2016

REQUEST FOR PROPOSAL (RFP) FOR GSAT-19 GROUND SYSTEM

SATCOM SYSTEMS TECHNOLOGY GROUP, SNAA

SPACE APPLICATIONS CENTRE, ISRO

DOC: Ka-BAND RFP/GSAT-19 GS/SAC/2016

Request for Proposal (RFP)

Supply, Installation and Commissioning of

GSAT-19 Ground System

SPACE APPLICATIONS CENTRE

INDIAN SPACE RESEARCH ORGANIZATION

AHMEDABAD

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LIST OF ABBREVIATIONS

RFP : Request for Proposal

RUT : Remote User Terminal

OFC : Optical Fiber Communication

COM : Comprehensive Operation and Maintenance

CAMC : Comprehensive Operation and Maintenance Contract

HVAC : Heating Ventilation and Air Conditioning

RFEH : RF Equipment Housing

TWTA : Travelling Wave Tube Amplifier

HPA : High Power Amplifier

LNA : Low Noise Amplifier

ACM : Adaptive Coding and Modulation

NMS : Network Manager System

NCC : Network Control Center

TFSS : Time & Frequency Subsystem

HMC : Hub Monitoring and Control

VCM : Variable Coding and Modulation

CCM : Constant Coding and Modulation

VNO : Virtual Network Operator

QoS : Quality of Service

CIR : Constant Information Rate

SIP : Session Initiation Protocol

TCP/IP : Transport Control Protocol / Internet Protocol

HTTP : Hyper Text Transfer Protocol

FTP : File Transfer Protocol

UDP : User Datagram Protocol

DDR : Detailed Design Review

Section-1: Introduction to GSAT-19 Ground Systems

1.1 Introduction

Space Applications Centre (SAC) located at Ahmedabad, India's one of the major centers of the Indian Space Research Organization (ISRO), Department of Space, Government of India.

The next-generation Ku/Ka communication satellite GSAT-19 is currently under development at ISRO. It is a High Throughput Satellite (HTS) and its application shall primarily focus on meeting the country-wide demand for satellite based broadband applications.

The ground infrastructure for complete GSAT-19 system will include two (2) Ka-band Gateways (or Hubs). Multiple services/Service providers will share the satellite bandwidth at L-band interface in the gateway stations and provide services to the end users. Each Service provider will have their own network architecture managed by themselves and operating within the designated bandwidth with their remote terminals. Each Gateway will have only main hub with capability to upgrade for interface with diversity site. Thus, each of the two Gateways will have only main Hub (Total two Hub).

The Gateways through their common facilities will provide satellite access to one or more service providers. The arrangement of service providers is outside the scope of this document and will be dealt with separately. However, the Gateways shall be suitably configured and equipped to provide full set of features and connectivity to multiple service providers.

This "Request for Proposal" is for "Supply, Installation, Commissioning and Maintenance of the complete GSAT-19 Ground System Network" comprising all Gateway Stations and related equipment, defined in this document.

1.2 GSAT-19 Ground Network

GSAT-19 Satellite will provide Ku-band user spot beams, covering Indian mainland as well as islands regions (Refer Section-3, Technical Details of Satellite Transponders). The Satellite will also provide Ka-band spot beams for Gateways. Figure-1 shows the overall ground system comprising two Ka-band Gateway earth stations.

The GSAT-19 Ground network will consist of following major components:

1.8 Ku-band spot beams over Indian region

2.2 Ka-band spot beams over Indian region with frequency and polarization reuse

3.Two interconnected Ka-band Gateways (Main Gateways) using OFC link/Data connectivity.

4.Ku-band 1.2m VSATs (Remote User Terminals-RUTs)

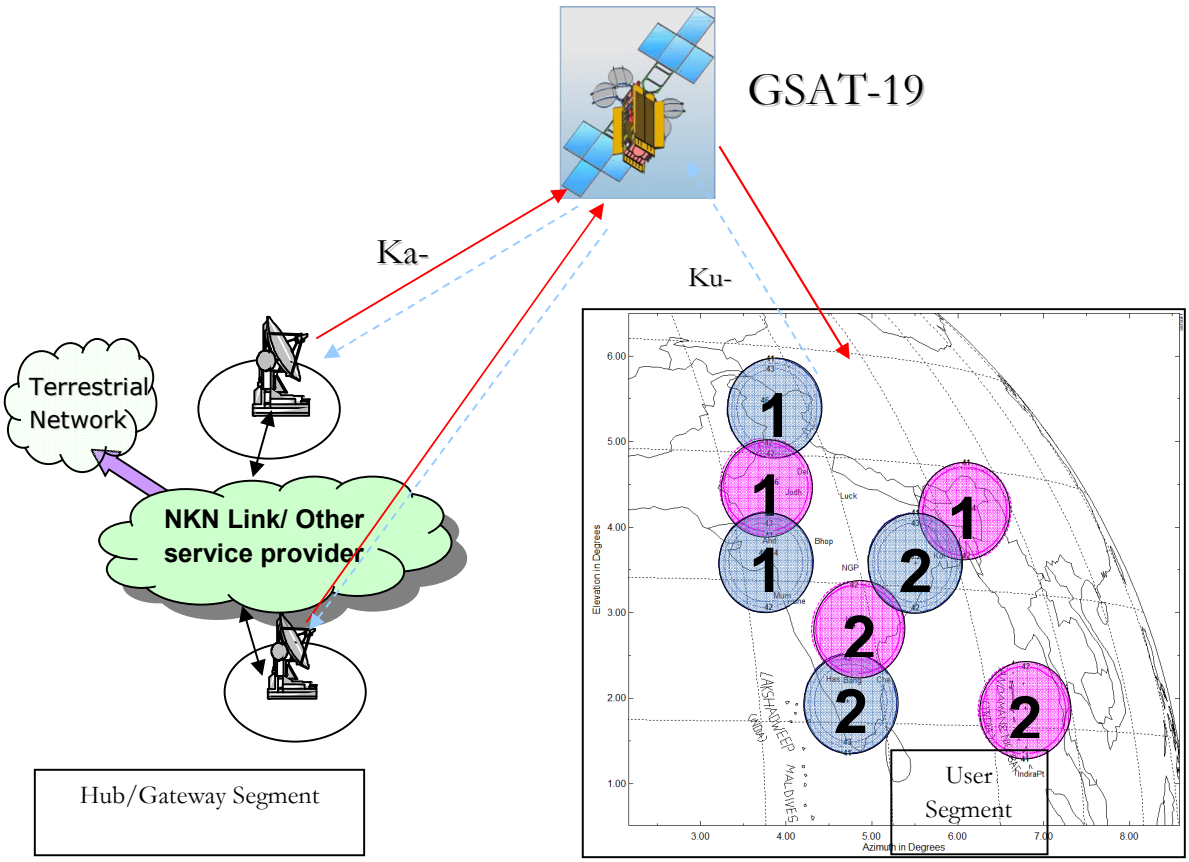

Figure 1: GSAT-19 Ground system Configuration

1.3 Network features

1.The Gateways will communicate to Satellite in Ka-band

2.RUTs will communicate in Ku-band with Satellite.

3.Star connectivity between Ku-band RUTs through Ka-band Gateways. The user-to-user communication will only be possible via Gateways.

4.Each Gateway will be connected to the RUTs through four Ku-band spot beams. Hub transmit and receive simultaneously in both polarizations (Two beams in one polarization, total four beams)

5.All Gateways shall be interconnected through OFC ground network for enabling seamless flow of user data as per satellite footprint.

1.4 Gateways Description

1.Each Gateway will house number of services/service providers, provision for multiple carriers with allotted satellite bandwidth capacity at IF level (L-Band).

2. Vendor shall run 4 (1:1 for transmit and 1:1 for receive) L- band cables / Optical Fiber link between RFEH (RF Equipment Housing) and main gateway stations where it will be interfaced with different baseband equipment housed in the racks. Exact interface connector details (SMA, N type etc) will be finalized at the time of DDR. SAC will provide the required space for keeping the racks, UPS and other related equipment in the main gateway stations.

3.It should be possible to operate the Gateways independently and from a common control site, which may or may not be co-located with any of the two Gateways.

4.With respect to baseband, it is planned to establish baseband equipment in each Gateway. The baseband equipment for this portion is **NOT part of this RFP**.

1.5 Gateway Locations

The Gateways shall be installed at two locations in India. These locations are Ahmedabad, Delhi or Bangalore. However, the exact location of the site within the places mentioned will be decided at the time of DDR,

Figure- 2 provides a country-wide map of India, showing site locations. Table-1 provides Gateway Geo Location of the sites:

Table 1: Site Geo Locations

Gateway Earth Station		
Place	**Latitude (in deg)**	**Longitude(in deg)**
Ahmedabad	23.023	72.414
Delhi/Bengaluru	28.38/12.97	77.12/77.59

Figure 2: GSAT-19 Gateway Locations

Section-2: RFP Details and Guidelines

2.1 Scope of Work

GSAT-19 network will consist of two main gateways and RUTs installed across all user beams. The Hub will be 24x7 operational. A good maintenance of hub from the vendor is also being envisaged. So, Comprehensive Annual Maintenance of these gateways also comes under the scope of work apart from installation, commissioning and testing of the hub.

The broad scope of work for prime vendor (Here after called as vendor) includes the following:

1.Supply, Installation, Commissioning and Maintenance of:

- Main Gateways (Hub)– with associated sub-system redundancy

2.The implementation of the project includes system engineering, associated design and development, supply of hardware & software, installation, integration, commissioning and testing of Gateways.

3.The establishment of basic Gateway infrastructure using state-of-the-art, cost-effective commercially available systems.

4.Each Gateway should have L- band interface to support multiple service providers for installation of their respective baseband equipment and creating their own independent communication network with suitable power and interface control mechanism.

5. The vendor has to provide a warranty for 3 years, which includes comprehensive maintenance with spares. Vendor has to provide quote for comprehensive maintenance including spares for 3 years after completion of 3-year warranty period. Vendor shall also accept extension of comprehensive maintenance for a period of next 4 years.

6. The vendor shall provide technology and spare support for hardware and software for a period of 10 years. Vendor should also provide policy for procuring spares at the beginning of 10^{th} year for support up to 15 years.

7. Vendor shall provide one week hands on training on hub operations and preventive maintenance for 10 persons free of cost at each site locations.

2.2 Responsibilities of Vendor

Following table-2 defines vendor's responsibilities for entire work involving the establishment & commissioning of Gateway infrastructure

Table 2 Vendor's Responsibility

Sl. No	Vendor's Responsibility	Compliance	Remarks/Justification
1.	To understand all the requirements and scope of work completely		
2.	Provide system engineering calculations along with the proposed hardware to meet the requirement, as projected in this RFP		
3.	Provide requirement of space for equipment and electricity.		
4.	Submit a comprehensive list of deliverables along with the offer with price masked for any/all proposed configurations		
5.	Provide detailed cost break-up as part of the offer in the financial bid		
6.	Provide delivery schedule as part of the offer		
7.	Prepare the detailed design review (DDR) document and make presentation during the DDR to the technical committee appointed by SAC. It will be mandatory for the vendor to close all actions generated during this review.		

	Closure of actions will be without impact on cost. This review should also provide system engineering details, protocol details of HMC, Gateway station, operational details, monitoring and maintenance considerations etc. Complete Mechanical details (FE Analysis for antenna assembly and support structure against RF specification, Racks dimension, Housing details etc)		
8.	Prepare, discuss and submit Acceptance Test Plan (ATP) to SAC. Changes suggested by SAC should be implemented by the vendor during DDR.		
9.	Carry out site preparation and antenna pedestal and other construction work.		
10.	Vendor shall provide the test reports for all sub-systems (eg. Antenna, Feed system, LNA system, TWTA, BUC, BDC, TLT, modem etc.) and get it approved by SAC before dispatch		
11.	Transportation of equipment to the respective site		
12.	Integration of the Hardware and Software of system		
13.	Installation, commissioning and testing of the complete ground system including Gateways as per the requirements given in this RFP		

14.	Vendor shall perform acceptance tests as per approved ATP document		
15.	Vendor shall provide list of all deliverables including cables, connector, waveguide, patch panel etc. in their proposal.		
16.	Supply documentation, relevant OEM certificates, performance report of all subsystems and manuals in hard and soft copies		
17.	Provide 24x7 technical support as and when required		
18.	Vendor shall submit comprehensive maintenance plan for services during warranty period of 3 years. After completion of warranty period, vendor must commit to undertake extended comprehensive maintenance services for next 3 years. Vendor must also commit to undertake extended comprehensive maintenance services for additional 4 years, after completing maintenance for 3+3 years, if called for by SAC. Vendor should also explain their strategy for CAMC. Annexure-1 shows details of CAMC.		
19.	Vendor shall provide a list of inventory of critical spares, which the vendor will maintain for maintenance of services,		

	along with offer.		
20.	The selection of the sub-systems of ground system should be done in a manner to ensure the continuity of service for at least 10 years (preferably 15 years) for the Gateway sub-systems. Vendor should also provide policy for procuring spares at the beginning of 10^{th} year for support up to 15 years. Vendor shall submit comprehensive obsolescence management plan along with offer, substantiated by OEM certificate or a credible alternative strategy.		
21.	Vendor shall obtain necessary regulatory clearance/license for establishment of gateways		

2.3 General Guidelines to the Vendors and Other Conditions

1.The offer must contain sufficient data and material to prove that bidding vendor possesses at least 10 years of experience as on the date of opening the technical bid in the similar type of work, as described in this RFP. Vendor should submit the relevant documents stating their previous experiences in executing similar type of work. For antenna hub system, the required experience is as follows:

a. Large antenna installations of 7.5m and above with tracking system

b.Frequency of operation – C/ext-C/Ku- Band and above

c.Simultaneous transmit and receive capability

All these above items should be in the same antenna. Any installation not meeting any of the above criteria will not be considered for the experience as similar type of work. This is mandatory condition which has to be met for qualification of bid. The vendor should fill the details of experience as per format provided in the Annexure-3. Only those experiences which are backed by relevant order documents will be considered during evaluation. Experience of OEM alone is not considered here.

2. Vendor shall comply to all the specifications, deviations if any shall be mentioned in a separate table and provide justification how these deviations will /will not hamper the overall performance of the system. Any improvement shall be separately brought out in the offer.

3.The overall configuration and implementation plan should be clearly explained with the help of block schematic of the complete system. The offer should also include the technical justification of choosing each sub-system with respect to the goal of meeting overall system specifications and other requirements.

4.The vendor must provide a Statement of Compliance (SoC), covering each point of system and sub-system specifications of complete earth station system as mentioned in respective sub-system details. SOC by the OEMs and not supported by vendor is not acceptable. In case of any discrepancy between OEM datasheet and compliance statement, OEM

datasheet will be considered final and binding. This SoC should be well supported by documentation consisting of data sheets, brochure, calculations, literature etc. All relevant details of each subsystem like make & model number, detailed specifications, block schematic, if possible test data sheet etc. should also be provided.

5.After receiving the offers, Vendors will be invited if found necessary to make technical presentation on their offer to an evaluation committee at SAC. Vendors will be required to provide clarification, if called for, by the evaluation committee, on any matter related to offer.

6.Vendors shall also note that the implementation schedules proposed by them should not exceed by **12** months from the date of placing the Purchase Order.

7.Vendors may further note that SAC (ISRO) also reserves the right of not considering an offer, if there are any deviations in the commercial and/or general terms and conditions offered against the requirements as per this RFP, even if the offer is technically suitable.

8.Consortium bidding is not allowed for this RFP. SAC (ISRO) shall assign the overall responsibility of implementation on a single vendor (prime vendor) for the entire works. Any dependency on any sub-contractors shall be managed by the prime vendor and should not have any bearing whatsoever on SAC (ISRO) and the performance of the final contract. However, the prime vendor must specify the source/partner against the proposed systems and the services which includes information like work/business profile of such a supplier, experience in executing/supplying similar type of system/subsystem for which the subcontract is being awarded, etc.

9.The responsibility of safe transportation / delivery of total system to the site rests with the Vendor. This includes:

(i)Transportation from factory to the site

(ii)Loading / unloading where applicable during transportation.

(iii)Transit insurance

All expenditures for above activities shall be borne by the Vendor. SAC (ISRO) will provide custom duty exemption certificate and other such certificates, whenever applicable and requested.

The vendor must project the requirements like custom duty exemption (CDEC) etc at the time of Bidding.

2.4 Preparation and Submission of Bids

Bids shall be submitted in two separate parts in sealed envelopes.

Part-1: This part should contain complete technical proposal. This section should bring out complete clarity on the total work involved including conceptualization, implementation and performance. This part should include following information but not limited to:

a)Heritage of providing similar products and services

b)Technical Compliance Statement (Point by Point Compliance) to **full RFP** including all tables by the vendor

c)Each Subsystem detail with complete specifications

d)Implementation details including subsystem I/O interface details, signal flow diagram, level diagram etc.

e) The level diagram shall indicate the nominal power input and output of each subsystem and should ensure that none of the subsystems eg. BDC, BUC, LNA etc goes into saturation

f)Complete Mechanical details (Indicative FE Analysis for antenna assembly and support structure against RF specification, critical frequencies, Racks dimension, Housing details etc.)

g) Simulation results of RF and antenna control system should be provided during bidding / PDR as and when needed.

h)Complete Civil Work requirements (Antenna Pedestal design, suggested overall building and housing outline drawings, clearly specifying area needed for the Gateway, air-conditioning, electricity, water etc.).

i)Gateway commissioning, characterization & acceptance test plan

j)Time Schedule with reference to major milestones

k)Comprehensive onsite Warranty for three years

l)Comprehensive Maintenance plan considering 24x7 uninterrupted operations after completing 3 years of warranty.

m)This should also include spares policy, plan for preventive and corrective maintenance or any other relevant details during warranty and CAMC.

n)Obsolescence management plan

o)All papers and documentation of part-2 **Without Price (Price masked)**.

p) All the sub-systems must be quoted **(Price Masked)** along with make and model number

q) Unmasking of the price in technical bid will lead to disqualification of the bid without any further queries

Part-2: Commercial offer covering entire scope of activity, giving complete cost break up, of the following but not limited to:

a)Cost of site preparation and civil work for antenna foundation (pedestal).

b)Cost of Antenna & RF subsystem with options, if any

c)Cost of Hub Monitoring and Control (Hardware and Software) System with options, if any

d)Cost of proposed spares with list of deliverable

e)Cost of CAMC

f)Cost of Comprehensive Maintenance Contract (CAMC) for three years after warranty and subsequent extension for additional 4 years in slabs of 1 year.

g)Any other costs such as integration, fabrication, testing, licensing etc. which are not reflected above, towards realization of systems under the scope of this RFP

2.5 Criteria for selection of lowest offer (L1):

Following table gives the item description which are tentatively considered for L1 criteria

Sr No	Item description	Quantity
Supply installation, integration, and acceptance testing of the following items :		
1.	Antenna system including reflector structure feed assembly and mount structure, control system with drive electronics, civil foundation	
2.	LNA and HPA system including associated cabling	
3.	BDC and BUC including frequency reference system	
4.	Data interfacing units and IF distribution system including HMC	
5.	Warranty for 3 years (comprehensive)	
6.	CAMC for 3 years	

2.6 Delivery & Schedule

- Delivery schedule of the complete earth station system including installation, commissioning and testing shall be defined in the offer by the vendor. Delivery schedule should be 9 months ARO (After Receipt of Order) and 3 months for

installation. Hence, total period of delivery, installation, commissioning and testing must not exceed 12 months.

- The delivery schedule must address major milestones including following

Table 3: Time Schedule

Serial No	Major Milestones	Schedule
1.	Detailed Design Review at SAC and Ground System Acceptance Plan Document Submission	
2.	Close out of DDR actions	
3.	Site Preparation (Antenna foundation etc, site wise schedule)	
4.	Antenna & RF installation	
5.	RF System Characterization	
6.	Total Ground System Acceptance	
7.	Commencement of operations	

2.7 Warranty, Operation and Maintenance

1. The Vendor shall provide comprehensive on-site warranty including maintenance and spares for a period of 3 years for the complete earth station system and sub-systems from the final date of acceptance.

2. The acceptance test is to be conducted with GSAT-19 satellite; however, the acceptance test plan should also contain a contingency test plan in case the satellite is not available by the time ground system installation is completed.

3. The terms and condition for repairs / services during the warranty period shall be clearly indicated by the vendor while submitting the offer.

4. The detail of CAMC is given in Annexure-1

Section-3: Technical Details of Satellite Transponders

3.1Technical Specifications

The major specifications of Ka x Ku transponders are given below:

Table 4: Ka X Ku Transponder Specifications

Sl No.	Parameter	Unit	Specifications
1	Saturation Flux Density(SFD)	dBW/m^2	-96 ± 2
3	Receive G/T (EOC)	dB/K	16
4	Effective Isotropic Radiated Power (EIRP) (EOC)	dBW	59*
5	Polarization Sense		
	- Transmit		LV,LH
	- Receive		LH,LV
6	Coverage		
	- Receive Spot Beams (each polarization)		2
	- Transmit Spot Beams (each polarization)		4
7	Number of Transponders	#	8
8	Usable Bandwidth /Transponder		
	- Per Receive Beam	MHz	464
	- Per Transmit Beam	MHz	116

***Transponder Configuration:**

- Two User beams sharing single Ku-band LTWTA in forward (Hub to user) link
- Two User beams sharing single Ka-band LCTWTA in return (User to Hub) link

The major specifications of Ku x Ka transponders are given in Table below:

Table 5: Ku X Ka Transponder Specifications

Sl No.	Parameter	Unit	Specifications
1	Saturation Flux Density(SFD)	dBW/m^2	-96 ± 2
3	Receive G/T (EOC)	dB/K	12
4	Effective Isotropic Radiated Power (EIRP) (EOC)	dBW	62
5	Polarization Sense		
	- Transmit		LH,LV
	- Receive		LV,LH
6	Coverage		
	- Receive Spot Beams (each polarization)		8
	- Transmit Spot Beams (each polarization)		2
7	Number of Transponders	#	8
8	Usable Bandwidth per Transponder		
	- Per Receive Beam	MHz	116
	- Per Transmit Beam	MHz	464

Section-4: Technical Specifications of Antenna and RF Subsystems

4.1Technical Details of Gateway Stations

The representative baseline configuration of the gateway is given in Figure-3. This Section provides details of antenna and RF section of gateway.

Mandatory Features

Each earth station antenna & RF system is proposed to have (but not limited to) the following features:

Table 6: Mandatory Features of Gateway Stations

Sl. No	Features	Compliance	Remarks/Justification
1.	Steerable dual reflector antenna system consisting of main reflector diameter ≥ 9.0 m (nine meter) with four port feed, associated electronics, backup structure, sub reflector, lightning arrestors, HVAC, rain blower, dehydrator, etc.		
2.	Antenna drives to have pointing capability to cover all satellites in the geo stationary arc of 20^0 E to 140^0 E visible to India.		
3.	Antenna Control System (ACS) with drive electronics including tracking down converter and beacon receiver for satellite tracking		
4.	Antenna foundation, Gateway and Elevation & Azimuth pedestals in El over Az configuration.		
5.	Two receive chains for simultaneous reception of orthogonal linearly polarized signals.		

6.	Two transmit chains (Each to transmit multiple carriers for four beams simultaneously) for simultaneous transmission of orthogonal linearly polarized signals including Uplink power control at IF/RF for rain fade mitigation.		
7.	Redundant RF electronics (LNA, Block Up/Down converters and HPAs).		
8.	Time & frequency reference disciplined to GPS with provision for external reference		
9.	L-band IF interface /OFC connectivity with Gateway equipment.		
10.	Centralized Gateway equipment (all RF equipment) Monitoring and Control (HMC) facility with IP based solution for remote operation.		
11.	L- Band Carrier (Transmit & Receive Spectrum) monitoring system to monitor carriers from different service providers either by exclusive instrumentation (i.e. Spectrum analyzer etc.) or by any other solution. Vendors should consider providing this option in the HMC facility. Provision for monitoring at Ka band for both transmit and receive path.		
12.	Data interfacing units at each gateway		

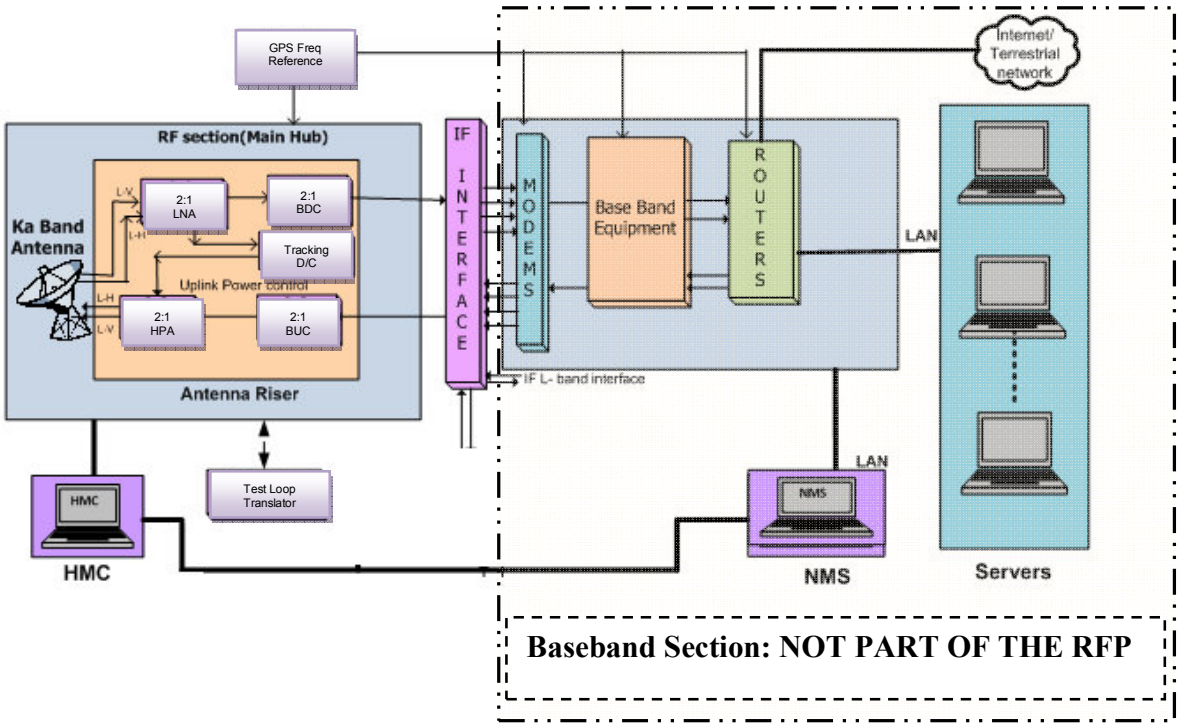

Figure 3: Representative Configuration of Gateway station

4.2Brief Description

The representative earth station base line configuration of antenna and RF system is shown in Figure-3. It shall have capability to transmit & receive multiple carriers in both linear polarizations at Ka band. The bidders must quote their best solution as a prime quotation and if they like to suggest multiple solutions, the same may be quoted as optional solutions.

As shown in Figure-3, transmit configuration has L- band input signal, which is combination of multiple digital modulated carriers available from base band system. This signal is up converted and transmitted by earth station in Ka- band. The redundancy configuration is 2:1 (two active with one hot standby) for block up converter and TWTA subsystems in order to increase earth station flexibility and availability during equipment failures.

In receive configuration LNA and block down converters have 2:1 **(two active with one hot standby)** redundancy similar to transmit section. The down converted L- band signal is obtained from the output of block down converter, which is given to base band section.

The antenna has 4-port linear feed with HVAC system. Tracking chain contains tracking down converter, beacon receiver, motors, encoders and antenna control unit (ACU) etc with cold redundancy. The tracking used is monopulse and feed should support it. Any other sub-systems required for monopulse tracing should be supplied by vendor.

Suitable spares for sub systems which are not operated in hot redundancy mode must be quoted (i.e. tracking chain equipment, Data interface equipment, TLT, time & frequency reference source etc.)

The RF system shall have a test loop translator (TLT) to test the Tx and Rx chain's RF performance in the absence of satellite. Appropriate test couplers, dummy load and other accessories for the Rx and TX chain are to be supplied by the vendor.

Two types of Link Management Technique (Uplink power controls (ULPC), ACM) to be provided for rain fade compensation.

The uplink system shall have capability for 20 dB (typical) uplink power control range with suitable interface. The vendor should note that the system should run with multiple outbound and multiple service provisions to be integrated with the system.

All RF equipment shall have M&C facility for remote control operation through Computer. Centralized Gateway equipment (all RF equipment) Hub Monitoring and Control (HMC) facility with IP based solution for remote operation shall be provided. Hot redundant HMC system with automatic switchover is to be supplied by the vendor.

The antenna section hosts all RF equipment like antenna and feed, HVAC system, antenna motors, encoders, TWTA(HPA) systems, waveguide switches, attenuators, dummy load, block up converters, LNA subsystem, block down converters, control logic system, time and reference frequency generation & distribution system etc.

Preferably, up link & down link L band signals should be converted to optical signals and brought to the baseband building through OFC for base band equipment connectivity. Alternatively, direct L band interface to base band equipment can also be considered with suitable gain slope equalizer.

4.3Gateway Specifications

The major specifications of the gateway station to be complied by the vendor are as given in Table-7.

Table 7 : Gateway System Specifications

Sr No	Parameter	Specification	Compliance	Remarks/Justification
1.	Frequency of operation (Antenna &Feed) Transmit Receive	 29.5 to 30 GHz 27.5 to 31 GHz (Desirable) 18.0 to 20.2 GHz 17.7 to 21.2 GHz (Desirable)		
2.	Antenna diameter	≥ 9.0 meter		
3.	Antenna Mount	Elevation over Azimuth		
4.	EIRP at mid band	86 dBW, minimum in multi carrier mode with Noise power ratio of 25dB in HPA in 29.5 to 30.0 GHz (Provide EIRP break up table in the quote and also provide HPA configuration and sizing details to meet the above minimum		

		EIRP requirement and provide detail block schematic. It must also include feed loss, all coupler loss and HPA assembly loss, if any)		
5.	EIRP Stability Over a day	±1 dB (vendor to provide break up including TWTA gain stability, BUC stability and antenna pointing & tracking errors)		
6.	Transmit Flatness over RF frequency band Full Band Any 40 MHz	 ≤ ±1.0 dB ≤ ± 0.25 dB		
7.	Up-link power control range	20 dB		
8.	G/T at 20^{o} EL at mid band	39 dB/K, minimum in 18.0 – 18.5 GHz frequency band (Provide break up table in the quote indicating feed loss coupler loss and any other component between feed and LNA system)		
9.	Tracking Mode	Manual, slew memory , Program & Auto		
10.	Tracking algorithms	Mono pulse, Step track		
11.	Polarization (Tx. /Rx.)	Dual Linear orientable (Vertical & Horizontal simultaneous)		

12.	Tx./Rx. Side lobes envelope	ITU-R Rec. S.580-5 (Vendor shall provide Tx/Rx radiation pattern extended cut patterns more than +/-10 deg and ITU mask superimposed over it)		
13.	Peak Pointing error	Maximum Average RMS pointing error should not exceed 1/4th of 3-dB Rx beam width for winds of 60 km/hr gusting to 80 km/hr (Provide break up in the quote)		
14.	Peak Tracking error	Maximum Average RMS tracking error should not exceed of 1/10th of 3-dB Rx beam width for winds of 60 km/hr gusting to 80Km/hr (Provide break up in the quote)		
15.	Travel rate of the antenna Az El	 0.02 - 0.5 ^{o}/sec or better 0.02 - 0.2^{o}/sec or better		
16.	Acceleration	0.2^{o}/sec^2 or better in AZ axis		
		0.2^{o}/sec^2 or better in EL axis		
17.	Travel Range	Azimuth: 120 deg+/- 60 south sectored Preferable 180^0 (± 90 Deg.) preferable		
		Elevation: 5-85 Deg. (0 to 90 deg desirable)		

18.	Angular resolution	Better than 0.001 ^{o}		
19.	Polarization movement	Polarization to match spacecraft polarization angle within 1 degree(Linear rotatable: ± 100 deg) through motor with digital display		
20.	Feed Assembly	4-Port, Tx/Rx Linear Polarized; capable of transmitting and receiving both polarization, simultaneously		
21.	VSWR	≤ 1.35:1 for both Tx port (29.5 – 30 GHz) and Rx port (18.0 – 18.5 GHz and at 19.7015 GHz)		
22.	Cross-Pol Isolation (Tx. , Rx)	≥ 30 dB within 1dB beam width		
23.	Power handling capability	≥ 1KW CW per port (2KW total)		
24.	Port-to-Port Isolation			
	Tx-Tx/Rx-Rx	≥30 dB		
	Rx-Tx/Tx-Rx	≥ 85 dB		
Transmit system (Block UP Converter Specifications)				
25.	Input frequency	0.95-1.45 GHz or higher		

26.	Spectral inversion	No		
27.	Tx. Phase noise	Better than IESS 308/309 standard		
28.	Spurious	65 dBc minimum up to 0 dBm output		
29.	Gain	≥30 dB		
30.	Gain control Range Step size	 25 dB 0.5 dB or less		
31.	Group Delay	4 ns p-p maximum over any 40 MHz band		
32.	Tx Frequency Stability Over Temperature (0 to 50^0 C) Over a day	 $\pm$ 5 X 10^{-8} 5 X 10^{-9} or better		
33.	External Reference Input	10 MHz, auto take over from external to internal in case of external reference failure, for all equipment		
TWTA Specifications				
34.	AM/PM conversion	$\leq$ 2.0°/dB		

35.	Noise Power Ratio	19dB at 4 dB OBO(typical) 22 dB at 5 dB OBO (typical) 25 dB at 6 dB OBO (typical)		
Receive System (Block Down Converter Specification)				
36.	Output frequency	0.95-1.45 GHz or higher		
37.	Spectral inversion	No		
38.	Gain	≥30 dB		
39.	Gain control Range Step size	 25dB 0.5 dB or less		
40.	Receive Gain Flatness over RF frequency band Full Band Any 40 MHz	 ≤ ±1.0 dB ≤ ± 0.25 dB		
41.	Group Delay	4 ns p-p maximum over 40 MHz band		
42.	Image rejection	Better than 60 dB		
43.	Rx. Phase noise	Better than IESS 308/309 standard		

44.	Spurious	65 dBc minimum up to 0 dBm output		
45.	Spurious (Signal independent)	-75 dBm maximum		
46.	Rx Frequency Stability Over Temperature (0 to 50^0C) Over a day	 $\pm$ 5 X 10^{-8} 5 X 10^{-9} or better		
47.	External Reference Input	10 MHz, auto take over from external to internal in case of external reference failure for all equipments		
Station Reference Timing source				
48.	Time & frequency reference generation	GPS disciplined with a provision for connecting external source		
49.	Frequency	10 MHz		
50.	Level	0 to ±3 dBm		
Redundancy				
51.	RF equipment	Redundancy for all active system **(**As specified in section 4.2). The recommended list of spares as a cold standby should be quoted		
Test Loop Translator				

52.	Provision to carry out local loop testing	Through Test Loop Translator		
53.	Input Frequency Range	29.5-30.0 GHz		
54.	Output Frequency	18.0-18.5 GHz		
55.	Gain Control	25 dB in 0.5 dB steps		
56.	Third Order Intercept	+18 dBm		
57.	Frequency Stability	±5 x 10^{-8}, over operating temperature 1 x 10^{-8} /Day typical		
58.	Phase Noise	As per IESS 308/309 standard		
59.	External Reference Input	10 MHz @ 0 dBm ±3 dB		
Interface between antenna and equipment room				
60.	Link to equipment room	L-band (OFC can be considered)		
61.	Spare IF interface	Transmit/Receive both		
62.	Distance	100m typical		
63.	IF Link Equalizer	With 20-dB gain minimum at center frequency, slope adjustment range adequate to equalize the total gain slope		

Monitoring & Control				
64.	Monitoring and Control	All equipment shall have provision for monitoring and control from local and remote location. TCP/IP interface is desirable		
65.	User interface	GUI		
66.	Operating System	Latest versions of Windows or Linux		
Prime power				
67.	The vendor shall give details of prime power requirement for the antenna and Electronics. The power distribution shall be done by the vendor **Note:** The prime power available in India is 240V ±10%, 50 Hz±3% for single phase and 440 V for three phase.			

***Vendor shall provide break up for backup power supply requirement of UPS & DG set for RF system in case of non-availability of prime power for both sites.**

Note: Figure 3 shows representative base line configuration of gateways. Vendor must provide detailed block schematic of gateways in their technical proposal.

4.4Antenna System

The antenna system is the outdoor unit and shall be complied for the requirements given in Table-8.

Table 8: Antenna and RF requirements

Detailed Scope of work		compliance	Remarks/ Justification
1.	The Antenna subsystem should include (but not limited to) the following components/items: i. ≥ 9 m diameter Ka-Band antenna, drive along with 4-port linear polarization feed with tracking system accessories ii. Appropriate antenna mounts with riser and work platform iii. Rain blower iv. **RF Equipment Housing (RFEH**) containing all RF Subsystem v. **RFEH** air conditioning vi. 1:1 Dehydrator system (one operational and another redundant) for antenna, Lightning protection system and aviation alarm lighting. (vendor should provide specifications of dehydrator to meet the requirement to maintain 0.5Psi nominal pressure)		
2.	Carry out soil testing. The test report shall include SBC (Safe Bearing Capacity) and should be presented in DDR.		

3.	The wind loads data, complete mechanical analysis for antenna assembly and support structure for meeting RF specification. These should include the following and presented in DDR: •FE Analysis for antenna, antenna RF Equipment Housing (RFEH) behind antenna •Details like foundation bolts size, clearances and interface requirements •Reflector panels and back up structure •Sub reflector fixture and supporting spars •Pedestal, screw, El / Az platform •Provide free vibration analysis with bending and torsion as part of dynamic analysis •Generate time-dependent wind loads from available meteorological data as part of the dynamic analysis, to estimate the dynamic stresses for these time-dependent extreme load conditions. •Final sets of drawings (assembly drawings, interface drawings, drawings related to maintenance of antenna systems and subsystems etc. including soft copy)		
4.	DDR documents to contain all the important results like maximum stresses in critical members, maximum deflections, and natural frequency of total antenna system etc.		
5.	DDR document should also contain the complete simulation or test result for the antenna system RF performance.		
Alignment Requirements:			
6.	Submit a detailed “alignment plan” with all relevant details in DDR		

7.	Alignment of Azimuth and Elevation axes		
8.	Alignment of reflector panels forming reflector surface		
9.	Alignment of feed and sub reflector with main reflector		
10.	Alignment with respect to true north direction		
11.	Alignment of reflector axis, feed axis, sub-dish axis, shall be carried out.		
Installation and Commissioning:			
12.	Arrange necessary equipment, tools and cranes/ materials handling equipment required for installation/assembly.		
13.	Carry out civil work for antenna foundation and pedestal after approval from SAC		
14.	The antenna exposed components shall be protected from environment. Vendor shall give details of them as: 1.All exposed antenna structural and mechanical parts shall be properly treated and preferably painted white to reflect solar energy and inhibit corrosion. 2.All bolting hardware shall preferably be hot dip galvanized or stainless steel. 3.Dissimilar metals contact shall be avoided unless properly protected against electrolytic corrosion.		

15.	Suitable electrical drives shall be used for Elevation and Azimuth axes to meet the pointing and tracking requirement. Vendor shall preferably use commercially available drive electronics and provide the information with SAC on the type of drives being proposed for each axis and their specifications/configuration in their technical proposal.		
16.	Antenna system shall have the provision for stow-locks in both Azimuth and Elevation axes. Hand-cranks shall also be provided in both the axes for moving the antenna to stow-lock position.		
17.	Lightning arrestors shall also be provided on the reflector for protection against lightning under all pointing conditions. The Vendor shall draw suitable conductors from lightning arrestors to the ground with proper earth pit as per prevailing earthing standards.		
18.	Cable-wrap or any other suitable arrangements to be provided to avoid cable twist during antenna rotation.		
19.	Beacon lights (aviation alarm)shall be provided if required by site regulation		
20.	**Antenna RF Equipment Housing (RFEH)** The RF electronics should be installed in **air conditioned equipment** room (RFEH) located immediately behind the antenna reflector. The **RFEH** layout shall be optimized to provide convenient access with features that increase system availability by providing quick, safe methods to replace electronics without affecting RF performance. This should preferably have the following: i) A large roll-up door at the rear of the **RFEH** to access the RF equipment. The door shall be easy to open. No hardware shall need to be moved for opening the **RFEH** door. ii) The antenna mount shall be equipped with a large work platform near the **RFEH** electronics and antenna drives. iii) Integral stairs for safer and convenient access to the platform from the ground. The work platform and stairs should provide access to the jack, motors, data packages, lubrication ports, and antenna Gateway electronics. The work platform shall be fabricated from non-		

	slip, expanded metal. iv) Convenient and level standing surfaces shall be provided in the RFEH at the primary operating elevation angle. v) The HPAs and RF converters shall preferably be mounted on the side walls in the **RFEH** facilitating feed access. The waveguide outputs of the HPAs shall be mounted in close proximity to the feed waveguide outputs. vi) Tapered alignment pins shall be provided for each HPA, eliminating any tedious adjustments when replacing a unit. vii) All selected RF equipment shall preferably be reliable, commercially off the Shelf (COTS) and not specific to single supplier. The MTBF of supplied equipment from past history shall be made available. viii) To increase electronics alignment repeatability, the HPAs, converters, and switching networks shall be mounted to precision frames in the **RFEH** preferably. The frames provide repeatable mounting features to eliminate any time-consuming alignment procedures when replacing RF electronics. Identical versions of the frames shall be provided to the HPA and converter. Vendors to assure the dimensional repeatability of the waveguide runs. ix) The air conditioning system shall preferably have local maintenance support. x) Utility outlets and lights shall be provided to aid maintenance in the **RFEH**. xi) Electrical interface requirement should be 230V/50 Hz AC. xii) The periodic maintenance schedule with time & procedure to be given for antenna & RF subsystem		
21.	Vendor should include a detailed "RF equipment housing plan (**RFEH)**" in the DDR.		
22.	List of Test and measurement equipment for installation, testing and maintenance should be provided by vendor during DDR. Equipments to be arranged by vendor.		

23.	Vendor may suggest list of test equipment required for day to day operation /maintenance of Gateway and quote it separately as an option.(Typical Test equipments required per main gateway site may Spectrum analyzer, Signal generator, Frequency Counter, Power meter, Oscilloscope and multimeter to support required Ka band frequency)		

Vendor shall furnish the following details:

SN	Parameter	Unit	Specification
1.	Antenna gain (without feed loss) @29.75 GHz @18.25 GHz @19.7 GHz	 dBi dBi dBi	
2.	Feed insertion loss @29.75 GHz @18.25 GHz @19.7 GHz	 dB dB dB	
3.	Feed VSWR @29.75 GHz @18.25 GHz @19.7 GHz Worst figure of VSWR in receive and transmit band		
4.	LNA Noise figure (typical) worst noise figure in the receive frequency band along with the frequency	dB dB	
5.	LNA gain @ 18.25 GHz	dB	

4.5Hub (Gateway) Monitoring and Control (HMC)

Hub (Gateway) Monitoring & Control System (HMC) is a centralized Gateway management tool or set of tools for Gateway /Earth station Equipments. It shall provide the integrated earth station monitoring and control facility during normal operation. The HMC system will be independent of Application/Service provider NMS (base band NMS).

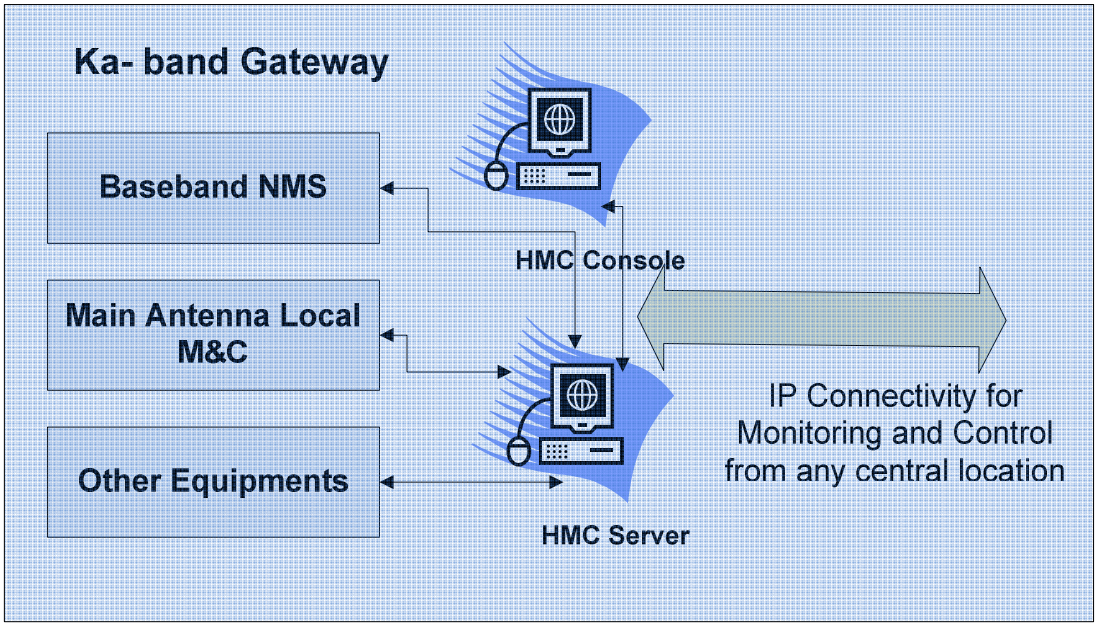

Figure 4: Block Diagram for HMC

Table 9: Features of HMC

Sl. No	Features	Compliance	Remarks/Justification
1.	Architecture: client server, where all back end will reside on server and Gateway operator will be provided a front end console to monitor/manage the Gateway.		
2.	Click and point interface like windows for easy control to network operator.		
3.	IP based solution for remote operation		
4.	One HMC per gateway to support the local operations		
5.	Remotely accessible from other Gateway or other remote locations.		
6.	Automatic configuration management to configure earth station for different operational requirements.		
7.	Multi-level authentication/password protection		
8.	Feature level as well as equipment level access right to operators.		
9.	Report Generation based on types of equipment, time of day, specific event, severities, particular users etc.		
10.	GUI to show the live information/ parameters values of the earth station		

	equipments.		
11.	Monitoring and display of RF parameter, Antenna control system Parameters, and RFEH environmental parameters with provision for logging of data.		
12.	Provision to export monitored data to some other application for graphical representation or spread sheet		
13.	Self-test facility of complete Gateway.		
14.	Carrier monitoring at L-band level for in-bound and out-bound carrier of different service providers. Vendor must clearly mention the methodology of carrier monitoring in his quote.		
15.	Display of spectrum and control from user console		
16.	Monitor the carrier of other Gateway to give complete picture at a glance.		
17.	Fully hot redundant system with automatic switchover		
18.	Generation of alarms in all abnormal conditions and also notification through SMS/Emails etc		
19.	Appropriate virus/firewall protection		

20.	Vendor to give consent for incorporating any changes is HMC during DDR if asked for, without any cost implications.		

Note: Figure 4 shows representative base line configuration of HMC. Vendor must provide detailed architecture & block schematic with different options in the architecture if any. Vendor must quote separate cost break up of different proposed options of HMC architecture, if any.

Section-5: Site Preparation/Civil Work for Establishment of Gateway Stations

5.1 Site Readiness

Site activity is to be done as per table-15.

Table 10: Site preparation Activity

Stage	Site Activity	Compliance	Remarks/Justification
PLANNING	1.Obtain available site information from SAC/ISRO 2.Ensure obtaining proper permits Visit site and conduct detailed site investigation 3.Review, verify, and evaluate site conditions and take photographs. 4.Determine site work required. 5.Perform site land survey, site grading survey, and take soil borings. 6.Measure soil grounding conditions (electrical resistivity and fall-of-potential tests) 7.Document as-built conditions on drawings 8.Analyze requirement of infrastructure for OFC between antenna and control room		
DESIGN	9.Prepare Site Preparation Requirements and Installment Plan (SPRIP): 10.Document specific site design requirements and discrepancies. 11.Present method of accomplishing work. 12.Present detailed site installation drawings and specifications. 13.Provide installation schedule. 14.Present site photographs. 15.Stage all site material at central staging area. 16.Submit SPRIP to ISRO. 17.Inform ISRO of readiness to proceed with site installation when all permits and material are received.		

Stage	Site Activity	Compliance	Remarks/Justification
INSTALLATION	1.Receive notice to proceed from SAC. 2.Deploy material and implementation team to site. 3.Trench and install conduit from utility demarcations. 4.Antenna Centre point (Lat, Long) marking and true north referencing 5.Install foundations. 6.Install RFEH with electrical work, smoke/ fire alarm system, false flooring and ceiling, air conditioning 7.UPS and generator set for antenna and RFEH 8.Install grounding and lightning protection systems 9.Install equipment racks and configure RFEH 10.Install antenna cabling and interface wiring 11.Install, commission and testing 12.Perform acceptance test and commissioning. 13.Assemble and prepare site O&M manuals. 14.Train operators for on-site maintenance and operations. 15.Perform site cleanup and close-out procedures. 16.Provide as-built documentation and training manuals. 17.Conduct final site acceptance for sign-off. 18.Implement warranty support.		

ANNEXURE-1

Comprehensive Annual Maintenance Contract (CAMC) for Ka-band Gateways

Introduction

Indian Space Research Organization (ISRO) is establishing Ka-band gateways (HUB) and field terminal for utilization of GSAT-19. The gateways are having main Hub located at Ahmedabad and Delhi/Bengaluru.

The main Hub is having Ka-band antenna system with RF electronics interface at L-Band. Main Hub is also having base band system interface at L-band.

The network consists of followings.

1)Hub (Main)

2)RUT (Remote User Terminal)

Scope of Work

Techno-commercial proposals from vendors are invited to provide Comprehensive on Site Maintenance Services for Hub gateways. Vendor has to carry out following activities.

1) Comprehensive On Site Maintenance Services for two Gateways (Hub) delivered as per this RFP

PERIOD OF CONTRACT:

The vendor has to execute maintenance as a part of warranty period as per the requirement specified in the following sections. The vendor has to maintain the hubs for 3 years after the completion of warranty period (3 years) with similar terms and conditions.

Activities to be carried out by Vendor

The vendor has to carry out following activities.

1. Comprehensive Annual Maintenance

1..1 The vendor shall carry out On Site Comprehensive Maintenance Services for Hub located at Ahmedabad and Delhi/Bengaluru

1..2 The details of equipments at Gateways are as per supply contract of this RFP. The address details of Gateways will be made available at the time of installation.

1..3 Preventive maintenance (PM) of Hubs would be done every three months during the period of contract, where hub equipments will be thoroughly checked, serviced and adjusted. A comprehensive PM report against each hub shall be submitted to SAC. The format of the report will be jointly finalized at appropriate time.

1..4 After every visit, the service engineer should take the signature of the custodian of the site with photograph of the fully installed hub.

1..5 The vendor has to prepare detailed maintenance report for each maintenance activity carried out for Hub.

1..6 For any problem reported by the user, the problem shall be attended within 24 hours.

2.Terms & Conditions

2.1 All Vendors has to provide certificates of OEM (Original Equipments Manufacturer) for the equipment used in HUB to support maintenance activity related to Hub during CAMC period. Offer received from the Vendor without providing above certificate will be treated as cancelled.

2.2 The term comprehensive means Vendor will diagnose repair / replace the faulty component / system / peripherals / software and OS installed for Hub with its own resources and equipments within given time frame, make system operational and all expenditure related to CAMC has to be borne by Vendor.

2.3 All logistics like arrangement of required transport of equipments and lodging / boarding for maintenance personnel will be the responsibility of Vendor.

2.4 In the event of the damages to user's property or personal injury to user / Vendor personnel due to the negligence of employee of Vendor, the responsibility shall be solely rest with vendor. ISRO shall not be responsible for the loss of life of employee of Vendor at the time of performance of contact at user agency's premises due to natural calamities / accident explosion etc, if any, the persons engaged by the Vendor for carrying out the maintenance work will not have any right or claim for regular employment in any of the ISRO / DOS and these establishments.

2.5 For any problem reported by the user, the problem shall be attended within 24 hours for Hub. Parts / equipments replaced duly repaired should be of same type & capacity. In case any part is replaced by lower capacity; the original capability should be restored within 3 months. In case of non-availability of identical replacement, suitable new equivalent replacement with similar or better specification should be carried out with approval of SAC.

2.6 Replacement of defective spare parts shall be arranged by vendor at no extra charge. The replacement shall be a new part or equivalent functional unit. In case maintenance is held up for spares and if the system is not working, corresponding amount for each system, which is non-functional, shall be deducted from the bill.

2.7 The faulty part replaced can be taken by Vendor. Vendor should prepare maintenance report for each maintenance activities carried out and sent to the Engineer -in- charge / focal person.

2.8 Vendor should define proper call reporting formats and reporting procedures

2.9 As maintenance is comprehensive in nature, Vendor should stock spares of essential nature or as recommended by manufacture(s). Vendor is required to furnish their spare management plan as part of their proposal.

2.10 Vendor shall be responsible for all types of charges like lodging, boarding, fares etc for visits to hub and various nodes.

3. Contract Manager

SAC/ISRO will nominate person as Contract Manager for this contract for the purpose of matters related to this CAMC. All correspondences shall be marked in his name.

4.Payment terms

4.1 Payment will be made after due signing and submission of every satisfactory comprehensive report.

4.2 The bill duly certified by SAC ISRO Nominated personal shall be submitted to Accounts officer, SAC, Ahmadabad for payment.

5. Penalty Clause / LD Clause

5.1 The down time is 4 hours for Hub. The faults reported / lodged from the user must be attended and repaired 4 hours from the time of report of compliant. For each subsequent hour of delay after 4 (four) working hours from the time of lodging the compliant, 0.5 % of annual CAMC value with ceiling of 10 % of total contract CAMC value of Hub. Vendor needs to factor and propose sufficient spares & redundancy to maintain this availability.

6.Arbitration

Dispute, if any, shall be settled mutually, failing which it shall be referred to a one-man arbitrator appointee by the Director, SAC, Ahmedabad in accordance with Arbitration Act 1996, whose decision shall be final and binding on both the parties.

7. Termination of contract

ISRO reserves the right to terminate the contract if the performance of the Vendor is found to be unsatisfactory during its currency of the contract by giving one month's notice in writing without any financial implications on either side.

8. Fall Clause

The charges for the above work shall in no event exceed the lowest charges at which you service the Hub of identical description to any other party during the currency of the contact. If, at any time during the said period, you reduce the charges for similar work to any other customer, you shall forthwith notify the same to us and the charges payable under the contract for the service shall stand correspondingly reduced.

9. Force Majeure

Should a part of whole of the services covered in this contact be delayed due to reasons of force Majeure (for sites identified by ISRO) which shall include Lock-outs, strikes, riots, civil commotion, fire accidents, acts of God and war, stoppage of deliveries by Government, refusal of or the training schedules referred in the respective orders shall be extended by a period(s) not in excess of duration of such force Majeure. Each party undertakes to advise the other as soon as it becomes aware of the circumstances of such force Majeure. So that actions under the provisions of those orders can be mutually reviewed and agreed upon between Vendor and ISRO if the force Majeure conditions extend over a period of six months both the parties of the order shall mutually discuss and arrive at an agreement for continuation or termination of the contact.

10. Price Bid format

The vendor should submit Price Bid as per the table given below.

Sr. No.	Item Description	Qty	Price (In Lacs)
01	a) Comprehensive Annual Maintenance Contract (CAMC) of Ka-band gateways) located at Ahmedabad, Delhi/Bangalore for the period of Three Years as per Scope of Work and Terms & Conditions of the RFP (after 3 years warranty) Vendor should also quote for additional 4 years with the similar terms and conditions after 3 years of warranty and 3 years of CAMC.	02 No.	

ANNEXURE-2

Environmental specifications for HUB Antenna and RF equipments

The earth station will be operating under controlled environmental condition. However, the equipments used shall have the capability to following environmental condition.

INDOOR UNITS		
1.	Operating Temperature	0º C to +50º C
2.	Storage temperature	-40º C to + 70 º C, desirable
3.	Humidity	95% RH @ 40º C
4.	EMI/EMC	As per IEC, class A equipments
OUTDOOR (EXPOSED) UNITS		
5.	Operating Temperature Range	-10ºC to +55º C
6.	Storage temperature	-40º C to +60º C, desirable
7.	Humidity	95% Rh @ 40º C
8.	Rain	As per JSS 55555 or equivalent
9.	Dust	As per JSS 55555 or equivalent
10.	Wind speed Operational Gusting Stowing speed to Zenith Survival wind speed	 60 kmph, Min 80 Kmph Min 100 kmph, Min 200 kmph, Min

ANNEXURE-3

Experience declaration form:

Details of Contracts of Antenna (≥ 7.5 meters) and RF installations during last 5 years

Name of Customer & contract No if any	OEM	Antenna diameter and BUC/HPA size	Band of operation	Tx /Rx or Rx only	Contract Award date and Completion date

Experience declaration form:

Details of Contracts of Antenna (≥ 7.5 meters) and RF installations during last 5-10 years

Name of Customer & contract No if any	OEM	Antenna diameter and BUC/HPA size	Band of operation	Tx /Rx or Rx only	Contract Award date and Completion date