

भारत सरकार/GOVERNMENT OF INDIA
अंतरिक्ष विभाग, इसरो/DEPARTMENT OF SPACE, ISRO
इसरो मुख्यालय/ISRO HEAD QUARTERS
क्रय एवं भंडार प्रभाग/PURCHASE & STORES DIVISION
दूरभाष/Tel: (080) 2217 2248/2249/2142
ई-मेल/email: spso_isrohq@isro.gov.in, pso_isrohq@isro.gov.in

अभिरुचि की अभिव्यक्ति/ EXPRESSION OF INTEREST

संदर्भ सं. इसरो/डी.टी.डी.आई./ई.ओ.आई./टेक/उद्योग/1/2023
Ref. No. ISRO/DTDI/EOI/TECH/INDUSTRY/1/2023

दिनांक/Date: 16/03/2023

“भारतीय अंतरिक्ष कार्यक्रम हेतु प्रौद्योगिकियों/उत्पादों/प्रणालियों के विकास में उद्योगों के माध्यम से
आत्मनिर्भरता” के प्रति अभिरुचि की अभिव्यक्ति

**EXPRESSION-OF-INTEREST towards “Atmanirbharta in Development of
Technologies/Products/Systems for Indian Space Programme through industries”**

इसरो मुख्यालय, भारतीय अंतरिक्ष कार्यक्रम हेतु प्रौद्योगिकियों/उत्पादों/प्रणालियों के विकास में उद्योग के माध्यम से
आत्मनिर्भरता के हेतु प्रत्याशित उद्योगों से ई.ओ.आई. आमंत्रित करता है। इच्छुक पक्षकार अपनी अभिरुचि की
अभिव्यक्ति, मुहरबंद लिफाफे में, संदर्भ सं. इसरो/डी.टी.डी.आई./ई.ओ.आई./टेक/उद्योग/1/2023 का
उल्लेख करते हुए 17/04/2023 [16:00 बजे] तक या उससे पहले निम्नलिखित पते पर प्रस्तुत कर सकते हैं :-

ISRO HQ invites EOI from prospective Industries towards Atmanirbharta in Development of
Technologies/Products/Systems for Indian Space Programme through Industries. Interested
parties may furnish their **Expression of Interest in Sealed Envelope** quoting our **Reference
No. . ISRO/DTDI/EOI/TECH/INDUSTRY/1/2023 on or before 17/04/2023 [16:00 Hrs.]** to the
following address :-

वरिष्ठ क्रय एवं भंडार अधिकारी/Sr. Purchase & Stores Officer,
क्रय अनुभाग, इसरो मुख्यालय/Purchase Section, ISRO Headquarters,
अंतरिक्ष भवन, न्यू बी.ई.एल. रोड/Antariksh Bhavan, New BEL Road,
बेंगलूरु/Bengaluru – 560 094
फोन/Ph: 080-2217 2248/2249/2142

नोट/Note :- मेक इन इंडिया नीति के अनुसार केवल श्रेणी-I तथा श्रेणी-II के स्थानीय आपूर्तिकर्ता इस
ई.ओ.आई. में भाग लेने हेतु पात्र हैं।

**Only Class-I and Class-II Local suppliers as per Make in India policy are
eligible to participate in the EOI.**

हस्ताक्षरित/Sd/-
वरिष्ठ क्रय एवं भंडार अधिकारी/Sr.Purchase & Stores Officer

**GOVERNMENT OF INDIA
DEPARTMENT OF SPACE
INDIAN SPACE RESEARCH ORGANIZATION HEADQUARTERS**
Tel: (080) 2217 2248/2249/2142; Email: spsos_isrohq@isro.gov.in, psos_isrohq@isro.gov.in

INVITATION FOR EXPRESSION OF INTEREST

Ref.No. ISRO/DTDI/EOI/2/23

Date: 16.03.2023

**Atmanirbharta in Development of Technologies/ Products/ Systems for
Indian Space Programme**

Indian Space Research Organisation (ISRO) under Department of Space (DoS) has been carrying out end-to-end space activities viz. designing, developing, and realizing the launch vehicles and spacecrafts, launching and services as well. Research and Development (R&D) has been the backbone of ISRO. The organization is pursuing multidisciplinary R&D programmes related to its major verticals viz., space transportation, space infrastructure, space applications, ground systems and human space exploration. Various ISRO Centres/ Units spread across the country are carrying out the R&D activities with the in-house expertise and facilities.

Supports from industries are also being harnessed through mechanisms like Purchase Order including technology developmental orders for various space systems of ISRO, Contract, Memorandum of Understanding, Technology Transfer etc. Many products are successfully developed and realized through industries for the Indian space programme. Some of the success stories in this regard are flashed in the next page.

Currently ISRO is in the need of developing certain potential technologies/ products/ systems for its programmes in a time-bound manner. In this context, an invitation for Expression of Interest (EOI) is hereby floated to identify suitable Indian industries for the development of identified technologies/ products/ systems in a time-bound manner.

Interested Indian industries may submit their Expression of Interest to Senior Purchase & Store Officer, ISRO Headquarters, Bengaluru – 560094 quoting reference number within 30 days from the date of appearance of this advertisement. The EOI should contain all the required details as mentioned in the document ref no. ISRO/DTDI/EOI/2/23 which is available in our website www.isro.gov.in.

For further queries, if any, Senior Purchase & Store Officer, ISRO Headquarters may be contacted (preferably through e-mail: spsos_isrohq@isro.gov.in, psos_isrohq@isro.gov.in) quoting this advertisement reference.

Some of the success stories: Products developed and realized through Industries for Indian Space programme



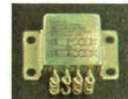
High Power & high Current DC contactor, used in Electromechanical actuator of launch vehicle control systems



Crystal Oscillator



Vikram Processor



Low & high current relays

Critical electronic components used in launch vehicle avionics system



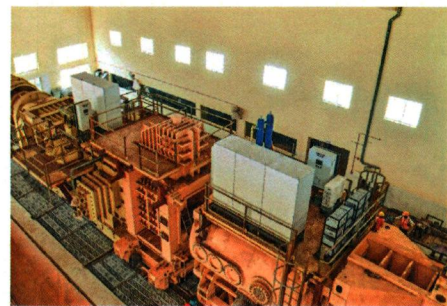
Indian Rail Navigator, provides real-time Train-tracking information for improving operational efficiency, control and management for Indian Railways



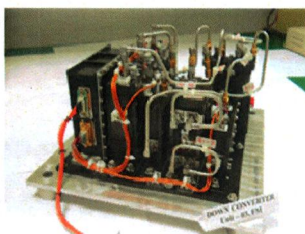
MSS Xponder for Coastal Monitoring, enables periodic position reporting, two-way messaging, boundary crossing alerts and emergency broadcast reception system for maritime domain



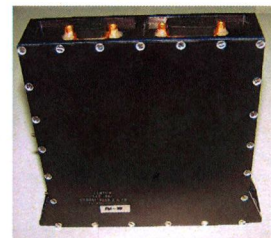
Liquid Hydrogen Tank for storing cryogenic Hydrogen propellant with liquid Nitrogen shielding



Tri-sonic Wind Tunnel, to aid aerodynamic design of rockets and re-entry spacecrafts



Ultra-high frequency Low Noise Amplifier & Down Converter, provides some degree of flexibility to change the operating frequency plan post launch by ground command



Electronic power conditioner, used for various Communication & Navigation Payload



Invitation for Expression of Interest (EOI)

from

Indian Industries

for

Atmanirbharta in

**Development of Technologies/ Products/
Systems for Indian Space Programme**

March 2023

Directorate of Technology Development and Innovation
Indian Space Research Organization Headquarters
Department of Space, Government of India
Antariksh Bhavan, New BEL Road
Bengaluru – 560094, India

1. INTRODUCTION

Indian Space Research Organisation (ISRO) under Department of Space (DoS) has been carrying out end-to-end space activities viz. designing, developing, and realizing the launch vehicles and spacecrafts, launching and services as well. Research and Development (R&D) has been the backbone of ISRO. The organization is conducting various research programmes or projects over the decades to fulfil its needs. ISRO is pursuing multidisciplinary R&D programmes related to its major verticals viz., space transportation, space infrastructure, space applications, ground systems and human space exploration. Various ISRO Centres/ Units spread across the country are carrying out the R&D activities with the in-house expertise and facilities. Supports from industries are also being harnessed through mechanisms like Purchase Order (PO) including technology developmental orders for various space systems of ISRO, Contract, Memorandum of Understanding (MoU), Technology Transfer (TT) etc.

Currently ISRO is in the need of developing certain potential technologies/ products/ systems for its programmes in a time-bound manner. In this context, an invitation for Expression of Interest (Eoi) is hereby floated to identify suitable Indian industries for the development of identified technologies/ products/ systems in a time-bound manner.

2. OBJECTIVES

The main objective of this Eoi is to engage eligible Indian industries (hereafter called 'Parties') to develop the technologies / products / Systems (hereafter called 'Items' for space programmes of ISRO. In this regard, Parties are required to study the list of items notified through this Eoi and carry out the feasibility study of the development by them. The list encompasses technologies required for launch vehicles, satellites, application sectors, human space flight and space exploration etc. Detailed proposals including the plan of realization are solicited from potential Parties for developing/ realizing the items in a time-bound manner. The format for submission of the proposals is given in Annexure-A.

3. LIST OF TECHNOLOGIES / PRODUCTS / SYSTEMS (ITEMS)

The list of technologies/products/systems which are to be developed through industries are list in the table-1 (below).

Table 1: List of technologies/products/systems

Sl. No.	Proposal ID	Name of the Technology / Product / System	Lead Centre of ISRO
1.	TDI001	Design, realization and flight testing of sub-scale Hybrid Drone Prototype for DroneNet	VSSC
2.	TDI002	Development of hexagonal honeycomb core	VSSC
3.	TDI003	Development of thin ply (70 gsm) cryo compatible prepreg system	VSSC
4.	TDI004	Development of Leaded Carbon Chip & Wire wound Resistors for Launch Vehicle	VSSC
5.	TDI005	Development of High Current Relays for Launch Vehicle	VSSC
6.	TDI006	Development of inductors	VSSC
7.	TDI007	Processing of Bi-metallic Adaptors (BMA) by Diffusion Bonding Technology and EB welding Technology	VSSC
8.	TDI008	Realization of scandate hollow thermionic emitter	VSSC
9.	TDI009	DC Contactor Development 600V/250A	VSSC
10.	TDI010	Development of surfactant, catalyst and curing agent (MDI) for polyurethane foams for cryogenic applications	VSSC
11.	TDI011	Development of onboard Telemetry system for NGLV	VSSC
12.	TDI012	Development of miniaturized VIS for NGLV	VSSC
13.	TDI013	Development of metallic TPS for future RLV missions	VSSC
14.	TDI014	Design and development of light weight additively manufactured 6U size metallic avionic enclosure	VSSC
15.	TDI015	3D printing of brackets and rings for structural applications in SSLV	VSSC
16.	TDI016	Development of BLDC motor for 30 KN engine	LPSC
17.	TDI017	Development of PS4 propellant tank through additive manufacturing	LPSC
18.	TDI018	Realization of spacecraft propellant tank parts by additive manufacturing with Ti6Al4V material	LPSC
19.	TDI019	Development of low power, low cost propellant Hall effect thruster based EPS as full package including thruster, power systems, propellant storage and feed systems	LPSC
20.	TDI020	Quad bridge Loadcell	SDSC

Sl. No.	Proposal ID	Name of the Technology / Product / System	Lead Centre of ISRO
21.	TDI021	Subsystem for the twin MRS85 rail track change-over system	SDSC
22.	TDI022	SCADA Software	SDSC
23.	TDI023	TDI chemcassette portable / fixed type monitor system for quantitative measurement of toxic Toluene Di-isocyanate vapours in propellant processing	SDSC
24.	TDI024	Development of multiple energy Linac based industrial X – ray machines	SDSC
25.	TDI025	Development of flat panel detectors for X – ray radiography	SDSC
26.	TDI026	Industrial Grade Dual 24VDC powered DIN Mounted L2 Managed Switches/ PoE Switch	SDSC
27.	TDI027	Ex. Certified CCTV PTZ/Fixed IP Cameras	SDSC
28.	TDI028	Inflatable end cap for segments maintenance during storage in magazine	SDSC
29.	TDI029	MEMS Accelerometer	IISU
30.	TDI030	Configurable Scan Mechanisms For Spacecrafts	IISU
31.	TDI031	Advanced Coating Techniques For High Speed Ball Bearing	IISU
32.	TDI032	Miniature SADA For Indian Miniature Satellite Bus	IISU
33.	TDI033	Active Vibration Control	IISU
34.	TDI034	Tethered Altitude Sensing Mechanism	IISU
35.	TDI035	Micro DTG Development	IISU
36.	TDI036	Nano & Micro Control Moment Gyroscope	IISU
37.	TDI037	Development of MMOD Impact Detection Sensor	HSFC
38.	TDI038	Dynamic Simulator	HSFC
39.	TDI039	Motorized butterfly valve for fluid flow control	HSFC
40.	TDI040	Centrifugal Blower	HSFC
41.	TDI041	Crew Hygiene Management System	HSFC
42.	TDI042	Design and development of Viewport	HSFC
43.	TDI043	Development of a Head Mount Display (HMD) for Gaganyaan crew for providing situational awareness	HSFC
44.	TDI044	Motorized ball valve for liquid shutoff	HSFC
45.	TDI045	Trapped mercury-ion atomic clock physics package+B2:B30	SAC
46.	TDI046	M-type Dispenser Cathode	SAC
47.	TDI047	Design, Development, Fabrication and Testing of miniaturized High Voltage Electronic Power Conditioner (HVEPC) for 4 collector (up to 7KV) Travelling Wave Tube Amplifiers	SAC

Sl. No.	Proposal ID	Name of the Technology / Product / System	Lead Centre of ISRO
48.	TDI048	Development of Erbium Doped Fiber Optical Amplifier (EDFA) Two types of EDFA will be required 1.1 High Power EDFA: up to 5W 1.2 Low Noise EDFA: -60dBm sensitivity	SAC
49.	TDI049	10cm telescope assembly with coarse and fine pointing mechanism for Optical Communication Terminal	SAC
50.	TDI050	MiniSAR upgrade / ver 2.0	SAC
51.	TDI051	Compact, Field-Deployable, Ground Based Atmospheric Sounder	SAC
52.	TDI052	High Power GaN Devices using GaN Power Bars	SAC
53.	TDI053	Miniaturized L & S band transceiver terminal for M2M (Machine to Machine Communication) Communication within SatCom based IoT framework	SAC
54.	TDI054	FPGA Based SDR Platforms for Space & Ground	SAC
55.	TDI055	Aeromobile Terminal (Electronic Beam Steering / Beam Forming Planner Antenna array, Frequency Converter Units, Broadband Modem, Baseband System, Antenna Control Unit with sensors etc.)	SAC
56.	TDI056	Handheld NavIC/GNSS Receiver with D-GNSS and dead reckoning capability	SAC
57.	TDI057	Optical systems for Navigation (Autonomous/Non-autonomous) and communication	SAC
58.	TDI058	Development of High Resolution X-Band Agile SAR Payload (RISAT-2B series follow-on)	SAC
59.	TDI059	LTCC based, hermetically sealed X-Band Transmit Receive Module	SAC
60.	TDI060	Development of space grade Pulsed TWTA	SAC
61.	TDI061	S-Band foldable antenna array with beam steering capability (Tech: Antenna Array, Analog beam former, controller)	SAC
62.	TDI062	CCSDS Compliant Ground Modems	SAC
63.	TDI063	VSAT Baseband System (TDM (DVB-S2x)/MF-TDMA) (It includes DVB-S2x HUB Modulator, TDMA, Demodulators, Network Control Processor, Network, Management System, Time Frequency Generation Units, and Remote Baseband Subsystem etc.)	SAC
64.	TDI064	Frequency Converter Units (C, Ku, Ka, Q, V Band)	SAC
65.	TDI065	Glass substrate for rigid OSR (Cerium Doped borosilicate glass substrate)	URSC
66.	TDI066	Variable Emissive Thermal Tape (Electro Chromic)	URSC

Sl. No.	Proposal ID	Name of the Technology / Product / System	Lead Centre of ISRO
67.	TDI067	Smart Radiator (Variable Emissivity -Thermo-chromic), Electric Resistance Heating Tapes, Etched Foil Heaters with Polyimide Cladding Adhesive	URSC
68.	TDI068	C/Ku 500W/750W TWT Amplifiers	MCF
69.	TDI069	Frequency Up/Down Converters (C/Ext-C/Ku)	MCF
70.	TDI070	Baseband IF Switch Matrix	MCF
71.	TDI071	20 / 50 / 100W Outdoor SSPA in C-Band / Ext. C-Band / Ku-Band	MCF
72.	TDI072	Low Noise Amplifiers in C, Ext-C and Ku Frequency Bands	MCF
73.	TDI073	Low Noise Block Converters in C, Ext-C and Ku Frequency Bands	MCF
74.	TDI074	RF Switches (Coaxial and Waveguide)	MCF
75.	TDI075	Directional Couplers	MCF
76.	TDI076	Servo Drives & Brushless DC/AC Servo Motor	MCF
77.	TDI077	Digital Twins	NRSC
78.	TDI078	Bhuvan Data Cube	NRSC
79.	TDI079	Development of NavIC Post -Processing software for Precision Applications	NRSC
80.	TDI080	Development of a low cost & portable bathymetry system for in-situ measurements	NRSC
81.	TDI081	Antenna Control Servo System for AZ-EL mount 4.5 M antenna	NRSC
82.	TDI082	Satellite data Processing & Acquisition Reconfigurable card (SPARC) Data Ingest Hardware	NRSC
83.	TDI083	Spatial inventory of agroforestry resources using geospatial technology and AI with very high-resolution images	NRSC
84.	TDI084	Development of Centralized electronics unit for processing data from multiple sensors.	LEOS
85.	TDI085	Development of ground based telescope, install and make it operational	LEOS
86.	TDI086	PAT system for free space inter-satellite Laser communication link	LEOS
87.	TDI087	Gyro Processing Electronics module with industrial/automotive grade components	LEOS
88.	TDI088	Millimetre Wave Cloud Radar System	ISTRAC
89.	TDI089	X-Band Solid State based Polarimetric Doppler Weather Radar System	ISTRAC

Sl. No.	Proposal ID	Name of the Technology / Product / System	Lead Centre of ISRO
90.	TDI090	C-Band Solid State based Polarimetric Doppler Weather Radar System	ISTRAC
91.	TDI091	Phased Array based Polarimetric Doppler Weather Radar System	ISTRAC
92.	TDI092	Urban flooding surveillance system using multi radar and sensor network	ISTRAC
93.	TDI093	Boundary Layer Wind Profiler	ISTRAC
94.	TDI094	Mid Tropospheric Wind Profiling Radar	ISTRAC
95.	TDI095	Space Debris Surveillance & Tracking Radar	ISTRAC
96.	TDI096	High Power Transmitter development using Vacuum tubes for ground based system	ISTRAC
97.	TDI097	High Power Transmitter development using Solid State Power Amplifier (SSPA) for ground based system	ISTRAC
98.	TDI098	Development of X-band dual polarized Doppler Weather Radar	ISTRAC
99.	TDI099	L-band GaN based Transmit Receive module with high power output	ISTRAC
100.	TDI100	RF Monitoring, Direction Finding and Geo-location system for SDSC SHAR	ISTRAC

The details of each item listed above are available as Annexure-I for more clarity and understanding.

Interested parties can also visit ISRO HQ/ Concerned ISRO Centres/ Units for understanding the quantum of works and clarifications, if any, during any working days [Monday to Friday, Between 10:00 – 15:00 hr] before the tender due date. Request for visit needs to be sent to Senior Purchase & Stores Officer, ISRO HQ through email in advance and consent to be obtained from ISRO HQ before the visit. Prevailing entry and security guidelines of the concerned ISRO Centres/ Units have to be strictly complied during the visit.

4. SUBMISSION OF THE PROPOSALS

The Proposals are to be submitted in the specified format given in Annexure-A, through the Head of the Industry (send the advance copy in “Word” and the signed pdf copy by speed post/ email) to:

Senior Purchase and Stores Officer,

ISRO Headquarters, Antariksh Bhavan, New BEL Road, Bangalore-560094

Email: spso_isrohq@isro.gov.in, psso_isrohq@isro.gov.in

The last date for receiving the proposal is 17th April, 2023. The proposal submitted beyond the last date will not be accepted.

5. REVIEW OF THE PROPOSALS

The proposals submitted by the Parties may be subjected to review by a Review and Shortlisting Committee (RSC) constituted by ISRO. In order to identify the suitability of the proposal and the Party, the proposals may be further fine-tuned by the Party and Parties may be required to interact with ISRO as and when required. The shortlisted proposals are expected to incorporate suggestions made by the committee.

6. SELECTION PROCESS

ISRO shall carry out shortlisting of the eligible proposals from the Parties based on technical merits of the proposal, technical expertise of the Party, feasibility perspective, cost effectiveness and verification of testimonials submitted. Assigned weightage for major attributes are given as follows.

Table 2: Weightage distribution among Attributes

Sl. No.	Attribute	Weightage (Max.)
1	Scientific/Technological objectives	10
2	Design approach and specifications, development process, test, evaluation and collaboration procedures.	20
3	Technical and Scientific team with domain experts	10
4	Technical infrastructure availability like development facilities, laboratory, testing etc.	20
5	Development strategy: Lab model, proto model, engineering model, Flight model/ final product	10
6	Deliverables (clearly define)	10
7	Schedule	10
8	Similar developments carried out earlier	10
Total		100

- Information pertaining to the above should invariably be submitted by the parties for evaluation.
- As part of evaluation, parties may be asked to provide clarifications or to give a presentation on their brief business profile which shall touch upon above attributes and proposed executing strategy for this contract. Communication in this regard will be sent by ISRO HQ.
- DOS/ISRO will take up references and reserves the right to pay due heed to the Bidder's performance elsewhere and any past experience.
- Screening of offers shall be carried out as per weightage mentioned in this document and based on verification of testimonials submitted.
- **Minimum weightage of 70 is essential for an offer to qualify for further stages of processing.**
- Upon the completion of EoI offer evaluation, Request for Proposals (RfP) will be issued to the shortlisted parties by the concerned ISRO Centres/ Units for the selected items. After completing the RfP evaluation, concerned ISRO Centres/ Units shall enter into Memorandum of Understanding (MoU) /Contract to the shortlisted Parties for the selected items. Details will be elaborated in the RfP.
- ISRO reserves the right to enter into multiple MoUs/ Contracts with more than one party for any item given in Table-1, if necessary. In such cases, techno-commercial negotiation will be done to unify the offers at technically qualified L1 (Lowest cost) level.

7. PAYMENT

After signing the MoU or release of Contract, payment will be released by ISRO to the shortlisted parties for the selected items, based on the defined milestone / deliverables, which shall be elaborated in the specific MoU / Contracts.

After signing the MoU/ Contract, evaluation of progress will be done by ISRO at various stages/ phases as follows and funding will be made accordingly:

- Configuration phase (submission of System Configuration Report (SCR))
- Design phase (submission of Baseline Design Report (BDR))
- Proto model generation phase
- Engineering model realization phase
- Final product realization phase

ISRO reserves the right to allow for continuation or termination of the activity, depending upon the progress. This aspect will be more elaborated in the MoU/ Contract.

8. SCHEDULE OF REALIZATION AND DELIVERY

After signing the MoU/ Contract, concerned party has to submit detailed schedule of realization, which includes overall completion period and key milestones vis-a-vis schedule within 1 month for the review by concerned ISRO Centres/ Units.

9. GENERAL TERMS AND CONDITIONS

- i. Parties should peruse this EoI only if it considers itself eligible and if it is in possession of all documents/information required as per EoI.
- ii. The EoI responses must be submitted on or before the due date. ISRO will not be responsible for non-receipt of offer due to any postal delays/loss of response documents in transit and delay due to customs/courier, etc. and it shall be the sole responsibility of the Parties to ensure delivery of the offers within the time fixed. Offer received after stipulated time and date will be rejected outright.
- iii. The requirements stated herein are minimum criteria and ISRO reserves the right to request for any additional information and also reserves the right to reject the EoI response of any Party, if in the opinion of ISRO, the qualification or data is incomplete or if the Party is found not qualified to satisfactorily perform the Contract.
- iv. Outsourcing / Sub-contracting of the activity, undertaken through this EoI, to 3rd party like other institute/ organization/ academia can be allowed only with the prior approval of ISRO.
- v. If a Party is found ineligible after opening the offer, the offer submitted by the Party shall become invalid ipso facto, and any cost borne by the Party while responding to this EoI shall not be refunded. EoI responses which are not in compliance with the terms & conditions shall be rejected, without assigning any reasons thereof. Failure to furnish all requisite information and/or documents shall result in repudiation of the offer.
- vi. The Parties shall bear all costs and expenses, if any, associated with preparation and submission of offer including post EoI clarifications, discussions, technical and other presentations and ISRO will in no case be

responsible or liable for such costs, regardless of the outcome of the process. The Parties shall also not be entitled to claim any costs, charges and expenses incidental to or incurred by it through or in connection with the submission of offer or its consideration by ISRO.

- vii. The Parties shall not hold ISRO responsible for any harm or bodily injury or death, any loss of equipment or property during realization/development of the technology/product/system.
- viii. The Technology/Product/System developed by the Parties in collaboration with ISRO as response to this EoI, shall not be allowed to be used for marketing/business purposes without prior permission from ISRO. ISRO reserves the right to accord or not to accord permission on such cases, considering the overall national interests.
- ix. **Intellectual Property Rights:**
 - a. Any/ All Intellectual Property Rights such as patents, copyrights, design rights etc. acquired by the Parties, through the design, development and realization of the technology/product/system shall be jointly owned by ISRO and the Party concerned, regardless of funding support.
 - b. Any commercialization of such IP rights by the Party shall be done only with the consent / permission from ISRO, on mutually agreed specific terms and conditions, which shall be determined on a case by case basis by ISRO.
- x. The shortlisted Parties shall be required to enter into a Non-Disclosure Agreement (NDA) with ISRO. Format for NDA will be shared to the shortlisted parties before signing the MoU/ Contract.
- xi. ISRO reserves the right to induct the technology/product/system developed through this EoI, to its products/ R&D programmes depending upon the requirements.
- xii. Reports /Documents submitted to ISRO, as a part of this EoI response, shall remain confidential and proprietary to ISRO. Parties shall not disclose any information in part or full to any third party, Agency or individual without written concurrence for the same by ISRO.

10. LANGUAGE

The Proposal submitted by the Parties shall be in English language only. If any supporting documents submitted are in any language other than English, translation of the same in English language is to be duly attested by the Parties. For purposes of interpretation of the documents, the English translation shall govern. All correspondence and documents relating to the Proposal exchanged by the Party and ISRO shall also be written in the English language.

11. SEQUENCE OF EVENTS AND TENTATIVE SCHEDULE

Table 3: Flow of Events with tentative schedule

Sl. No.	Event/ Activity	Tentative Schedule
1	Release of Expression of Interest	Mar-2023
2	Pre-bid clarifications	Mar-Apr 2023
3	Submission of offers/ response (for Eol)	Apr-2023
4	Review of Eol offers	May-2023
5	Release of RfP to the shortlisted parties	Jul-2023
6	Submission of offers (for RfP)	Sep-2023
7	Review of RfP offers	Oct-2023
8	Signing of MoU/ Contract & NDA	Nov-2023

Format for submitting the Eol response

- 1. Title of the proposal and abstract:**
- 2. Details of the industry (partners, if any) and registration**
- 3. Contact Details:**
 - a. Industry: Postal address, Telephone number, Website
 - b. Contact Point (Principal Investigator / Focal Point person): Name, Phone number, Mobile number, Email.
- 4. Details of the proposal:**
 - a. Executive summary
 - b. Scientific/Technological objectives
 - c. Design approach and specifications, development process, test, evaluation and collaboration procedures.
 - d. Technical and Scientific team with domain experts
 - e. Collaborating Parties if any to be specified
 - f. Consultancy support if any to be specified
 - g. Laboratory facilities
 - h. Details of available test equipment and test facilities.
 - i. Laboratory facilities for development, qualification and calibration
 - j. Test equipment and test facilities
 - k. Plan for testing/qualification outside the Party's lab, if yes, give details.
 - l. Development strategy: Lab model, Proto Model, Engineering Model, Flight model or Products, as applicable
 - m. Plan for data processing, storage, archival and payload interface plan, as applicable.
 - n. Deliverables (clearly define)
 - o. Details of similar developments carried out earlier
 - p. Schedule
 - q. Risk & Mitigation plan
 - r. Any other details (please specify)

5. Nature of support sought from ISRO

- a. Technical consultancy (will be done as per prevailing mechanism)
- b. Facility/Tests support (will be done as per prevailing mechanism)
- c. Any other support (please specify)

Declaration

I/We declare that all the information/ technical details furnished above are factually correct to the best of my/our knowledge.

I/We further declare that, I/we would utilize the financial support and resources provided under this proposal by ISRO for the proposed activities.

Signature

Name

Date & Place

Official Seal

**Atmanirbharta in Development of Technologies/ Products/ Systems
for Indian Space Programme**

(Ref. Doc. No. ISRO/DTDI/EOI/2/23)

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1	Name of the item:	Design, realization and flight testing of sub-scale Hybrid Drone Prototype for DroneNet	
	Proposal ID	TDI001	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	<p>Detailed design, development, fabrication, ground testing and flight testing of a sub-scale hybrid drone prototype for DroneNet applications.</p> <p>Launch vehicle stage recovery is a key technology for low-cost access to space. A novel Mid Air Recovery technique, named DroneNet, is being developed to recover the spent stages of the launch vehicle on a net held by a swarm of autonomous drones. This technology results in < 5% loss in payload mass and requires minimum changes in the launch vehicle spent stage to enable recovery. It is very useful for rapid reuse of launch vehicles and requires minimal refurbishment of the spent stage due to recovery operations. Hybrid Drones are proposed to be used for DroneNet as they have both long range (100s of km) and Vertical Take Off & Landing (VTOL) capabilities.</p>		
	Scope/ Deliverables/ Outcome:		
	<p>Following is the scope and the corresponding expected deliverables:</p> <ol style="list-style-type: none"> 1. Detailed design of hybrid drone 2. Fabrication drawings 3. Design and testing of flight control software 4. Design & layout of flight instrumentation, telemetry and telecommand systems 5. Fabrication of the sub-scale hybrid drone prototype 6. Ground testing of hybrid drone components & software 7. Flight testing of the sub-scale hybrid drone prototype 		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	<p>VSSC has been working to develop the DroneNet technology since 2018. Conceptual Design of a Hybrid Drone for DroneNet is in progress. Hybrid drones are being flight tested world over for both manned & unmanned applications. The TRL of hybrid drone 4 technology in the world is ~6. VSSC has initiated conceptual design of the hybrid drone for DroneNet applications</p>		

2	Name of the item:	Development of hexagonal honeycomb core	
	Proposal ID	TDI002	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	Development of honeycomb core using HOBE method and Development of honeycomb core using Corrugation method.		
	Scope/ Deliverables/ Outcome:		
	Honeycomb sheets of low density & high-density cores which can be directly used for sandwiching (for light weight composite panels used for the development of LV and Spacecraft structures).		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	TRL-3		

3	Name of the item:	Development of thin ply (70 gsm) cryo compatible prepreg system	
	Proposal ID	TDI003	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	Thin ply cryo compatible prepreg system works as resistance to micro-cracking and is suitable for composite cryo tank realization through automatic fibre placement (AFP). The ply shall be available in form of standard size tapes/sheets to facilitate handling through AFP systems		
	Scope/ Deliverables/ Outcome:		
	AFP compatible prepreg form for composite cryogenic tankage realization		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	Carried out the sub-scale level process trials (TRL-1).		

4	Name of the item:	Development of Leaded Carbon Chip & Wire wound Resistors for Launch Vehicle	
	Proposal ID	TDI004	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	Development of Leaded Resistors (RNC and RWR).		
	Scope/ Deliverables/ Outcome:		
	<p>To achieve self-reliance in manufacturing of wire wound & carbon chip resistors, development of Carbon Chip technology for RNC resistors and wound technology for RWR resistors is planned:</p> <p>a) Carbon chip technology for RNC resistors Specifications: Tolerance: $\pm 1\%$, TCR: 25ppm/$^{\circ}\text{C}$ Value: 10Ω to 1MΩ,</p> <p>b) Wire Wound technology for RWR resistors Specifications: Tolerance: $\pm 1\%$, TCR: 60ppm/$^{\circ}\text{C}$ to 150ppm/$^{\circ}\text{C}$ Value: 0.2Ω to 220Ω</p> <p>Deliverables during the process of development involves:</p> <ul style="list-style-type: none"> • Proto Model(60nos.) • Engineering Model(50Nos.) • Qualification Model(600Nos.) • Flight Model for Flight induction on successful qualification(1000Nos.) 		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	Technology available with Industry for development of above 2 types. (TRL-5)		

5	Name of the item:	Development of High Current Relays for Launch Vehicle	
	Proposal ID	TDI005	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	Development of Relays (Non-Latching and Latching).		
	Scope/ Deliverables/ Outcome:		
	<p>To achieve self-reliance as well as reduced lead time in manufacturing & supply of MIL Grade Relays, development of relays with following specification is planned:</p> <p>Nominal voltage:28V Current: 15A Coil resistance: 290Ω Dropout voltage: 1.5V @-65°C Max. pick up voltage: 18V@125°C Operate time and release time: 10msec</p> <p>Deliverables during the process of development involves:</p> <ul style="list-style-type: none"> • Proto model(5Nos) • Engineering Model(5Nos) • Qualification Model(70Nos) • Flight model(30Nos) 		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	Development of low current relays has been carried out through Industry. (TRL-5)		

6	Name of the item:	Development of inductors	
	Proposal ID	TDI006	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	Development of Inductors through Indian Industries		
	Scope/ Deliverables/ Outcome:		
	<p>To achieve self-reliance in the field of inductors, suitable technology with capability at industries are to be identified for development.</p> <p>Deliverables during the process of development involves:</p> <ul style="list-style-type: none"> • Proto model • Engineering Model • Qualification Model • Flight model 		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	(TRL-5)		

7	Name of the item:	Processing of Bi-metallic Adaptors (BMA) by Diffusion Bonding Technology and EB welding Technology	
	Proposal ID	TDI007	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	Develop industry which can take up the diffusion bonding activity on industrial scale		
	Scope/ Deliverables/ Outcome:		
	Industrial production to meet higher demand (100 BMAs/year) of BMAs for multiple missions of GSLV and LVM3		
	Schedule (from date of signing of MoU/ Contract):	One year	
	Previous works carried out by ISRO:		
	Technology demonstrated for several dimensions and qualification is under progress. Development larger diameter BMA through diffusion bonding is under progress. (TRL-6)		

8	Name of the item:	Realization of scandate hollow thermionic emitter	
	Proposal ID	TDI008	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	<p>ISRO's 1 N stationary plasma thruster requires thermionic emitter with current requirements of 60 A-100 A. presently using W-BCA411 thermionic emitter can provide maximums current of 25 A. Hence it requires development of alternate hollow emitter. Scandate cathodes are one such emitter which can provide higher current density even at lower operating conditions. (~200°C lower temperature than W-BCA411 cathode). Hence it doesn't require the development of another cathode assembly like in the case of LaB6 emitter for which the operating temperature is 1600°C. Replacing the emitter with scandate emitter in the existing cathode assembly of 300 mN SPT can cater to the current requirement of 1 N SPT. Scope of the work is the development and emission characterization of scandate emitter.</p>		
	Scope/ Deliverables/ Outcome:		
	<p>Realization and emission characterization of scandate thermionic emitter. Supply of 5 emitters to VSSC</p>		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	<p>Thermionic emitter for 300 mN SPT through Industry, qualified and supplied for TDS-01 flight. Carried out literature survey about scandate emitter and discussion in progress with Industry for the realization of scandate emitter. (TRL-2)</p>		

9	Name of the item:	DC contactor Development 600V/250A	
	Proposal ID	TDI009	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	High power and high current DC contactors are used for battery ON/OFF control of Electro-Mechanical Actuator (EMA) drive coils. The proposed development is planned to develop 600V/250A DC Contactor used in LVM3 S200 EMA actuator system. The system should address suitable contact materials, arc quenching mechanism, fast switch ON/OFF characteristics, inert gas filling etc.		
	Scope/ Deliverables/ Outcome:		
	600V/250A rated High voltage DC Contactor Component.		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	250V/50A DC Contactor development taken up and completed successfully. Development & qualification adhering to aerospace environmental standards completed. (TRL-8)		

10	Name of the item:	Development of surfactant, catalyst and curing agent (MDI) for polyurethane foams for cryogenic applications	
	Proposal ID	TDI010	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	Surfactant and catalysts are used as functional additives for PU foam formation and methylene diphenyl diisocyanate (MDI) is used as curing agent for production of PU foam. This proposal is to develop above chemicals.		
	Scope/ Deliverables/ Outcome:		
	Annual requirements Surfactant: 500 kg Catalyst: 400 kg MDI: 4 Tonnes		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	(TRL-1)		

11	Name of the item:	Development of onboard Telemetry system for NGLV	
	Proposal ID	TDI011	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	<p>Design, development and realization of onboard Telemetry system (OTS) for Next Generation Launch Vehicle (NGLV) requires advanced Avionics systems. The OTS to cater the following requirements:</p> <ol style="list-style-type: none"> To provide sensor excitation, acquire and process the data from various types of sensors such pressure, temperature, speed, vibration, acceleration and acoustics To have required PCM formatting The system shall be configurable and integrated baseband and RF system. System to use COTS based components To have fault tolerant feature like SEU and provide redundancy in design. The system shall be compact and the size shall be limited 75mmx75mm. 		
	Scope/ Deliverables/ Outcome:		
	Telemetry Systems for NGLV		
	Schedule (from date of signing of MoU/ Contract):	One year	
	Previous works carried out by ISRO:		
	<ol style="list-style-type: none"> Configurable Telemetry system being developed for ORV and ATVP mission. Miniaturized avionics systems with functional integration are used in SSLV. <p>Conceptualizing the design needs to be carried out. (TRL-1)</p>		

12	Name of the item:	Development of miniaturized VIS for NGLV	
	Proposal ID	TDI012	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	<p>Design, development and realization of miniaturized Video Imaging System (VIS) with multiple cameras and with suitable compact illumination system weighing which enable transmission of high quality seamless video capturing various stage events, satellite separation and stage recovery in land/barge for Next Generation Launch Vehicle (NGLV). The illumination system shall be integral of camera system. Proposal envisages development of miniaturized hardware with multiple camera along with software for use in NGLV.</p>		
	Scope/ Deliverables/ Outcome:		
	Video imaging system and Camera with illumination system		
	Schedule (from date of signing of MoU/ Contract):	One year	
	Previous works carried out by ISRO:		
	<p>Miniaturized VIS was developed and flown in RH300/IAD mission. Higher quality video using multiple camera is required in NGLV.</p> <p>TRL 9 - Miniaturized VIS flown in RH300/IAD</p>		

13	Name of the item:	Development of metallic TPS for future RLV missions	
	Proposal ID	TDI013	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	<p>Future RLV missions demand advanced TPS having less mass, more temperature capability, easy fabrication, more reliability, less integration time & less refurbishing time. Many options were studied and considering the above aspects, development & qualification of Metallic TPS is proposed for future RLV missions.</p>		
	Scope/ Deliverables/ Outcome:		
	Development of TPS for future missions		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	<p>VSSC has completed development of sub-scale metallic TPS of size 450 mm x 300 mm x 45 mm using Inconel 617 material using in-house facility.</p> <p>Thermo-structural testing was carried out and it was found that the back wall temperature is less than 150°C.</p> <p>Technology is demonstrated in the sub-scale level and found acceptable. Development and testing in the scaled up level with flight interfaces to be carried out.</p>		

14	Name of the item:	Design and development of light weight additively manufactured 6U size metallic avionic enclosure	
	Proposal ID	TDI014	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	Development of a 3D printed, single-chassis package configuration which can house 7 numbers of 6U PCBs (with Wedglock & Backplane configuration)		
	Scope/ Deliverables/ Outcome:		
	Design, Structural Analysis, Realization (including 3D printing & post-processing, surface plating), assembly (with dummy 6U PCBs), vibration-tests (to demonstrate durability to generic Qualification levels) and correlation to analysis data. Outcome: Design & Analysis report, Test-report, Printed article along with test-coupons.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	Literature survey on target configuration, and identification of application & certification requirements.		

15	Name of the item:	3D printing of brackets and rings for structural applications in SSLV	
	Proposal ID	TDI015	
	Concerned ISRO Centre/ Unit:	VSSC	
	Objectives/ Brief Description:		
	<ul style="list-style-type: none"> • Development of schedule & cost effective alternate manufacturing (3D Printing) route for realizing components • To optimize the thickness and thereby the weight of the components by selecting alternate high strength alloys • To select a Design for additive manufacturing (DfAM) approach for brackets to optimize the weight, result in cost savings and payload gain 		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Design for additive manufacturing (DfAM) approach for brackets to optimize the weight • Laser powder bed fusion (LPBF) route manufacturing of brackets • Near-net shape 3D printing of rings for Structural applications through Wire arc additive manufacturing (WAAM) route <p>Outcome: Realize qualified First off components for structural/ functional testing.</p>		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	<ul style="list-style-type: none"> • 3D printing, characterization, qualification and induction of SS316L VTM brackets (2 Types) into SSLV-D1 successfully completed. • Several other components in various alloys have been 3D printed through laser powder bed fusion (LPBF) route and extensive characterization and qualification has been completed. • Initial trials and coupon printing of Wire Arc additive manufacturing (WAAM) carried out with Industry. • DfAM of VTM Type-II & Type II brackets carried out resulting in ~45% weight savings. • TRL 7 for LPBF route & TRL 5 for WAAM route. 		

16	Name of the item:	Development of BLDC motor for 30 KN engine	
	Proposal ID	TDI016	
	Concerned ISRO Centre/ Unit:	LPSC	
	Objectives/ Brief Description:		
	Design and development of High power, high speed BLDC motor for 30kN (3 tonne) Engine		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Design and development of high power, high speed BLDC motor (35kW, 20000rpm) for 30kN electric pump fed engine. • Realization of motor (Total: 4 Nos, 2 proto models and 2 qualification models). • Testing of motor to evaluate the performance requirements and to the specified environmental levels. <p>Deliverables/ Outcome:</p> <ul style="list-style-type: none"> • Establish design concepts for high power high speed BLDC motor • Realization of 4 motors (2 proto and 2 QM) • Testing and evaluation of the motor 		
	Schedule (from date of signing of MoU/ Contract):	Two year	
	Previous works carried out by ISRO:		
	TRL-7		

17	Name of the item:	Development of PS4 propellant tank through additive manufacturing	
	Proposal ID	TDI017	
	Concerned ISRO Centre/ Unit:	LPSC	
	Objectives/ Brief Description:		
	To develop a PS4 propellant tank through Directed Energy Deposition (DED).		
	Scope/ Deliverables/ Outcome:		
	<p>Development and optimization of DED (power/ wire based) process parameter for Ti6Al4V.</p> <p>Development and realization of tank segment namely</p> <ul style="list-style-type: none"> • Fore end dome assembly • Common bulk head dome assembly • AFT end dome assembly • Cylindrical segment • Catch tank <p>Deliverables/ Outcome:</p> <ul style="list-style-type: none"> • Optimized process parameter for DED with Ti6Al4V. • PS4 propellant tank segments. 		
	Schedule (from date of signing of MoU/ Contract):	18 months	
	Previous works carried out by ISRO:		
	Pilot projects on AM with DMLS were executed.		

18	Name of the item:	Realization of spacecraft propellant tank parts by additive manufacturing with Ti6Al4V material	
	Proposal ID	TDI018	
	Concerned ISRO Centre/ Unit:	LPSC	
	Objectives/ Brief Description:		
	<p>Realization of thin walled propellant tank parts by additive manufacturing shall reduce the lead time and material wastage compared to conventional forging and fabrication route.</p> <p>Realization and characterization of thin walled propellant tank (<400 mm) parts with Ti6Al4V material in near net shape (NNS) by Direct Metal Laser Sintering (DMLS) Addictive Manufacturing technique.</p>		
	Scope/ Deliverables/ Outcome:		
	<p>Technology demonstration for realization of thin walled propellant tank (<400 mm) parts with Ti6Al4V material by DMLS Additive Manufacturing technique in near net shape.</p> <p>Spacecraft propellant tank parts for 30/35L, 7.5L/10 L & 30L Xenon tank.</p> <p>Reports with DMLS Build parameters, Heat treatment, Compatibility data and test data pertaining to metallurgical and mechanical properties.</p>		
	Schedule (from date of signing of MoU/ Contract):	15 months	
	Previous works carried out by ISRO:		
	Realized PS4-PAS catch tank hemispheres (Dia 170 mm) in near net shape and characterization carried out and meeting AMS 4999A specification.		

19	Name of the item:	Development of low power, low cost propellant Hall effect thruster based EPS as full package including thruster, power systems, propellant storage and feed systems	
	Proposal ID	TDI019	
	Concerned ISRO Centre/ Unit:	LPSC	
	Objectives/ Brief Description:		
	Development of 200W Magnetically shielded Half Effect Thruster (HET) throttlable to 400W- with LaB6/CeB6 Cathode and all sub-systems.		
	Scope/ Deliverables/ Outcome:		
	<p>Development of the following systems in a modular concept:</p> <ul style="list-style-type: none"> • Low Power Magnetically shielded Hall Effect Thruster (using advanced ferromagnetic materials) with LaB6/CeB6 Cathode (either heater less or Heater type with maximum 300V keeper voltage) • High efficiency Power Processing and Control Unit (PPCU). • Feed system including pressure and flow control devices, transducers etc. • Propellant storage system. <p>Deliverables/ Outcome:</p> <ul style="list-style-type: none"> • Design, Development, qualification of flight worthy elements and systems. • Delivery of development (2 nos.) and qualification (2 nos.) elements, documents and systems 		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	<p>Completed development of 350W HET system and flight proven.</p> <p>Developed and tested 200W HET.</p> <p>Completed qualification of 1.6kW HET system.</p> <p>Completed qualification of 5kW HET system.</p>		

20	Name of the item:	Quad bridge Loadcell	
	Proposal ID	TDI020	
	Concerned ISRO Centre/ Unit:	SDSC	
	Objectives/ Brief Description:		
	Loadcells are being used to measure Motor thrust during static testing of solid rocket motors. The measured thrust data using loadcells will decide the flight worthiness of solid rocket motors in a launch vehicle. Hence high accuracy loadcells are essential for thrust measurement.		
	Scope/ Deliverables/ Outcome:		
	1. Column type loadcell, of range 750t, capable of measuring both tensile and compressive loads with an accuracy of 0.1% of Full scale, with 4 outputs. 2. Calibration certificate		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	NA		

21	Name of the item:	Subsystem for the twin MRS85 rail track change-over system	
	Proposal ID	TDI021	
	Concerned ISRO Centre/ Unit:	SDSC	
	Objectives/ Brief Description:		
	Twin rail track with MRS 85 rails are installed at SVAB which are having track change-over system to connect to SLP track. Spares for the change-over system can be manufactured by Indian industries through onsite switch blade profile measurement and machining from department supplied MRS 85 rails in CNC machines.		
	Scope/ Deliverables/ Outcome:		
	Critical subsystems.		
	Schedule (from date of signing of MoU/ Contract):	One year	
	Previous works carried out by ISRO:		
	Switch blade is already installed, tested and qualified. (TRL-8)		

22	Name of the item:	SCADA software	
	Proposal ID	TDI022	
	Concerned ISRO Centre/ Unit:	SDSC	
	Objectives/ Brief Description:		
	In LSSF Entity different safety and launch critical process and systems are monitored and controlled using Programmable Logic Controllers. This proposal is to develop the SCADA Software used in the critical ground systems used for Liquid Stage Servicing & Solid motor production.		
	Scope/ Deliverables/ Outcome:		
	<p>Scope: Development of Graphics builder, Redundant Runtime services, Trend, Alarm, Report services and historian server. Demonstration of the product at Factory and also at field.</p> <p>Deliverables/ Outcome: In house developed SCADA software. The source code will be openly available for review and it will be completely developed in India supporting the "Make in India" initiative.</p>		
	Schedule (from date of signing of MoU/ Contract):	18 months	
	Previous works carried out by ISRO:		
	(TRL 4)		

23	Name of the item:	TDI chemcassette portable / fixed type monitor system for quantitative measurement of Toluene Di-isocyanate vapours in propellant processing	
	Proposal ID	TDI023	
	Concerned ISRO Centre/ Unit:	SDSC	
	Objectives/ Brief Description:		
	Quantitative measurement of Toluene Di-Isocyanate (TDI) vapours through a dedicated portable / fixed monitoring system in ppb levels to be developed through Industries.		
	Scope/ Deliverables/ Outcome:		
	Quantitative measurement of TDI vapours through a dedicated portable / fixed monitoring system is highly essential for ensuring safe working environment at TDI handling facilities. Based on the monitoring system, we can alert the facility personnel before the emergency and also to improve the accident loss prevention.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	TRL-1		

24	Name of the item:	Development of multiple energy Linac based industrial X – ray machines	
	Proposal ID	TDI024	
	Concerned ISRO Centre/ Unit:	SDSC	
	Objectives/ Brief Description:		
	The technology/product will be used for carrying out Radiography of large solid propellant motors.		
	Scope/ Deliverables/ Outcome:		
	High energy industrial radiography machine which is switchable between 5MeV to 15MeV X – ray energies.		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	Earlier, SDSC SHAR contributed in the development of single energy 9MeV and 15MeV.		

25	Name of the item:	Development of flat panel detectors for X – ray radiography	
	Proposal ID	TDI025	
	Concerned ISRO Centre/ Unit:	SDSC	
	Objectives/ Brief Description:		
	The technology/product will be used for carrying out Radiography of solid propellant motors and other propulsion engines		
	Scope/ Deliverables/ Outcome:		
	Industrial flat panel X – ray detectors which can be used from 200kV to 15MeV		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	To be developed.		

26	Name of the item:	Industrial Grade Dual 24VDC powered DIN Mounted L2 Managed Switches/ PoE Switch	
	Proposal ID	TDI026	
	Concerned ISRO Centre/ Unit:	SDSC	
	Objectives/ Brief Description:		
	<p>Presently all process control systems across ISRO centers are network-based system for Monitoring, Acquiring & controlling the respective process programs. For supporting continuous production, process control system network elements located in harsh environmental area is required to run continuously for 24x7 Basis. As all instrumentation systems in process control industries utilize standard 24VDC powered, these types of network products can be developed within India to meet demands of all Production/ Servicing/ Testing facilities of ISRO. Also, PoE/PoE+ based switches are more essential in Process surveillance areas in harsh environments.</p>		
	Scope/ Deliverables/ Outcome:		
	Network switch		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	To be initiated.		

27	Name of the item:	Ex. Certified CCTV PTZ/Fixed IP Cameras	
	Proposal ID	TDI027	
	Concerned ISRO Centre/ Unit:	SDSC	
	Objectives/ Brief Description:		
	CCTV surveillance systems are vital equipment for surveillance of hazardous process activities. Commercial cameras will not suit for hazardous area.		
	Scope/ Deliverables/ Outcome:		
	CCTV cameras with PESO Ex. certifications		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	To be initiated.		

28	Name of the item:	Inflatable end cap for segments maintenance during storage in magazine	
	Proposal ID	TDI028	
	Concerned ISRO Centre/ Unit:	SDSC	
	Objectives/ Brief Description:		
	Segment part to be sealed air tight after N2 Gas purging for its effectiveness and to make silica gel bags changing at ease.		
	Scope/ Deliverables/ Outcome:		
	This structure will ensure the presence of N2 gas at specified pressure for maintaining the healthiness & performance of the segments.		
	Schedule (from date of signing of MoU/ Contract):	One year	
	Previous works carried out by ISRO:		
	To be initiated.		

29	Name of the item:	MEMS Accelerometer	
	Proposal ID	TDI029	
	Concerned ISRO Centre/ Unit:	IISU	
	Objectives/ Brief Description:		
	<p>The objective of this programme is to develop MEMS accelerometers for target applications as bending mode accelerometers in ISRO launch vehicles in short term and to develop inertial grade MEMS accelerometers for target applications as sensors in Inertial Navigation Systems of ISRO launch vehicles in long term.</p> <p>The scope of the programme is as follows:</p> <p>(i) Design of sensors and fixtures, generating drawings.</p> <p>(ii) Mechanical design of Sensor structure, Flexure and Proof Mass; FE Analysis, parametric study and design finalisation.</p> <p>(iii) Electrical design for Pick-off, Torquer and Capture loop circuit.</p> <p>(iv) Sensor Fabrication, assembly and packaging.</p> <p>(v) Qualification of Sensor for design parameters.</p>		
	Scope/ Deliverables/ Outcome:		
	MEMS based accelerometers ready-to-use in launch vehicles.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	<p>Design and analysis of sensor structure, flexure and proof mass carried out and available for fabrication through industry.</p> <p>(TRL3)</p>		

30	Name of the item:	Configurable Scan Mechanisms For Spacecrafts	
	Proposal ID	TDI030	
	Concerned ISRO Centre/ Unit:	IISU	
	Objectives/ Brief Description:		
	<p>(i) The scan mechanisms currently being used for meteorological applications are configured as single-axis or dual-axis scan types, depending upon the scanning modes and the nature of the orbit in which such payloads are to be launched.</p> <p>(ii) The design of such mechanisms, however, is specific to a particular project, depending upon the size and inertia of the scan mirror, the speed of rotation, the pointing accuracy etc. and hence calls for changes in the configuration from one project to another.</p> <p>(iii) This advanced R&D envisages to employ a robotic system / manipulator having significantly high stiffness and high load bearing capability and capable of accommodating scan mirror of any shape and size with considerably good pointing accuracy.</p> <p>(iv) Parallel manipulators are envisaged to employ judiciously in order to avoid singularity in the working range so that it can meet the various scanning requirements.</p> <p>(v) The design of the mechanism essentially envisages to use a platform which can be oriented about a chosen point spatially. Optimisation for the number of actuators and the type of actuators required to orient the platform will be done to make the platform compact in size and mass.</p>		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Configuration design of platform and manipulator. • Mathematical modelling, simulation and Motion Planning Algorithm. • Optimisation of actuators and design of encoders. • Design of characterisation scheme. • Realisation of Engineering Model and Technology demonstration. 		
	Schedule (from date of signing of MoU/ Contract):	Five years	
	Previous works carried out by ISRO:		
	TRL-1		

31	Name of the item:	Advanced Coating Techniques For High Speed Ball Bearing	
	Proposal ID	TDI031	
	Concerned ISRO Centre/ Unit:	IISU	
	Objectives/ Brief Description:		
	The aim is to develop thin film coatings for ball bearings to enhance the life and performance of bearings for long life spacecraft applications.		
	Scope/ Deliverables/ Outcome:		
	Thin film coated ball bearings.		
	Schedule (from date of signing of MoU/ Contract):	One Year	
	Previous works carried out by ISRO:		
	TRL-2		

32	Name of the item:	Miniature SADA For Indian Miniature Satellite Bus	
	Proposal ID	TDI032	
	Concerned ISRO Centre/ Unit:	IISU	
	Objectives/ Brief Description:		
	Miniature satellite involves development of various modern micro-electronics and micro-mechanisms, emphasizing multi-functionality and system integration. Solar Array Drive Assembly (SADA) shall be miniaturized for applications in IMS BUS. The miniature SADA shall be a compact mechanism incorporating state of the art technologies in the area of power/signal transfer assembly, motor and lubricants.		
	Scope/ Deliverables/ Outcome:		
	Development and Realization of New mechanism		
	Schedule (from date of signing of MoU/ Contract):	One Year	
	Previous works carried out by ISRO:		
	TRL-3		

33	Name of the item:	Active Vibration Control	
	Proposal ID	TDI033	
	Concerned ISRO Centre/ Unit:	IISU	
	Objectives/ Brief Description:		
	<p>Active vibration control is the active application of force in an equal and opposite fashion to the forces imposed by external vibration. With this application, a precision assemblies or scientific payloads which demand very fine and precise measurements can be made essentially vibration-free. Objective of active vibration control is to reduce or eliminate the vibration of a mechanical system by automatic modification of the system's structural response. It mainly consists of 1. Sensor (to detect the vibration), 2. Electronic controller (to suitably manipulate the signal from the detector. actuator (which influences the mechanical response of the system). the actuators can be fully-active or- semi-active.</p> <p>Scope and objectives:</p> <p>a. Design, Modelling and realization of active vibration control systems.</p> <p>b. Trials on various systems and subassemblies</p>		
	Deliverables/ Outcome:		
	Mathematical models and realisation of system.		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	TRL-3		

34	Name of the item:	Tethered Altitude Sensing Mechanism	
	Proposal ID	TDI034	
	Concerned ISRO Centre/ Unit:	IISU	
	Objectives/ Brief Description:		
	<p>The system would consist of a tethered wire connected to a reeling mechanism with a micro switch enabled sensor to sense the touch down.</p> <p>Scope:</p> <ul style="list-style-type: none"> i) Design of sensor ii) Realizing tethered reeling mechanism iii) Demonstration of performance and evaluation 		
	Scope/ Deliverables/ Outcome:		
	Realisation of sensor and demonstration of working.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	TRL-4		

35	Name of the item:	Micro DTG Development	
	Proposal ID	TDI035	
	Concerned ISRO Centre/ Unit:	IISU	
	Objectives/ Brief Description:		
	Development of medium accuracy mass producible gyroscope (eDTG). It is a hybrid type gyroscope with a wafer rotor rotated at constant speed by a BLDC motor. The rotor deflection is sensed by capacitance variation between the rotor and electrode disks. The tuning and rebalancing is achieved by electrostatic force. There is a large scope for medium accuracy sensors for aided navigation, micro satellites etc. The main advantage is that the sensor is mass producible and the tuning and rebalancing can be achieved electrostatically which is achieved by mechanical correction in DTGs.		
	Scope/ Deliverables/ Outcome:		
	Proof of concept		
	Schedule (from date of signing of MoU/ Contract):	One Year	
	Previous works carried out by ISRO:		
	TRL-3		

36	Name of the item:	Nano & Micro Control Moment Gyroscope	
	Proposal ID	TDI036	
	Concerned ISRO Centre/ Unit:	IISU	
	Objectives/ Brief Description:		
	<p>Design, technology development and realization of prototype model of Single Gimbal Control Moment Gyroscope, an actuator for the agile, small and medium sized earth observation satellites as well as for improving the controllability of various small and medium sized space robotics applications.</p> <p>The satellite classes are listed below:</p> <p>(a) Nano Satellites : 10Kg to 50Kg</p> <p>(b) Micro Satellites : 50Kg to 100Kg</p> <p>The development of miniaturized CMGs in IISU can serve the needs of future small satellites in a big and efficient way.</p>		
	Scope/ Deliverables/ Outcome:		
	Realization of Nano & Micro Control Moment Gyroscope		
	Schedule (from date of signing of MoU/ Contract):	One Year	
	Previous works carried out by ISRO:		
	Completed the design of NANO-CMG prototype model. TRL 1		

37	Name of the item:	Development of MMOD Impact Detection Sensor	
	Proposal ID	TDI037	
	Concerned ISRO Centre/ Unit:	HSFC	
	Objectives/ Brief Description:		
	<ul style="list-style-type: none"> • The Impact Detection Sensor shall detect in-situ MMOD impacts (while in orbit) and the same data shall be transmitted back to ground data recorders. • The Sensor should be capable of: <ul style="list-style-type: none"> o Detecting impact instance and keeping a count o Determine the location of impact o Determine the size of the impact o Determine velocity and angle of the impact 		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Identifying and developing different impact detection sensors based on resistive grid or acoustic sensors or a combination of both. • Developing a flexible PCB (included in the design of Resistive Grid Detector) to cover various surface profiles of spacecraft. • Developing impact detector capable of handling all of the possible environmental loads (both launch and on-orbit loads). • Realising a setup to appropriately measure the instance, location, size, velocity and angle of impact for an on-ground HVI test case (for performance evaluation) • Developing a logic for high bit-rate data collection, interpretation and storage. 		
	Schedule (from date of signing of MoU/ Contract):	One year	
	Previous works carried out by ISRO:		
	Conceptualised and designed a resistive grid based MMOD impact detection sensor and performed successful demonstration of the 2D (Cartesian Grid) Resistive Grid Detector (RGD) proof of concept working model using COTS components.		

38	Name of the item:	Dynamic Simulator	
	Proposal ID	TDI038	
	Concerned ISRO Centre/ Unit:	HSFC	
	Objectives/ Brief Description:		
	Simulator to familiarize the Crew with the dynamics encountered in the mission.		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Stewart platform-based dynamics platform • Closed loop Virtual Reality software with cabin simulation • Augmented Reality setup with the console and other interaction elements. • Simulation software integration with Virtual reality and stewart platform for closed loop simulation. 		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	<ul style="list-style-type: none"> • Specifications of the Stewart platform is worked out and configuration of the simulator is reviewed and cleared. • The integration of simulation software and emulation software is tested and completed. • An initial version of cabin simulation in Virtual reality is completed. Augmentation is required for closed loop design. 		

39	Name of the item:	Motorized butterfly valve for fluid flow control	
	Proposal ID	TDI039	
	Concerned ISRO Centre/ Unit:	HSFC	
	Objectives/ Brief Description:		
	For cabin ventilation unit and pressure regulation of future space habitats.		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Development of butterfly valve with minimum leak tightness for space applications. • Motor & drive system 		
	Schedule (from date of signing of MoU/ Contract):	1.5 years	
	Previous works carried out by ISRO:		
	Manually actuated valve realised.		

40	Name of the item:	Centrifugal Blower	
	Proposal ID	TDI040	
	Concerned ISRO Centre/ Unit:	HSFC	
	Objectives/ Brief Description:		
	For use in Flight Suit, Carbon Dioxide Removal Assembly (CDRA)-Air Revitalization System, Trace Containment Control Assembly, Regenerative Environmental Control & Life Support Systems (ECLSS).		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Compact and efficient Blower. • Test set ups for characterization. 		
	Schedule (from date of signing of MoU/ Contract):	1.5 years	
	Previous works carried out by ISRO:		
	Mathematical model completed.		

41	Name of the item:	Crew Hygiene Management System	
	Proposal ID	TDI041	
	Concerned ISRO Centre/ Unit:	HSFC	
	Objectives/ Brief Description:		
	Development of compact system to collect and store human faeces, urine and vomit in a short duration space flight.		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Development of waste collection systems for operations in microgravity. • Development of compact and efficient air blowers. • Moisture absorption foam. • Waste stabilization agents. 		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	Initial design in progress.		

42	Name of the item:	Design and development of Viewport	
	Proposal ID	TDI042	
	Concerned ISRO Centre/ Unit:	HSFC	
	Objectives/ Brief Description:		
	<ul style="list-style-type: none"> • Identifying the potential optical materials for Viewport panes. • Identifying and development of interfacing elements in Viewport. • Qualification and testing of all the components of Viewport. • Functional demonstration of Viewport as a system. 		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Optical Glass. • Thermal Seal which can sustain high temperature upholding structural integrity and maintain compatibility with glass. • Interfaces within Viewport and between Viewport and Crew Module. 		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	<ul style="list-style-type: none"> • Conceptual Study is completed. • Candidates for seals, gaskets and glasses are identified, will be finalized after design. • Preliminary Configuration is generated with respect to current IML and OML of Gaganyaan Crew Module. • Preliminary thermo-structural analysis is completed. 		

43	Name of the item:	Development of a Head Mount Display (HMD) for Gaganyaan crew for providing situational awareness	
	Proposal ID	TDI043	
	Concerned ISRO Centre/ Unit:	HSFC	
	Objectives/ Brief Description:		
	<ul style="list-style-type: none"> • Development of curved display technology as a light and versatile replacement to the current crew display system with inherent redundancy. • Development of audio/video interface system and integrating it to the crew suit and on-board avionics systems. • Transfer of high data content between the On-board avionics and heads-up display for depiction via wireless means. 		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Development of curved display technology as a light and versatile replacement to the current crew display system with inherent redundancy. • Development of audio/video interface system and integrating it to the crew suit and on-board avionics systems. • Transfer of high data content between the On-board avionics and heads-up display for depiction via wireless means. 		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	The helmet mounted cueing system for Off-Bore Sighting and out-the-window viewing to expand the field of view, for aiding perception in presence of hazy environment, eye strain or visual discomfort, etc. for Air force pilots (developed at AFRL) was analysed to derive in-depth understanding.		

44	Name of the item:	Motorized ball valve for liquid shutoff	
	Proposal ID	TDI044	
	Concerned ISRO Centre/ Unit:	HSFC	
	Objectives/ Brief Description:		
	Development of motorized ball valve for ON/OFF (shutoff) application, throttling for liquid flow control. It has application in Environmental Control & Life Support Systems (ECLSS) for long duration missions. Proposed to be used on Water dispensing system, Thermal & Humidity Control Systems (THCS) etc.		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Development of ball valve with minimum leak tightness for space applications. • Motor & drive system. 		
	Schedule (from date of signing of MoU/ Contract):	2.5 years	
	Previous works carried out by ISRO:		
	Preliminary Design in progress.		

45	Name of the item:	Trapped mercury-ion atomic clock physics package+B2:B30	
	Proposal ID	TDI045	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	The trapped mercury-ion atomic clocks can reach stabilities and drifts, which are 1 and 2 orders (respectively) better than the rubidium lamp-based RF clocks. These are strong potential candidates for the future deep space navigation missions alongside the current NavIC missions.		
	Scope/ Deliverables/ Outcome:		
	Demonstration of a trapped mercury-ion-clock model meeting the specified performances.		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	SAC has developed Flight models of the Rubidium based Atomic Frequency Standards. (Current TRL -1)		

46	Name of the item:	M-type Dispenser Cathode	
	Proposal ID	TDI046	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	<p>M-type Dispenser Cathode is used in Vacuum electron devices as a source of an electron beam. It emits an electron beam by thermionic emission. A heater is placed behind the emitting surface for heating the surface.</p> <p>To develop M-type Dispenser cathodes with an emission Density of 2 A/Cm², operating at a temperature of 950 ±20 °C (operated in space charge limited region) and with expected life of 2.0 lakh hours of continuous operation.</p>		
	Scope/ Deliverables/ Outcome:		
	<p>Outcome: Development of M-type Dispenser Cathodes.</p> <p>Deliverables:</p> <ol style="list-style-type: none"> 1) 5 prototypes of Cathodes 2) Report on weight gain of Tungsten pallet 3) Inspection report of cathode surface 4) Inspection report of temperature uniformity on cathode surface 5) Life estimation report 		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	<p>Measurement activities, related to brightness temperature, current measurement have been conducted.</p> <p>(Current TRL -1)</p>		

47	Name of the item:	Design, Development, Fabrication and Testing of miniaturized High Voltage Electronic Power Conditioner (HVEPC) for 4 collector (up to 7KV) Travelling Wave Tube Amplifiers	
	Proposal ID	TDI047	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	<ul style="list-style-type: none"> • Design of compact HVEPC using Hybrid Micro Circuit (HMC) technology. • Designs of HMC Layout, multilayer PCB Layout for Low Voltage Card and High Voltage Card. • Design of compact and lightweight Mechanical Package for HV EPC. • Fabrication and Testing of Proto model HVEPC. • Delivery of Proto HVEPC. 		
	Scope/ Deliverables/ Outcome:		
	Proto Model HVEPC: 1 No's		
	Schedule (from date of signing of MoU/ Contract):	2.5 years	
	Previous works carried out by ISRO:		
	Design development and testing of discrete component based Proto Model of HVEPC has been carried out. (Current TRL -7)		

48	Name of the item:	Development of Erbium Doped Fiber Optical Amplifier (EDFA) Two types of EDFA will be required 1.1 High Power EDFA: up to 5W 1.2 Low Noise EDFA: -60dBm sensitivity	
	Proposal ID	TDI048	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	Development of EDFA for high power transmit section and receiver frontend. Optical amplifier is indispensable element in optical transmit and receive chain to boost the incoming signal for long distance transmission and to improve sensitivity at receiver. Scope: The development of the vacuum compatible EDFA (high power for transmit section and low noise for receiver section) in optical C-Band covering 1530-1565 nm.		
	Scope/ Deliverables/ Outcome:		
	Prototype units of two types with following typical specifications: High Power EDFA: 1530-1565 nm operation, Output power: 5W, Input Drive <-5 dBm, NF ~5-7 dB Low Noise EDFA: 1530-1565 nm operation, Output power: +1520 dBm, Input Drive <-60 dBm, NF ~3.5-4 dB Generic Features: Output power tunability, control and monitoring of output/input power, pump power and temperatures, analog and digital telemetries , SM/PM fiber output with FC/APC connector, RS422/232 operation.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	DVM realization of 2.5W EDFA at TRL 4 has been done. (Current TRL -3)		

49	Name of the item:	10cm telescope assembly with coarse and fine pointing mechanism for Optical Communication Terminal	
	Proposal ID	TDI049	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	<p>Design and development of optical telescopes for Optical communication terminal. These telescopes are required for establishing free space optical link between different ISL or satellite to ground link.</p> <p>These telescopes should operate at 800 nm and 1550 nm band with diffraction limited performance with more than 90% transmission. 2 axis Gimballed mirror for coarse scanning and fast steering mirror based fine pointing mechanisms should be incorporated with the telescope assembly.</p>		
	Scope/ Deliverables/ Outcome:		
	<p>Prototype units of 10 cm telescope assembly with coarse pointing assembly and fine pointing assembly with following typical specifications:</p> <p>20 urad divergence with < 40dB back scattering, two-way optical channel for transmit and receive channels with proper isolation. scan range 0 to 90 Deg for EL, ± 180 Deg for azimuth with <0.1 Deg accuracy, slew rate 5 Deg/sec, fine pointing range ± 5 mrad with <2 urad resolution, Fiber ports for connecting optical transmitter and receivers.</p> <p>Size: Typically <200x200x300 mm, weight <8 Kg.</p>		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	<p>20 cm Telescope was developed for GSAT-29 payload.</p> <p>(Current TRL -2)</p>		

50	Name of the item:	MiniSAR upgrade /ver2.0	
	Proposal ID	TDI050	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	<p>Synthetic aperture radar (SAR) is an important remote sensing technique due to its distinctive advantages of imaging ability in almost any weather, day or night, thereby overcoming many of the limitations of other passive imaging technologies such as optical and infrared.</p> <p>MiniSAR is a X-band High resolution (30cm), multi-polarization (Single /Dual /Circular), miniaturized Synthetic Aperture Radar designed to be operated from airborne platform. MiniSAR is configured to have less size and weight so that it can be flown in small aircrafts as well as in UAVs.</p> <p>Compact SAR with high resolution imaging capability, flown in small aircrafts as well as UAVs, has immense usage in area of surveillance as well as military missions. These types of SAR have huge advantage due to its fast deployment capability and generation of data products in operational scenario with minimum turnaround time. Furthermore, UAV based SAR has advantages due to its fast deployment capability with low operational cost and also no risk of losing human life.</p> <p>Low-cost bulk production of MiniSAR is very much necessary and that can be achieved by development through Indian industry.</p>		
	Scope/ Deliverables/ Outcome:		
	X-band High resolution (30cm), multi-polarization (Single /Dual /Circular), miniaturized (~6kg) Synthetic Aperture Radar that can be flown in small aircrafts as well as in UAVs.		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	MiniSAR hardware is developed and successfully demonstrated. (Current TRL-8)		

51	Name of the item:	Compact, Field-Deployable, Ground Based Atmospheric Sounder	
	Proposal ID	TDI051	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	<p>Atmospheric sounders operating at 20-30 GHz and 50-60 GHz can profile earth's atmosphere (humidity and temperature) up to an altitude of 10-12km nearly in all weather conditions. The data from these sounders are ingested into Numerical Weather Prediction models as well as for profile retrievals. These ground-based atmospheric sounders are extremely useful for localized nowcasting of extreme weather events, especially at sensitive installations. In order to establish a country-wide network of these profilers, low-cost bulk production is necessary that can be achieved by development through Indian industry. There is a huge demand for these profilers at establishments of the Indian Navy, Airport Authority of India (AAI) and weather stations of India Meteorological Department (IMD). DOS and DST research centres as well as Astronomical Observatories in India routinely use these instruments for creating long-term database and validating models.</p>		
	Scope/ Deliverables/ Outcome:		
	<p>A Compact, field deployable, noise injection and selfcalibrating mm-wave Temperature and Humidity Sounder Instrument (comprising of miniaturized RF front-ends at K, Ka and V-Band, modular IF back-end, wideband tunable LO, antenna system, digital system, EPC and Scan mechanism) with compact form factor (Volume: ~0.9*0.5*0.7 m³ and Mass: ~25Kg).</p>		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	<p>Successful technology demonstration of temperature and humidity sounders operating at 23/31, 50-60GHz, 89 & 183GHz. (Current TRL -5)</p>		

52	Name of the item:	High Power GaN Devices using GaN Power Bars	
	Proposal ID	TDI052	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	Required for development of SSPAs/RF Transmitters for XBand SAR Payloads.		
	Scope/ Deliverables/ Outcome:		
	GaN Devices with output power of up to 100W at X-Band.		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	Taken up development. (Current TRL -2)		

53	Name of the item:	Miniaturized L & S band transceiver terminal for M2M (Machine to Machine Communication) Communication within SatCom based IoT framework	
	Proposal ID	TDI053	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	The objective is to develop and build L & S band transceiver terminals with NB-IoT or modified NB-IoT like waveforms for M2M communication, Asset Tracking applications in an hybrid communication network of GEOMSS and 5G. The miniaturized hardware can also be developed for Satellite Phone applications or usage as IoT hub.		
	Scope/ Deliverables/ Outcome:		
	Miniaturized L & S band transceiver terminal.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	S-band terminals hardware with custom waveform suitable for satellite/NTN communication developed for various MSS applications. IIT-H developed SoC with NB-IoT is being evaluated for waveform upgradation. (Current TRL -7)		

54	Name of the item:	FPGA Based SDR Platforms for Space & Ground	
	Proposal ID	TDI054	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	<p>The objective is to develop and build SDR Platforms, which can be used for developing Physical layer with different communication waveforms & baseband processing for future SATCOM networks.</p> <ol style="list-style-type: none"> 1. Standard SDR Hardware with 20-40 MHz bandwidth & FPGA/ SoC devices with different processing resources (100k to 500k) for standard ground applications compact form factor 2. Wideband SDR Hardware with 500MHz bandwidth with high end FPGA/SoC devices for extremely high throughput applications (such as RADAR/Optical payloads HDR telemetry). 3. Space-worthy SDR Hardware's for CubeSats/LEO/GEO satellite payloads in miniaturized low power form factor 		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Standard SDR Hardware with 20-40 MHz bandwidth • Wideband SDR Hardware with 500 MHz bandwidth • Space Grade SDR Hardware 		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	<p>Prototypes of SDR variants with smaller processing bandwidth are being developed in-house. (Current TRL -4)</p>		

55	Name of the item:	Aero mobile Terminal (Electronic Beam Steering / Beam Forming Planner Antenna array, Frequency Converter Units, Broadband Modem, Baseband System, Antenna Control Unit with sensors etc.)	
	Proposal ID	TDI055	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	The objective is to develop, build and qualify Aero mobile terminals, which can be used in conjunction with HTS/UHTS satellites to offer broadband communication on the move in air platforms. The expertise will also be used to implement the Communication on The Move (COTM) systems offering broadband services to Land Mobile platforms. The product to be developed in Ku and Ka band.		
	Scope/ Deliverables/ Outcome:		
	Aero mobile Terminal in Ku/Ka Band. COTM terminal in Ku and Ka band. These products & its variants will be capable of operating with GEO-HTS and LEO-HTS.		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	Broadband Modem is developed, ACU development is in advance stage. FCU is under realization. EBS concept realized in scale-down model. (Current TRL -3)		

56	Name of the item:	Handheld NavIC/GNSS Receiver with D-GNSS and dead reckoning capability	
	Proposal ID	TDI056	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	SAC/ISRO has developed GNSS Baseband ASIC for multi-GNSS processing including all NavIC signals. The receiver unit based on this ASIC with various unique features is of importance for proliferation and NavIC utilization. For this purpose, a GNSS receiver product based on this ASIC is proposed. This product will be useful for civilian and as well as for special users.		
	Scope/ Deliverables/ Outcome:		
	Hardware: 1. Developed based on SAC/ISRO provided GNSS Baseband ASIC with ASIC software 2. Handheld format including battery and antenna in single unit 3. Support for multi-GNSS L5/L1/S bands and D-GNSS communication as well as INS sensors 4. Processor on-board for INS integration and D-GNSS processing with SAC/ISRO ASIC output Software: Software for INS and D-GNSS integration with SAC/ISRO ASIC output and generating PNT output of the product		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	<ul style="list-style-type: none"> • SAC/ISRO 36 channel GNSS Baseband ASIC and its receiver development. • INS integration with SAC/ISRO receiver IP on FPGA based GNSS receiver. • Raw Carrier phase observables generation on FPGA-based receiver. (Current TRL -4)		

57	Name of the item:	Design and Development of Light Weight Optical Communication & Ranging Inter-Satellite Link Terminal (C&R-ISL) for On-board Navigation Satellites	
	Proposal ID	TDI057	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	<p>In view of increased user requirements in-terms of coverage and providing flexibility, NavIC satellite constellation requires to implement Inter-Satellite Links (ISLs) enabling one-to-one connections between satellites of the MEO constellation, providing intra-system communication layer with reduced number of required RMSs & TTC stations, providing precise two-way ranging, and supporting clock synchronization. Both Radio-Frequency (RF) and optical links are available as the options for ISLs. Optical ISLs carry the advantage of enabling higher data rates, very precise ranging, accurate time-transfer, improved on-board clock stability and robustness to jamming. Hence, light weight optical C&R-ISL terminal for on-board navigation satellites for MEO constellation is required to meet the desired performance and operational requirements.</p>		
	Scope/ Deliverables/ Outcome:		
	<p>Proto-Type Development of low Size, Weight and Power (SWaP) optical C&R-ISL terminal for future NavIC satellites for MEO constellation. Optical C&R-ISL shall also include the required digital packages to carry out acquisition & tracking of optical ISL terminal and two-way ranging. The optical ISL terminal shall also be capable of demonstrating the performance and operational requirements in LEO to LEO ISL operations.</p> <p>Targeted Specifications (C&R optical ISL Terminal):</p> <ul style="list-style-type: none"> • ISL range 45000 km range • Terminal Acquisition/Tracking Capability: MEO-MEO and LEO-LEO In-plane and out of plane between GEO/MEO and LEO • Ranging accuracy: <2 cm • Communication Data Rate: 1 to 10 Mbps (selectable) • Mass: <5 kg • DC power: <60 W Design robustness as per space environment 		
	Schedule (from date of signing of MoU/ Contract):	2 years	
	Previous works carried out by ISRO:		

Optical communication terminal for high data rate applications (upto 1 Gbps) onboard GSAT-29 has already been developed at SAC. Optical ISL for communication and ranging is the novel field for which system studies are underway.

58	Name of the item:	Development of High-Resolution X-Band Agile SAR Payload (RISAT-2B series follow-on)	
	Proposal ID	TDI058	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	<p>To provide continuity to RISAT-2B, RISAT2B-R1 and EOS-01 satellites, follow-on missions are planned.</p> <p>Scope:</p> <p>1. Development of following subsystems for X-Band SAR payloads:</p> <ul style="list-style-type: none"> • 250W Pulsed SSPA • 8x8 Butler Matrix • High-Power front-end Circulator-Switch Assembly (CSA) • Frequency Generator • Driver Amplifiers • Front-end LNAs • Receiver • Calibration Switch Matrix (CSM) • 5:4 Switch Matrix • Chirp Generator and Data Acquisition and Compression Subsystem (CGDACS) • Payload Controller (PLC) • Power Dividers, Waveguide Couplers <p>2. Assembly, Integration and Testing of Payload Subsystems.</p>		
	Scope/ Deliverables/ Outcome:		
	High Resolution Agile X-Band SAR Payload		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	<p>Designed and developed RISAT-2B Series of payloads for RISAT-2B, RISAT2B-R1 and EOS-01 satellites. Satellites have been launched and are in-operation.</p> <p>(Current TRL - 9)</p>		

59	Name of the item:	LTCC based, hermetically sealed X-Band Transmit Receive Module	
	Proposal ID	TDI059	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	<p>Transmit receive (T/R) modules are the basic building blocks of an active beam forming antenna, which are required for phased array radars. These modules need to be compact, lightweight and modular to meet the demand of agile, lightweight and robust microwave imaging sensor.</p> <p>LTCC based T/R modules, consisting of multifunctional and high power MMIC dies, having beamforming capability and low noise performance provides solutions to stringent requirements of microwave imaging radars.</p>		
	Scope/ Deliverables/ Outcome:		
	X-Band 10 W LTCC based hermetically sealed T/R module		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	<p>Designed, developed and qualified X-Band 10 W LTCC based hermetically sealed T/R module.</p> <p>(Current TRL - 8)</p>		

60	Name of the item:	Development of space grade Pulsed TWTA	
	Proposal ID	TDI060	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	Required for development of high power RF Transmitters for microwave remote sensing payloads.		
	Scope/ Deliverables/ Outcome:		
	Space grade Pulsed TWTA at X-Band (300W) and Ku-Band (150W)		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	Development of X-band 300W pulsed TWTA is in progress. DVM development is carried out and further design qualification activities are in progress. (Current TRL - 4)		

61	Name of the item:	S-Band foldable antenna array with beam steering capability (Tech: Antenna Array, Analog beam former, controller)	
	Proposal ID	TDI061	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	The objective is to develop and build standalone S-band foldable antenna array with Analog/Digital beam steering capability for different MSS applications. This subsystem to be developed as a standalone unit with built-in antenna control unit to be used as attachment to S-band transceiver system.		
	Scope/ Deliverables/ Outcome:		
	S-Band foldable array antenna system with beam steering capability and built-in antenna control unit for on the move applications.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	Proto beamformer with 2X2 elements and beam steering capability has been realized. (Current TRL - 4)		

62	Name of the item:	CCSDS Compliant Ground Modems	
	Proposal ID	TDI062	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	<p>The objective is to develop product for CCSDS compliant Ground Modems for telemetry & tele commanding operations and Space to Ground Communication Networks for current & future space missions</p> <ol style="list-style-type: none"> 1. PCM/PSK/PM, PCM/PSK/FM, PCM/PSK, CDMA Modems with different flavors of latest CCSDS encoding & decoding & CCM/ACM/VCM capabilities 2. Very High Bit Rate Modems 		
	Scope/ Deliverables/ Outcome:		
	CCSDS Compliant Ground Modems		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	<p>Prototypes of CCSDS compliant CDMA Modem & PCM/PSK Modems are being developed in-house. (Current TRL - 4)</p>		

63	Name of the item:	VSAT Baseband System (TDM (DVB-S2x)/MF-TDMA) (It includes DVB-S2x HUB Modulator, TDMA Demodulators, Network Control Processor, Network Management System, Time Frequency Generation Units and Remote Baseband Subsystem etc.)	
	Proposal ID	TDI063	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	The objective is to develop and build VSAT Baseband product with state-of-the-art waveform leading to enhanced communication security and self-reliance in ground segment of fixed satellite service. This will also be a steppingstone for building country's own communication standard.		
	Scope/ Deliverables/ Outcome:		
	VSAT Baseband System (Hardware, Firmware and Software).		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	All algorithm development and IP development for Physical Layer (DVB-S2 Modem, TDMA Modem, Scale Down NCP and NMS etc.) completed and tested in Satellite link in a scale-down version. (Current TRL - 7)		

64	Name of the item:	Frequency Converter Units (C, Ku, Ka, Q, V Band)	
	Proposal ID	TDI064	
	Concerned ISRO Centre/ Unit:	SAC	
	Objectives/ Brief Description:		
	The objective is to develop and build rack mounted and miniaturized modular Frequency Converter Units for Ground Segment and User Segment of SATCOM networks in C, Ku, Ka, Q, V Band.		
	Scope/ Deliverables/ Outcome:		
	Frequency Converter Units as Product which will convert C, Ku, Ka, Q, V Band to L-band IF frequency with required gain and frequency resolution as desired by SATCOM networks.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	Engineering models of FCU's developed and realized for C and Ku band. (Current TRL - 3)		

65	Name of the item:	Glass substrate for rigid OSR (cerium doped borosilicate glass substrate)	
	Proposal ID	TDI065	
	Concerned ISRO Centre/ Unit:	URSC	
	Objectives/ Brief Description:		
	Development of rigid OSR		
	Scope/ Deliverables/ Outcome:		
	40mm x40mm x (0.075mm – 0.2mm): 20,000 Nos. per year		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	TRL1		

66	Name of the item:	Variable Emissive Thermal Tape (Electro Chromic)	
	Proposal ID	TDI066	
	Concerned ISRO Centre/ Unit:	URSC	
	Objectives/ Brief Description:		
	For changing the emittance of a surface as per the changes in internal & external heating loads on board spacecraft. Change of emittance will happen with the supply of an excitation voltage.		
	Scope/ Deliverables/ Outcome:		
	Change of emittance of tape with the supply of an excitation voltage.		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	Nil		

67	Name of the item:	Smart Radiator (Variable Emissivity -Thermo-chromic), Electric Resistance Heating Tapes, Etched Foil Heaters with Polyimide Cladding Adhesive	
	Proposal ID	TDI067	
	Concerned ISRO Centre/ Unit:	URSC	
	Objectives/ Brief Description:		
	<p>Smart Radiator: For changing the emittance of a radiating surface with respect to temperature. In general Vanadium oxide based thin film coatings are used for this application.</p> <p>Electric Resistance Heating Tapes: For generating Joule heat and keep systems above minimum operating temperatures on board spacecraft.</p> <p>Etched Foil Heaters with Polyimide Cladding Adhesive: For generating Joule heat and keep systems above minimum operating temperatures on board spacecraft.</p>		
	Scope/ Deliverables/ Outcome:		
	<p>Smart Radiator: Change of emittance of radiator surface with respect to changing internal heat load / temperature.</p> <p>Electric Resistance Heating Tapes: Self-adhesive heating tape with resistive elements.</p> <p>Etched Foil Heaters with Polyimide Cladding Adhesive: Heater with etched heating element, cladded between polyimide film layers using polyimide adhesive.</p>		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	Nil		

68	Name of the item:	C/Ku 500W/750W TWT Amplifiers																												
	Proposal ID	TDI068																												
	Concerned ISRO Centre/ Unit:	MCF																												
	Objectives/ Brief Description:																													
	<p>TWT Amplifiers are primarily used in the uplink chains of Antenna terminals being used for various kinds of satellite operations like Tele-commanding, Ranging and payload operations. These operations require uplink in various frequency bands such as C and Ku bands with sufficient power margin in the uplink chain. Hence for different kind of operations TWT Amplifiers with different Power capacity such as 500W and 750W and bandwidth of minimum 800 MHz in both frequency bands with a typical gain of 70 dB min. are needed. The development of the travelling wave tube is also in the scope of this project.</p> <p>To cater to the above requirement, development of TWT Amplifiers as per the below guideline specifications is required.</p> <table border="1"> <thead> <tr> <th>S.no.</th> <th>Parameters</th> <th>Specifications</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Input Freq. Range</td> <td>50-90 MHz</td> </tr> <tr> <td rowspan="2">2.</td> <td rowspan="2">Output Freq. Range</td> <td>C band</td> <td>5850-6650 MHz</td> </tr> <tr> <td>Ku band</td> <td>12750-14500 MHz</td> </tr> <tr> <td rowspan="2">3.</td> <td rowspan="2">Output Power</td> <td>750 W</td> <td>650 W @ Flange</td> </tr> <tr> <td>500 W</td> <td>400 W @ Flange</td> </tr> <tr> <td>4.</td> <td>Saturated Gain</td> <td>70 dB. Min.</td> </tr> <tr> <td>5.</td> <td>Harmonic Output:</td> <td>-60dBc @ rated power</td> </tr> <tr> <td>6.</td> <td>Third Order IMP:</td> <td>- 25 dBc or better w.r.t each of two equal carriers 1 MHz apart, at 4 dB output power back-off</td> </tr> </tbody> </table>			S.no.	Parameters	Specifications	1.	Input Freq. Range	50-90 MHz	2.	Output Freq. Range	C band	5850-6650 MHz	Ku band	12750-14500 MHz	3.	Output Power	750 W	650 W @ Flange	500 W	400 W @ Flange	4.	Saturated Gain	70 dB. Min.	5.	Harmonic Output:	-60dBc @ rated power	6.	Third Order IMP:	- 25 dBc or better w.r.t each of two equal carriers 1 MHz apart, at 4 dB output power back-off
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	Scope/ Deliverables/ Outcome:																													
	Prototype unit																													
	Schedule (from date of signing of MoU/ Contract):	Three years																												
	Previous works carried out by ISRO:																													
	Development phase starts from TRL-2 (Technology Formulation)																													

69	Name of the item:	Frequency Up/Down Converters (C/Ext-C/Ku)																																																					
	Proposal ID	TDI069																																																					
	Concerned ISRO Centre/ Unit:	MCF																																																					
	Objectives/ Brief Description:																																																						
	<p>Spacecraft operations require frequency conversion from IF i.e. 70 MHz to various RF frequency band i.e. C, Ext. C and Ku band in uplink chain and Vice versa in Downlink Chain with a typical gain of 35dB and shall have sufficient input and output frequency bandwidth for catering to the needs of satellite uplink and downlink operations.</p> <p>The converters shall have Dual conversion to avoid spectrum inversion and for better image rejection. Hence, development of converters with following guideline specifications is needed.</p>																																																						
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1.	Input Freq.:	C band	3400-4200 MHz																																																				
		Ext. C band	4500-4800 MHz																																																				
		Ku band	10700-12000 MHz																																																				
2.	Output frequency	50-90 MHz																																																					
3.	Conversion:	Double Conversion without Inversion																																																					
4.	Level Control:	25 dB. Min.																																																					
	Scope/ Deliverables/ Outcome:																																																						
	Prototype unit.																																																						
	Schedule (from date of signing of MoU/ Contract):		Two years																																																				

	Previous works carried out by ISRO:
	Development phase starts from TRL-2 (Technology Formulation).

70	Name of the item:	Baseband IF Switch Matrix	
	Proposal ID	TDI070	
	Concerned ISRO Centre/ Unit:	MCF	
	Objectives/ Brief Description:		
	<p>Baseband IF switch matrix is an integral component in the Earth station Uplink and Downlink chain. Basically it is an interfacing element between the Baseband Area and RF Area where it can provide the dynamic routing. The matrix enables us to connect or re-route any baseband entity to the RF entity. Matrix operation supports from IF 50MHz-90MHz frequency.</p> <p>There are basically two types of Baseband IF switch matrices, Distributive IF Switch Matrix and Combining Switch Matrix. Depending on the functionality they offer, the Distributive Type matrix is required in Downlink path for routing one downconverter IF out to different receivers, whereas Combining Type Matrix is required in Uplink path to combine and/or switch the single or multiple modulators to an up-converter path. Matrix is also characterized by the number of input and output ports it can offer.</p> <p>Switch matrix comes with the different I/O capacity like 8x8, 16x16, 32x32, & 64x64. There is a single card for each input and output. All the cards work independently and failure in one input or one output card does not disturb the other cards functionality.</p>		
	Scope/ Deliverables/ Outcome:		
	Full-fledged combining and distributive IF switch matrix (32x32).		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	Development phase starts from TRL-2 (Technology Formulation).		

71	Name of the item:	20 / 50 / 100W Outdoor SSPA in C-Band / Ext. C-Band / Ku-Band	
	Proposal ID	TDI071	
	Concerned ISRO Centre/ Unit:	MCF	
	Objectives/ Brief Description:		
	<p>Solid State Power Amplifier is used as final amplifier in the SATCOM Uplink to boost the RF signal levels for transmission of information carriers at the required power levels in order to overcome various link losses encountered along a SATCOM Link to ensure a reliable link performance. A Solid State Amplifier with rated Output Power of 20/50/100W is envisaged to be designed, developed and fabricated through Indian Industry ensuring following minimum guideline specifications:</p> <p>a) Freq. Range: C-Band (5.85 – 6.45 GHz); Ext. C-Band (6.75 – 7.1 GHz); KuBand (12.75 – 14.5 GHz)</p> <p>b) Output Power (P1 dB): 20W (43dBm) / 50W (47dBm) / 100W (50dBm)</p> <p>c) Gain at P1dB (minimum): 20 W SSPA (55 dB) / 50W SSPA (56dB) / 100W SSPA (59dB)</p> <p>d) Gain Adjustability Range: 20 dB in 01. dB steps minimum</p> <p>e) Gain Flatness: 1.5 dB (C-Band) / 2-dB (Ext. C-Band) / 3 dB (Ku-Band)</p> <p>f) Gain Slope: 0.6-dB / 40 MHz</p> <p>g) 3rd Order Intermodulation products: -23dBc at 3-dB Back-off from P1</p> <p>h) AM/PM Conversion: 2.5□ dB Maximum at P1</p> <p>i) Spurious/Harmonics: -60dBc Max. at rated 1-dB Compression Point</p> <p>j) Input / Output VSWR: 1.3:1 Max.</p> <p>k) Input Interface: N-type (f)</p> <p>l) Output Interface: WR-137 (C/Ext. C-Band) / WR-75 (Ku-Band)</p> <p>m) Output Power Stability: ± 0.25dB (peak-to-peak) at any set RF Power</p> <p>n) Power Supply: 230V, 50 Hz AC (Single Phase)</p> <p>o) Power Consumption: 20W SSPA (≤350W) / 50W SSPA (≤500W) / 100W SSPA (≤800W)</p> <p>p) Chassis: Suitable Chassis for Outdoor Applications with min. IP-65 rating</p>		
	Scope/ Deliverables/ Outcome:		
	Product prototype.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO: Development phase starts from TRL-2		

72	Name of the item:	Low Noise Amplifiers in C, Ext-C and Ku Frequency Bands																																													
	Proposal ID	TDI072																																													
	Concerned ISRO Centre/ Unit:	MCF																																													
	Objectives/ Brief Description:																																														
	<p>In any communication system, Low Noise Amplifier (LNA) is an essential device in the receiver section or receive chain of satellite communication. LNAs are devices capable of amplifying extremely weak signals and provide levels suitable for further analog/digital processing. Normally, signals at the input of the LNA are very weak hence, the performance of the receive system is dominated by gain and noise introduced by the first stage. Thus, selection of LNA is critical for the good operation of the receive system. As the LNAs are intended to provide very high gains and add little noise to the input signal, design should focus on the parameters such as Noise factor, Noise Figure, Gain, Linearity, Frequency and Gain Stability, Maximum RF input level, etc.</p> <p>LNAs are of various types such as Parametric Amplifier, Bipolar Transistor LNA, FET LNA and HEMT (High Electron Mobility Transistor) LNA. Present day LNAs available commercially are mainly FET or HEMT type LNA.</p> <p>Some of the important parameters that are required for Design and Development of LNAs is provided below.</p>																																														
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	7.	Third Order IMP:	+20 dBm for all bands
	Scope/ Deliverables/ Outcome:		
	Product prototype.		
	Schedule (from date of signing of MoU/ Contract):		Two years
	Previous works carried out by ISRO:		
	Development phase starts from TRL-2 (Technology Formulation).		

73	Name of the item:	Low Noise Block Converters in C, Ext-C and Ku Frequency Bands	
	Proposal ID	TDI073	
	Concerned ISRO Centre/ Unit:	MCF	
	Objectives/ Brief Description:		
	<p>Low Noise Block-Converter (LNB) is a receiving device mounted on a satellite antenna, which collects the RF signals and converts them to a signal, which is then fed to receiver. LNBs are essentially a Low Noise Amplifiers with addition of frequency mixer, local oscillator and L/IF amplifier. The down-conversion stage in LNBs consists of a mixer, local oscillator followed by a filter. LNBs are capable of amplifying extremely weak signals and converting the RF to desired L-band which is then directly fed to the receive system. Gain and Noise at the input of the LNBs are the most important parameter of reliable and efficient LNB design. Normally, signals at the input of the LNA are very weak hence, the performance of the receive system is dominated by gain and noise introduced by the first stage. As the LNBs are intended to provide very high gains and add little noise to the input signal, design should focus on the parameters such as LO stability, Noise factor, Noise Figure, Gain, Linearity, Gain Stability, etc.</p> <p>Design and Development of LNBs is required to be carried out in C (3.4 to 4.2 GHz), Ext-C (3.625 – 4.8 GHz) and Ku (10.7 to 12.00 GHz). Some of the important parameters required to be considered during design and development are as follows:</p> <ol style="list-style-type: none"> 1. Input Frequency: C-Band – 3400 to 4200 MHz, Ext C-Band – 3625 to 4800 MHz Ku-Band – 10700 to 12000 MHz 2. Output Frequency: L-Band 950 to 1950 MHz 3. Gain : 55 dB to 70 dB 4. Gain Flatness : ± 1 dB over 40 MHz : ± 3.5 dB over full band 5. Noise Temperature for C/Ext-C/Ku-Band (30 – 40°K) 6. LO Stability of ± 5 to 25 KHz 7. Output P1 dB: + 9 dBm 		
	Scope/ Deliverables/ Outcome:		
	Product prototype.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	Nil		

74	Name of the item:	RF Switches (Coaxial and Waveguide)	
	Proposal ID	TDI074	
	Concerned ISRO Centre/ Unit:	MCF	
	Objectives/ Brief Description:		
	<p>RF Switches (Coaxial and Waveguide) are primarily used for directing the microwave power from one transmission line to another or turns the microwave power on and off. Switches can be mechanically or electronically actuated. Mechanically actuated switches connect and disconnect the transmission line by mechanical means. Electronically actuated microwave switches use PIN diodes. For low power requirements, coaxial switches are used whereas for high power RF signals, waveguide switches are used. Four electrical parameters characterize the performance of these switches. Isolation, Insertion Loss, Switching time and power handling. Isolation is measure of how effectively a switch is turned off. It is the attenuation between the input and output ports of the circuit. Insertion loss is the total power lost through the switch in its 'ON' state. Insertion loss is the most critical parameter because it adds directly to the system's noise figure. Switching time is the period a switch needs for changing state from "on" to "off" and "off" to "on". Power handling is the maximum RF input power that the switch can withstand without any permanent degradation in electrical performance.</p> <p>Usually, both types of switches operate from DC to 18 GHz. There are several design configurations possible that can range from single-pole/single-throw (SPST) to single-pole/sixteen-throw or higher (SP16T), where one input can switch between 16 different output states. Transfer switches are double-pole/double-throw (2P2T) designs. They have four ports with two possible switch state and have the capability to switch a load between two sources.</p> <p>Following important parameters may be considered during the design development of RF Switches.</p> <p>Coaxial Switches</p> <ol style="list-style-type: none"> 1. Operating Frequency Range: DC to 18 GHz 2. Insertion Loss: 0.5 dB max. 3. VSWR: 1.5:1 max 4. Isolation: 60 dB min. 5. Impedance: 50 ohm. <p>Waveguide Switches</p> <ol style="list-style-type: none"> 1. Switch Type: Rotary Transfer Switch 		

	<p>2. Waveguide Size: Depending on the frequency band (WR 137/WR-159/WR-229 for C-Band, WR-75 for Ku and WR-62 for DBS-band)</p> <p>3. Isolation: 60 dB</p> <p>4. Insertion Loss: 0.1 dB typ.</p> <p>5. VSWR: 1.2:1</p> <p>6. Power Handling: 5 KW Average</p> <p>7. Drive Mechanism: Motorized Latching Type</p>
	<p>Scope/ Deliverables/ Outcome:</p>
	<p>Product prototype.</p>
	<p>Schedule (from date of signing of MoU/ Contract): Two years</p>
	<p>Previous works carried out by ISRO:</p>
	<p>Development phase starts from TRL-2 (Technology Formulation).</p>

75	Name of the item:	Directional Couplers																																																								
	Proposal ID	TDI075																																																								
	Concerned ISRO Centre/ Unit:	MCF																																																								
	Objectives/ Brief Description:																																																									
	<p>A directional coupler is a passive device which couples part of the transmission power by a known amount out through another port, often using two transmission line set close enough together such that energy passing through one is coupler to the other. The device consists of four ports – input port, output port, coupled port and isolated port. Directional couplers can be realized in microstrip, stripline, coaxial and waveguide. They are basically used for sampling a signal, sometimes both incident/forward power and reflected/return power. Any directional coupler is bi-directional coupler, i.e. it performs equally well when the signal is incident on output port versus input port, but the coupled and isolated ports flip.</p> <p>Some of the important parameters of the directional coupler design are: Wide frequency range, Coupling factor, Directivity and Return Loss. Following important parameters may be considered during the design development of directional couplers.</p>																																																									
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	Scope/ Deliverables/ Outcome:																																																									

	Product prototype.	
	Schedule (from date of signing of MoU/ Contract):	Two years
	Previous works carried out by ISRO:	
	Development phase starts from TRL-2 (Technology Formulation).	

76	Name of the item:	Servo Drives & Brushless DC/AC Servo Motors
	Proposal ID	TDI076
	Concerned ISRO Centre/ Unit:	MCF
	Objectives/ Brief Description:	
	<p>The objective of the above is regarding the development of Brushless Servo motor along with its drive amplifier. This product can be used as a subsystem for the antenna drive control system. Also these type of motor and amplifier systems are used in various industrial automation applications.</p> <p>The scope includes the development of the following technology:</p> <p>1. Brushless Servo Motor: Electronically field oriented vector commutated permanent magnet motor with low Inertia, near flat torque speed characteristic with the following guideline specifications:</p> <ul style="list-style-type: none"> • Ingress Protection: IP 67 • Input Voltage: 200-480 VAC 3 Phase • Rated Speed: 2000 to 4000 rpm typical • Torque: 20-30 Nm Typical • Feedback: Resolver/Encoder • Brake: 24 V DC in build brake <p>2. Servo Drive Amplifier Capability to drive above motor in torque / velocity / position mode with the following guideline specifications:</p> <ul style="list-style-type: none"> • Input Voltage: 200-480 VAC 3 Phase • Current: 30 A Typical • Control Mode: User configurable Torque or Velocity or Position mode • Feedback: Resolver/Encoder • Control interface: Analog input ± 10 V • Digital Control Logic supply: 24 V DC • Output: Voltage/Current/Frequency should be compatible for controlling the Brushless Servo Motor mentioned in item-1 • Should have capability to set the servo gains and motor dependent parameters in drive amplifier. • Should have provisions for digital Input/Outputs for monitoring and configuring the safety interlocks. • Should have provisions for providing simulated velocity feedback to external motion controller in case 	

	Scope/ Deliverables/ Outcome:	
	Brushless Servo motor and Drive amplifier.	
	Schedule (from date of signing of MoU/ Contract):	Two-Three years
	Previous works carried out by ISRO:	
	Development phase starts from TRL-2 (Technology Formulation).	

77	Name of the item:	Digital Twins	
	Proposal ID	TDI077	
	Concerned ISRO Centre/ Unit:	NRSC	
	Objectives/ Brief Description:		
	Establishing new geospatial framework to transfer real time data to create functional digital twins. Better decision support system by leveraging high speed data transfer networks and 3D modelling systems.		
	Scope/ Deliverables/ Outcome:		
	Create a framework for decision support systems using digital twin models with secure data sharing mechanism.		
	Schedule (from date of signing of MoU/ Contract):	Two-Three years	
	Previous works carried out by ISRO:		
	Nil		

78	Name of the item:	Bhuvan Data Cube	
	Proposal ID	TDI078	
	Concerned ISRO Centre/ Unit:	NRSC	
	Objectives/ Brief Description:		
	Establishing Bhuvan data cube with the data sets available for download through Bhuvan NOEDA, Bhoonidhi and other Open Data sources Better analysis support system by ingesting different datasets to the Bhuvan Data Cube.		
	Scope/ Deliverables/ Outcome:		
	Create a framework of Tools for users for exploring the available data sets ingested into Datacube		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	Nil		

79	Name of the item:	Development of NavIC Post -Processing software for Precision Applications	
	Proposal ID	TDI079	
	Concerned ISRO Centre/ Unit:	NRSC	
	Objectives/ Brief Description:		
	<p>The aim of the project is to develop code and carrier based post-processing software through custom development and customization of the existing open source GNSS processing tools to provide positioning solutions using NavIC signals in Single Point, Differential and Precise Point Positioning (PPP) modes.</p> <p>Navigation with Indian Constellation (NavIC) is an Indian regional navigation satellite system consisting of seven satellites operating in L5 and S-band. In future this system will evolve into a global constellation. Presently it provides real-time navigation/positioning service with an accuracy better than 10 metres using the code data. Most navigational satellite constellation systems, in addition to real-time navigation, are used for precise positioning applications for the establishment of control networks, Ground Control Point surveys, platform trajectory estimation, utility GIS etc.</p> <p>Presently no commercial post processing software supports the processing of NavIC code and carrier phase signals in single-point and differential positioning and PPP modes/approaches to achieve centimetre-level accuracy. This project envisages to develop a standalone software in collaboration with industry which in the long run can be promoted commercial NavIC post-processing software enabling precision applications using NavIC globally.</p>		
	Scope/ Deliverables/ Outcome:		
	Development of NavIC post processing software for precision applications for Utility GIS, GCP surveys, Airborne/Terrestrial platform trajectory estimation.		
	Schedule (from date of signing of MoU/ Contract):	Three Years	
	Previous works carried out by ISRO:		
	<p>NRSC has recently started development of NavIC-based Single point positioning which has been implemented and tested for a few sites in and around Hyderabad. The development of Differential code and carrier based post processing solution is planned.</p> <p>NRSC has more than two decades of expertise and experience in the area GNSS based control network establishment, Ground control point collection for high resolution Aerial and Satellite projects, Geodynamic applications for plate tectonics, precise trajectory</p>		

estimation of aerial/terrestrial platforms and long baseline scientific post processing software. This expertise can be leveraged for this activity.

This proposal to collaborate with the industry can bring synergy between industry, academia and NRSC/ISRO to expedite the software development, testing, deployment, application development and commercialization.

80	Name of the item:	Development of a low cost & portable bathymetry system for in-situ measurements	
	Proposal ID	TDI080	
	Concerned ISRO Centre/ Unit:	NRSC	
	Objectives/ Brief Description:		
	<p>Production of compact bathymetry system for validation of remotely estimated bathymetric measurements.</p> <p>Usually, the depth of an open water body is remotely estimated using airborne and satellite based sensors with wide coverage. Unmanned Aerial Vehicle (UAV) borne bathymetry systems are current trends for bathymetry applications although with limited depth subjected to water quality. These remotely estimated measurements are validated with in-situ measurements using field sensors/systems. To cater to the requirement of ground truth measurement system especially for validating airborne based (Aircrafts/UAVs) bathymetry systems, a requirement arises for development of portal bathymetry system.</p>		
	Scope/ Deliverables/ Outcome:		
	Low cost and compact Bathymetry system.		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	<p>Developed prototype – A customized & compact immersion type bathymetry system was developed in-house. The functionality of developed system was demonstrated and the field performance of the system was successfully assessed for bathymetry upto 100 meters (RMSE = 1.722).</p>		

81	Name of the item:	Antenna Control Servo System (ACSS) for AZ-EL mount 4.5 M antenna	
	Proposal ID	TDI081	
	Concerned ISRO Centre/ Unit:	NRSC	
	Objectives/ Brief Description:		
	Design, develop and to become self-reliant in ACSS technology development. To use with any full motion LEO tracking antenna.		
	Scope/ Deliverables/ Outcome:		
	Development of Digital Antenna Control Servo System.		
	Schedule (from date of signing of MoU/ Contract):	Eight months.	
	Previous works carried out by ISRO:		
	One similar system delivered and installed at INCOIS Ground Station on 7.5 M antenna.		

82	Name of the item:	Satellite data Processing & Acquisition Reconfigurable card (SPARC) Data Ingest Hardware	
	Proposal ID	TDI082	
	Concerned ISRO Centre/ Unit:	NRSC	
	Objectives/ Brief Description:		
	Production of SPARC Data Ingest Hardware PCBs. To meet the NRSC, User/FSBS ground station requirements of real-time data ingest hardware		
	Scope/ Deliverables/ Outcome:		
	SPARC PCBs		
	Schedule (from date of signing of MoU/ Contract):	Six months.	
	Previous works carried out by ISRO:		
	The design & development of the SPARC data ingest hardware has been carried out in-house at NRSC.		

83	Name of the item:	Spatial inventory of agroforestry resources using geospatial technology and AI with very high-resolution images	
	Proposal ID	TDI083	
	Concerned ISRO Centre/ Unit:	NRSC	
	Objectives/ Brief Description:		
	<p>Reliable spatial database on agroforestry land use systems are not available. With the recent advancements in state-of-the-art Machine Learning / Deep Learning techniques, particularly for remote sensing applications with considerable improvements in achieving classification accuracies, it is possible to identify different agroforestry components in a more efficient manner and better accuracy using Very High-Resolution Satellite Images. Objective: Development of geospatial methodology for assessment of agroforestry using High Resolution Satellite (HRS) imageries and Machine Learning Techniques for development of proof of concept</p>		
	Scope/ Deliverables/ Outcome:		
	<ul style="list-style-type: none"> • Integrated Agroforestry land use map along with other land use classes for six districts spread across the country. • Development of deep learning model for mapping different agroforestry land use types and components. 		
	Schedule (from date of signing of MoU/ Contract):	One year for six districts across the country.	
	Previous works carried out by ISRO:		
	Preliminary Development Project.		

84	Name of the item:	Development of Centralized electronics unit for processing data from multiple sensors	
	Proposal ID	TDI084	
	Concerned ISRO Centre/ Unit:	LEOS	
	Objectives/ Brief Description:		
	<p>Multiple sensors developed at LEOS use a dedicated processor, namely Star Sensor, Fibre Optics Gyroscopes (FOG), Sensor Processing electronics etc. A novel idea is conceived if a single centralized - Sensor Processing Unit (SPU) can be used for multiple sensors and on-orbit sensor calibration. This will lead to miniaturization and enhance performance through onboard sensor calibration.</p> <p>Interface to AOCE for control will also be simplified without affecting the update rates of individual sensors.</p>		
	Scope/ Deliverables/ Outcome:		
	<p>Sensor Processing electronics package, broadly consisting of:</p> <ol style="list-style-type: none"> 1) Multiple sensors interfaces 2) Multi core processor 3) External memory 4) Test System 		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	<p>Demonstrated integrated processing unit - SPU for Star Sensor and FOG.</p> <ul style="list-style-type: none"> • Design and development of 32-Bit Fault tolerant SPARCV8 Dual Core processor. • Multi-threaded software for parallel processing of Star Sensor and FOG data. • Development of test setup using test simulators. 		

85	Name of the item:	Development of ground based telescope, install and make it operational	
	Proposal ID	TDI085	
	Concerned ISRO Centre/ Unit:	LEOS	
	Objectives/ Brief Description:		
	<p>There is a requirement for ground-based telescope catering to different applications of satellite missions such as quantum communication, optical communication & space situational aware ness systems.</p> <p>LEOS has the technology for manufacturing optical hardware and proven heritage in realizing 1.2m light weighting optics for Cartosat-3 as well as 0.7m optics realized for cartosat-2 etc. In addition, necessary mechanical hardware & control system to be developed.</p>		
	Scope/ Deliverables/ Outcome:		
	<ol style="list-style-type: none"> 1. Optics Hardware 2. Mechanical, assembly demonstration 3. Mechanical control system hardware& software 4. Installation & demonstration 		
	Schedule (from date of signing of MoU/ Contract):	Three Years	
	Previous works carried out by ISRO:		
	<ol style="list-style-type: none"> 1. Developed dia 1.2 m light weighted optics with concave hyperbolic shape with 80% light weighting and achieved surface figure better than 12nm. 2. Test set ups for testing individual and integrated test of the mirrors. 3. Ø 0.7-meter light weighted optics with 60% light weighting. 		

86	Name of the item:	PAT (position, Acquisition, Tracking) system for free space inter-satellite Laser communication link	
	Proposal ID	TDI086	
	Concerned ISRO Centre/ Unit:	LEOS	
	Objectives/ Brief Description:		
	<p>Need: Optical link for high data rate communication uses Laser beam. In view of very narrow beam divergence of the Laser, accompanied by satellite pointing accuracy, stability and position knowledge, there is a demand for accurate PAT system which will point, acquire and track the Laser beam and thus maintain continuous LoS for seamless data transfer between two terminals.</p> <p>Objective: To Point, Acquire and Track the Line-of sight (LoS) with an accuracy of 2 urad between the two optical communication terminals placed on two satellites in LEO orbit or LEO-GEO orbit separated by distance in range of 2000 km – 45000 km.</p> <p>Scope: A typical PAT system consists of Laser source (either beacon laser or communication laser), coarse pointing mechanism, fine pointing mechanism, wide FOV acquisition sensor, tracking sensor and opto-mechanical assembly.</p>		
	Scope/ Deliverables/ Outcome:		
	<p>System configuration</p> <ul style="list-style-type: none"> • PAT configuration finalization based on literature survey and trade-off analysis. <p>Hardware:</p> <ul style="list-style-type: none"> • 2 units of PAT system comprising of coarse pointing mechanism, fine pointing mechanism, acquisition sensor, tracking sensor and PAT controller. <p>Software: Any onboard software and algorithm that will part of the PAT system.</p>		
	Schedule (from date of signing of MoU/ Contract):	Two years	
	Previous works carried out by ISRO:		
	Beaconless PAT system configuration is completed. The realization of hardware is in progress.		

87	Name of the item:	Gyro Processing Electronics module with industrial/ automotive grade components															
	Proposal ID	TDI087															
	Concerned ISRO Centre/ Unit:	LEOS															
	Objectives/ Brief Description:																
	To realize the Gyro processing electronics module with industrial/automotive grade components, and to qualify it for space (LEO and GEO) in order to realize low cost, low volume, low mass electronics package. This package is stackable to the gyro head. Also results in miniaturization of skewed modules.																
	Scope/ Deliverables/ Outcome:																
	Electronics module which can be integrated to Gyro head module, DC power source and serial data bus.																
	<table border="1"> <thead> <tr> <th>Type</th> <th>Deliverables</th> </tr> </thead> <tbody> <tr> <td>Hardware</td> <td>Electronics module with interface to Gyro head, DC power source and serial data bus in compact housing</td> </tr> <tr> <td>Hardware Design files</td> <td>Schematic, Component list, PCB board files</td> </tr> <tr> <td>FPGA/MuP</td> <td>Source code, design files (LEOS developed)</td> </tr> <tr> <td>Tests</td> <td>Screening, qualification and radiation tests, with SEU mitigation techniques wherever applicable</td> </tr> <tr> <td>Mechanical parts for the electronics assembly</td> <td>Light weight, non-magnetic metallic housing</td> </tr> <tr> <td>Mechanical Design files</td> <td>Drawings</td> </tr> </tbody> </table>			Type	Deliverables	Hardware	Electronics module with interface to Gyro head, DC power source and serial data bus in compact housing	Hardware Design files	Schematic, Component list, PCB board files	FPGA/MuP	Source code, design files (LEOS developed)	Tests	Screening, qualification and radiation tests, with SEU mitigation techniques wherever applicable	Mechanical parts for the electronics assembly	Light weight, non-magnetic metallic housing	Mechanical Design files	Drawings
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Mechanical Design files	Drawings																
	Schedule (from date of signing of MoU/ Contract):	Three years															
	Previous works carried out by ISRO:																
	The in-house developed electronics has flown in Cartosat-3, GISAT-1, which was with space grade QMLV components. Functionally equivalent, miniaturised electronics module to be developed with industrial/automotive grade components.																

88	Name of the item:	Millimetre Wave Cloud Radar System	
	Proposal ID	TDI088	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<p>Objective: Establishing Cloud and precipitation radar network for reducing uncertainties in cloud parameterizations used in global climate models</p> <p>Need: Investigation of horizontal and vertical distributions of clouds, as well as the retrieval of geophysical variables to characterize cloud properties.</p> <p>Scope: Development of Ka band Dual Polarimetric Scanning Cloud Radar system and advanced data products.</p>		
	Scope/ Deliverables/ Outcome:		
	Ka band Dual Polarimetric Scanning Cloud Radar system and advanced data products.		
	Schedule (from date of signing of MoU/ Contract):	Two Years	
	Previous works carried out by ISRO:		
	Developed technology for cloud radar systems and realizing Integrated system.		

89	Name of the item:	X-Band Solid State based Polarimetric Doppler Weather Radar System	
	Proposal ID	TDI089	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<p>Objective: Weather Surveillance & Monitoring</p> <p>Need: Geographic locations which are highly influenced by hilly terrain and severe weather conditions are essential to have observation system at X-Band frequency which will give a radial range of observation around 75 to 100kms. These radars also can be deployed in flash flood prone area for early warning and disaster mitigation support & management, rain catchment areas to observe the rain fall rate in a continuous manner which will help in formulating short time prediction and planning.</p> <p>Scope: Design & Realisation of X-Band Solid State based Polarimetric Doppler Weather Radar System. Solid State transmitters, Specialised Waveform Generations and Signal Processing, Data Acquisition & Advanced Products Generation.</p>		
	Scope/ Deliverables/ Outcome:		
	X-Band Solid State based Polarimetric DWR System and advanced data products.		
	Schedule (from date of signing of MoU/ Contract):	Two Years	
	Previous works carried out by ISRO:		
	Developed the systems for weather monitoring.		

90	Name of the item:	C-Band Solid State based Polarimetric Doppler Weather Radar System	
	Proposal ID	TDI090	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<p>Objective: Weather Surveillance & Monitoring.</p> <p>Need: C-Band DWR system is an ideal instrument to use for long Range Weather Surveillance with an expected deployment for a range of 200kms radially.</p> <p>Scope: Design & Realisation of C-Band Solid State based Polarimetric Doppler Weather Radar System. Solid State transmitters, Specialised Waveform Generations and Signal Processing, Data Acquisition & Advanced Products Generation.</p>		
	Scope/ Deliverables/ Outcome:		
	C-Band Solid State based Polarimetric DWR System and advanced data products.		
	Schedule (from date of signing of MoU/ Contract):	Two Years	
	Previous works carried out by ISRO:		
	Developed the systems for weather monitoring.		

91	Name of the item:	Phased Array based Polarimetric Doppler Weather Radar System	
	Proposal ID	TDI091	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<p>Objective: Phased array electronically scanning X-band phased array Doppler Weather Radar are next generation operational Radars which can obtain rapid scan observations. Need: Measurement of 3-dimensional fine structure of rainfall with high spatial and temporal resolution, Rapid volumetric coverage and Observation of a three dimensional structure of a cumulonimbus clouds.</p> <p>Scope: Design & Realisation of Phased array Polarimetric Doppler Weather Radar for observations of a microburst, hail shafts, super cells & a tornado super cell and also high spatial resolutions for meso-cyclones, localized heavy rainfalls, gusts, tornadoes and other storm-scale features. Applications include applications like urban hydrology, microburst detection in aviation and general meteorology, hail, and other severe weather detection and warning.</p>		
	Scope/ Deliverables/ Outcome:		
	X band Dual Polarimetric Scanning DWR system and advanced data products.		
	Schedule (from date of signing of MoU/ Contract):	Two Years	
	Previous works carried out by ISRO:		
	Developed similar phased array systems for atmospheric systems and System Design is carried out.		

92	Name of the item:	Urban flooding surveillance system using multi radar and sensor network	
	Proposal ID	TDI092	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<p>Objective: Developing Weather radar, CCTV network and other monitoring devices for early warning urban flood surveillance system.</p> <p>Need: As the climate has been changing, global rainfall patterns have been constantly changing. Due to the rapid changes in climate and global rainfall patterns most of the urban regions in India are getting more severe rainfalls and floods due to the fact that excessive rainfall cannot be drained with short period of time in the regions, which usually causes considerable economic losses. Early warning systems are required with advanced technologies with Doppler radars and other monitoring devices.</p> <p>Scope: Development of X band portable Polarimetric weather radar network and integrate with other monitoring devices for early warning urban flooding surveillance system.</p>		
	Scope/ Deliverables/ Outcome:		
	X band Modular and portable Polarimetric weather radar system and advanced data products.		
	Schedule (from date of signing of MoU/ Contract):	Two Years	
	Previous works carried out by ISRO:		
	Developed technology for Weather radar systems and commissioned advanced C & X Band weather Radars.		

93	Name of the item:	Boundary Layer Wind Profiler	
	Proposal ID	TDI093	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<p>Objective: Establishing Wind Profiler radar network for reducing uncertainties in atmospheric boundary layer and wind parameterizations used in global climate models.</p> <p>Need: The atmospheric boundary layer is affected by the surface properties such as soil moisture and roughness. The turbulent mixing and dispersion of air pollutants is strongly dependent on the vertical structure of the wind, which constitutes one of the major challenges affecting the determination of boundary layer height. Investigation of horizontal and vertical distributions of winds, as well as atmospheric boundary layer height has great implications for environmental and climate studies.</p> <p>Scope: Development of L band Wind Profiling Radar system and advanced data products.</p>		
	Scope/ Deliverables/ Outcome:		
	L band Modular wind profiling Radar system and advanced data products.		
	Schedule (from date of signing of MoU/ Contract):	Two Years	
	Previous works carried out by ISRO:		
	Developed technology for wind profiling radar systems and realizing Integrated system.		

94	Name of the item:	Mid Tropospheric Wind Profiling Radar	
	Proposal ID	TDI094	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<p>Objective: Development of Wind Profiler for Determining wind velocity and direction upto Mid Troposphere. Establishing Wind Profiler radar network for quantifying and understanding the impact of different atmospheric processes over the various regions of India.</p> <p>Need: To improve numerical weather forecasting, to study various aspects of atmospheric processes, dynamics, climatology, weather hazard, Monsoon system, etc.</p> <p>Scope: Development of a network of Wind Profilers for Determining wind velocity and direction upto Mid Troposphere.</p>		
	Scope/ Deliverables/ Outcome:		
	Mid Tropospheric Wind Profiling Radar		
	Schedule (from date of signing of MoU/ Contract):	Two Years	
	Previous works carried out by ISRO:		
	Developed technology for wind profiling radar systems and realizing Integrated system.		

95	Name of the item:	Space Debris Surveillance & Tracking Radar	
	Proposal ID	TDI095	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<p>Objective: To establish observational capability of space objects, including space debris, through a network of tracking facilities, in order to safeguard national space assets.</p> <p>Need: Detection, tracking and analysis of space objects/debris in LEO orbit.</p> <p>Scope: Design & Development of Space Debris Surveillance & Tracking Radar to detect, track and image multiple pieces of space objects and determine object parameters such as size, velocity, altitude and orientation.</p>		
	Scope/ Deliverables/ Outcome:		
	Space Debris Surveillance & Tracking Radar.		
	Schedule (from date of signing of MoU/ Contract):	Three Years	
	Previous works carried out by ISRO:		
	Developed technology for phased array systems and conventional Tracking radars.		

96	Name of the item:	High Power Transmitter development using Vacuum tubes for ground based system	
	Proposal ID	TDI096	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<p>Ground based RF chain requires high power transmitter as uplink. To serve uplink purpose of high power as per link budget, Vacuum tube based system can generate steady power output with high reliability.</p> <p>Application specific vacuum tubes can be integrated with other subsystems and transmitter can be developed with waveguide integration to extend the RF energy.</p>		
	Scope/ Deliverables/ Outcome:		
	Integrated transmitter system on a Rack with specified output RF power which will contain vacuum tube, RF Driver, Rectifier, modulator with IGBT/ SiC power switch, Transmitter control and remote operation, Protection Interlock electronics, Pressurizer/ Dehumidizer.		
	Schedule (from date of signing of MoU/ Contract):	1.5 Year	
	Previous works carried out by ISRO:		
	<ul style="list-style-type: none"> • 1 Megawatt Peak power output S-Band pulsed Transmitter for Doppler weather Radar with Klystron amplifier. • 250 Kilo watt Peak Power C band pulsed Transmitter for Doppler weather Radar with Klystron amplifier. • 70 Kilo watt Peak Power X band pulsed Transmitter for Doppler weather Radar with Magnetron amplifier. • 3 Kilo watt Peak power output Ka band pulsed Transmitter for Cloud Radar with Extended Interactive Klystron (EIK) amplifier. 		

97	Name of the item:	High Power Transmitter development using Solid State Power Amplifier (SSPA) for ground based system	
	Proposal ID	TDI097	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	Ground based RF chain requires high power transmitter as uplink. To serve uplink purpose of high power as per link budget, SSPA based system with higher duty can generate steady power output with pulse integration method.		
	Scope/ Deliverables/ Outcome:		
	Integrated transmitter system on a Rack with specified output RF power which will contain SSPA including, RF Driver, Power Supply Control System to switch on with remote operation.		
	Schedule (from date of signing of MoU/ Contract):	1.5 Year	
	Previous works carried out by ISRO:		
	<ul style="list-style-type: none"> • 4 Kilo watt Peak Power C band pulsed Transmitter for Doppler weather Radar with SSPA. • 300 watt Peak power X band pulsed Transmitter for Doppler weather Radar with SSPA. 		

98	Name of the item:	Development of X-band dual polarized Doppler Weather Radar	
	Proposal ID	TDI098	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<ul style="list-style-type: none"> • The Objective of the work includes to realise X-band dual Polarimetric Doppler Weather Radar (DWR) with capability to detect and estimate meteorological parameters of severe weather phenomena up to a slant range of 100km with 13dB reflectivity. • Required signal processing algorithms shall be developed for achieving the required clutter suppression capability and generation of weather products. 		
	Scope/ Deliverables/ Outcome:		
	The proposed X- Band Dual Polarimetric DWR is required to meet the critical weather forecast requirements of launch missions including upcoming Gaganyaan missions in all seasons. The DWR is capable of monitoring and tracking rain events and thunderstorms for 100Km range with less than 75m resolution with scanning rate up to 3 rpm. X- Band Dual Polarimetric DWR with required detection capability can be realized through this developmental activity.		
	Schedule (from date of signing of MoU/ Contract):	Two Years	
	Previous works carried out by ISRO:		
	Overall design and system configuration has been carried out. Detailed technical specification has been generated. TRL 2		

99	Name of the item:	L-band GaN based Transmit Receive module with high power output	
	Proposal ID	TDI099	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	<p>To demonstrate L-band GaN HEMT based Transmit Receive module with the following technical features.</p> <ul style="list-style-type: none"> • Transmit power output of 400W minimum. • Receive path noise figure less than 3dB. • Improved receive path protection capable of handling RF leakage up to 600W peak power into receive path. • Improved efficiency of 60% minimum. 		
	Scope/ Deliverables/ Outcome:		
	<p>L-band GaN HEMT based Transmit Receive module.</p> <p>Hardware Deliverable:</p> <ul style="list-style-type: none"> • 2 numbers of L-band GaN HEMT based Transmit Receive module. • Test jig for controlling TRM operation on bench. <p>Software Deliverable:</p> <ul style="list-style-type: none"> • TRM controller FPGA firmware for controlling transmit, receive operations, beam steering control. • Test GUI for command and control interface with TRM. 		
	Schedule (from date of signing of MoU/ Contract):	One year	
	Previous works carried out by ISRO:		
	<p>Conceptual design of Transmit Receive module is completed. Selection of power amplifier device and configuration for thermal management are in progress.</p> <p>TRL - 3</p>		

100	Name of the item:	RF Monitoring, Direction Finding and Geo-location system for SDSC SHAR	
	Proposal ID	TDI100	
	Concerned ISRO Centre/ Unit:	ISTRAC	
	Objectives/ Brief Description:		
	System is capable of monitoring, direction finding and Geo-location of multiple RF sources of same/different frequencies in real time covering complete SDSC SHAR over frequency range of 20 MHz to 18 GHz.		
	Scope/ Deliverables/ Outcome:		
	RF Spectrum occupancy over the frequency range of 20 MHz to 18 GHz at launch complex.		
	Schedule (from date of signing of MoU/ Contract):	Three years	
	Previous works carried out by ISRO:		
	TRL-2		