INTRODUCTION

Proposed system is going to be used in satellite TT&C ground station on 24/7 round the clock basis. The TTC Processor shall be capable of providing Telemetry data acquisition, tele-command generation and modulation, ranging and Doppler measurement, simulation etc., for spacecraft in GEO & LEO orbits and launch vehicle missions. The equipment should functionally adhere to all technical requirement listed below.

FUNCTIONAL DESCRIPTION

TTC Processor shall perform the following major functions as described below.

1. The TTC Processor shall receive two orthogonally polarized (RCP & LCP) 70MHz down converted signals; perform pre-detection diversity combination and carryout Phase, Frequency, BPSK and QPSK demodulation of the carrier.

2. In case of direct PCM/PM or PCM/FM or PCM/BPSK or PCM/QPSK or PCM/OQPSK modulated signals, the unit shall bit and frame synchronize the demodulated PCM signal, carry out CCSDS decoding, if required, and make it available as formatted and time tagged data on a TCP/IP (100 base T or above) and UDP/IP (selectable).

3. In case of PCM/PSK/PM modulated signals the unit shall also carry out PSK sub-carrier demodulation, bit and frame synchronization, for two sub-carriers simultaneously and make both data streams available as formatted and time tagged on a TCP/IP (100 Base T or more) bus.

4. The unit should be able to output data without a break, even if the bit rate changes (with also frame size change) in between, by having suitable configuration (i.e. by configuring two separate TM demodulator for different data rates).

5. The system should have CCSDS standard Derandomizer, Viterbi, Reed-Solomon and Turbo Decoders for both streams for all kinds of modulations. The TTC Processor shall, in the uplink chain, phase or frequency modulate the internally generated range tones and the telecommand video or the externally provided ISRO standard Telecommand video, either one at a time or simultaneously, on a 70 MHz carrier and the 70 MHz modulated output shall be provided for further up conversion. The modulator shall also have the provision for sweeping the carrier with selectable sweep ranges and rates. An external noise generator for simulation at 70 MHz, shall also be provided as an internal part of the system. The modulator shall also accept external simulation signal for modulation.

6. The uplink module shall also consist of a CCSDS compatible Telecommand encoder/ controller for the generation of CCSDS standard command signals and the PSK sub-carrier modulator.

7. It shall house a, continuous-tone ranging system, with major tone of 100 KHz and harmonically related minor tones up to 8 Hz (ESA-100 Standard) including ESA programmable tones, USB standard, for the measurement of slant range. It shall also provide the Range rate information, by measuring the two-way Doppler shift. The range and the range rate data shall be made available on the TCP/IP bus after formatting and time tagging.
8. The system shall accept 5/10 MHz external frequency reference to which all the signal sources of different functions will be phase locked.

9. The system shall accept IRIG-B mod. code for deriving time information. Can have optional NTP/PTP client for locking to time information.

10. The system shall also have a simulation and testing function, like BER measurement with an internal base band noise source, for internal and long loop checks.

11. The system shall have local and remote monitor and control through TCP/IP (1000/100 Base T or more) bus. System shall offer 8” TFT / LCD monitor with KB/mouse functionality for local control.
DETAILED SPECIFICATIONS:

I - Telemetry Processing:

A. RECEIVER:

The receiver shall perform the following functions.

1. Receives two orthogonal (Channel RCP and LCP) polarizations of IF signals at 70 MHz with independent acquisition management.
2. Tracking of both IF channels using two, second order PLLs.
3. Anti-sideband facility using FFT selectable.
4. Optimal Ratio Pre-detection diversity combination of channels A and B.
5. PM, FM, BPSK and QPSK demodulation of telemetry and ranging signals.
6. Automatic recovery of data frame lock even in case of modulation On/Off, in presence of carrier, for all kind of modulation.
7. Doppler measurement from the best channel or combined received signal.
8. Spectral Analysis data and Display

Specifications:

1. Input Frequency: 70 MHz ±4 MHz
2. Input bandwidth: ±15 MHz min. (3 dB)
3. No. of IF Receivers: Minimum two (one for RHCP & LHCP signal each)
4. No. of IF ports per receiver: 2 (Main and alternate)
5. Isolation between inputs: > 60 dB
6. Acquisition Range: Up-to ±500 KHz Selectable
8. VSWR: ≤ 1.4:1
9. Dynamic Range: -20 dBm to –95 dBm
10. Noise Figure: 10 dB (Typical) or better
11. Noise Density: -100 dBm/Hz Max.
12. Loop BW: 30, 100, 300, 1000, 3000 Hz Selectable
13. AGC Time Constant: 1,10,100,1000 msec Selectable
   Should hold lock for a variation of 30 dB/sec within dynamic range.
14. AGC Type: Non-coherent before carrier Acquisition, there after Coherent. Should be linear up to -95 dBm I/p level.
15. AGC Output: Analog / Digital
16. Lock in threshold (PM): 10 dB (8 dB desirable) C/N in Selected PLL BW
17. Anti side band: Using FFT technique, On/OFF Selectable

Capable of locking correctly to carrier under the following signal dynamics and varying modulation formats, by analyzing spectral symmetry.

i) Max. doppler: ± 200 KHz.
ii) Max. doppler rate: 5 KHz/sec
iii) Max. Fade Rate: 20 dB/sec

iv) Typical Modulation Formats:
1. HK modulation up to 0.7 rad., alone on 25.6 / 32 KHz sub-carrier PSK modulated by PCM bit rate of 1024 / 4000 bps.
2. As (1) above and another 128 KHz. sub-carrier modulation up to 1.0 rad. PSK modulated by PCM bit rate of 4 kbps / 16 kbps.
3. As (1 & 2) above and up to 0.9 rad of 100 KHz pure tone modulation.
4. Proper carrier lock to be ensured in case of direct PCM/PM also.
5. Proper carrier lock should be ensured during uplink and sweep and onboard change over to coherent mode.

18. Threshold degradation with ASB On : ≤ 1 dB
19. Acquisition time (with ASB on) : < 1 sec
20. Combiner Type : Optimal ratio/pre-detection combiner
    Combiner modes : CH-A, CH-B, Combined
21. Combiner Improvement : i) Within 0.5 dB of theoretical, when diff. Between channels is less than 10 dB.
    ii) Best channel selected when S/N difference between channels exceed 10 dB, with hysteresis to avoid frequent toggling at cross-over point.
22. Demodulation Modes: PM, FM, BPSK, QPSK and OQPSK (optional requirement: AQPSK, UQPSK, GMSK)
    ii) Direct PCM/PM (Biφ-L) and BPSK and QPSK having basic data rate of 10 Mbps. 20 Msymbols/s with Viterbi & RS coding.
    Up-to 10 Mbps with Turbo Code (rate ½).

**Optional Requirement:** Unit shall support for Basic data rate of 20 Mbps (40 Msps with coding).

24. PM demodulation index : 2 rad. Max.
25. FM Max. Deviation : 20 MHz.
26. FM Threshold : < 6 dB
27. AFC range for FM demodulation : up to +/- 250 KHz
28. Acquisition threshold for BPSK : Eb/N0 of +3 dB or better
29. Doppler Measurement : On best channel selected or for combined signal (with hysteresis to avoid toggling)
    i) Resolution : 0.01 Hz.
    ii) Accuracy : 0.1 Hz. RSS @ -65dBc phase noise
    iii) Data Format : As per agreed ICD.
    iv) Time tagging Resolution : 0.1 milli sec.
30. Group Delay Stability : < 10 nsec over signal dynamic range
    < 5 nsec over 8 hours
    < 15 nsec over carrier frequency
    < 5 nsec over temperature
31. Outputs : 1. Video output (50 ohms, 1V/rad)
    2. Digital AGC data, 100/10 samples/sec. 8 bits. AGC for channels A,B & combined and Eb/No time tagged and logging locally.
    3. Optional: Analog AGC output for recording (50 ohms, 1V/10 dB)
Monitor & Control:
Input Frequency, PM/FM/BPSK/QPSK selection, ASB On/Off, Loop BW, Receiver mode etc.

B. PSK DEMODULATOR AND BIT SYNC.

The PSK Demodulator and Bit Sync. Shall perform the following functions.

1. Sub-carrier frequency selection and locking.
2. Bit rate selection.

3. Simultaneous BPSK demodulation of two sub-carriers.
4. Bit synchronization (3 bit soft decision or better)
5. Simultaneous processing of 2 bit streams (PCM/PSK) for low rate telemetry.
6. Capable of handling a bit rate change over (one bit rate at a time) in the direct PCM modulated stream, using suitable configuration, for high rate telemetry (PCM/PM, PCM/FM) and the data made available on different ports.
7. $E_b/N_0$ Evaluation and data output with AGC.
8. During the bit rate changeover, the data loss shall not be more than 3 telemetry frames with appropriate settings.
9. The telemetry frame shall contain the data quality bit information corresponding to the frame sync pattern errors.

Specifications:

1. Type of demodulation : PCM/BPSK
2. Code : Bi-phase (L,M,S) or NRZ (L,M,S)
3. Sub-carrier Frequency Range : 5 KHz to 2 MHz in 1 Hz step
4. PCM bit rate (For sub-carrier modulation) : 100 bps to 256 Kbps in 1 bit step.
5. PCM bit rate for direct modulation : Up-to 10 Mbps basic data rate (with Bi-phase decoding). Upto 20 M symbols/s with Viterbi & RS coding for direct PCM/PM, PCM/FM, BPSK and QPSK (I+Q) modulation. Up-to 10 Mbps with Turbo Code (rate $\frac{1}{2}$).

Optional Requirement: Unit shall support for Basic data rate of 20 Mbps (40 Msps with coding) in direct modulation mode.

6. No. of sub-carrier to be processed : 2, Simultaneously
7. Capability to handle a bit rate change over, in high rate direct PCM modulated stream and provide continuous data without break.
8. Sub-carrier loop BW : 0.03, 0.1, 0.3, 1, 3% of bit rate
9. PCM loop BW : 0.03, 0.1, 0.3, 1, 3% of bit rate
10. Sync. Threshold : $E_b/N_0 \leq 0 \text{ dB}$.
11. Bit sync fly-wheeling : Should be able to hold lock for data containing 128 bits of continuous zeros or ones, with 1000 bits gap.
12. PSK demod./ Bit sync. Performance : $<1 \text{ dB of theoretical up to 5 Mbps}$
   : $<2 \text{ dB of theoretical up to 10 Mbps}$
14. De-randomizer : CCSDS Standard (user defined as optional Requirement)
Monitor & Control

1. Sub-carrier frequencies, Bit rates, PCM codes, Lock status, Loop BW, \( E_b/N_0 \) etc.

C FRAME SYNCHRONIZER

The frame sync. Shall perform the following functions

1. Frame locking using dedicated sync. word by classical locking phases of Search, Check and Lock.
2. For all kinds of modulation, the frame sync should be able to lock automatically, without the need for manual receiver re-acquisition, when the modulation is made OFF and ON in between, with the carrier being present continuously.
3. Time tagging at the end of sync. word detection.
4. Processing of 2 TM streams simultaneously.
5. Automatic BPSK / QPSK ambiguity resolution.
7. CCSDS standard RS, Viterbi and Turbo decoding & Packet Telemetry Processing.

Specifications:

1. Bit rate : Net 100 bps-10 Mbps without coding. (With Bi-Phase Decoding).
   Up to 20 Msps with RS & Viterbi code
   Turbo code (rate \( \frac{1}{2} \)) up-to 10 Mbps
2. Sync. Pattern Length : 16 to 32 bits programmable
   (Optional Requirement: up-to 64 bits programmable)
3. Sync. Window : 1 or 3 bits
4. Word Length : 8 to 16 bits programmable
5. Frame length : 16 to 4096 words per frame.
6. Error parameters tolerance (Selectable) :
   a) Search to Check : 0 to 7
   b) Check to Lock : 1 to 8
   c) Lock to Search : 1 to 8
7. Time tagging : Corresponds to last bit of FS code (Desirable)
8. Data Output : TCP/IP (100/100 base T) and UDP/IP
   Format : To be mutually agreed
9. Data Decoding : 1. Derandomizer (CCSDS)
   2. Reed-Solomon Decoder (CCSDS)
   3. Turbo decoder rate \( \frac{1}{2} \) (CCSDS)
10. Data Quality Indicator : The header should contain Information on data
    Quality like Rx., PSK demod, Bit & Frame Sync
    lock status, FS error presence, no of uncorrected
    errors for coded signal etc.

Monitor & Control:

1. Lock Status (S,C,L)
2. Setup parameters
3. Quality byte indicating FS errors
II. Telecommand Processing

A TELECOMMAND ENCODER/ IF MODULATOR

The Tele-command Encoder/ IF Modulator shall perform the following functions.

1. Internal CCSDS compatible command encoder.
2. Provision of COP software to handle segment level and CLTU level telecommand messages.
3. Handles externally fed or internally generated telecommand video for modulation.
4. Phase locking to external 5/10 MHz reference.
5. Carrier sweeping facilities.
6. PM/FM modulation of tones and TC video (internal or external) independently or simultaneously.
7. Internal Noise generator provision when used as simulator.
8. Should accept external command video during real-time for PM modulation and external PCM and PCM/PSK (sub-carrier) signals during simulation for all specified modulations.

Specifications:

Telecommand Encoder

1. Command standard : CCSDS Standard
2. Modulation : PCM/PSK
3. Sub-carrier frequencies : 4-50 KHz (Selectable)
4. Frequency accuracy : ±1 in 10^6 or better
5. Frequency stability : ±1 in 10^6 / Day
6. Bit rates : 4000/2^n where n= 0 to 9

IF Modulator

1. Output Frequency : 70 +/- 4 MHz. Selectable (Optional requirement: AQP5K, GMSK, UQPSK).
2. Type of Modulation: PM/FM/BPSK/QPSK
3. Sweep Range : ±1 KHz to ±500 KHz in steps of 1 KHz, single sweep positive going. Automatic disabling of Modulation while sweeping.
4. Sweep Rate (Linear) : 1 Hz/s to 150 KHz/s
5. Output Level : -60 to 0 dBm. Adjustable.
6. Output stability over a day/ temp. range : +/- 0.5 dB
7. Output impedance : 50 ohms
8. VSWR : ≤ 1.4:1
9. Phase Noise (PM Mode) : 10 dB max. Degradation when locked to station 5 / 10 MHz reference
10. Spurious : Better than -60 dBc
11. Harmonics : Better than -60 dBc
12. No. of External Modulation Inputs : One for connecting external TC video or External simulation signal
13. Modulation Input Impedance  : 50 ohms
14. Modulation Sensitivity   : 1 rad./ volt
15. PM Modulation Index : 2.0 radians (Max) in steps of 0.1 rad. 
   Independently adjustable for tones and TC.
16. Sense                  : Positive
17. Linearity              : 2%
18. Group Delay Stability  : < 5 ns over 8 hours
   < 10 ns over dynamic range
   < 15 ns over temperature
   < 5 ns over Doppler
19. Phase non-linearity    : < 6 deg. over the band

Monitor & Control
1. Sweep range and rate, sweep start/ stop
2. Modulation Index, Output level
3. Noise generator power setting
4. External reference lock indication
5. Modulation input ON/OFF, Modulation type.
6. Carrier on/off  etc.

III. Tracking Processor

A RANGING

The ranging shall perform the following functions.

1. Range tone generation and sequential transmission.
2. Ambiguity resolution & Range measurement.
3. Accurate Time tagging.
4. Internal test loop and calibration for ground station delay and phase compensation.
5. Automatic compensation of calibration and correction memory values from measured range value.
6. Automatic selection of RHCP / LHCP / Combine D/L signal for Range delay measurement.
7. Unit shall have Doppler Aid capability for Range loop PLL.

Specifications:
   Optional requirement: ESA tone + code standard
2. i) Tone Frequencies (ESA-100)
   Major Tone (MRT) : 100 KHz.
   Ambiguity Resolving Tones (ART) : 20KHz, 4KHz, 800Hz, 160Hz, 32Hz and 8 Hz minor tones
   (Continuous transmission of MRT and Sequential transmission of ARTs)
ii) ESA Like User Specific tones : Major and minor tones (ART) user programmable. Major Tone up-to 500 KHz.
   Lower most minor tone till 1 Hz
iii) ESA tone + code standard (optional) : Tones from 100 KHz to 500 KHz
   Codes as applicable

   16 KHz for ESA-100.
4. Tone distortion : <1%
5. Amplitude : Settable separately for major & minor tones
   for M.I. up to 1.5 rad. in IF modulator
6. Acquisition Time duration : < 5 sec. at 50 dBHz SNDR
   < 10 sec for lower SNDR
7. Tone PLL BW : 0.1 to 8 Hz Adaptable to meet Dynamics
   and accuracy.
9. Maximum unambiguous range : 18750 km for 8 Hz minor tone
10. Major Tone acquisition threshold : S/No ≤ 13 dBHz.
11. Overall accuracy : 13m RSS at 27 dBHz SNDR with 100 KHz
    MRT in 1 Hz loop BW. Within 1 dB of theoretical (1 sigma).
12. Sampling rates : 0.1, 1 & 10 Samples/ sec
13. No. of measurement samples per block : 1, 10, 100 per block selectable
14. Time tagging
   i) Resolution : 0.1 msec.
   ii) Accuracy : Within 1 microsecond of time ref. signal,
                 with 1 pps input
   iii) Instant of time tagging : Instant of sampling of received tone
15. Data Output : Time tagged data output on TCP/IP
   i) Format : To be mutually agreed as per ICD.
16. Calibration loops & Delay entry : RF Calibration memory for 4 RF paths
    and delays (desirable requirement).
17. Correction for calibration : Correction memory for each of the 4 RF
    Calibrations (desirable requirement).

Monitor & Control:
1. Sampling rate
2. Working mode: Standby, Calibration, Measurement (Ranging) etc.
3. Facility for entering station delay, calibration, correction and TOF
4. Other selectable parameters

IV Others:

A Time and Frequency Reference:

This unit shall perform the following functions.

1. Distribution of reference frequency to other internal units.
2. Demodulation of input time code.
3. Time distribution to other internal functions.
4. Shall have Leap second & leap year management.
5. Provides time tagging information to other modules
6. Accepts 1 pps signal for ranging time tag.
**Specifications:**

1. Input frequency : 5 / 10 MHz.
2. Input Level : 0 dBm +/- 5 dBm
3. Impedance : 50 ohms.
4. VSWR : < 1.3:1
5. Reference frequency output : Suitable for internal distribution.
6. Input time code : IRIG-B Mod Code (optional NTP/PTP)
7. Time code Input level : 0.5 volt to 6 volt p-p
8. Time tag capacity : 365 days, 23 hours, 59 minutes
   59 seconds & 999 milliseconds.
9. Resolution : 0.1 msec.
10. Time tag Accuracy : 0.1 msec worst case or better.
11. Phase noise degradation : < 10 dB with reference to input.

**B TM SIMULATOR**

The TM Simulator shall perform the following functions.

1. Programmable sub-carrier frequency and bit rate generation.
2. PCM generation using PRN sequence or stored TM file from disk.
3. Analog PSK/PCM or PCM signal output with amplitude control.
4. BER Measurement.
5. Internal Noise generator at 70 MHz to cover C/No range of 25 dBHz to 85 dBHz.
6. Encoding for RS, Convolution and Turbo coding and Randomizer

**Specifications:**

1. Analog signal output level : 0.1 V to 4 V peak in 0.1 V steps.
2. Impedance : 50 ohms
3. Sub-carrier frequencies (Sine) : 5 KHz to 1024 KHz in 1Hz step.
4. Bit rate : 100 bps to 500 Kbps in 1 bps step.
   Up-to 10 Mbps for direct PCM Mod.
5. PCM code : NRZ (L,M,S) and bi-phase (L,M,S)
6. PCM sequence type : PRN or stored file from HDD or LAN mode of simulation
7. Modulation type : PCM/PSK on subcarrier, PCM/PM
   PCM/FM, PCM/BPSK, PCM/QPSK (optional: AQPSK, GMSK, UQPSK)
8. BER Measurement
   - Automatic delay adjustment between transmitted and received signal.
   - Bit to bit comparison between transmitted and received signal.
9. S/N dynamic range : +2dB ≤ E_b/N_0 ≤12dB or better
10. BER measuring range : 10³ to 10⁸ and totalizer

**Monitor & Control**

1. Sub-carrier frequency, PCM code, PCM sequence
2. Bit rate and BER
3. Modulation type
Optional Requirement: 2nd simulator (having same above specs.) for simultaneous two sub carrier simulation.

Accessories:
1. Spectrum Analysis Display and spectral data on LAN.
2. Data Logging on internal Hard disk (Min. 120 GB) for logging time tagged TM, Range, Doppler, digital AGC and M&C data and retrieval.
3. Display of selected words.
4. Self test sequence for locating faults including TCP/IP Ports.

GENERAL
1. Power : 230 V±10%, 47-53 Hz, 1-Phase
2. Dimension : 19” Rack mountable, Max. 5U height
3. Operating Temperature : 5-45 deg.C, Max. Humidity 95%
4. Storage Temperature : 0-55 deg.C
   Requirement as per Annexure-A.
6. MTBF : To be provided by party. Min. 40,000 hours.
7. MTTR : ≤ 1 Hour with spare parts available
8. Operation & Maintenance Manual : To be provided in English – Both Hard & soft copy.

Data Exchange Formats:
Once the confirm Purchase Order is received, party shall submit preliminary Interface Control Document (ICD) to ISTRAC for Review. Document shall cover all data exchange format (Telemetry Data, Doppler & Range data, TC requests, Monitoring & Control requests etc.) being used by any TT&C ground station. Based on the feedback provided by ISTRAC and with mutual agreement, party shall carry out any changes required in ICD and submit FINAL copy of the ICD to ISTRAC along with Factory Acceptance Test Results for review and clearance by ISTRAC.

Design Review:
The party shall have sufficient experience and expertise in manufacturing similar equipments. The product offered shall be based on a proven design which is already been demonstrated in the field and not on any new development which is yet to be qualified. The party shall provide the list of customers, to whom similar systems have been supplied earlier by them and performance certificates from the concerned for all the functional & performance related parameters of the product including Range & Doppler measurement.

ISTRAC reserves right to call for the design review (DR) of the system under production. If requested by ISTRAC, design review shall be held within 10 weeks from the placement of the order. This review shall address the high level design of the system,
mapping the system requirements to the ordered specifications. The venue of DR shall be ISTRAC, Bangalore / Video Conference mode. Party shall deliver all relevant documents required for design review 2 weeks before the actual review.

The design review shall include:

- System Overview,
- General architecture with proposed hardware and software modules.
- Design considerations and design details of major subsystems.
- Performance analysis of major requirements and specifications.
- Preliminary analysis of reliability, availability, Maintainability etc.
- Mechanical, Environmental and thermal design aspects.
- List of hardware and software elements.
- Detailed activity and time schedule.

Additionally, if asked by ISTRAC, party shall be ready to provide one fully functional TTC Processor unit to ISTRAC for technical assessment during tender evaluation process before the placement of actual order.

Factory Acceptance Tests:

For TTC Processor, the factory acceptance tests shall be carried out before shipment, as per the standard procedures. The supplier shall provide the types of tests to be carried out & the test procedures for carrying out the Factory Acceptance Tests well in advance, for the approval & mutual agreement. The tests results shall be submitted to ISTRAC for approval, before the actual shipment of the equipment. ISTRAC reserves the right to witness the tests at factory, if required.

General Conditions:

1. The party shall provide slab wise quotation (for e.g. Qty. 1-3, 4-6, 7-10 etc.) up to quantity 15 nos.
2. This is a **TWO PART tender**. So, bidder shall submit techno-commercial offer and price bid in two separate sealed covers. Techno-commercial bid shall include all commercial terms & conditions, delivery place, delivery schedule etc.
3. **Warranty:** Minimum 3 years OEM comprehensive warranty covering on-site support. Warranty should start from the date of acceptance of the system.
4. The party shall be ISO 9001:2008 certified one with established Quality Assurance Plan which shall consist of periodical inspections and progressive Quality Control throughout the developmental and production cycle of the product offered. The manufacturer of the device shall be in total control of the lifecycle (Design, release, support, obsolescence and termination of the critical subsystems) of the product. Party may attach supporting documents on this with their offer.
5. The bidder shall provide complete technical details of the offer with detailed explanation of the function of the system, the various options available and any other
information that may be required to evaluate the offer. Party shall clearly quote separately for all the optional requirements in this RFP.

6. The bidder shall bring out point-by-point technical compliance matrix against all the specifications and functional requirements. The bidder shall explicitly bring out all the points in the remark column wherever the specifications are not met or exceeded. ISTRAC reserves right to reject any incomplete offer.

7. The bidder may obtain required clarifications, if any, before presenting the bid.

8. If ISTRAC requires, Party shall provide hands on training covering full installation and operational aspects of the offered product after delivery. Any cost implications towards that shall be clearly mentioned by the party in his offer.

9. The bidder shall bring out all the optional features of the offer and shall accordingly quote the price for each of the options separately.

10. Use of high reliable screened components to be ensured.

11. The system shall be considered to be accepted by ISRO only after the successful completion of the on-site acceptance tests (performed at Bangalore) duly certified by ISRO.

12. At the time of installation and commissioning of the system if it is found that some additional hardware accessories or software items with licenses are required to complete the configuration or to meet the total system requirement of the configuration which were not included in the vendor's original list of deliverables then vendor is required to supply such items to ensure the completeness of the configuration at no extra cost. Vendor should ensure completeness of the list of deliverables in the offer to avoid such discovery during installation.

13. The bidder shall also provide the quotation for the essential spare cards/ modules/components that may be required for the maintenance of the system at site.

14. The bidder shall also provide the quotation for extended warranty period (after the expiry of standard warranty) up to 5 years.

15. Software updates, if any, should be supplied free of cost, as and when required.

16. The bidder shall guarantee supply of spares and maintenance support for at least 10 years from the date of acceptance of the system.

**Annexure-A**

Remote Monitoring & Control Requirements as per following table:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>For M &amp; C transaction should be in the decodable commands.</td>
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<tr>
<td>2</td>
<td>All parameters monitored locally should be present on the remote interface for monitoring &amp; commanding.</td>
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<tr>
<td>3</td>
<td>There should be a single monitoring command to get all parameters.</td>
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<td>4</td>
<td>The monitoring data block should be byte oriented and of fixed length.</td>
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<td>5</td>
<td>There should be a header &amp; trailer at fixed defined byte location.</td>
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<td>6</td>
<td>Group-wise monitoring commands and individual parameters monitoring</td>
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<td>commands may also be made available.</td>
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<td>7</td>
<td>The command format should be text oriented.</td>
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<td>8</td>
<td>It should be possible to chain monitoring &amp; control commands. Chained commands &amp; response should be delimited by defined character (, ; , etc.). If monitoring commands are chained &amp; sent, it is desirable that the response should also be sent in same order.</td>
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<tr>
<td>9</td>
<td>The response time for any monitoring command should be less than 300 msec. Similarly, when control command is given, the control operation should get executed immediately &amp; must be observed in the next monitoring data.</td>
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<tr>
<td>10</td>
<td>It is preferred to get data from the system on polling basis. This means asynchronously sending data is not preferred.</td>
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