oscillator (LO) and low pass FIR filter. The digital baseband samples are passed to the DSP chip, where algorithms have been ported which does the functions such as demodulation, decoding & any other tasks if required.

This digital implementation based architecture is referred as SDR or Software Defined Radio. Often, FPGA is also used in place of DSP in this software defined architecture.

The baseband processing chain software on DSP/FPGA will help in correcting real time baseband and RF related impairments present in I/Q data with the use of advanced algorithms. Typically, algorithms such as DC offset correction, I/Q gain and phase imbalance correction, time, frequency and channel impairment correction are implemented in SDR receiver.

In addition to the main functions of SDR, an additional Secure module will be provisioned as a jackable / add-on card, which will be encrypting / decrypting the data using AES 256 Encryption Standard. ITI will develop a Proprietary Algorithm and port the same into the additional Secure module for getting suitable grading from SAG as per the specific grading requirements of various Customers.

The below sections will indicate the generic / provisional specifications of various form factors of SDRs. The EoI respondents are requested provide the detailed specifications as per their experience / expertise in the field of SDR.

1. Specifications:

Manpack SDR

Product Description:

- The Equipment shall be Single or Multichannel and Multi-band radio that will meet requirements of speech, data& video for ground-to-ground and ground-to-air communications with software defined waveforms.
- The equipment shall support the creation of Mobile Adhoc Networks (MANET) to provide secure and jam resistant voice, data and video communication

Sl. No.	Parameter	Description	Remarks
A. System Specifications			
i	Network Topology	Peer-Peer MANET	
ii	No. of Maximum Nodes	Narrow Band: 32 minimum; vendor to specify the number of Nodes Wide Band: 64 minimum; vendor to specify the number of Nodes	
iii	Transmission Protocols	<ul style="list-style-type: none"> • Unicast • Multicast • Broadcast 	
iv	Channel Bandwidth	25 KHz to 5 MHz (Typical); Vendor to specify the range of Bandwidth that is settable	
v	Data Rates	Narrow Band: 100 Kbps with Channel Bandwidth of < 500 KHz	

		Wide Band: 1 Mbps with Channel Bandwidth of < 5 MHz; Vendor to specify the max. data rates supported along with Bandwidth	
vi	ECCM	Narrow Band: 100 Hops/sec minimum; Vendor to specify the Hopping rate Wide Band: 500 Hops/sec minimum (1000 Hops/sec preferred); Vendor to specify the Hopping rate	
vii	Network Relay Hops	Voice: 3 Hops minimum; Vendor to specify the Network relay Hops Data: 5 Hops minimum; Vendor to specify the Network relay Hops	
viii	SCA (Software Communication Architecture)	Version 4.1 or latest ; Vendor to specify the version of SCA	
ix	Security	<p>Functionality:</p> <ul style="list-style-type: none"> • Cater for separate additional security module (to port AES 256 as well as to proprietary algorithms SAG gradable hardware module) • Hardware based, an appropriate slot and interface to be made available in the SDR • Security support at Transmission level and Message level <ul style="list-style-type: none"> ○ At transmission level, cryptographically controlled frequency hopping ○ At message level, capable of embedding CPC approved user specific cryptographic security 	
		<p>Key Management:</p> <p>The cryptographic algorithms and keys shall be capable of being loaded into the security device via a handheld device/ Key Gun</p>	
		<p>Key Handling and Storage:</p> <p>The SDR shall be capable of secure storage of key information/data for duration as specified by the user. The SDR shall provide positive</p>	

		confirmation following each successful key loading from the key loading device and should notify in the event of key load failures. Emergency key erasure facility should also be provided	
		<p>User Authentication: The SDR should be password protected for normal usage. Another password authentication should be provided for waveform and mission parameter programming.</p> <p>Platform Integrity checking also shall be provided</p>	
x	Position, Navigation and Timing	<p>GNSS and IRNSS: The SDR should have an inbuilt GNSS receiver catering to multiple GNSS services like GLONASS and GPS. It should cater for IRNSS Services.</p> <p>Synchronization: The SDR should support synchronization by both internal timing source and by time signal from GNSS receiver including IRNSS. It is desirable to have an external clock input also apart from timing signal from GNSS Receiver.</p>	
xi	Booting and Switching	The SDR should bootup in less than 90 seconds; Vendor to indicate booting time	
		It should be possible to load the waveforms without power off and rebooting; however, this loading of waveforms will be with proper authentication.	
		On powering up, the SDR should offer selection of the last operated waveform or any other waveform residing in the SDR.	
xii	Operational Modes	<ul style="list-style-type: none"> • Squelch • Whisper • Sulk 	
B. RF Specifications			
i	Frequency Range	<p>HF: 3 MHz to 30 MHz (Typical) V/UHF: 30 MHz to 512 MHz (Typical) L: 1775 MHz to 1815 MHz (Typical) S: 2200 MHz to 2250 MHz (Typical); Vendor to specify the exact ranges for</p>	

		each band	
ii	Channel Bandwidth	25 KHz to 5 MHz (Typical) ; 1KHz to 8MHz preferable Actual BW supported by Manpack SDR to be specified by vendor	
iii	Channel Selection/ Frequency resolution	1 KHz	
iv	Frequency Accuracy	+/- 1 PPM or better	
v	RF Output Power	a. Transmitter Power: 0.5W to 10W adjustable digitally / 5 to 50Watts b. Harmonics: better than 60dBc c. Spurious :better than 70dBc Vendor to indicate the values of Tx Power, Harmonic level & Spurious level	
vi	Carrier Suppression	Greater than 50 dB; Vendor to indicate the value	
vii	Sideband Suppression	Greater than 50 dB; Vendor to indicate the value	
viii	Receiver Sensitivity	a. Vendor to specify the actual receiver sensitivity separately for AM, FM & other digital modulation schemes along with applicable BW& data rates for BER of 1×10^{-6} b. Approximate Coverage Range to be specified for each Modulation/ Waveform to be specified	
ix	Image rejection	Greater than 60 dB; Vendor to specify the value	
x	IF rejection	Greater than 80 dB; Vendor to specify the value	
xi	Adjacent channel rejection	Greater than 50 dB; Vendor to specify the value	
C. Waveforms			
C.1 Essential			
i	Modern Digital Waveforms	COFDM with Modulations <ul style="list-style-type: none"> • QPSK • 16 QAM • 64 QAM • Any other waveform to be 	

		specified by the Vendor	
		Forward Error Correction <ul style="list-style-type: none"> • CC or CTC • Coding Rates: 1/2, 3/4, 5/6 • Any other FEC rates supported to be specified by vendor 	
C.2 Desirable			
i	Additional Waveforms	<ul style="list-style-type: none"> • GMSK • DSSS • SOQPSK / CPM 	The platform should be capable of supporting these additional waveforms
ii	Legacy Waveforms	<ul style="list-style-type: none"> • AM • FM • FSK • PSK 	The platform should be capable of supporting these legacy waveforms
D. Human Machine Interface			
i	Display	Front or external panel display with support for configuration, monitoring and applications; Size & Type of Display to be specified by the Vendor	
ii	User Interface	<ul style="list-style-type: none"> • Status LEDs • Keypad; details of keypad to be specified by the Vendor 	
iii	Physical Buttons	<ul style="list-style-type: none"> • PTT (Push to Talk) Button • Power/Volume Knob • Display On/Off Button • 16-position Channel Selector 	
E. Hardware			
E.1. Interface Specifications			
i	Interfaces	Audio Interface	1 Analog Audio channel with PTT
		Data Interface	Ethernet 10/100/1000 BT & 1GE Opt (optional)
			RS232
			RS485
			USB

		Control Interface	Ethernet interface & SNMP Protocol	
ii	Built-in-Test	<p>Power-ON BIT (PBIT) : After Power-ON, it starts automatically and may take about 5 second or less; Vendor to specify the maximum time taken to complete the PBIT. It tests the main functions such as Rx & Tx modes. It also detects installed modules and options and their versions.</p> <p>Initiated or Manual BIT (IBIT): It is the most in-depth of the built-in tests and may take about 10 seconds; Vendor ti indicate the maximum time fot this manual BIT</p> <p>Continuous BIT (CBIT): It is a continuous test that runs in the background and has no impact on radio operation or radio settings. The CBIT information may be updated periodically when the radio is switched ON and in operating mode; vendor to indicate the minimum & maximum periodicity of status updation, which is settable.</p>		
E.2 Electrical Specifications				
i	Power Input	<p>The SDR should be capable of working continuously for a minimum period of 8 hours at 1:9 Transmit to Receive ratio with rechargeable and disposable batteries and for 12 hours with 12V 75Ah secondary batteries.</p> <p>The radio also should have capability to work off 230 +/- 20% volt AC using provided adapter.</p> <p>Power Consumption: Typical Power Consumption to be specified by the Vendor</p> <p>Battery Charging: Following Battery chargers with suitable connectors should be provided</p> <ol style="list-style-type: none"> a. Solar charger which is foldable and man portable b. Mains Supply charger with a facility to increase the charging rate in order to reduce the charging time of the batteries. c. Vendor to specify the time for fully charging the Battery 		

E.3 Physical Specifications			
i	Weight	Less than 4.5 Kg including battery. Weight including&excluding battery to be specified by the Vendor	
ii	Physical Dimensions	Less than 350 mm x 250 mm x 100 mm; Vendor to specify the physical dimension	
iii	Connectors	The SDR should provide interface connectors for connecting data terminal and other accessories	
iv	Control	The SDR should have front panel having control and selector knobs including sulk mode, display and keypad for SDR functioning and programming of parameters.	
E.4 Environmental Qualification Specifications			
i	EMI/EMC	As per latest MIL STD 461	
ii	Operating Temperature	-40 deg C to +70 deg C	
iii	Storage Temperature	-40 deg C to +85 deg C	
iv	Ruggedisation& Environmental conditions	All the environmental tests including temperature shall be carried out in accordance with the latest version of JSS 55555 & MIL Std. 810F of later as applicable/ as per Customer requirements as per relevant Tables	
E.5 Reliability, Maintenance and Miscellaneous			
i	Safety	<ul style="list-style-type: none"> • Reverse Polarity • Power and line surge spikes • Short and Open Circuit antenna connection • Over voltage / under voltage protection 	
ii	Emergency Erasure	Facility for emergency erasure should be inbuilt to erase all the keys and algorithm. Tamper detection and response mechanism should be inbuilt in the radio set to automatically erase algorithms, secrecy keys and other operational parameters to make SDR not functional.	
iii	Reliability	The equipment should be capable of continuous operation for at least 72 hours on a single set basis without breakdown. MTBF should be at least 5000 hours and MTTR not more than	

	24 hours.	
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Handheld SDR

Product Description:

- The Equipment shall be Single or Multichannel and Multi-band radio that will meet requirements of speech and data for ground-to-ground and ground-to-air communications with software defined waveforms.
- The equipment shall support the creation of Mobile Adhoc Networks (MANET) to provide secure and jam resistant voice, data and video communication.

Sl. No	Parameter	Description	Remarks
A. System Specifications			
i	Network Topology	Peer-Peer MANET	
ii	No of Max Nodes	Narrow Band: 32 minimum; vendor to specify the number of Nodes Wide Band: 64 minimum; vendor to specify the number of Nodes	
iii	Transmission Protocols	<ul style="list-style-type: none"> • Unicast • Multicast • Broadcast 	
iv	Channel Bandwidth	25 KHz to 5 MHz (Typical); Actual BW supported by Handheld SDR to be specified by vendor	
v	Data Rates	Narrow Band: 100 Kbps with Channel Bandwidth of < 500 KHz; Wide Band: 1 Mbps with Channel Bandwidth of < 5 MHz; Vendor to specify the max. data rates supported along with applicable Bandwidth	
vi	ECCM	Narrow Band: 100 Hops / Sec minimum; Vendor to specify the Hopping rate Wide Band:1000 Hops/ Sec minimum; Vendor to specify the Hopping rate	
vii	Network Relay Hops	Voice: 3 Hops minimum; Vendor to specify the Network relay Hops Data: 5 Hops minimum; Vendor to specify the Network relay Hops	
viii	SCA (Software Communication Architecture)	Version 4.1 or latest ; Vendor to specify the version of SCA	
	Security	Functionality:	

ix		<ul style="list-style-type: none"> • Cater for separate additional security module (To port AES 256 & Proprietary Algorithm which is SAG gradable hardware module) • Hardware based, an appropriate slot and interface to be made available in the SDR • Security support at Transmission level and Message level <ul style="list-style-type: none"> ○ At transmission level, cryptographically controlled frequency hopping ○ At message level, capable of embedding CPC approved user specific cryptographic security 	
		<p>Key Management: The cryptographic algorithms and keys shall be capable of being loaded into the security device via a handheld device/ Key Gun</p>	
		<p>Key Handling and Storage: The SDR shall be capable of secure storage of key information/data for duration as specified the user. The SDR shall provide positive confirmation following each successful key load from the key loading device and should notify in the event of key load failures. Emergency key erasure facility should also be provided</p>	
		<p>User Authentication: The SDR should be password protected for normal usage. Another password authentication should be provided for waveform and mission parameter programming.</p>	
x	Cellular Access	3GPP 3G/4G or better	
xi	Wi-Fi	Integrated Wi-Fi and Standards Supported 802.11a/b/g/n/ac/ax	
xii	Position, Navigation and Timing	<p>GNSS and IRNSS: The SDR should have an inbuilt GNSS receiver catering to multiple GNSS services like GLONASS and GPS. It should cater for IRNSS Services.</p> <p>Synchronization: The SDR should support synchronization by both internal timing source and by time signal from GNSS receiver including IRNSS It is desirable to have an external clock input also apart from timing signal from GNSS Receiver.</p>	

xiii	Bootling and Switching	The SDR should bootup in less than 90 seconds; vendor to indicate this duration	
		It should be possible to load the waveforms without power off and rebooting; however, this loading will be with proper password Authentication	
		On powering up, the SDR should offer selection of the last operated waveform or any other waveform residing in the SDR.	
xiv	Operational Modes	<ul style="list-style-type: none"> • Squelch • Whisper • Sulk 	
B. RF Specifications			
i	Frequency Range	HF: 3 MHz to 30 MHz (Typical) V/UHF: 30 MHz to 512 MHz (Typical) L: 1775 MHz to 1815 MHz (Typical) S: 2200 MHz to 2250 MHz (Typical); Vendor to specify the exact ranges for each band	
ii	Channel Bandwidth	25 KHz to 5 MHz (Typical); Actual BW supported by Handheld SDR to be specified by vendor	
iii	Channel Selection/ Frequency resolution	1 KHz	
iv	Frequency Accuracy	+/- 1 PPM or better	
v	RF Output Power	<ul style="list-style-type: none"> a. Transmitter Power: 0.5W to 10W adjustable digitally; Vendor to specify the transmitter power output range b. Harmonics: better than 60dBc c. Spurious :better than 70dBc 	
vi	Carrier Suppression	Greater than 50 dB	
vii	Sideband Suppression	Greater than 50 dB	
viii	Receiver Sensitivity	<ul style="list-style-type: none"> a. Vendor to specify the actual receiver sensitivity separately for AM, FM & other digital modulation schemes for different data rates along with applicable BW for BER of 1×10^{-6} b. Approximate Coverage Range to be specified for each Modulation/ Waveform to be specified 	
ix	Image rejection	> 60 dB;	

		Vendor to specify the value	
x	IF rejection	> 80 dB; Vendor to specify the value	
xi	Adjacent channel rejection	>50 dB; Vendor to specify the value	
C. Waveforms			
C.1 Essential			
i	Modern Digital Waveforms	COFDM with Modulations <ul style="list-style-type: none"> • QPSK • 16 QAM • 64 QAM • Any other waveform to be specified by the Vendor 	
		Forward Error Correction <ul style="list-style-type: none"> • CC or CTC • Coding Rates: $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{6}$ • Any other FEC rates supported to be specified by vendor 	
C.2 Desirable			
i	Additional Waveforms	<ul style="list-style-type: none"> • GMSK • DSSS • SOQPSK / CPM 	The platform should be capable of supporting these additional waveforms
ii	Legacy Waveforms	<ul style="list-style-type: none"> • AM • FM • FSK • PSK 	The platform should be capable of supporting these legacy waveforms
D. Human Machine Interface			
i	Display	4-6" colour OLED display, 480x800pixels. Capacitive touch screen with Gorilla Glass Usable with gloves up to 4 mm thick. Resistant to false actuation from fresh or salt, water, snow, dirt or grease	
ii	User Interface	<ul style="list-style-type: none"> • Status LEDs • Keypad; details of keypad to be specified by the Vendor 	
iii	Physical Buttons	<ul style="list-style-type: none"> • PTT (Push to Talk) Button 	

		<ul style="list-style-type: none"> • Power/Volume Knob • Display On/Off Button • 16-position Channel Selector 	
E. Hardware			
E.1. Interface Specifications			
i	Interfaces	Audio Interface	1 Analog Audio channel with PTT
		Data Interface	Ethernet 10/100/1000 BT & 1GE Opt (optional)_
			RS232
			RS485
Control Interface	Ethernet interface & SNMP Protocol		
ii	Built-in-Test	<p>Power-ON BIT (PBIT) : After Power-ON, it starts automatically and may take about 5 second or less; Vendor to specify the max time taken to complete the PBIT. It tests the main functions such as Rx & Tx modes. It also detects installed modules and options and their versions.</p>	
		<p>Initiated or Manual BIT (IBIT): It is the most in-depth of the built-in tests and may take about 10 seconds; vendor to specify the maximum time taken for this process</p>	
		<p>Continuous BIT (CBIT): It is a continuous test that runs in the background and has no impact on radio operation or radio settings. The CBIT information may be updated periodically when the radio is switched ON and in operating mode; vendor to indicate the periodicity (Min & Max that is settable)</p>	
E.2 Electrical Specifications			
i	Power Input	<p>The Handheld SDR should be capable of working continuously for a minimum period of 8 hours at 1:9 Transmit to Receive ratio with rechargeable and disposable batteries and for 12 hours with secondary batteries. Vendor to indicate the Battery sizing.</p>	
		<p>The radio also should have capability to work off 230 +/- 20% volt AC using provided adapter.</p>	
		<p>Max. Power Consumption: To be specified by the Vendor for Handheld SDR</p>	
		<p>Battery Charging: Following Battery chargers with suitable connectors should be provided a. Solar charger which is foldable and man portable</p>	

		<p>b. Mains Supply charger with a facility to increase the charging rate in order to reduce the charging time of the batteries.</p> <p>c. Vendor the specify the time for fully charging the Battery</p>	
E.3 Physical Specifications			
i	Weight	Less than 1 Kg including battery. Weight including &excluding battery to be specified by the Vendor	
ii	Physical Dimensions	Less than 100 mm(w) x 200(L) mm x 60 mm(D) Vendor to specify the physical dimension	
iii	Connectors	The SDR should provide interface connectors for connecting data terminal and other accessories	
iv	Control	The SDR should have front panel having control and selector knobs including sulk mode, display and keypad for SDR functioning and programming of parameters.	
E.4 Environmental Qualification Specifications			
i	EMI/EMC	As per latest MIL STD 461	
ii	Operating Temperature	-40 deg C to +70 deg C	
iii	Storage Temperature	-40 deg C to +85 deg C	
iv	Ruggedisation& Environmental conditions	All the environmental tests including temperature shall be carried out in accordance with the latest version of JSS 55555 as applicable/ as per Customer requirements as per relevant Tables as well as MIL Std. 810F/G	
E.5 Reliability, Maintenance and Miscellaneous			
i	Safety	<ul style="list-style-type: none"> • Reverse Polarity • Power and line surge spikes • Short and Open Circuit antenna connection • Over voltage / under voltage protection 	
ii	Emergency Erasure	Facility for emergency erasure should be inbuilt to erase all the keys and algorithm. Tamper detection and response mechanism should be inbuilt in the radio set to automatically erase algorithms, secrecy keys and other operational parameters to make SDR not functional.	
iii	Reliability	The equipment should be capable of continuous operation for at least 72 hours on	

		a single set basis without breakdown. MTBF should be at least 5000 hours and MTTR not more than 24 hours. Vendor to indicate the MTBF vaue	
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Vehicular SDR

Product Description:

- The Equipment shall be Single or Multichannel and Multi-band vehicle mountable radio that will meet requirements of speech and data for ground-to-ground and ground-to-air communications with software defined waveforms.
- The equipment shall support the creation of Mobile Adhoc Networks (MANET) to provide secure and jam resistant voice, data and video communication while mounted on vehicle.

Sl. No.	Parameter	Description	Remarks
A. System Specifications			
i	Network Topology	Peer-Peer MANET	
ii	No of Max Nodes	Narrow Band: 32 minimum; vendor to specify the number of Nodes Wide Band: 64 minimum; vendor to specify the number of Nodes	
iii	Transmission Protocols	<ul style="list-style-type: none"> • Unicast • Multicast • Broadcast 	
iv	Channel Bandwidth	25 KHz to 10 MHz (Typical); Vendor to specify the range of Bandwidth that is settable	
v	Data Rates	Narrow Band: 100 Kbps with Channel Bandwidth of < 500 KHz Wide Band: 1 Mbps with Channel Bandwidth of < 5 MHz; Vendor to specify the max. data rates supported	
vi	ECCM	Narrow Band: 100 Hops/sec minimum; Vendor to specify the Hopping rate Wide Band:500 Hops/sec minimum	

		(1000 Hops/sec preferred); Vendor to specify the Hopping rate	
vii	Network Relay Hops	Voice: 3 Hops minimum; Vendor to specify the Network relay Hops Data: 5 Hops minimum; Vendor to specify the Network relay Hops	
viii	SCA (Software Communication Architecture)	Version 4.1 or latest ; Vendor to specify the version of SCA	
ix	Security	<p>Functionality:</p> <ul style="list-style-type: none"> • Cater for separate additional security module (SAG gradable hardware module) • Hardware based, an appropriate slot and interface to be made available in the SDR • Security support at Transmission level and Message level <ul style="list-style-type: none"> ○ At transmission level, cryptographically controlled frequency hopping ○ At message level, capable of embedding CPC approved user specific cryptographic security 	
		<p>Key Management:</p> <p>The cryptographic algorithms and keys shall be capable of being loaded into the security device via a handheld device/ Key Gun</p>	
		<p>Key Handling and Storage:</p> <p>The SDR shall be capable of secure storage of key information/data for duration as specified the user. The SDR shall provide positive confirmation following each successful key load from the key loading device and should notify in the event of key load failures. Emergency key erasure facility should also be provided</p>	
		<p>User Authentication:</p> <p>The SDR should be password protected for normal usage. Another</p>	

		password authentication should be provided for waveform and mission parameter programming.	
x	Position, Navigation and Timing	GNSS and IRNSS: The SDR should have an inbuilt GNSS receiver catering to multiple GNSS services like GLONASS and GPS. It should cater for IRNSS Services.	
		Synchronization: The SDR should support synchronization by both internal timing source and by time signal from GNSS receiver including IRNSS It is desirable to have an external clock input also apart from timing signal from GNSS Receiver.	
xi	Bootup and Switching	The SDR should bootup in less than 90 seconds. Vendor to indicate the max time for Bootup.	
		It should be possible to load the waveforms without power off and rebooting.	
		On powering up, the SDR should offer selection of the last operated waveform or any other waveform residing in the SDR.	
xii	Operational Modes	<ul style="list-style-type: none"> • Squelch • Whisper • Sulk 	
B. RF Specifications			
i	Frequency Range	HF: 3 MHz to 30 MHz (Typical) V/UHF: 30 MHz to 512 MHz (Typical) L: 1775 MHz to 1815 MHz (Typical) S: 2200 MHz to 2250 MHz (Typical); Vendor to specify the exact range for each band	
ii	Channel Bandwidth	25 KHz to 10 MHz (Typical) ; 1KHz to 10MHz preferable Actual BW supported by Vehicular SDR to be specified by vendor	
iii	Channel Selection/ Frequency resolution	1 KHz	
iv	Frequency Accuracy	+/- 1 PPM or better	
v	RF Output Power & Spurious	a. Transmitter Power: 0.5W to 50W adjustable digitally	

		<p>b. Harmonics: Better than 60dBc</p> <p>c. Spurious : better than 70dBc</p> <p>Vendor to indicate the values of Tx Power, Harmonic level & Spurious level</p>	
vi	Carrier Suppression	Greater than 50 dB	
vii	Sideband Suppression	Greater than 50 dB	
viii	Receiver Sensitivity	<p>a. Vendor to specify the actual receiver sensitivity separately for AM, FM & other digital modulation schemes along with applicable data rate & BW for BER of 1×10^{-6}</p> <p>b. Approximate Coverage Range to be specified for each Modulation/ Waveform & data rate to be specified</p>	
ix	Image rejection	Greater than 60 dB; Vendor to specify the value	
x	IF rejection	Greater than 80 dB; Vendor to specify the value	
xi	Adjacent channel rejection	Greater than 50 dB; Vendor to specify the value	
C. Waveforms			
C.1 Essential			
i	Modern Digital Waveforms	<p>COFDM with Modulations</p> <ul style="list-style-type: none"> • QPSK • 16 QAM • 64 QAM • Any other waveform to be specified by the Vendor 	i
		<p>Forward Error Correction</p> <ul style="list-style-type: none"> • CC or CTC • Coding Rates: $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{6}$ • Any other FEC rates supported to be specified by vendor 	
C.2 Desirable			
i	Additional Waveforms	<ul style="list-style-type: none"> • GMSK • DSSS • SOQPSK / CPM 	The platform should be capable of supporting these additional waveforms

ii	Legacy Waveforms	<ul style="list-style-type: none"> • AM • FM • FSK • PSK 	The platform should be capable of supporting these legacy waveforms
D. Human Machine Interface			
i	Display	Front or external panel display with support for configuration, monitoring and applications; Size & Type of Display to be specified by the Vendor	
ii	User Interface	<ul style="list-style-type: none"> • Status LEDs • Keypad; details of keypad to be specified by the Vendor 	
iii	Physical Buttons	<ul style="list-style-type: none"> • PTT (Push to Talk) Button • Power/Volume Knob • Display On/Off Button • 16-position Channel Selector 	
E. Hardware			
E.1. Interface Specifications			
i	Interfaces	Audio Interface	1 Analog Audio channel with PTT
		Data Interface	Ethernet 10/100/1000 BT & 1GE Opt (optional)
			RS232
			RS485
		Control Interface	Ethernet interface & SNMP Protocol
ii	Built-in-Test	Power-ON BIT (PBIT) : After Power-ON, it starts automatically and may take about 5 second or less; Vendor to specify the time taken to complete the PBIT. It tests the main functions such as Rx & Tx modes. It also detects installed modules and options and their versions.	
		Initiated or Manual BIT (IBIT): It is	

		the most in-depth of the built-in tests and may take about 10 seconds; Vendor to indicate this value	
		Continuous BIT (CBIT): It is a continuous test that runs in the background and has no impact on radio operation or radio settings. The CBIT information may be updated periodically when the radio is switched ON and in operating mode; vendor to indicate the min & max periodicity	
E.2 Electrical Specifications			
i	Power Input	The SDR should be capable of working continuously for a minimum period of 8 hours with DC input of 24V at 1:9 Transmit to Receive ratio with rechargeable and disposable batteries and for 12 hours with 12V 75Ah secondary batteries.	
		The radio also should have capability to work off 230 +/- 20% volt AC using provided adapter.	
		Power Consumption: Typical Power Consumption to be specified by the Vendor	
		Battery Charging: Following Battery chargers with suitable connectors should be provided <ul style="list-style-type: none"> a. Solar charger which is foldable and man portable b. Mains Supply charger with a facility to increase the charging rate in order to reduce the charging time of the batteries. c. Time to fully charge the battery to be specified by the Vendor. 	
E.3 Physical Specifications			
i	Weight	Less than 15 Kg including battery. Weight excluding battery to be specified by the Vendor	
ii	Physical Dimensions	Less than 350 mm x 275 mm x 250 mm; Vendor to specify the physical dimension	
iii	Connectors	The SDR should provide interface connectors for connecting data terminal and other accessories	

iv	Control	The SDR should have front panel having control and selector knobs including sulk mode, display and keypad for SDR functioning and programming of parameters.	
E.4 Environmental Qualification Specifications			
i	EMI/EMC	As per latest MIL STD 461	
ii	Operating Temperature	-40 deg C to +70 deg C	
iii	Storage Temperature	40 deg C to +85 deg C	
iv	Ruggedisation & Environmental conditions	All the environmental tests including temperature shall be carried out in accordance with the latest version of JSS 55555 as applicable/ as per Customer requirements as per relevant Tables as well as MIL Std. 810F/G	
E.5 Reliability, Maintenance and Miscellaneous			
i	Safety	<ul style="list-style-type: none"> • Reverse Polarity • Power and line surge spikes • Short and Open Circuit antenna connection • Over voltage / under voltage protection 	
ii	Emergency Erasure	Facility for emergency erasure should be inbuilt to erase all the keys and algorithm. Tamper detection and response mechanism should be inbuilt in the radio set to automatically erase algorithms, secrecy keys and other operational parameters to make SDR not functional.	
iii	Reliability	The equipment should be capable of continuous operation for at least 72 hours on a single set basis without breakdown. MTBF should be at least 5000 hours and MTTR not more than 24 hours. Vendor to indicate the value of MTBF	

Truck Ground SDR

Product Description:

- The Equipment shall be Single or Multichannel and Multi-band radio that will meet requirements of speech and data for ground-to-ground and ground-to-air communications with software defined waveforms.
- The equipment shall support the creation of Mobile Adhoc Networks (MANET) to provide secure and jam resistant voice, data and video communication

SN	Parameter	Description	Remarks
A. System Specifications			
i	Network Topology	Peer-Peer MANET	
ii	No of Max Nodes	Narrow Band: 32 minimum; vendor to specify the number of Nodes Wide Band: 64 minimum; vendor to specify the number of Nodes	
iii	Transmission Protocols	<ul style="list-style-type: none"> • Unicast • Multicast • Broadcast 	
iv	Channel Bandwidth	25 KHz to 10 MHz (Typical); Vendor to specify the range of Bandwidth that is settable	
v	Data Rates	Narrow Band: 100 Kbps with Channel Bandwidth of < 500 KHz Wide Band: 1 Mbps with Channel Bandwidth of < 5 MHz; Vendor to specify the max. data rates supported	
vi	ECCM	Narrow Band: 100 Hops/sec minimum; Vendor to specify the Hopping rate Wide Band:500 Hops/sec minimum (1000 Hops/sec preferred); Vendor to specify the Hopping rate	
vii	Network Relay Hops	Voice: 3 Hops minimum; Vendor to specify the Network relay Hops Data: 5 Hops minimum; Vendor to specify the Network relay Hops	
viii	SCA (Software Communication Architecture)	Version 4.1 or latest ; Vendor to specify the version of SCA	

ix	Security	<p>Functionality:</p> <ul style="list-style-type: none"> • Cater for separate additional security module (SAG gradable hardware module) • Hardware based, an appropriate slot and interface to be made available in the SDR • Security support at Transmission level and Message level <ul style="list-style-type: none"> ○ At transmission level, cryptographically controlled frequency hopping ○ At message level, capable of embedding CPC approved user specific cryptographic security 	
		<p>Key Management:</p> <p>The cryptographic algorithms and keys shall be capable of being loaded into the security device via a handheld device/ Key Gun</p>	
		<p>Key Handling and Storage:</p> <p>The SDR shall be capable of secure storage of key information/data for duration as specified the user. The SDR shall provide positive confirmation following each successful key load from the key loading device and should notify in the event of key load failures. Emergency key erasure facility should also be provided</p>	
		<p>User Authentication:</p> <p>The SDR should be password protected for normal usage. Another password authentication should be provided for waveform and mission parameter programming;</p>	
	Position,	GNSS and IRNSS:	

x	Navigation and Timing	The SDR should have an inbuilt GNSS receiver catering to multiple GNSS services like GLONASS and GPS. It should cater for IRNSS Services.	
		Synchronization: The SDR should support synchronization by both internal timing source and by time signal from GNSS receiver including IRNSS It is desirable to have an external clock input also apart from timing signal from GNSS Receiver.	
xi	Booting and Switching	The SDR should bootup in less than 90 seconds; Vendor to indicate the Booting time	
		It should be possible to load the waveforms without power off and rebooting.	
		On powering up, the SDR should offer selection of the last operated waveform or any other waveform residing in the SDR.	
xii	Operational Modes	<ul style="list-style-type: none"> • Squelch • Whisper • Sulk 	
B. RF Specifications			
i	Frequency Range	HF: 3 MHz to 30 MHz (Typical) V/UHF: 30 MHz to 512 MHz (Typical) L: 1775 MHz to 1815 MHz (Typical) S: 2200 MHz to 2250 MHz (Typical); Vendor to specify the exact ranges for each band	
ii	Channel Bandwidth	25 KHz to 5 MHz (Typical) ; 1KHz to 8MHz preferable Actual BW supported by Truck Ground SDR to be specified by vendor	
iii	Channel Selection/ Frequency resolution	1 KHz	
iv	Frequency Accuracy	+/- 1 PPM or better	
v	RF Output Power & Spurious	a. Transmitter Power: 0.5W to 20W adjustable digitally / 5	

		<p>to 50Watts</p> <p>b. Harmonics: Better than 60dBc</p> <p>c. Spurious :Better than 70dBc</p> <p>Vendor to indicate the values of Tx Power, Harmonic level & Spurious level</p>	
vi	Carrier Suppression	Greater than 50 dB	
vii	Sideband Suppression	Greater than 50 dB	
viii	Receiver Sensitivity	<p>a. Vendor to specify the actual receiver sensitivity separately for AM, FM & other digital modulation schemes and data rate along with applicable BW for BER of 1×10^{-6}</p> <p>b. Approximate Coverage Range to be specified for each Modulation/ Waveform to be specified</p>	
ix	Image rejection	Greater than 60 dB; Vendor to specify the value	
x	IF rejection	Greater than 80 dB; Vendor to specify the value	
xi	Adjacent channel rejection	Greater than 50 dB; Vendor to specify the value	
C. Waveforms			
C.1 Essential			
i	Modern Digital Waveforms	<p>COFDM with Modulations</p> <ul style="list-style-type: none"> • QPSK • 16 QAM • 64 QAM • Any other waveform to be specified by the Vendor 	
		<p>Forward Error Correction</p> <ul style="list-style-type: none"> • CC or CTC • Coding Rates: $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{6}$ • Any other FEC rates supported to be specified by vendor 	

C.2 Desirable			
i	Additional Waveforms	<ul style="list-style-type: none"> • GMSK • DSSS • SOQPSK / CPM 	The platform should be capable of supporting these additional waveforms
ii	Legacy Waveforms	<ul style="list-style-type: none"> • AM (SSB & DSB) • FM (Narrow Band & Wideband) • FSK • PSK 	The platform should be capable of supporting these legacy waveforms
D. Human Machine Interface			
i	Display	Front or external panel display with support for configuration, monitoring and applications; Size & Type of Display to be specified by the Vendor	
ii	User Interface	<ul style="list-style-type: none"> • Status LEDs • Keypad; details of keypad to be specified by the Vendor 	
iii	Physical Buttons	<ul style="list-style-type: none"> • PTT (Push to Talk) Button • Power/Volume Knob • Display On/Off Button • 16-position Channel Selector 	
E. Hardware			
E.1. Interface Specifications			
i	Interfaces	Audio Interface	1 Analog Audio channel with PTT
		Data Interface	Ethernet 10/100/1000 BT & 1GE Opt (optional)_
			RS232
			RS485
			USB
Control Interface	Ethernet interface & SNMP Protocol		

ii	Built-in-Test	<p>Power-ON BIT (PBIT) : After Power-ON, it starts automatically and may take about 5 second or less; Vendor to specify the time taken to complete the PBIT. It tests the main functions such as Rx & Tx modes. It also detects installed modules and options and their versions.</p> <p>Initiated or Manual BIT (IBIT): It is the most in-depth of the built-in tests and may take about 10 seconds; Vendor to specify max time for Manual BIT</p> <p>Continuous BIT (CBIT): It is a continuous test that runs in the background and has no impact on radio operation or radio settings. The CBIT information may be updated PERIODICALLY when the radio is switched ON and in operating mode; vendor to indicate the main & max time settable</p>	
E.2 Electrical Specifications			
i	Power Input	<p>The SDR should be capable of working continuously for a minimum period of 8 hours with 24 V battery at 1:9 Transmit to Receive ratio with rechargeable and disposable batteries; vendor to indicate the Battery capacity</p> <p>The radio also should have capability to work off 230 +/- 20% volt AC using provided adapter.</p> <p>Power Consumption: Typical Power Consumption to be specified by the Vendor</p> <p>Battery Charging: Following Battery chargers with suitable connectors should be provided</p> <ol style="list-style-type: none"> a. Solar charger which is foldable and man portable b. Mains Supply charger with a facility to increase the charging rate in order to reduce the charging time of the batteries. c. Time to fully charge the battery to be specified by the Vendor. 	
E.3 Physical Specifications			

i	Weight	Less than 15 Kg including battery. Weight excluding battery to be specified by the Vendor	
ii	Physical Dimensions	Less than 350 mm x 250 mm x 200 mm; Vendor to specify the physical dimension	
iii	Connectors	The SDR should provide interface connectors for connecting data terminal and other accessories	
iv	Control	The SDR should have front panel having control and selector knobs including sulk mode, display and keypad for SDR functioning and programming of parameters.	
E.4 Environmental Qualification Specifications			
i	EMI/EMC	As per latest MIL STD 461 G	
ii	Operating Temperature	-40 deg C to +70 deg C	
iii	Storage Temperature	40 deg C to +85 deg C	
iv	Ruggedisation & Environmental conditions	All the environmental tests including temperature shall be carried out in accordance with the latest version of JSS 55555 as applicable/ as per Customer requirements as per relevant Tables as well as MIL Std. 810F/G	
E.5 Reliability, Maintenance and Miscellaneous			
i	Safety	<ul style="list-style-type: none"> • Reverse Polarity • Power and line surge spikes • Short and Open Circuit antenna connection • Over voltage / under voltage protection 	
ii	Emergency Erasure	Facility for emergency erasure should be inbuilt to erase all the keys and algorithm. Tamper detection and response mechanism should be inbuilt in the radio set to automatically erase algorithms, secrecy keys and other operational parameters to make SDR not functional.	
iii	Reliability	The equipment should be capable of continuous operation for at least 72 hours on a single set basis without breakdown. MTBF should be at least 5000 hours and	

		MTTR not more than 24 hours; Vendor to indicate the MTBF Value	
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Airborne SDR

Product Description:

- The Equipment shall be Single or Multichannel and Multi-band radio that will meet requirements of speech, Video and data for ground-to-ground and ground-to-air communications with software defined waveforms.
- The equipment shall support the creation of Mobile Adhoc Networks (MANET) to provide secure and jam resistant voice, data and video communication

SN	Parameter	Description	Remarks
A. System Specifications			
i	Network Topology	Peer-Peer MANET	
ii	No of Max Nodes	Narrow Band: 32 minimum; vendor to specify the number of Nodes Wide Band: 64 minimum; vendor to specify the number of Nodes	
iii	Transmission Protocols	<ul style="list-style-type: none"> • Unicast • Multicast • Broadcast 	
iv	Channel Bandwidth	25 KHz to 10 MHz (Typical); Vendor to specify the range of Bandwidth that is settable	
v	Data Rates	Narrow Band: 100 Kbps with Channel Bandwidth of < 500 KHz Wide Band: 1 Mbps with Channel Bandwidth of < 5 MHz; Vendor to specify the max. data rates supported	
vi	ECCM	Narrow Band: 100 Hops/sec minimum; Vendor to specify the Hopping rate Wide Band: 500 Hops/sec minimum (1000 Hops/sec preferred); Vendor to specify the Hopping rate	
vii	Network Relay Hops	Voice: 3 Hops minimum; Vendor to specify the Network relay Hops	

		Data: 5 Hops minimum; Vendor to specify the Network relay Hops	
viii	SCA (Software Communication Architecture)	Version 4.1 or latest ; Vendor to specify the version of SCA	
ix	Security	<p>Functionality:</p> <ul style="list-style-type: none"> • Cater for separate additional security module (SAG gradable hardware module) • Hardware based, an appropriate slot and interface to be made available in the SDR • Security support at Transmission level and Message level <ul style="list-style-type: none"> ○ At transmission level, cryptographically controlled frequency hopping ○ At message level, capable of embedding CPC approved user specific cryptographic security 	
		<p>Key Management:</p> <p>The cryptographic algorithms and keys shall be capable of being loaded into the security device via a handheld device/ Key Gun</p>	
		<p>Key Handling and Storage:</p> <p>The SDR shall be capable of secure storage of key information/data for duration as specified the user. The SDR shall provide positive confirmation following each successful key load from the key loading device and should notify in the event of key load failures. Emergency key erasure facility should also be provided</p>	
		<p>User Authentication:</p> <p>The SDR should be password</p>	

		protected for normal usage. Another password authentication should be provided for waveform and mission parameter programming.	
x	Position, Navigation and Timing	GNSS and IRNSS: The SDR should have an inbuilt GNSS receiver catering to multiple GNSS services like GLONASS and GPS. It should cater for IRNSS Services.	
		Synchronization: The SDR should support synchronization by both internal timing source and by time signal from GNSS receiver including IRNSS It is desirable to have an external clock input also apart from timing signal from GNSS Receiver.	
xi	Booting and Switching	The SDR should bootup in less than 90 seconds; Vendor to indicate the max booting time	
		It should be possible to load the waveforms without power off and rebooting.	
		On powering up, the SDR should offer selection of the last operated waveform or any other waveform residing in the SDR.	
xii	Operational Modes	<ul style="list-style-type: none"> • Squelch • Whisper • Sulk 	
B. RF Specifications			
i	Frequency Range	HF: 3 MHz to 30 MHz (Typical) V/UHF: 30 MHz to 512 MHz (Typical) L: 1775 MHz to 1815 MHz (Typical) S: 2200 MHz to 2250 MHz (Typical); Vendor to specify the exact range for each band	
ii	Channel Bandwidth	25 KHz to 10 MHz (Typical) ; 1KHz to 10MHz preferable Actual BW supported by Airborne SDR to be specified by vendor	
iii	Channel Selection/	1 KHz	

	Frequency resolution		
iv	Frequency Accuracy	+/- 1 PPM or better	
v	RF Output Power	<p>a. Transmitter Power: 0.5W to 10W adjustable digitally / 5 to 50Watts</p> <p>b. Harmonics: 60dBc</p> <p>c. Spurious : 70dBc</p>	
vi	Carrier Suppression	Greater than 50 dB	
vii	Sideband Suppression	Greater than 50 dB	
viii	Receiver Sensitivity	<p>a. Vendor to specify the actual receiver sensitivity separately for AM, FM & other digital modulation schemes along with data rate & applicable BW for BER of 1×10^{-6}</p> <p>b. Approximate Coverage Range to be specified for each Modulation/ Waveform to be specified</p>	
ix	Image rejection	Greater than 60 dB; Vendor to specify the value	
x	IF rejection	Greater than 80 dB; Vendor to specify the value	
xi	Adjacent channel rejection	Greater than 50 dB; Vendor to specify the value	
C. Waveforms			
C.1 Essential			
i	Modern Digital Waveforms	<p>COFDM with Modulations</p> <ul style="list-style-type: none"> • QPSK • 16 QAM • 64 QAM • Any other waveform to be specified by the Vendor 	
		<p>Forward Error Correction</p> <ul style="list-style-type: none"> • CC or CTC • Coding Rates: $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{6}$ • Any other FEC rates supported to be specified by vendor 	
C.2 Desirable			

i	Additional Waveforms	<ul style="list-style-type: none"> • GMSK • DSSS • SOQPSK / CPM 	The platform should be capable of supporting these additional waveforms
ii	Legacy Waveforms	<ul style="list-style-type: none"> • AM • FM • FSK • PSK 	The platform should be capable of supporting these legacy waveforms
D. Human Machine Interface			
i	Display	Front or external panel display with support for configuration, monitoring and applications; Size & Type of Display to be specified by the Vendor	
ii	User Interface	<ul style="list-style-type: none"> • Status LEDs • Keypad; details of keypad to be specified by the Vendor 	
iii	Physical Buttons	<ul style="list-style-type: none"> • PTT (Push to Talk) Button • Power/Volume Knob • Display On/Off Button • 16-position Channel Selector 	
E. Hardware			
E.1. Interface Specifications			
i	Interfaces	Audio Interface	1 Analog Audio channel with PTT
		Data Interface	Ethernet 10/100/1000 BT & 1GE Opt (optional)
			RS232
			RS485
		Control Interface	Ethernet interface & SNMP Protocol
ii	Built-in-Test	Power-ON BIT (PBIT) : After Power-ON, it starts automatically and may take about 5 second or less; Vendor to specify the time taken	

		<p>to complete the PBIT. It tests the main functions such as Rx & Tx modes. It also detects installed modules and options and their versions.</p>	
		<p>Initiated or Manual BIT (IBIT): It is the most in-depth of the built-in tests and may take about 10 seconds; vendor to indicate Max Manual BIT duration</p>	
		<p>Continuous BIT (CBIT): It is a continuous test that runs in the background and has no impact on radio operation or radio settings. The CBIT information may be updated every second when the radio is switched ON and in operating mode</p>	
E.2 Electrical Specifications			
i	Power Input	<p>The SDR should be capable of working continuously for a minimum period of 8 hours with DC supply of 24 V at 1:9 Transmit to Receive ratio with rechargeable and disposable batteries; Vendor to indicate the Battery capacity</p>	
		<p>The radio also should have capability to work off 230 +/- 20% volts AC using provided adapter.</p>	
		<p>Power Consumption: Typical Power Consumption to be specified by the Vendor</p>	
		<p>Battery Charging: Following Battery chargers with suitable connectors should be provided</p> <ol style="list-style-type: none"> a. Solar charger which is foldable and man portable b. Mains Supply charger with a facility to increase the charging rate in order to reduce the charging time of the batteries. c. Time to fully charge the battery to be specified by the Vendor. 	
E.3 Physical Specifications			
i	Weight	<p>Less than 5 Kg including battery. Weight excluding battery to be specified by the Vendor</p>	
ii	Physical Dimensions	<p>Less than 350 mm x 250 mm x 250 mm; Vendor to specify the</p>	

		physical dimension	
iii	Connectors	The SDR should provide interface connectors for connecting data terminal and other accessories	
iv	Control	The SDR should have front panel having control and selector knobs including sulk mode, display and keypad for SDR functioning and programming of parameters.	
E.4 Environmental Qualification Specifications			
i	EMI/EMC	As per latest MIL STD	
ii	Operating Temperature	-40 deg C to +70 deg C	
iii	Storage Temperature	-40 deg C to +85 deg C	
iv	Ruggedisation & Environmental conditions	All the environmental tests including temperature shall be carried out in accordance with the latest version of JSS 55555 as applicable/ as per Customer requirements as per relevant Tables & MIL Std. 810F/G	
E.5 Reliability, Maintenance and Miscellaneous			
i	Safety	<ul style="list-style-type: none"> • Reverse Polarity • Power and line surge spikes • Short and Open Circuit antenna connection • Over voltage / under voltage protection 	
ii	Emergency Erasure	Facility for emergency erasure should be inbuilt to erase all the keys and algorithm. Tamper detection and response mechanism should be inbuilt in the radio set to automatically erase algorithms, secrecy keys and other operational parameters to make SDR not functional.	
iii	Reliability	The equipment should be capable of continuous operation for at least 72 hours on a single set basis without breakdown. MTBF should be at least 5000 hours and MTTR not more than 24 hours; MTBF to be specified by the Vendor	

Air Traffic Control (ATC) SDR

Product Description:

- The Equipment shall be Single or Multichannel and Multi-band radio that will meet requirements of speech, Video and data for ground-to-ground and ground-to-air communications with software defined waveforms.
- The equipment shall support the creation of Mobile Adhoc Networks (MANET) to provide secure and jam resistant voice, data and video communication

SN	Parameter	Description	Remarks
A. System Specifications			
i	Network Topology	Peer-Peer MANET	
ii	No of Max Nodes	Narrow Band: 32 minimum; vendor to specify the number of Nodes Wide Band: 64 minimum; vendor to specify the number of Nodes	
iii	Transmission Protocols	<ul style="list-style-type: none"> • Unicast • Multicast • Broadcast 	
iv	Channel Bandwidth	25 KHz to 5 MHz (Typical); 1KHz to 8MHz preferable; Vendor to specify the range of Bandwidth that is settable	
v	Data Rates	Narrow Band: 100 Kbps with Channel Bandwidth of < 500 KHz Wide Band: 1 Mbps with Channel Bandwidth of < 5 MHz; Vendor to specify the max. data rates supported	
vi	ECCM	Narrow Band: 100 Hops/sec minimum; Vendor to specify the Hopping rate Wide Band:500 Hops/sec minimum (1000 Hops/sec preferred); Vendor to specify the Hopping rate	
vii	Network Relay Hops	Voice: 3 Hops minimum; Vendor to specify the Network relay Hops Data: 5 Hops minimum; Vendor to specify the Network relay Hops	
viii	SCA (Software Communication Architecture)	Version 4.1 or latest ; Vendor to specify the version of SCA	
	Security	Functionality:	

ix		<ul style="list-style-type: none"> • Cater for separate additional security module (SAG gradable hardware module) • Hardware based, an appropriate slot and interface to be made available in the SDR • Security support at Transmission level and Message level <ul style="list-style-type: none"> ○ At transmission level, cryptographically controlled frequency hopping ○ At message level, capable of embedding CPC approved user specific cryptographic security 	
		<p>Key Management: The cryptographic algorithms and keys shall be capable of being loaded into the security device via a handheld device/ Key Gun</p>	
		<p>Key Handling and Storage: The SDR shall be capable of secure storage of key information/data for duration as specified the user. The SDR shall provide positive confirmation following each successful key load from the key loading device and should notify in the event of key load failures. Emergency key erasure facility should also be provided</p>	
		<p>User Authentication: The SDR should be password protected for normal usage. Another password authentication should be provided for waveform and mission parameter programming.</p>	
	Position,	GNSS and IRNSS:	

x	Navigation and Timing	The SDR should have an inbuilt GNSS receiver catering to multiple GNSS services like GLONASS and GPS. It should cater for IRNSS Services.	
		Synchronization: The SDR should support synchronization by both internal timing source and by time signal from GNSS receiver including IRNSS It is desirable to have an external clock input also apart from timing signal from GNSS Receiver.	
xi	Booting and Switching	The SDR should bootup in less than 90 seconds; Vendor to indicate Max booting time	
		It should be possible to load the waveforms without power off and rebooting.	
		On powering up, the SDR should offer selection of the last operated waveform or any other waveform residing in the SDR.	
xii	Operational Modes	<ul style="list-style-type: none"> • Squelch • Whisper • Sulk 	
B. RF Specifications			
i	Frequency Range	HF: 3 MHz to 30 MHz (Typical) V/UHF: 30 MHz to 512 MHz (Typical) L: 1775 MHz to 1815 MHz (Typical) S: 2200 MHz to 2250 MHz (Typical); Vendor to specify the exact range for each band	
ii	Channel Bandwidth	25 KHz to 5 MHz (Typical) ; 1KHz to 8MHz preferable Actual BW supported by ATC SDR to be specified by vendor	
iii	Channel Selection/ Frequency resolution	1 KHz	
iv	Frequency Accuracy	+/- 1 PPM or better	
v	RF Output Power	a. Transmitter Power: 0.5W to	

		<p>5W adjustable digitally / 5 to 50Watts</p> <p>b. Harmonics: Better than 60dBc</p> <p>c. Spurious :Better than 70dBc</p>	
vi	Carrier Suppression	Greater than 50 dB; Vendor to specify the value	
vii	Sideband Suppression	Greater than 50 dB; Vendor to specify the value	
viii	Receiver Sensitivity	<p>a. Vendor to specify the actual receiver sensitivity separately for AM, FM & other digital modulation schemes for various data rates along with applicable BW for BER of 1×10^{-6}</p> <p>b. Approximate Coverage Range to be specified for each Modulation/ Waveform to be specified</p>	
ix	Image rejection	> 60 dB; Vendor to specify the value	
x	IF rejection	> 80 dB; Vendor to specify the value	
xi	Adjacent channel rejection	>50 dB; Vendor to specify the value	
C. Waveforms			
C.1 Essential			
i	Modern Digital Waveforms	<p>COFDM with Modulations</p> <ul style="list-style-type: none"> • QPSK • 16 QAM • 64 QAM • Any other waveform to be specified by the Vendor 	
		<p>Forward Error Correction</p> <ul style="list-style-type: none"> • CC or CTC • Coding Rates: $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{6}$ • Any other FEC rates supported to be specified by vendor 	
C.2 Desirable			
ii	Additional Waveforms	<ul style="list-style-type: none"> • GMSK • DSSS 	The platform should be capable of

		<ul style="list-style-type: none"> • SOQPSK / CPM 	supporting these additional waveforms
iii	Legacy Waveforms	<ul style="list-style-type: none"> • AM • FM • FSK • PSK 	The platform should be capable of supporting these legacy waveforms
D. Human Machine Interface			
i	Display	Front or external panel display with support for configuration, monitoring and applications; Size & Type of Display to be specified by the Vendor	
ii	User Interface	<ul style="list-style-type: none"> • Status LEDs • Keypad; details of keypad to be specified by the Vendor 	
iii	Physical Buttons	<ul style="list-style-type: none"> • PTT (Push to Talk) Button • Power/Volume Knob • Display On/Off Button • 16-position Channel Selector 	
E. Hardware			
E.1. Interface Specifications			
i	Interfaces	Audio Interface	1 Analog Audio channel with PTT
		Data Interface	Ethernet 10/100/1000 BT & 1GE Opt (optional)
			RS232
			RS485
			USB
Control Interface	Ethernet interface & SNMP Protocol		
ii	Built-in-Test	Power-ON BIT (PBIT) : After Power-ON, it starts automatically and may take about 5 second or less; Vendor to specify the time taken to complete the PBIT. It tests the main functions such as Rx & Tx modes. It also detects	

		<p>installed modules and options and their versions.</p> <p>Initiated or Manual BIT (IBIT): It is the most in-depth of the built-in tests and may take about 10 seconds; Vendor to indicate max IBIT duration</p> <p>Continuous BIT (CBIT): It is a continuous test that runs in the background and has no impact on radio operation or radio settings. The CBIT information may be updated periodically when the radio is switched ON and in operating mode; Vendor to indicate the min & max periodicity that is settable</p>	
E.2 Electrical Specifications			
i	Power Input	<p>The SDR should be capable of working continuously for a minimum period of 8 hours with DC supply of 24V at 1:9 Transmit to Receive ratio with rechargeable and disposable batteries ; Vendor to indicate the Battery capacity for Secondary batteries</p> <p>The radio also should have capability to work off 230 +/- 20% volts AC using provided adapter.</p> <p>Power Consumption: Typical Power Consumption to be specified by the Vendor</p> <p>Battery Charging: Following Battery chargers with suitable connectors should be provided</p> <ol style="list-style-type: none"> a. Solar charger which is foldable and man portable b. Mains Supply charger with a facility to increase the charging rate in order to reduce the charging time of the batteries. c. Time to fully charge the battery to be specified by the Vendor. 	
E.3 Physical Specifications			
i	Weight	Less than 5 Kg including battery. Weight excluding battery to be specified by the Vendor	
ii	Physical Dimensions	Less than 350 mm x 250 mm x 250 mm; Vendor to specify the	

		physical dimension	
iii	Connectors	The SDR should provide interface connectors for connecting data terminal and other accessories	
iv	Control	The SDR should have front panel having control and selector knobs including sulk mode, display and keypad for SDR functioning and programming of parameters.	
E.4 Environmental Qualification Specifications			
i	EMI/EMC	As per latest MIL STD 461G	
ii	Operating Temperature	-40 deg C to +70 deg C	
iii	Storage Temperature	-40 deg C to +85 deg C	
iv	Ruggedisation & Environmental conditions	All the environmental tests including temperature shall be carried out in accordance with the latest version of JSS 55555 as applicable/ as per Customer requirements as per relevant Tables & MIL Std. 810G	
E.5 Reliability, Maintenance and Miscellaneous			
i	Safety	<ul style="list-style-type: none"> • Reverse Polarity • Power and line surge spikes • Short and Open Circuit antenna connection • Over voltage / under voltage protection 	
ii	Emergency Erasure	Facility for emergency erasure should be inbuilt to erase all the keys and algorithm. Tamper detection and response mechanism should be inbuilt in the radio set to automatically erase algorithms, secrecy keys and other operational parameters to make SDR not functional.	
iii	Reliability	The equipment should be capable of continuous operation for at least 72 hours on a single set basis without breakdown. MTBF should be at least 5000 hours and MTTR not more than 24 hours; Vendor to indicate the MTBF	

Ground Data Terminal (GDT) SDR

Product Description:

- The Equipment shall be Single or Multichannel and Multi-band radio that will meet requirements of speech and data for ground-to-ground and ground-to-air communications with software defined waveforms.
- The equipment shall support the creation of Mobile Adhoc Networks (MANET) to provide secure and jam resistant voice, data and video communication

SN	Parameter	Description	Remarks
A. System Specifications			
i	Network Topology	Peer-Peer MANET	
ii	No of Max Nodes	Narrow Band: 32 minimum; vendor to specify the number of Nodes Wide Band: 64 minimum; vendor to specify the number of Nodes	
iii	Transmission Protocols	<ul style="list-style-type: none"> • Unicast • Multicast • Broadcast 	
iv	Channel Bandwidth	25 KHz to 10 MHz (Typical); Vendor to specify the range of Bandwidth that is settable	
v	Data Rates	Narrow Band: 100 Kbps with Channel Bandwidth of < 500 KHz Wide Band: 1 Mbps with Channel Bandwidth of < 5 MHz; Vendor to specify the max. data rates supported	
vi	ECCM	Narrow Band: 100 Hops/sec minimum; Vendor to specify the Hopping rate Wide Band: 500 Hops/sec minimum (1000 Hops/sec preferred); Vendor to specify the Hopping rate	
vii	Network Relay Hops	Voice: 3 Hops minimum; Vendor to specify the Network relay Hops Data: 5 Hops minimum; Vendor to specify the Network relay Hops	
viii	SCA (Software Communication Architecture)	Version 4.1 or latest ; Vendor to specify the version of SCA	
ix	Security	Functionality: <ul style="list-style-type: none"> • Cater for separate additional security module 	

		<p>(SAG gradable hardware module)</p> <ul style="list-style-type: none"> • Hardware based, an appropriate slot and interface to be made available in the SDR • Security support at Transmission level and Message level <ul style="list-style-type: none"> ○ At transmission level, cryptographically controlled frequency hopping ○ At message level, capable of embedding CPC approved user specific cryptographic security 	
		<p>Key Management: The cryptographic algorithms and keys shall be capable of being loaded into the security device via a handheld device/ Key Gun</p>	
		<p>Key Handling and Storage: The SDR shall be capable of secure storage of key information/data for duration as specified the user. The SDR shall provide positive confirmation following each successful key load from the key loading device and should notify in the event of key load failures. Emergency key erasure facility should also be provided</p>	
		<p>User Authentication: The SDR should be password protected for normal usage. Another password authentication should be provided for waveform and mission parameter programming.</p>	
x	Position, Navigation and Timing	<p>GNSS and IRNSS: The SDR should have an inbuilt GNSS receiver catering to multiple</p>	

		GNSS services like GLONASS and GPS. It should cater for IRNSS Services.	
		Synchronization: The SDR should support synchronization by both internal timing source and by time signal from GNSS receiver including IRNSS It is desirable to have an external clock input also apart from timing signal from GNSS Receiver.	
xi	Booting and Switching	The SDR should bootup in less than 90 seconds; Vendor to indicate the max booting time	
		It should be possible to load the waveforms without power off and rebooting.	
		On powering up, the SDR should offer selection of the last operated waveform or any other waveform residing in the SDR.	
xii	Operational Modes	<ul style="list-style-type: none"> • Squelch • Whisper • Sulk 	
B. RF Specifications			
i	Frequency Range	HF: 3 MHz to 30 MHz (Typical) V/UHF: 30 MHz to 512 MHz (Typical) L: 1775 MHz to 1815 MHz (Typical) S: 2200 MHz to 2250 MHz (Typical); Vendor to specify the exact range for each band	
ii	Channel Bandwidth	25 KHz to 10 MHz (Typical) ; 1KHz to 8MHz preferable Actual BW supported by GDT SDR to be specified by vendor	
iii	Channel Selection/ Frequency resolution	1 KHz	
iv	Frequency Accuracy	+/- 1 PPM or better	
v	RF Output Power	a. Transmitter Power: 0.5W to 10W adjustable digitally / 5 to 50Watts	

		<p>b. Harmonics: 60dBc c. Spurious : 70dBc</p> <p>Vendor to indicate the values of Tx Power, Harmonic level & Spurious level</p>	
vi	Carrier Suppression	Greater than 50 dB; Vendor to specify the value	
vii	Sideband Suppression	Greater than 50 dB; Vendor to specify the value	
viii	Receiver Sensitivity	<p>a. Vendor to specify the actual receiver sensitivity separately for AM, FM & other digital modulation schemes along data rates along with applicable BW for BER of 1×10^{-6}</p> <p>b. Approximate Coverage Range to be specified for each Modulation/ Waveform to be specified</p>	
ix	Image rejection	Greater than 60 dB; Vendor to specify the value	
x	IF rejection	Greater than 80 dB; Vendor to specify the value	
xi	Adjacent channel rejection	Greater than 50 dB; Vendor to specify the value	
C. Waveforms			
C.1 Essential			
i	Modern Digital Waveforms	<p>COFDM with Modulations</p> <ul style="list-style-type: none"> • QPSK • 16 QAM • 64 QAM • Any other waveform to be specified by the Vendor 	
		<p>Forward Error Correction</p> <ul style="list-style-type: none"> • CC or CTC • Coding Rates: $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{6}$ • Any other FEC rates supported to be specified by vendor 	
C.2 Desirable			
i	Additional Waveforms	<ul style="list-style-type: none"> • GMSK • DSSS 	The platform should be capable of supporting

		<ul style="list-style-type: none"> • SOQPSK / CPM 	these additional waveforms
ii	Legacy Waveforms	<ul style="list-style-type: none"> • AM • FM • FSK • PSK 	The platform should be capable of supporting these legacy waveforms
D. Human Machine Interface			
i	Display	Front or external panel display with support for configuration, monitoring and applications; Size & Type of Display to be specified by the Vendor	
ii	User Interface	<ul style="list-style-type: none"> • Status LEDs • Keypad; details of keypad to be specified by the Vendor 	
iii	Physical Buttons	<ul style="list-style-type: none"> • PTT (Push to Talk) Button • Power/Volume Knob • Display On/Off Button • 16-position Channel Selector 	
E. Hardware			
E.1. Interface Specifications			
i	Interfaces	Audio Interface	1 Analog Audio channel with PTT
		Data Interface	Ethernet 10/100/1000 BT & 1GE Opt (optional)_
			RS232
			RS485
		Control Interface	Ethernet interface & SNMP Protocol
ii	Built-in-Test	Power-ON BIT (PBIT) : After Power-ON, it starts automatically and may take about 5 second or less; Vendor to specify the time taken to complete the PBIT. It tests the main functions such as Rx & Tx modes. It also detects installed modules and options and	

		<p>their versions.</p> <p>Initiated or Manual BIT (IBIT): It is the most in-depth of the built-in tests and may take about 10 seconds; Vendor to indicate the max time for IBIT</p> <p>Continuous BIT (CBIT): It is a continuous test that runs in the background and has no impact on radio operation or radio settings. The CBIT information may be updated every second when the radio is switched ON and in operating mode</p>	
E.2 Electrical Specifications			
i	Power Input	<p>The SDR should be capable of working continuously for a minimum period of 8 hours with DC supply of 24 V at 1:9 Transmit to Receive ratio with rechargeable and disposable batteries; Vendor to indicate the Battery capacity</p> <p>The radio also should have capability to work off 230 +/- 20% volt AC using provided adapter.</p> <p>Power Consumption: Typical Power Consumption to be specified by the Vendor</p> <p>Battery Charging: Following Battery chargers with suitable connectors should be provided</p> <ul style="list-style-type: none"> a. Solar charger which is foldable and man portable b. Mains Supply charger with a facility to increase the charging rate in order to reduce the charging time of the batteries. c. Time to fully charge the battery to be specified by the Vendor. 	
E.3 Physical Specifications			
i	Weight	<p>Less than 5 Kg including battery. Weight excluding battery to be specified by the Vendor</p>	
ii	Physical Dimensions	<p>Less than 350 mm x 250 mm x 250 mm; Vendor to specify the physical dimension</p>	
iii	Connectors	<p>The SDR should provide interface connectors for connecting data terminal and other accessories</p>	

iv	Control	The SDR should have front panel having control and selector knobs including sulk mode, display and keypad for SDR functioning and programming of parameters.	
E.4 Environmental Qualification Specifications			
i	EMI/EMC	As per latest MIL STD 461	
ii	Operating Temperature	-40 deg C to +70 deg C	
iii	Storage Temperature	- 40 deg C to +85 deg C	
iv	Ruggedisation& Environmental conditions	All the environmental tests including temperature shall be carried out in accordance with the latest version of JSS 55555 as applicable/ as per Customer requirements as per relevant Tables and MIL Std. 810F/G	
E.5 Reliability, Maintenance and Miscellaneous			
i	Safety	<ul style="list-style-type: none"> • Reverse Polarity • Power and line surge spikes • Short and Open Circuit antenna connection • Over voltage / under voltage protection 	
ii	Emergency Erasure	Facility for emergency erasure should be inbuilt to erase all the keys and algorithm. Tamper detection and response mechanism should be inbuilt in the radio set to automatically erase algorithms, secrecy keys and other operational parameters to make SDR not functional.	
iii	Reliability	The equipment should be capable of continuous operation for at least 72 hours on a single set basis without breakdown. MTBF should be at least 5000 hours and MTTR not more than 24 hours; Vendor to indicate the MTBF Value	

A. Finalization of detailed requirements

Vendor shall finalize the detailed requirements for hardware (electrical & mechanical), software and test procedures in consultation with ITI and submit the same to ITI, after the placing of order.

ANNEXURE-A : DELIVERABLES FOR MOBILE HANDSET INTERFACE UNITS at RFP Stage

Sl. No.	Item	Qty
Section A.	Functional units	
1	<p>Supply of functional Software Defined Radio (SDR)unit meeting all the functional and performance requirements as per the Technical Specification.</p> <p>SDR one Set is as follows:</p> <ul style="list-style-type: none"> a. Handheld SDR - 1 No. b. Manpack SDR - 1No. c. Manpack HF - 1 No d. Truck Ground SDR - 1 No. e. Truck Ground HF - 1 No f. AFV (Armoured Fighting Vehicles) SDR - 1No. g. AFV HF - 1No. h. Heptr Configuration 1 - 1 No. i. Heptr Configuration 2 - 1 No. j. Air Traffic Controller (ATC) - 1 No. k. Ground Data Terminal (GDT) - 1 No. <p>Note: Complete knock down kits of Software Defined Radio (SDR)unit are to be supplied as per Section-C (Only 6 sets of CKD kits of Software Defined Radio (SDR)unit are to be supplied in addition to supply of 6 sets of Software Defined Radio (SDR)unit).</p>	6 Sets
Section B.	Software & Accessories	

1	Source code of all FPGA, Software and Microcontrollers for functional for Software Defined Radio (SDR)unit meeting all the functional and performance requirements as per the Technical Specification; Foreign Vendors shall agree for PROVIDING ALL DOCUMENTATION for Manufacturing ToT for productionising of SDRs at ITI; Willingness to transfer the IPR may be commented for Foreign Vendors.	1 Set (for each of 11 form factors)
2	Test results of all 10 Software Defined Radio (SDR)unit (hard and soft copy).	1 Set (for each of 11 form factors)
3	List of test & Measuring instruments for Software Defined Radio (SDR)unit (hard and soft copy).	1 Set
4	User manual with precautions & procedures to put into service and operate the module to full capacity for Software Defined Radio (SDR)units (hard & soft copy).	1 Set (for each of 11 form factors)
5	Detailed process & procedure to port add-on software at ITI end for Software Defined Radio (SDR) unit (hard and soft copy).	1 Set (for each of 11 form factors)
6	Hands on training for operation, maintenance and trouble shooting at ITI premises for Software Defined Radio (SDR)unit and associated units.	11 weeks
Section C.	Complete Knock Down (CKD) Kits	
1	Kit of complete parts for Software Defined Radio (SDR)unit including PCBs, components, mechanical parts, and fixing items.	6 Sets. (1 for each of 11 form factors)
2	Detailed BoMs for Software Defined Radio (SDR)unit covering Electrical/Electronics/Mechanical parts and fixing items including front panel with sensor to erase (hard & soft copy in A3 or A4 format suitable to view/edit in AUTOCAD).	1 Set (for each of 11 form factors)
3	Sources of supply for Software Defined Radio (SDR)unit for the items covered in the BoMs with multiple sources (min 4) for each item (hard & soft copy).	1 Set (for each of 11 form factors)
4	Detailed assembly drawings for Software Defined Radio (SDR)unit (hard & soft copy in A3 or A4 format suitable to view/edit in AUTOCAD).	1 Set (for each of 11 form factors)
5	Technical document for the methods involved in manufacturing & assembly process for Software Defined Radio (SDR)unit (hard & soft copy).	1 Set (for each of 11 form factors)
6	Complete PCB design project files for all types of PCBs of Software Defined Radio (SDR)unit suitable for standard PCB design package (soft copy).	1 Set (for each of 11 form factors)

		factors)
7	Gerber files for all types of PCBs (RS274X format) for all layers, legend markings, solder masks, etc. of Software Defined Radio (SDR)unit (soft copy).	1 Set (for each of 11 form factors)
8	Details of PCB complexity like number of layers, minimum track width, pad to pad/track distance, minimum drill diameter, etc for all types of Software Defined Radio (SDR)unit (hard & soft copy).	1 Set (for each of 11 form factors)
9	Gerber file for stencil and file for X-Y co-ordinates/orientation, for complete SMT assembly of components of all PCBs of Software Defined Radio (SDR)unit (soft copy).	1 Set (for each of 11 form factors)
10	Individual PCB layer graphical data of all PCBs of Software Defined Radio (SDR)unit in AUTOCAD format (soft copy).	1 Set (for each of 11 form factors)
11	Drill data details of all PCBs of Type-A & Type-B, in the medium and format (EXELLON) compatible with CNC machines in the market (soft copy).	1 Set (for each of 11 form factors)
12	Bare board testing data for inspection of all PCBs of Software Defined Radio (SDR)unit (soft copy).	1 Set (for each of 11 form factors)
13	Software built into all the programmable devices of all modules of Software Defined Radio (SDR)unit as bit file / MCS file (soft copy).	1 Set (for each of 11 form factors)
14	Programmer unit with associated driver software suitable for latest OS to program software controlled parts of modules of Type-A & Type-B.	1 Set (for each of 11 form factors)
15	Source code for the software built into the programmable devices of all the modules of Software Defined Radio (SDR)unit (soft copy).	1 Set (for each of 11 form factors)
16	List of development tools for the design & development of firmware of all modules of Type-A & Type-B.	1 Set (for each of 11 form factors)
17	Right to amend the design of all modules to suite the future requirements of customer.	1 Set (for each of 11 form factors)
18	Functional block diagram of all modules of Software Defined Radio (SDR)unit (hard & soft copy)	1 Set (for each of 11 form factors)

		factors)
19	Functional description of all modules of Software Defined Radio (SDR)unit (hard & soft copy).	1 Set (for each of 11 form factors)
20	Circuit schematic/Layout of all PCBs and also the schematic of inter module connectivity within Software Defined Radio (SDR)unit (hard and soft copy).	1 Set (for each of 11 form factors)
21	Technical document for the detailed testing procedure at all module /unit levels of Software Defined Radio (SDR)unit (hard & soft copy)	1 Set (for each of 11 form factors)
22	Vendor to provide ATP document for Software Defined Radio (SDR)unit (hard & soft copy)	1 Set (for each of 11 form factors)
23	Hands on training for assembly, testing and trouble shooting, porting of software of all modules of Software Defined Radio (SDR)unit to Technicians / Engineers at ITI premises.	4 weeks
24	List of proprietary test/measuring instruments including special functions / packages for functional verification of Software Defined Radio (SDR)unit (hard & soft copy).	1 Set (for each of 11 form factors)
25	Proprietary test accessories & test jigs including software.	1 Set (for each of 11 form factors)
26	Vendor to conduct EMI/EMC/Environment tests to meet specified requirements at unit level and submit the test results and test certificates for successful completion for Software Defined Radio (SDR)unit (hard copy)	1 Set (for each of 11 form factors)

ANNEXURE-B :TERMS & CONDITIONS FOR SOFTWARE DEFINED RADIO (SDR)

2. **NDA:** Vendor shall give NonDiscloser Agreement (NDA) for the quoted product along with Technical offer.
3. **Confidentiality:** Vendor should not disclose/display on their website, Brochures, showcase the quoted product in any kind of exhibitions or in any other form to third party.
4. **Design Reuse:** Vendor should not sell same product or product architecture consist of 80 percent of used component on quoted product.
5. **PCB Design:** Vendor shall design PCB with available package at ITI CAD group premises for the quoted product.
6. **Progress Report:** Periodic presentation on progress of intermediate hardware and software architecture to be provided.
7. **ToT:** Vendor shall give the full transfer of technology (ToT) for the quoted product, for in-house production. All deliverables shall be re-usable, re-modifiable and re-compileable.
8. **Royalty-free:** Vendor shall not have any proprietary components with specific firmware and the ToT is totally royalty/license free.
9. **Warranty:** Standard warranty shall be for 2 year (free of charge) from the date of completion of ToT for the Hardware / Firmware and ToT. During warranty period, vendor shall also support to resolve all the issues observed during the fabrication of PCBs and assembly/testing of units at ITI premises and field integration and network issues including Software & Hardware issues.
10. **ATP:** Acceptance tests shall be conducted along with ITI officials at ITI premises in ITI's Testbed as per mutually agreed ATP. Vendor shall carryout modification of all units (hardware/software) including documents to incorporate any changes observed during testing at any stage.
11. **Technical support:** Technical support shall be extended to resolve the Network integration problems in 2 year warranty period (free of cost) and on chargeable basis beyond warranty period for a period of 5 years which includes Software upgrades & Hardware modifications. Vendor shall visit the ITI premises & end-user sites to resolve the issues observed during testing/warranty period.
12. **Schedule:** a.
 - i. Total period of development & qualification testing shall be approximately 36 Months from the PO date.
 - ii. Interested parties may indicate the timeframe for development & Qualification testing for each of the 11 types of SDRs.