KARI 한국항공우주연구원
305-806. 대전광역시 유성구 과학로 169-84
TEL.(대) 042-860-2114 FAX. 042-860-2004

http://www.kari.re.kr
KOREA AEROSPACE RESEARCH INSTITUTE
169-84 Gwahangno, Yuseong-Gu, Daejeon, 305-806, Korea
Telephone : (82)42-860-2114 Fax : (82)42-860-2004

To Potential LEOP TT&C and Overseas Ranging Service Providers

Subject: Request for Proposal (RFP) for GEO-KOMPSAT-2 LEOP TT&C and Overseas Ranging Service

Korea Aerospace Research Institute (KARI) is hereby issuing this Request for Proposal (RFP), as enclosed hereto, to look for the qualified potential LEOP TT&C and Overseas Ranging service provider for GEO-KOMPSAT-2.

After evaluation of the proposal submitted from the potential LEOP TT&C and Overseas Ranging service providers in response to this RFP, KARI will officially make a contract with the best-qualified provider for GEO-KOMPSAT-2 LEOP TT&C and Overseas Ranging service.

KARI requests that the Proposal to this RFP should be submitted to the address as stated in Section 2.1.4 of the RFP by the Bid Closing Date (May 2, 2017 15:00PM in Korean Local Time).

If you have any question about this bidding, you may contact the designated persons in Section 2.1.5 of the RFP.

Thanks in advance for your cooperation and your valuable Proposal will be highly appreciated.

Sincerely yours,

조 정 남

Mr. Jung Nam CHO
Head of Procurement Team
Korea Aerospace Research Institute

Encl.: Request for Proposal for GEO-KOMPSAT-2 LEOP TT&C and Overseas Ranging Service

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REQUEST FOR PROPOSAL
FOR GEO-KOMPSAT-2
LEOP TT&C AND OVERSEAS RANGING SERVICE

March 22, 2017

Korea Aerospace Research Institute
169-84 Gwahak-ro, Yuseong-gu, Daejeon, 34133, Korea

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1. INTRODUCTION

1.1 Scope

This RFP document describes all requirements related to the Contract for GEO-KOMPSAT-2 LEOP TT&C and Overseas Ranging Services and also explains the procedure to be undertaken by Bidder seeking to respond to this RFP. This RFP consists of following Sections and Appendices.

Section 1 Introduction
Section 2 Bid Instruction
Section 3 Statement of Work
Section 4 Technical Requirements
Section 5 General Terms and Conditions

Appendix A General GEOS-C File Format for LEOP TT&C Service
Appendix B COMS Ground Network (Information Only)
Appendix C GEOS-C File Format for Overseas Ranging Service
Appendix D Compliance Matrix
Appendix E Price Proposal Form

1.2 GEO-KOMPSAT-2 Overview

The GEO-KOMPSAT-2 (hereafter, “GK2”) program is a national program of Korean government to develop and operate two geostationary satellites, GEO-KOMPSAT-2A (hereafter, “GK2A”) and GEO-KOMPSAT-2B (hereafter, “GK2B”). GK2A will perform the meteorological and space weather monitoring missions, and GK2B will perform the ocean and environmental missions. The GK2A has two Payloads, the Advanced Meteorological Imager (AMI) and the Korean Space Environment Monitor (KSEM), and the GK2B also has two Payloads, the Geostationary Ocean Color Imager II (GOCI-II) and the Geostationary Environment Monitoring Spectrometer (GEMS). The target launch date of each satellite is May 2018 for the GK2A and March 2019 for the GK2B. Both satellites will be collocated on a geostationary orbit.

The satellite operation center (hereafter “SOC”) for the GK2A and the GK2B is located at Daejeon in Korea.

(1) to manage and control GK2A and GK2B mission as the primary function,
(2) to receive and process the payload data from the on-board payloads as the backup function, and
(3) to broadcast on-ground processed data through the spacecraft as the backup function.

The GK2 SOC consists of seven ground subsystems as followings;

- Command and Data Acquisition Subsystem (CDAS)
- Integrated Test and Operation System (ITOS)
- Flight Dynamics Subsystem (FDS)
- Mission Planning Subsystem (MPS)
- Data Pre-processing Subsystem (DPS)
- Product Dissemination Subsystem (PDS)
- Management and Support Subsystem (MSS)

1.3 Acronyms

AOS	Acquisition of Signal
BPSK	Binary Phase Shift Keying
CCSDS	Consultative Committee for Space Data Systems

CLTU	Command Link Transmission Unit
COP-1	Communications Operation Procedure-1
EIRP	Effective Isotropic Radiated Power
ESA	European Space Agency
FTP	File Transfer Protocol
GK2	GEO-KOMPSAT-2
ICD	Interface Control Document
KARI	Korea Aerospace Research Institute
LEOP	Launch and Early Orbit Phase
LHCP	Left-Handed Circular Polarization
LOS	Lost Of Signal
NRZ-L	Non Return to Zero-Level
NRZ-M	Non Return to Zero-Mark
PCM	Pulse Coded Modulation
PSTN	Public Switched Telephone Network
RAU	Ranging Unit
RHCP	Right-Handed Circular Polarization
RS	Reed-Solomon
SOH	State of Health
SOW	Statement Of Work
TBD	To Be Determined
TM/TC	Telemetry/Telecommand
TT&C	Telemetry, Tracking and Command
VCDU	Virtual Channel Data Unit
VCID	Virtual Channel ID
VPN	Virtual Private Network
VoIP	Voice over Internet Protocol

2. Bid Instruction

2.1 Submittal of Proposal

2.1.1 Proposal Documents (organization)

The following information as required for KARI's evaluation shall be included in the Bidder's Proposal.

- Company Overviews (Organization, Heritages, etc.)
- Statement of Work with Compliance Matrix
- Technical Proposal with Compliance Matrix
- Management Proposal
- General Terms and Condition with Compliance Matrix
- Price Proposal (to be submitted in a separate sealed envelope)

2.1.1.1 Company Overview

The Bidder shall submit company overviews describing company organization and heritages. In terms of heritage, the Bidder shall provide the proof documents to demonstrate experience with operations of similar satellites in general.

2.1.1.2 Statement of Work

The Bidder shall submit an abbreviated statement of work for the GK2 LEOP TT&C and Ranging Services as required in Section 3 "Statement of Work". The Bidder shall demonstrate experience of routine/emergency operations from TT&C station and shall provide availability for emergency passes, preferably from a single station. Compliance Matrix attached as Appendix D shall be provided to demonstrate whether or not requirements specified in Section 3 "Statement of Work" are complied

2.1.1.3 Technical Proposal

The Bidder shall provide a full description on its recommended technical Proposal including command, telemetry and tracking capability as well as ranging capability for GK2 satellites. Compliance Matrix attached as Appendix D shall be provided to demonstrate whether or not requirements specified in Section 4 "Technical Requirements" are complied. In the compliance matrix, relevant page number of technical Proposal shall be specified to allow KARI evaluation board to find out that TT&C station and Ranging Service proposed by Contractor are fully satisfied with requirements.

2.1.1.4 Management Proposal

For the management Proposal, the Bidder shall provide a full description but not limited to:

- Program organization and resource
- Financial capability
- Any issues or comments on permission for S-Band uplink transmission.

In case that Contractor is not the owner of TT&C station and/or Ranging station, the relationship of each involved organization shall be also described.

2.1.1.5 General Terms and Conditions

The Bidder shall review the General Terms and Conditions provided by KARI as Section 5 “General Terms and Conditions” and provide the compliance matrix attached as Appendix D for the Contract negotiation.

2.1.1.6 Price Proposal

For the Price Proposal, the Bidder shall provide detailed price breakdown for each satellite as follows,

- Preparation cost for GK2A and GK2B LEOP TT&C Service, respectively.
- Preparation cost for GK2A and GK2B Ranging Service, respectively.
- Price for GK2A and GK2B LEOP TT&C Service, respectively.
  (The LEOP TT&C Service duration is 480 hours (24 hours per day, 20 days) for each satellite.)
- Price for GK2A and GK2B Overseas Ranging Service, respectively.
  (The number of ranging measurement for both GK2A and GK2B is 8,640times (24times per day, 30days per 1month, 6 months, 2 satellites)
- Price for GK2A and GK2B Overseas Ranging Service in nominal operation (This price is optional item.)

Preparation cost shall be expressed as engineering time and corresponding cost for the working package 1 of LEOP TT&C Service and the working package 1 of Overseas Ranging Service which are specified in Section 3 “Statement of Work”.

The price or rate proposed by Bidders shall be firm and fixed price not subject to change for a price escalation for the entire period of the Contract. The currency quoted in the Proposal shall be expressed in U.S Dollar only. If Bidder expresses other currency other than U.S Dollar, then for the conversion of excahnge rate, the price evaluation will be performed based upon the 1st basic exchange rate of KEB Hana Bank on the Price Evaluation Date. However, the currency of the Contract could be the national currency of Contractor within the USD value of estimated budget of the this Bidding, if necessary. In such a case, the 1st basic exchange rate noticed by KEB Hana Bank of Korea on the Price Evaluation Date shall be applied for the exchange rate for currency change. Any kinds of taxes and duties arising in connection with Bidder’s work under this RFP and under the eventual Contract shall be Bidder’s responsibility, except for the customs duties and value added taxes levied in Korea. The price shall be inclusive any cost or charge incurred due to the delivery of any equipment, hardware, software or documentation to KARI.

2.1.2 Number of Copies

One (1) original and seven (7) copies of the Proposal except for the Price Proposal shall be submitted. In addition, One (1) CD-ROM disk (Preferably in PDF format) containing the text of the Proposal except for the Price Proposal shall be additionally submitted. And one (1) Price Proposal separately enveloped shall be submitted.

In case of any discrepancies between the Proposal and CD-ROM version, the original hardcopy (Proposal) shall prevail.

2.1.3 Bid Closing Date

The closing time for the Proposal is May 2, 2017, 15:00PM in Korean Local Time. If any part of the Proposal as required under this RFP is submitted after the stipulated closing time, the entire Proposal will be deemed late. KARI in its absolute discretion may exclude any late Proposal from further consideration.

2.1.4 Method of Submittal

The Proposal shall be submitted to the following address:

Mr. Won-Suk LEE
Senior administrator of Procurement Team
Korea Aerospace Research Institute
169-84 Gwahak-ro, Yuseong-gu, Daejeon,
34133, Korea

Tel) +82-42-860-2406
Fax)+82-42-860-2666
e-mail) wsl@kari.re.kr

2.1.5 KARI Point of Contact

For the administrative part

Mr. Won-Suk LEE
Senior administrator of Procurement Team
Korea Aerospace Research Institute
169-84 Gwahak-ro, Yuseong-gu, Daejeon,
34133, Korea
Tel) +82-42-860-2406
Fax)+82-42-860-2666
e-mail) wsl@kari.re.kr

For the technical part

Mr. Durk-Jong PARK
Senior engineer of Ground System Development Team
Korea Aerospace Research Institute
169-84 Gwahak-ro, Yuseong-gu, Daejeon,
34133, Korea
Tel) +82-42-860-2721
Fax)+82-42-860-3919
e-mail) parkdj@kari.re.kr

With C.C

Dr. Chi-Ho KANG
Head of Ground System Development Team
Korea Aerospace Research Institute
169-84 Gwahak-ro, Yuseong-gu, Daejeon,
34133, Korea
Tel) +82-42-860-2918
Fax)+82-42-860-3919
e-mail) chkang@kari.re.kr

2.2 Bidding Schedule

The following schedule is a tentative milestone for the eventual Contract and may be changed at KARI's sole discretion:

- RFP Release: T0
- Bid Closing Date: T0 + 41days
- Evaluation of Proposal: T0 + 50days
- Selection of the Successful Bidder: T0 + 55days
- Contract Negotiation Start: T0 + 60days
- Expected Contract Date: T0 + 90days

If KARI and the Successful Bidder fail to agree on the terms and conditions for the eventual Contract, KARI may proceed with the Contract negotiations with the second ranking Bidder without any obligations to the Successful Bidder.

2.3 Validity of Proposal

The Proposal shall be valid for six (6) months from the Bid Closing Date and upon KARI's request, shall be extended for additional six (6) months.

2.4 Bid Bond

Bidders intending to submit the Proposal shall provide the Bid Bond as required under this Section. If the Bid Bond is not submitted with Proposal, the Proposal shall not be accepted.

2.4.1 Amount of Bid Bond

Bidder shall establish a Bid Bond in favor of KARI not later than the Bid Closing Date and submit the bond to KARI along with its Proposal. The total amount of the Bid Bond shall be at least five (5) percent of bidding price corresponding to the 40 days (960hr) of LEOP TT&C Service for both satellites including preparation cost and 8,460 times of Overseas Ranging Service for both satellites including preparation cost. The bond shall remain valid until six (6) months after the bid closing date and if the Bid validity is extended, the Bid Bond shall be also extended accordingly.

2.4.2 Bid Bond Establishment Method

The Bid Bond shall be in the form of a surety bond issued by the Seoul Guarantee Insurance Company, in the form of an irrevocable standby letter of credit or bank guarantee by first class international bank, cash or other means of gurantee acceptable to KARI. In case of a surety bond, it shall be advised through " Seoul Guarantee Insurance Company". In case of cash, bank guarantee, or the irrevocable standby letter of credit, it shall be advised through "Woori Bank" (Daejeon Branch at 29 Munye-ro, Seo-gu, Daejeon, 35241 Korea, Tel:+82-42-488-9704, Ext.312, Fax:+82-505-003-0759). The bond shall be available by KARI's request on the Seoul Guarantee Insurance Company or by KARI's draft at sight drawn on the bank, accompanied by the statement of KARI stating that Bidder has refused to enter into a Contract with the terms and conditions in the RFP as amended, if any, that Bidder has hindered the fair bidding by fraud or mispresentation, or that Bidder has withdrawn its Proposal after the Bid Closing Date.

2.4.3 Bid Bond Return

All of the Bid Bonds will be released promptly at the time of final Contract award by KARI without interest.

2.5 Questions and Modifications

2.5.1 Questions

Any questions as to the intent and clarity of the RFP may be asked to KARI's point of contact as Section 2.1.5 "KARI Point of Contact " by e-mail, fax or letter no later than ten (10) days before the Bid Closing Date. After the Bid Closing Date, Bidder shall not amend, modify, or supplement the Proposal, or submit any other documents to KARI, except for the case of KARI's written request.

2.5.2 Modifications

KARI may ask each Bidder to submit and supply additional information or documents for evaluation of the Proposal. And KARI may also ask each Bidder in writing for clarifications, amendments, revisions, or

supplementation of the Proposal and any other documents submitted by Bidder at any time before the execution of the Contract.

2.6 Non Contractual Obligation

This RFP shall not be interpreted as an offer for a Contract or any type of guarantee by KARI. It is KARI's sole discretion whether or not to allow the award to any Bidder. KARI owes no responsibility or obligation to select the Contractor among Bidders.

This solicitation for the Proposal shall neither be construed to create an obligation on KARI to enter into a contractual instrument, nor shall it serve as a basis for any claim for reimbursement of costs for the effort to prepare, submit, amend, revise or supplement the Proposal, and other related documents expended by Bidder regardless of whether or not Bidder is successful in receiving an award as a result of the solicitation.

2.7 Acceptance/Rejection of Bids

KARI reserves the right to accept or reject any Bidding, and to amend the Bidding process and reject all Bidding at any time prior to the award of the Contract without thereby incurring any liability to the affected Bidder(s), nor is KARI under any obligation to inform the affected Bidder(s) of the ground for its action.

2.8 Evaluation of Proposal

The evaluation of the Proposals will be made by the KARI evaluation committee and the following evaluation process is for information only. The evaluation committee reserves the right to modify the evaluation process and criteria without any prior notification to Bidders.

2.8.1 Evaluation Process

During the Bid evaluation, KARI may send to Bidders a set of questions for clarification and request any supplement to the Proposals and the evaluation will be made based on the Proposal and the answers and the supplement received from Bidders.

The evaluation consists of two (2) parts of the technical part and bidding price and, after the evaluation of technical part, the evaluation committee selects the Qualified Bidders and performs the bidding price evaluation for the selected Qualified Bidders. The total evaluation score is one hundred (100) points and the weight of technical part and bidding price is eighty (80) and twenty (20), respectively. Bidder who gets score exceeding eighty five percent (85%) of score in technical part will be selected as Qualified Bidder and after the evaluation of bidding price, the Successful Bidder and other ranking Bidders will be determined by the sum of scores in technical part and bidding price. If the total score is the same, the Bidder to get the higher score in technical part is preferred to others.

2.8.2 Evaluation Factors

The Compliance Matrix, TT&C Support Heritage, TT&C Station Network, Number of Station, Duration, Single Network Operation Center, Auto-Diversity Tracking, Diversity Unit in Data Channel, Primary/Backup Configuration of Overseas Ranging Station, Site, Success Rate of Ranging Measurement and Price are the most critical elements in the process of evaluation.

Therefore, it is recommended to provide the detailed statements and it is highly requested to prepare the Proposal in the order provided in Section 2.1.1.

2.9 Selection of Successful Bidder

The Successful Bidder will be selected by the evaluation committee among the Bidders subjec to the evaluation of the Proposals. At the time the Successful Bidder is selected, the ranking of the other Qualified Bidders will be notified.

In the event mutually agreeable terms and conditions including price are not reached with the Successful Bidder within the time limit specified by KARI, KARI may proceed with the Contract negotiations with next ranking (the 2nd ranking) Qualified Bidder without undertaking a new Bidding process and without any obligation to the Successful Bidder.

In case KARI initiates the Contract negotiations with the next ranking (the 2nd ranking) Qualified Bidder, the Bidder will occupy the position as the Successful Bidder and assume any obligations imposed upon the Successful Bidder under this RFP.

The result of evaluation is at the Proposal evaluation committee's discretion based on evaluation process and any Bidders shall not raise any objection regarding the Proposal evaluation committee's decision thereupon.

2.10 Language and Measurement Unit

The Proposal and any documents submitted to KARI under the RFP and communication and the Contract language shall be in English. System Internationa (SI) units shall be used for measurements and quantities in the Proposal and all the accompanying documents.

2.11 Certificate and Government Approvals

Bidder shall receive and represent the government approval and certificates in relevant countries, necessary for the participation of this bidding, if any. And Bidder shall provide the plan and schedule to get the government approval and certificates necessary for the performacne of Contract in the Management Proposal.

2.12 Confidentiality

There shall be no news release, public announcements, denials or confirmation in connection with this RFP or Contract award without the prior written approval of KARI. All documentation submitted in response to this RFP shall be marked "COMMERCIALS-IN-CONFIDENCE" on the first page of each document. All elements of the RFP shall be kept confidential, and shall not be intentionally disclosed by Bidder to any Third Party. All elements of the Proposal will be kept confidential, and will not be intentionally disclosed by KARI to any Third Party except for the case connected with the evaluation of Proposal.

2.13 Withdrawal of Proposal

Bidder may withdraw its Proposal at any time before the Bid Closing Date. Withdrawal shall be made in writing, and shall be received by KARI before the Bid Closing Date.

2.14 Property of Proposal

All documents submitted in response to the RFP shall become the property of KARI and will be retained by KARI.

2.15 Expenses

Expenses incurred by Bidder in connection with the preparation, submittal, and any subsequent clarification of Proposal or negotiation activities are for its own account and will not be reimbursed by KARI.

2.16 Governing Law

This RFP and the Contract shall be construed in accordance with and governed by the laws of the Republic of Korea.

2.17 Arbitration

Any disputes in relation to, and under the RFP and the Contract shall be resolved through arbitration in Seoul, Korea under the Rules of the Korean Commercial Arbitration Board.

3. STATEMENT OF WORK

3.1 GK2 LEOP TT&C Service

This chapter presents the Statement of Work for GK2A and GK2B LEOP TT&C service (hereafter in this chapter, service)

3.1.1 Scope of Service

3.1.1.1 Design and Development

[REQ-3111-1] Design and Development
The service to be provided by Contractor shall meet the requirements of this SOW and technical requirements specified in Section 3 and Section 4.

[REQ-3111-2] New Antenna Station
In case that the service requires for Contractor to procure new antenna stations, the Contractor shall notify KARI of such plan as soon as the Contractor becomes aware of the situation.

[REQ-3111-3] FOV of Antenna Station
FOV (Field Of View) of each antenna station shall be guaranteed above at least five (5) degrees of elevation angle in any azimuth direction.

[REQ-3111-4] Acquisition Plan
All antenna stations shall have search & time-offset capability with pre-defined acquisition plan. +/-60sec of time-offset with combined search like azimuth or spiral scan shall be provided in each relevant antenna station.

[REQ-3111-5] Auto-diversity Function in Tracking Channel
All antenna stations shall equip with auto-diversity tracking receiver to conduct auto-tracking by using dominant channel signal between RHCP and LHCP channel.

[REQ-3111-6] Diversity Unit in Tracking Channel
All antenna stations shall equip with diversity unit in data channel to determine the dominant one between RHCP and LHCP channels. Even though dominant channel is determined, signal level and Eb/No in both RHCP and LHCP channel shall be continuously notified to KARI through voice loop. Switching to dominant channel shall be performed by KARI decision.

3.1.1.2 Basic Service

[REQ-3112-1] Basic Service
The basic service to be provided by Contractor shall be as followings

- Initial Acquisition Service
- Command Service
- Telemetry Service
- Tracking Service
- Ranging Measurement
- 2-way Doppler Measurement
- Angle Data Measurement

3.1.1.2.1 Initial Acquisition Service

[REQ-3112-2] Initial Acquisition Service
Initial acquisition service is important due to its effectiveness in case that real separation vector from launch vehicle is different with expected one and that satellite is going into emergency even in normal

operation. During acquisition period, mode transition to auto-track is mandatory after successful signal acquisition. Mode transition can be done by manually comparing signal strength and checking spectrum pattern or by automatically setting signal strength level in tracking receiver. For initial acquisition, AOS antenna position elevation angle can be 2 or 3 deg. instead of 0 deg. This acquisition scheme shall not impact on normal operations like command uplink, telemetry downlink and tracking file generation using angle data, ranging data, Doppler data.

3.1.1.2.2 Command Service

[REQ-3112-3] Command Service
All TT&C station shall provide S-Band command upload service. Command format will be CLTU or transfer frame according to CCSDS standard. All commands interface between SOC and TT&C station are really standard CORTEX^{TM} native protocol. Therefore, all TT&C system shall implement the corresponding CORTEX^{TM} unit.

3.1.1.2.3 Telemetry Service

[REQ-3112-4] Telemetry Service (On-line Telemetry Transfer)
All TT&C ground station shall conduct IF-converted, Viterbi decoding, frame-synchronized, and de-randomized on the GK2A and GK2B downlink signal right after downlink signal acquisition.

[REQ-3112-5] Structure of Telemetry Data
The structure of telemetry data from TT&C ground station to SOC shall be in form of CORTEX^{TM} native. The size of native format shall be TBD bytes consisting of header (64bytes) + VCDU (TBD bytes) + trailer (4bytes).

[REQ-3112-6] Time Code
Time code configured in CORTEX^{TM} unit shall be code 2. The structure of code 2 appeared in the header is consisting of first field and second field. First field is CORTEX^{TM} unit time in second (number of seconds elapsed since January 1st, 0:00:000 of current year). Second field is the number of milliseconds in current seconds. First field is a 32-bit integer (hexadecimal-coded) while second field is a 32-bit float value.

[REQ-3112-7] Telemetry Data Recording
All TT&C station shall have a capability to record telemetry data during satellite pass.

[REQ-3112-8] Telemetry Service (Off-line Telemetry Transfer)
TT&C station shall keep the recorded telemetry data in CORTEX^{TM} native form. The recorded data shall be compressed as zip file and automatically placed into FTP server of SOC after satellite pass.

3.1.1.2.4 Tracking Service

[REQ-3112-9] Tracking Service
TT&C station shall provide tracking data formatted as GEOS-C format. Contents of general GEOS-C format are described in Appendix A. A GEOS-C file includes three (3) different tracking data, angle data, ranging, and Doppler.

[REQ-3112-10] Timeliness for Tracking Service
The tracking data shall be provided to SOC within 10[TBD] minutes after the completion of ranging measurement.

3.1.1.2.5 Ranging Measurement

[REQ-3112-11] Ranging Measurement
TT&C station shall provide ranging measurement service on KARI operator's request. It is baseline to continuously conduct ranging measurement in every 30 minutes during LEOP.

[REQ-3112-12] CORTEX^{TM} Unit Configuration for Ranging Measurement

CORTEX^{TM} unit shall be configured to operate in ESA tone standard in RAU window.

[REQ-3112-13] Ground Delay Compensation
Ground delay of local TT&C station shall be compensated (subtracted) from the result of ranging measurement.

[REQ-3112-14] Duration of Ranging Measurement
Exact time and duration of ranging measurement shall be confirmed by SOC via voice loop before satellite pass. CORTEX^{TM} unit shall be configured according to SOC request before satellite pass.

3.1.1.2.6 2-Way Doppler Measurement

[REQ-3112-15] 2-Way Doppler Measurement
GK2A and GK2B will be configured to coherent mode to make 2-way Doppler measurement be possible. Exact duration of 2-way Doppler measurement shall be confirmed by SOC via voice loop before satellite pass.

3.1.1.2.7 Angle Data Measurement

[REQ-3112-16] Angle Data Measurement
Only auto-tracked angle measurement data shall be applied as input data for GEOS-C format. It is baseline that 1 second of time resolution is considered.

3.1.2 Working Package

The services to be provided by Contractor are divided up as followings:

Working Package 1: Pre-engineering and station validation
Working Package 2: LEOP support

3.1.2.1 Working Package 1: Pre-engineering and Station Validation

[REQ-3121-1] Documentation
Contractor shall provide following documents for the pre-engineering activities, as minimum.

- ICD for Communication Link between provider's network management center and SOC
- Review on Voice Procedure between provider's network management center and SOC. KARI will initially write the Voice Procedure
- LEOP Network Detailed Design
- LEOP Network Test Plan, Test Procedure and Test Report
- Initial Acquisition Procedure
- Antenna Blind Searching Procedure

[REQ-3121-2] Validation Test
During working package 1, Contractor shall perform technical validation tests to demonstrate, as minimum:

- Ground Interface with SOC
- Compliance of technical requirement specified for GK2A and GK2B
- Tracking File generation by tracking LEO satellite like KOMPSAT satellites

[REQ-3121-3] Test Report
Test reports describing validation test results shall be provided to KARI within three (1) months after validation test.

[REQ-3121-4] Data Package
At the end of this working package, Contractor shall send for KARI approval a data package including all documents described in [REQ-3121-1]. The data package for GK2A shall be delivered to KARI by

December 10, 2017. The data package for GK2B shall be delivered to KARI by December 10, 2018. This working package will be finished by the acceptance by KARI.

3.1.2.2 Working Package 2: LEOP Support

[REQ-3122-1] Working Package 2
The working package 2 shall include the following activities to be performed by Contractor

- Operational Readiness Checkup within 3 months before satellite launch
- Operation during LEOP (approximately 1 month after satellite launch)

[REQ-3122-2] Operational Engineer in Local TT&C Station
During LEOP support, operational engineer shall be placed in local TT&C station aimed to directly monitor the working of whole system.

[REQ-3122-3] Pre-Pass Check
During LEOP support, checking of data flow and configuration setup shall be completely conducted at relevant TT&C stations prior to satellite pass

[REQ-3122-4] Pass Report
Contractor shall provide technical report describing signal level and Eb/No measured at each RHCP and LHCP channel with 1 second of time step after satellite pass. Details on the contents in pass report will be defined after Contract. Following items shall be contained as minimum,

- Uplink carrier frequency sweeping or not
- Auto-tracking or not
- Antenna angle data (AZ/EL) with 1 second of time step
- Signal Level and Eb/No measured at each RHCP and LHCP channel with 1 second of time step

The pass report shall be placed into FTP server of SOC after satellite pass.

[REQ-3122-5] Number of Ground Stations
Contractor shall provide more than four regional-separated TT&C stations to ensure the visibility of satellite during LEOP

[REQ-3122-6] Duration
Contract shall provide LEOP support for 20 days after satellite launch. Depending on LEOP operation, the duration can be changed.

[REQ-3122-7] Pass Scheduling in Advance
For the first three days after satellite separation from launcher, pass shall be scheduled with highest priority.

[REQ-3122-8] Single Network Operation Center
Regional-separated TT&C stations even in northern and southern hemisphere shall be integrated by using single network operation center to be communicated with SOC.

3.1.3 Customer-Furnished Items (CFI)

KARI will be responsible for documentation about the setup of CORTEX unit for TM/TC and ranging measurement and preparation of test telemetry data file.

3.2 GK2 Overseas Ranging Service

This chapter presents the Statement of Work for GK2A and GK2B Overseas Ranging Service (hereafter in this chapter, service)

3.2.1 Scope of Service

3.2.1.1 Design and Development

[REQ-3211-1] Design and Development
The service to be provided by Contractor shall meet the requirements of this SOW and technical requirements specified in Section 3 and Section 4.

[REQ-3211-2] New Antenna Station
In case that the service requires for Contractor to procure new antenna stations, the Contractor shall notify KARI of such plan as soon as the Contractor becomes aware of the situation.

[REQ-3211-3] FOV of Antenna Station
FOV (Field Of View) of each antenna station shall be guaranteed to looking GK2A and GK2B satellites. The location of GK2A and GK2B is informed after contract.

[REQ-3211-4] Primary/Backup Configuration
Overseas ranging station shall be configured as primary and backup station at same site. When primary station is in problem, switching to backup station shall be accomplished within 1 hour.

[REQ-3211-5] Uplink License
Contractor shall acquire uplink license from local government at least 6 months before satellite launch.

[REQ-3211-6] Site
Overseas ranging station shall be deployed at site to meet OD requirements. If bidder propose site with its longitude and latitude information, KARI will use the expected OD performance at the site as a part of technical evaluation.

[REQ-3211-7] Ranging Accuracy
Overseas ranging station shall provide ranging result which meets ranging accuracy, 10m RMS.

[REQ-3211-8] Number of Ranging Measurement
Overseas ranging station shall conduct ranging measurement in every at least 1 hour for GK2A and GK2B, respectively. In each ranging measurement, 100 times of ranging measurement shall be done within 10 sequence.

[REQ-3211-9] Success Rate
Ranging measurement shall be successfully conducted with more than 98 % of success rate per daily passes.

[REQ-3211-10] Availability of Network Line
Availability of network line between overseas ranging station and SOC shall be more than 99.5 % in daily operation.

[REQ-3211-11] Abort of Ranging Measurement
In the emergency of satellite, ranging measurement shall be aborted within 5[TBD] minutes on SOC request.

[REQ-3211-12] Daily-Based Ranging Schedule File
Overseas ranging station shall be scheduled based on the daily-based ranging schedule file sent by SOC operator. In the ranging schedule file, time in hour, minutes and seconds will be specified for GK2A and GK2B ranging measurement, respectively.

[REQ-3211-13] Ranging Results in GEOS-C Format
Overseas ranging station shall upload ranging results in GEOS-C format to SOC FTP server within 5 [TBC] minutes after each ranging measurement.

3.2.1.2 Basic Service

[REQ-3212-1] Basic Service
The basic service to be provided by Contractor shall be as followings

- Ranging Measurement

3.2.1.2.1 Ranging Measurement

[REQ-3212-2] Ranging Measurement
TT&C station shall provide ranging measurement service whenever required.

[REQ-3212-3] CORTEX^{TM} Unit Configuration for Ranging Measurement
CORTEX^{TM} unit shall be configured to operate in ESA tone standard in RAU window.

[REQ-3212-4] Ground Delay Compensation
Ground delay of local TT&C station shall be compensated (subtracted) from the result of ranging measurement.

3.2.2 Working Package

The services to be provided by Contractor are divided up as followings:

Working Package 1: Pre-engineering and station validation
Working Package 2: IOT support

3.2.2.1 Working Package 1: Pre-engineering and Station Validation

[REQ-3221-1] Documentation
Contractor shall provide following documents for the pre-engineering activities, as minimum.

- ICD between provider's network management center and SOC
- RF communication characteristics of overseas ranging station
- Validation Test Procedure and Test Report

[REQ-3221-2] Validation Test
During working package 1, Contractor shall perform technical validation tests to demonstrate, as minimum:

- Ground Interface with SOC
- Compliance of technical requirement specified for GK2A and GK2B
- Tracking File generation by ranging measurement of COMS satellite

[REQ-3221-3] Test Report
Test reports describing validation test results shall be provided to KARI within three (1) months after validation test.

[REQ-3221-4] Data Package
At the end of this working package, Contractor shall send for KARI approval a data package including all documents described in [REQ-3221-1] The data package for GK2A shall be delivered to KARI by December 10, 2017. The data package for GK2B shall be delivered to KARI by December 10, 2018. This working package will be finished by the acceptance by KARI.

3.2.2.2 Working Package 2: IOT Support

[REQ-3222-1] Working Package 2
The working package 2 shall include the following activities to be performed by Contractor

- Operational Readiness Checkup within 3 months before satellite launch
- Operation during IOT (approximately 6 month after LEOP)

3.2.3 Customer-Furnished Items (CFI)

KARI will be responsible for documentation about the setup of CORTEX unit for ranging measurement and daily-based ranging schedule file format.

4. Technical Requirements

4.1 GK2 LEOP TT&C Service

This chapter presents the technical requirements for GK2 LEOP TT&C Service

4.1.1 Space-to-Ground Interface

For the space-to-ground interface, both S-Band RF uplink and S-Band RF downlink between GK2A/GK2B and GK2 LEOP TT&C ground station are necessary.

4.1.1.1 S-Band Downlink Requirements

[REQ-4111-1] S-Band Downlink Parameters for TT&C Stations
TT&C station shall be applicable for S-Band downlink parameters described in Table 1.

Table 1 S-Band Downlink Parameters for TT&C Stations

Parameters	Value
G/T	More than 22 dB/K
Polarization(note1)	Simultaneous RHCP and LHCP, Auto diversity, Combining Mode
Center Frequency	Frequency for GK2A and GK2B will be informed after Contract
Modulation	PCM(NRZ-L)/PSK/PM
Modulation Index	1.0 radian
Sub-carrier Frequency	65544Hz
Coding	Convolutional coding (r=1/2, K=7)
Telemetry Datarate	4096 bps (after Viterbi decoding)
Downlink Acquistion Range @ Ground Receiver	$\leq \pm$ 150kHz

Note 1) GK2A and GK2B are designed to transmit downlink signal through nadir-direction antenna and zenith-direction antenna at the same time. The polarization of nadir-direction and zenith-direction for GK2A and GK2B is as followings,

- GK2A: RHCP for Nadir-direction, LHCP for Zenith-direction
- GK2B: LHCP for Nadir-direction, RHCP for Zenith-direction

Depending on the orbit and attitude of GK2A and GK2B, the signal level of RHCP and LHCP channel can be varied. For the reason, TT&C ground station needs to have an auto-diversity function to manually or automatically select the dominant polarization between RHCP and LHCP according to the signal level of RHCP and LHCP channel for the auto-tracking at antenna. On top of that, in terms of receiving telemetry signal without any packet loss, TT&C ground station needs to have so-called combining mode which can automatically combine the two telemetry signals from RHCP and LHCP channels so that Eb/No of telemetry signal is continuously stable.

4.1.1.2 S-Band Uplink Requirements

[REQ-4112-1] S-Band Uplink Parameters for TT&C Stations

TT&C station shall be applicable for S-Band uplink parameters described in Table 2.

Table 2 S-Band Uplink Parameters for TT&C Stations

Parameters	Value
EIRP	More than 68 dBW
Polarization	Selectable RHCP or LHCP
Center Frequency	Frequency for GK2A and GK2B will be informed after Contract
Modulation	PCM(NRZ-L)/PSK/PM
Modulation Index	1.4 ± 5% radian
Sub-carrier Frequency	8000Hz
Telecommand Datarate	2000 bps
Uplink Sweeping Range	≤ 140kHz
Uplink Sweeping Rate	≤ 32kHz/sec

[REQ-4112-2] Preamble and Idle Pattern
For the reliable on-board receiver's bit-sync performance, preamble and idle pattern shall be provided at local TT&C modem such as CORTEX^{TM} CRT-Q unit which has been using at KARI site. The size of preamble shall be more than 176[TBD] bits and the idle pattern shall be configured as 55555555_H.

4.1.1.3 Ranging Requirements

[REQ-4113-1] Ranging Parameters for TT&C Stations
TT&C station shall be applicable for ranging parameters described in Table 3.

Table 3 Ranging Parameters for TT&C Stations

Parameters	Value
Type	ESA Tone Standard
Major Tone Frequency	100kHz
(Virtual) Minor Tone Frequency	20kHz, 4kHz, 0.8kHz, 0.16kHz, 0.032kHz, 0.008kHz
(Real) Minor Tone Frequecny	20kHz, 16kHz, 16.8kHz, 16.16kHz, 16.032kHz, 16.008kHz
Modulation	Phase Modulation
Modulation Index for Major Tone Only	1.4 ± 5% radian for uplink, 0.45 (+10%, -15%) radian for downlink
Modulation Index for Major + Minor Tone	(0.7 rad + 0.7 rad) ± 5% for uplink, 0.32rad + 0.32(+10%, -15%) for downlink

Both GK2A transponder and GK2B transponder will be configured to be coherent mode during ranging and 2-way Doppler measurements. In coherent mode, the ratio of 240/221 which is standard frequency translation is used.

4.1.2 Ground Interface

Communication interface between SOC and signal network operation center of GK2 LEOP TT&C ground network will be prepared as followings,

- Primary Link: Dedicated-Leased Line (64 kbps, TBD)
- Backup Link: VPN Internet (64 kbps, TBD)

4.1.2.1 Telemetry Interface

[REQ-4121-1] Telemetry Request Message
On reception of a telemetry request message, all local CORTEX^{TM} unit shall check its validity and returns a negative acknowledgment message in case of invalid request or telemetry message/data in case of valid request. Details of telemetry request message and negative acknowledgment message are described in the user's manual issued by Zodiac Data Systems.

[REQ-4121-2] Telemetry Message
On reception of a telemetry request message, telemetry message shall be returned to ITOS of SOC. In case that there is no data available, any telemetry data shall not be transmitted. This shall be done by CORTEX^{TM} unit automatically without any special software. Details of telemetry message are described in user's manual issued by Zodiac Data Systems.

4.1.2.2 Telecommand Interface

[REQ-4122-1] Telecommand Message
CORTEX^{TM} unit located at all TT&C stations shall be properly to be compatible with telecommand message delivered by ITOS of SOC for sending telecommand to GK2A and GK2B. Details of telecommand message are described in user's manual issued by Zodiac Data Systems.

[REQ-4122-2] Telecommand ACK Message
In case that TT&C station successfully transmits command with local CORTEX^{TM} unit to the satellite, positive message shall be returned to the TM/TC gateway in MMOC. If not, negative message shall be returned. This shall be done by CORTEX^{TM} unit, automatically. Details of satellite command acknowledgement message and negative acknowledgement message are described in [RD1] issued by Zodiac Data Systems.

4.1.2.3 Tracking File Interface

[REQ-4123-1] Tracking File Interface
Antenna auto-track angle data and ranging/Doppler data measured at each TT&C station shall be placed at FTP server of SOC as a GEOS-C formatted file. The detail of GEOS-C file format is presented in Appendix A.

4.1.2.4 Voice Interface

[REQ-4124-1] VoIP
Verbal interface shall be performed via VoIP as primary and PSTN black-phone as backup.

4.2 GK2 Overseas Ranging Service

This chapter presents the technical requirements for GK2 Overseas Ranging Service.

4.2.1 Space-to-Ground Interface

For the space-to-ground interface, GK2 overseas ranging station shall communicate with GK2A and GK2B through S-Band uplink and downlink.

4.2.1.1 S-Band Downlink Requirements

[REQ-4211-1] S-Band Downlink Parameters for Ranging Stations
Overseas ranging station shall be applicable for S-Band downlink parameters described in Table 4.

Table 4 S-Band Downlink Parameters for Ranging Stations

Parameters	Value
G/T	More than 16.8 dB/K
Polarization	RHCP, LHCP
Center Frequency	Frequency for GK2A and GK2B will be informed after contract
Modulation	PCM(NRZ-L)/PSK/PM
PLL Bandwidth	configurable from 0.1Hz to 4Hz
Downlink Acquistion Range @ Ground Receiver	± 150kHz, minimum

4.2.1.2 S-Band Uplink Requirements

[REQ-4212-1] S-Band Uplink Parameters for Ranging Stations
Ranging station shall be applicable for S-Band uplink parameters described in Table 5.

Table 5 S-Band Uplink Parameters for Ranging Stations

Parameters	Value
EIRP	More than 53 dBW
Polarization	RHCP, LHCP
Center Frequency	Frequency for GK2A and GK2B will be informed after contract
Modulation	PCM(NRZ-L)/PSK/PM
Uplink Sweeping Range	≤ 140kHz
Uplink Sweeping Rate	≤ 32kHz/sec

4.2.1.3 Ranging Requirements

[REQ-4213-1] Ranging Parameters for Ranging Stations
Ranging station shall be applicable for ranging parameters described in Table 6.

Table 6 Ranging Parameters for Ranging Stations

Parameters	Value
Type	ESA Tone Standard
Major Tone Frequency	100kHz
(Virtual) Minor Tone Frequency	20kHz, 4kHz, 0.8kHz, 0.16kHz, 0.032kHz, 0.008kHz
(Real) Minor Tone Frequecny	20kHz, 16kHz, 16.8kHz, 16.16kHz, 16.032kHz, 16.008kHz
Modulation	Phase Modulation
Modulation Index for Major Tone Only	1.4 ± 5% radian for uplink, 0.45 (+10%, -15%) radian for downlink
Modulation Index for Major + Minor Tone	(0.7 rad + 0.7 rad) ± 5% for uplink, 0.32rad + 0.32(+10%, -15%) for downlink

Both GK2A transponder and GK2B transponder will be configured to be coherent mode during ranging measurements. In coherent mode, the ratio of 240/221 which is standard frequency translation is used.

4.2.2 Ground Interface

Communication interface between SOC and signal network operation center of GK2 LEOP TT&C ground network will be prepared as followings,

- VPN Internet (64 kbps, TBD)

4.2.2.1 Tracking File Interface

[REQ-4221-1] Tracking File Interface
Ranging data shall be placed at FTP server of SOC as a GEOS-C formatted file. The detail of GEOS-C file format is presented in Appendix C.

5. General Terms and Conditions

Preamble

This Contract, made on June _____, 2017 by and between Korea Aerospace Research Institute, duly established and existing under the law of Republic of Korea, with its main office at 169-84 Gwahak-ro, Yuseong-Gu, Daejeon 34133 Korea, hereinafter referred to as "KARI" and [Contractor], duly established and existing under the laws of [nationality], with its main office at [address], hereinafter referred to as "Contractor".

Witnesseth

WHEREAS, KARI desires to obtain TT&C and associated services as well as overseas Ranging services from Contractor for GEO-KOMPSAT-2A and GEO-KOMPSAT-2B satellites;

WHEREAS, Contractor is an experienced provider of technologically advanced and reliable service; and

WHEREAS, Contractor is willing to provide the services as specified in this Contract;

NOW THEREFORE, in consideration of the premises and the mutual agreements herein contained, KARI and Contractor have agreed to the followings:

Article 1. Definition

The terms defined in this Article shall have the meaning ascribed to them herein whenever they are used in this Contract, unless otherwise clearly indicated by the context.

1.1 **Associates** mean all individual or legal entities organized under public or private law, who shall act, directly or indirectly, on behalf of KARI or Contractor, or at the direction of either Party to this Contract to fulfill the obligations undertaken by such Party in this Contract, including, without limitation, the employee of each Party, their suppliers and subcontractors.

1.2 **Contract** means this Contract including Appendix as attached hereto, and all amendments that may be agreed by the Parties in accordance with terms and conditions of this Contract.

1.3 **Contractor** means _____.

1.4 **Contract Price** means the amount of Contract. If there is any change in Contract Price due to any reason, then the Contract Price means current total amount of Contract.

1.5 **Deliverable Item(s)** means any hardware, software, data or documentation to be provided to KARI by Contractor under this Contract.

1.6 **EDC** means the Effective Date of the Contract in accordance with Article 15 "Effective Date of Contract".

1.7 **Events of Force Majeure** means any act of God, war, whether or not declared, act or failure to act of any government in its sovereign capacity, fire, earthquake, flood, severe weather, epidemic, quarantine, riot, social uprisings, strikes, lock-outs, nuclear incident, or any other act beyond the reasonable control and without the fault of either Party or its Subcontractors.

1.8 **GEO-KOMPSAT-2A** or **GEO-KOMPSAT-2B** or **Satellite(s)** means the Geostationary Earth Orbit Korea Multi-Purpose Satellite 2A or 2B or both to be developed under KARI's responsibility.

1.9 **GEO-KOMPSAT-2 program** means the satellite development program for Geostationary Earth Orbit Korea Multi-Purpose Satellite 2A and 2B to be performed by KARI.

1.10 **IOT** means In-Orbit Test for GEO-KOMPSAT-2A and GEO-KOMPSAT-2B after LEOP, respectively.

1.11 **KARI** means Korea Aerospace Research Institute.

1.12 **KARI Furnished Item(s)** means the data, information or documentation to be provided to Contractor by KARI under this Contract.

1.13 **LEOP** means launch and early orbit phase for the GEO-KOMPSAT-2A and GEO-KOMPSAT-2B.

1.14 **Overseas Ranging Service** means the ranging measurement by Contractor's overseas ranging station under this Contract.

1.15 **Pass** means the time frame Contractor is using an antenna system to track the GEO-KOMPSAT-2A and GEO-KOMPSAT-2B for the purpose of receiving downlink signals and transmitting uplink signal from/to the GEO-KOMPSAT-2A and GEO-KOMPSAT-2B in accordance with the schedule provided by KARI to Contractor and accepted by Contractor.

1.16 **Unit Price** means the price for each Works defined in Article 4.1.

1.17 **Party or Parties** means KARI or Contractor, or both, according to the context.

1.18 **Subcontract** means any subcontract, at any tier under this Contract.

1.19 **Subcontractor** means a contractor under any Subcontract including Main Subcontractor and suppliers.

1.20 **TT&C Service** means the telemetry receiving, satellite tracking and command transmitting by LEOP ground network under this Contract.

1.21 **Third Party(ies)** means any individual or legal entity other than the Parties and Associates.

1.22 **Work** means all services, including the TT&C Service and Overseas Ranging Services, to be performed by Contractor in accordance with Appendix A “Statement of Work”.

Article 2. Contract Documents

2.1 This Contract shall comprise the following documents, as amended from time to time by written agreement by and between both Parties;

General Terms and Conditions
Appendix A. Statement of Work
Appendix B. Technical Requirements

2.2 In the event of any inconsistency or discrepancy between or among the Contract documents as listed in Article 2.1 above, the Contract documents shall be applied in the decreasing order of precedence.

Article 3. Scope of Work and Manner of Performance

3.1 Contractor shall provide KARI with the Work as stipulated in Appendix A “Statement of Work” and Deliverable Items as required under this Contract.

3.2 Contractor shall provide sufficient engineering manpower and prepare suitable facilities for the completion of the Works as set forth in Appendix A “Statement of Work”. If the Works are not completed with manpower and facilities foreseen due to Contractor’s fault, Contractor shall provide any additional manpower and facilities to accomplish each Work without any additional cost to KARI.

3.3 Contractor shall provide any technical information or assistance as may be needed for KARI to understand Deliverable Item or output of Contractor’s Work hereunder, without any additional charge to KARI.

3.4 KARI shall have the right to monitor the Work as specified in Appendix A “Statement of Work” in progress at Contractor’s facilities.

3.5 KARI shall provide the KARI Furnished Items to Contractor in order for Contractor to perform the Work, in timely manner.

3.6 Both Parties shall get any government approval necessary for the performance of this Contract, respectively.

Article 4. Price and Terms of Payments

4.1 Each Unit Price for the Work performed by Contractor under this Contract is specified as follows;

Item	No.	Price Items	Unit Price (USD)
Preparation	1	Preparation Cost for TT&C Service of GEO-KOMPSAT-2A	
	2	Preparation Cost for TT&C Service of GEO-KOMPSAT-2B	
	3	Preparation Cost for Ranging Service of GEO-KOMPSAT-2A	
	4	Preparation Cost for Ranging Service of GEO-KOMPSAT-2B	
Operation	5	TT&C Service for Pass of GEO-KOMPSAT-2A (minute basis)	
	6	TT&C Service for Pass of GEO-KOMPSAT-2B (minute basis)	
	7	Ranging Service for GEO-KOMPSAT-2A (Pass basis)	
	8	Ranging Service for GEO-KOMPSAT-2B (Pass basis)	

[Note] TBD

4.2 The Unit Price as specified in Article 4.1 above shall be a firm and fixed price that is not subject to any adjustment or revision by reason of the actual costs incurred by Contractor in the performance of the Work under this Contract.

4.3 The payment of Contract Price shall be subject to the establishment of performance bond and shall be made in accordance with the following table;

No.	Payment Milestone (EDC + month)	Payment Due Date	Payment (USD)	Percentage (%)
1	EDC	EDC + 1M		TBD %
2	Completion of Preparation for TT&C Service of GK-2A (EDC + TBD M)	EDC + TBD M		TBD %
3	Completion of Preparation for Ranging Service of GK-2A (EDC + TBD M)	EDC + TBD M		TBD %
4	Completion of Preparation for TT&C Service of GK-2B (EDC + TBD M)	EDC + TBD M		TBD %
5	Completion of Preparation for Ranging Service of GK-2B (EDC + TBD M)	EDC + TBD M		TBD %
6	Completion of TT&C Service for GK-2A (EDC + TBD M)	EDC + TBD M		TBD %
7	Ranging Services #1 for GK-2A (EDC + TBD M)	EDC + TBD M		TBD %
8	Ranging Services #2 for GK-2A (EDC + TBD M)	EDC + TBD M		TBD %
9	Completion of TT&C Service for GK-2B (EDC + TBD M)	EDC + TBD M		TBD %
10	Ranging Services #1 for GK-2B (EDC + TBD M)	EDC + TBD M		TBD %
11	Ranging Services #2	EDC + TBD M		TBD %

	for GK-2B (EDC + TBD M)			
Total				100%

4.4 All payments shall be made in U.S dollars by wire transfer to the bank account as designated by Contractor in its invoices within thirty (30) days after KARI's receipt of the invoice as follows;

4.4.1 Preparation Unit Price for both TT&C and Ranging Services and Operation Unit Price for TT&C Services for each of the GEO-KOMSPAT-2A and GEO-KOMSPAT-2B ordered by KARI shall be made after the completion of Work.

4.4.2 Operation Unit Price for Ranging Services for each of the GEO-KOMSPAT-2A and GEO-KOMSPAT-2B ordered by KARI shall be made on quarterly basis.

4.5 All banking charges incurred in Korea shall be borne by KARI, and those charges incurred outside of Korea shall be borne by the Contractor.

Article 5. Criteria of Successful Pass and Pass schedule

5.1 If the data to be acquired in a Pass is forwarded to KARI as valid data, the Pass is considered successful. However, if the data to be acquired in a Pass is not forwarded to KARI as valid data, KARI shall not be liable for the payment for the invalid data transmission period of each Satellite for the TT&C Service and for the Pass of each Satellite for the Ranging Service.

5.2 The Pass schedule requested by KARI shall be provided to Contractor in timely manner and no later than one (1) week prior to the actual Work is to be occurred.

Article 6. Taxes and Duties

6.1 In the event taxes are charged in Korea, KARI shall be fully responsible for payment of such taxes. The Contractor shall be fully responsible for the payment of all applicable taxes imposed outside Korea including any customs duties and charges. In any event, any taxes or duties of any nature levied by Korean tax authorities on the Contractor shall be borne and directly paid by the Contractor to the Korean tax authorities.

6.2 Neither Party shall be responsible for paying the customs duties, and related taxes, fees, or charges for the personnel and the personal belongings of the other Party.

Article 7. Performance Bond

7.1 Contractor shall establish a performance bond within three (3) weeks after EDC in favor of KARI in the value of ten percent (10 %) of the sum of each Preparation Cost, in the form of an irrevocable and unconditional standby letter of credit available by KARI's draft at sight.

7.2 The entire amount covered by the performance bond shall be payable to KARI on demand together with KARI's written statement to the effect:

(a) that there was a default of the Contractor in the performance of the Contract (including Subcontractor's default under the Subcontract), or
(b) that any amount KARI is entitled to receive from Contractor has not been paid by Contractor to KARI through any other means, or
(c) that this Contract was terminated by Contractor's breach as specified in Article 13.2.

7.3 The letter of credit shall be issued by first class international bank acceptable to KARI. The letter of credit shall be drawn in favor of KARI and advised through the Woori Bank (Daejeon Branch at 29 Munye-ro, Seo-gu, Daejeon, 35241 Korea, Tel: +82-42-488-9704, Ext. 312 / Fax:+82-505-003-0759) and shall remain valid until the end of Overseas Ranging Service for GEO-KOMPSAT-2B. The letter of credit shall not be amended, modified or canceled without KARI's prior written consent.

7.4 It is hereby agreed between the Parties that payment from the performance bond under this Article 7 shall not affect any other KARI's rights, privileges, interests or remedies under this Contract or the applicable law.

Article 8. Licenses, Clearances and Permits

8.1 Unless otherwise specified in this Contract, each Party is responsible for obtaining all government approvals from any government authority which has jurisdiction and authority to require such approvals, including, but not limited to, licenses, visas, and permits necessary to carry out such Party's obligations in accordance with this Contract. KARI is responsible for obtaining any necessary Korean government approvals, and Contractor is responsible for all other government approvals.

8.2 The Parties shall cooperate and provide each other, upon request of and without cost to the other Party, all reasonable and necessary assistance in obtaining any and all governmental approvals, which they respectively are required to obtain for the performance of this Contract.

8.3 Each Party shall be solely responsible for any expenses incurred in obtaining the approvals, which are required under this Article. The Parties shall provide to each other, upon request of and without cost to the other Party, suitable documents or other reasonable evidence to show that they have obtained any and all governmental approvals, which they respectively are required to obtain pursuant to this Contract.

8.4 Each Party and its employees shall comply with all applicable legal requirements of any place in which any part of Work under this Contract is to be done and with the legal requirements of public, municipal and other authorities in any way affecting or applicable to any Work performed by each Party and its employees.

8.5 Either Party shall notify the other Party immediately if either Party becomes aware of any activity attributable to the other Party which is inconsistent with the permission to operate.

Article 9. Delay

9.1 Excusable Delay

9.1.1 Neither Party shall be responsible to the other Party for any delay in performing its obligations under this Contract due to any Events of Force Majeure.

9.1.2 The Party whose performance of obligations hereunder has been affected by any Events of Force Majeure shall notify the other Party within ten (10) days thereafter by sending a detailed statement and sufficient evidence with respect thereto, and promptly of any subsequent change in the circumstances, if any. The affected Party shall exercise its best efforts under the circumstances to remove or remedy the Events of Force Majeure and the effects thereof and resume full performance hereof as soon as possible.

9.1.3 Notwithstanding Article 9.1.1 hereof, any such delay that has not been notified to the other Party pursuant to Article 9.1.2 hereof shall not be excused for any reason whatsoever. Notwithstanding Article 9.1.1 hereof, any delay of performance of the affected Party falling due after delay, failure or incompleteness in exercising the pertinent best efforts to remove or remedy the pertinent Events of Force Majeure or the effects thereof pursuant to Article 9.1.2 hereof shall not be excused for any reason whatsoever.

9.1.4 The Party who has received or is entitled to duly receive the notice of Events of Force Majeure under Article 9.1.2 hereof may suspend performance of its obligations which shall be due subsequent to such Events of Force Majeure, until the other Party has effected such delayed performance to the full extent after and in view of such Events of Force Majeure.

9.2 Non-Excusable Delay

9.2.1 In the event that, unless otherwise excused by virtue of this Contract or the governing or applicable law, Contractor delays the provision of the Works as stipulated under this Contract, Contractor shall pay for damages as defined in the Article 9.2.2 to KARI as a result of such delay.

9.2.2 Contractor acknowledges and agrees that the timely provision of Preparation Work for TT&C Service and Ranging Service as stipulated under this Contract or its performance of other obligations under this Contract is essential to KARI, and that such delay as provided for in

Article 9.2.1 hereof may cause substantial financial loss or damage to KARI's rights, interests, privileges and benefits, which may not be assessable or recoverable. Both Parties therefore specifically agree that in the event of such loss or damage caused by delay attributable to Contractor, its Subcontractor or any of its agents, Contractor shall pay KARI as liquidated damages zero point two five percent (0.25%) per day of the sum of Preparation Unit Price. In no case, however, shall the aggregated liquidated damages for the Preparation Work for TT&C Service and Ranging Service exceed ten percent (10%) of the sum of Preparation Unit Price. It is also agreed by both Parties that KARI shall be entitled to exercise its right to terminate the Contract for Contractor's breach pursuant to Article 14.2, if the aggregated liquidated damages under this Article, excluding those days of delay excused by KARI in writing, exceeds ten percent (10%) of the sum of Preparation Unit Price.

9.2.3 It is hereby agreed between the Parties, that the payment of the liquidated damages under this Article 9.2.2 shall be in full and final settlement under applicable law or in equity or under the Contract for any loss or damages incurred by KARI for late provision of the Work.

9.2.4 For the purpose of this Article, any action or omission of Contractor's Subcontractor, agent, or servant, de facto or de jure, shall be deemed to be Contractor's own.

Article 10. Intellectual Property Rights

10.1 Any intellectual property rights and industrial property rights to any equipment or parts of equipment or software developed by each Party for the implementation of this Contract shall be retained by each Party. The property rights include methods, know-how, original software and techniques developed by each Party.

10.2 Any intellectual property rights and industrial rights to any equipment or parts of equipment or software developed by both Parties during implementation of this Contract shall be retained by both Parties. The property rights include methods, know-how, original software and techniques.

10.3 For the implementation of this Contract, any KARI Furnished Items provided by KARI to the Contractor shall remain KARI property.

10.4 In the event that any suit, claim, action or proceeding against KARI arises from allegations that any proprietary rights to be provided by Contractor hereunder constitute infringement of any patent, copyright, trade secret, know-how, or any other proprietary right of any Third Party, Contractor shall defend KARI's right, title and interest to the same against such suit, claim, action, or proceeding at Contractor's expense and shall hold KARI harmless from any damages or losses of any kind including without limitation legal fees. If as a result of such suit, claim, action or proceeding, the proprietary rights or any part thereof is held to constitute an infringement and the use of said proprietary rights, or any part thereof, is enjoined, Contractor shall promptly, at its option and expense, either procure for KARI the right to continue using said proprietary rights, or the part thereof, or replace the same with non-infringing proprietary rights acceptable to KARI.

Article 11. Confidentiality

11.1 Each Party agrees to keep secret and confidential all information obtained pursuant to this Contract from the other Party, which is designated as confidential by the other Party. The Parties agree to take all necessary precautions in a manner acceptable to the Party furnishing the confidential information in order to keep secret and confidential such information and to restrict its use outside and beyond the scope of this Contract; provided, however, that the above shall not apply to information that;

(a) is publicly known at the time of disclosure under this Contract, or becomes publicly known after disclosure without breach of this Contract by the receiving Party; or
(b) prior to disclosure under this Contract was already in the possession of the receiving Party as established by documentary evidence dated prior to the date of disclosure; or
(c) after disclosure under this Contract is obtained from any Third Party who is rightfully in possession of such informration and not subject to a confidentiality obligation with respect to said information; or
(d) is independently developed by or for the receiving Party without use of or recourse to theinformation of the disclosing Party; or
(e) is requested to disclose by receiving Party to competent government authorities as is required to bring about the purposes intended by this Contract.

11.2 Any information shall be protected and kept in confidence by the receiving Party, which shall use, at least, the same degree of care and safeguard as it uses to protect its own information of like importance. Said care shall be no less than reasonable care.

11.3 Contractor shall obtain the prior written approval of KARI concerning the content and timing of news releases, articles, brochures, advertisements, prepared speeches, and other information releases, proposed to be made by such party concerning this Contract or the Work performed or to be performed hereunder. KARI shall be given a reasonable time to review the proposed text prior to the date scheduled for its release.

Article 12. Indemnity

12.1 Each Party agrees to indemnify, defend and hold the other Party, and its officers, directors, employees, agents, shareholders and subcontractors, their officers, directors, employees, agents and shareholders, harmless against and in respect of any claim, liability, obligation, loss, damage, assessment, proceeding, judgment, cost and expense (including, without limitation, reasonable attorney's costs and expenses reasonably incurred in investigating, preparing, defending against or prosecuting any litigation or claim, action, suit, proceeding or demand) (collectively, the "Damages"), arising out of or in any manner incident, relating or attributable to any inaccuracy in any representation or breach of a warranty or covenant by each Party contained in this Contract except any gross negligent or willful misconduct by each Party.

Article 13. Warranty

13.1 Contractor represents and warrants to KARI that:

(a) Contractor shall perform the Work in a timely and efficient manner and in accordance with the-state-of-art engineering and design industry standards and practices;

(b) Each of its employees and other personnel who perform the Work shall be qualified and sufficiently experienced so as to provide the Works competently, professionally and efficiently with the standards and practices as set forth in Paragraph (a) above;

(c) All Deliverable Item that Contractor is providing as part of the Works shall be free from defects and errors that materially affect the value of such Deliverable Item to KARI;

(d) Contractor shall have good title or otherwise have all necessary rights to all engineering or technical data or documents, and all materials provided to KARI, free from any and all claims, demands, liens and encumbrances on title; and

(e) Neither part of the engineering or technical data or documents, and all materials provided to KARI, when given and in the future, shall infringe any Third Party intellectual property rights.

13.2 For KARI's remedy of the warranty as above, Contractor shall reperform the Work in question at Contractor's expense in order to cause such Deliverable Item to conform to such warranty. However, if Contracator fails to provide such a remedy for KARI, then KARI may terminate this Contract for Contractor's breach in accordance with Article 14.2.

Article 14. Termination

14.1 In the event that the excusable delay under Article 8 "Delay" exceeds six (6) months for any single Events of Force Majeure or nine (9) months in the aggregate for all Events of Force Majeure, KARI, at its sole discretion, may declare frustration of this Contract, and terminate the whole or any part of this Contract by sending a three (3) days prior notice to the Contractor. In case of such termination, Contractor shall be entitled to the payments received and payments due as of the date of termination, in which case Contractor shall return fifty percent (50%) of the amount paid by KARI under this Contract. KARI shall return the Deliverable Item to Contractor, if any.

14.2 KARI may, by written notice to the Contractor, terminate the whole or any part of this Contract, if any of the following circumstances occurs;

(a) The Contractor commits a material breach of any of its obligations under this Contract; or
(b) The Contractor fails to obtain any necessary government approval for this Contract; or
(c) The Contractor delays the Preparation Work in accordance with Article 9.2.2.

In case of the circumstances in this Article, KARI may notify the Contractor and may suspend any further performance of its obligation under this Contract. If the Contractor fails, within five (5) days from the dispatch of the notice, to produce and notify KARI of reasonable evidence of its intent and ability to effect due performance of the obligation in breach within ten (10) days from due dispatch of written notice, then KARI may terminate this Contract with three (3) days' prior notice of termination. In case of such termination for Contractor's breach, the Contractor shall return all the amounts paid by KARI under the Contract and also pay the termination charge of ten percent (10%) of the Contract Price. KARI shall return the Deliverable Item to Contractor, if any.

14.3 KARI may terminate this Contract, in whole or in part, at any time for its convenience, upon thirty (30) days prior written notice to Contractor. In case of such termination, Contractor shall be entitled to the payments received and payments due as of the date of such termination based on the Price as defined in Article 4.1, and KARI shall be entitled to the Deliverable Items as of the date of such termination.

14.4 In case of total loss or constructive total loss of GEO-KOMPSAT-2A and/or GEO-KOMPSAT-2B after each launch, KARI may terminate this Contract, in whole or in part, upon prompt prior written notice to Contractor. In case of such termination, Contractor shall be entitled to the payments received and payments due as of the date of such termination based on the Price as defined in Article 4.1, and KARI shall be entitled to the Deliverable Items as of the date of such termination.

Article 15. Notice

15.1 Any and all notice, requests, demands, approvals, reports, and other correspondence to be provided pursuant to this Contract shall be in writing and shall be deemed to have been duly given to the Party to be notified: (i) on the date of delivery if delivered in person, (ii) on the date of dispatch if by facsimile, telex or e-mail, or (iii) on the date of receipt if by registered airmail or overnight courier. All notices shall be addressed to the appropriate Party at its address as follows:

For KARI : Korea Aerospace Research Institute
169-84 Gwahak-ro, Yuseong-gu, Daejeon, 34133 Korea

Commercial Issue	Technical Issue
Name : Mr. Won-Suk LEE	Name : Mr. Durk Jong Park
Title : Senior Administrator	Title : Senior Researcher
Dept. : Procurement Team	Dept. : Ground System Development Team
Tel. : +82-42-860-2406	Tel. : +82-42-860-2727
Fax : +82-42-860-2666	Fax : +82-42-870-3919
e-mail : wsl@kari.re.kr	e-mail : parkdj@kari.re.kr

For Contractor : TBD
TBD

Commercial Issue	Technical Issue
Name : TBD	Name : TBD
Title : TBD	Title : TBD
Dept. : TBD	Dept. : TBD
Tel. : TBD	Tel. : TBD
Fax : TBD	Fax : TBD
e-mail : TBD	e-mail : TBD

15.2 Each Party may change its address for notice by notice given to the other Party in the manner set forth above. And any notices given as provided herein shall be considered effective seven (7) days after the registered postage pre-paid airmailing thereof or the day of actual receipt thereof, whichever occurs first, or on the day of personal delivery, or the day of sending if by facsimile, telex or e-mail.

Article 16. Effective Date of Contract

16.1 The effective date of this Contract ("EDC") is the date on which the duly authorized representatives of both Parties have signed this Contract, as designated in the “Preamble” of the Contract.

16.2 Any amendment to this Contract shall be effective upon signature by the authorized representatives of both Parties and the approval of such amendment by the government of both Parties, if required.

Article 17. Governing Law and Arbitration

17.1 In cases any controversy or claim arises out of or in relation to this Contract or with respect to a breach hereof, the Parties shall seek to resolve the matter amicably through discussions between themselves. In the event of any disagreement between KARI and the Contractor about the interpretation of the provisions or definitions used in this Contract, the interpretation of KARI shall govern until and unless otherwise decided by arbitration conducted pursuant to the following provisions.

17.2 If the Parties cannot resolve such controversy or claim in accordance with Article 15.1 above, it shall be finally settled by arbitration of the International Chamber of Commerce (ICC) and the place of arbitration shall be Seoul in Korea. The proceedings shall be conducted in English. The award rendered by the board shall be final and binding on the Parties and may be entered in any court of competent jurisdiction for execution.

17.3 The validity, performance, construction, and effect of this Contract shall be governed by the laws of Korea.

Article 18. Miscellaneous

18.1 Assignability

This Contract and each and every covenant, term and condition hereof shall be binding upon and inure to the benefit of the Parties and their respective successors, and neither this Contract nor any rights and obligations hereunder shall be assignable or delegable directly or indirectly by any Party without the prior written consent of the other Party.

18.2 Entire Agreement

This Contract embodies the entire agreement of the Parties with respect to the subject matter hereof and supersedes and cancels any and all prior understandings or agreements, oral or written, in relation hereto, which may exist between the Parties. No oral explanation or oral information by any of the Parties shall alter the meaning or interpretation of this Contract.

18.3 Amendment

No amendment or change hereof or addition hereto shall be effective or binding on any of the Parties unless reduced to writing and executed by the respective duly authorized representatives of each of the Parties.

18.4 Unenforceable Terms

If any term or provision of this Contract shall for any reason be invalid, illegal or unenforceable in any respect, this Contract shall be interpreted and construed as if such term or provision had never been included herein.

18.5 Non-Waiver

The failure or delay of any Party to require performance by the other Party of any provision of, or of any right or obligation under, this Contract, shall not constitute a waiver thereof, nor shall such affect that Party's right to thereafter require performance of such or any other provision, right or obligation.

18.6 Disclaimer of Agency

This Contract shall not be deemed to constitute any Party the agent of the other Party.

18.7 Headings

The headings in this Contract have been inserted for convenience of reference only and are not to be used in construing or interpreting this Contract.

18.8 Language and Units

This Contract is executed in English. All documents, drawings, plans and any other writings as well as communication between the Parties shall be in English. Weight and measurement for deliverable documents shall be recorded in units of metric system.

18.9 Time Limits

Unless otherwise indicated, any time limits to which this Contract binds Contractor or KARI shall be counted in calendar days from the day following that of the event marking the start of the time limit, and shall end on the last day of the period specified. When the last day of a time limit is a Saturday or Sunday, or a legal holiday in the country in which the particular contractual performance is required, such time limit shall be extended to the first working day following.

18.10 Expenses

Each Party shall bear its own attorney fees and other expenses incurred to negotiate and execute this Contract.

18.11 Subcontractors

Each Party shall be fully responsible for the work of its Subcontractors under this Contract, and such subcontracting shall not relieve that Party of its obligation under this Contract.

IN WITNESS WHEREOF, the Parties hereto have executed this Contract in duplicate in English by causing these presents to be signed by their duly authorized representatives as of the day and year first above written.

Korea Aerospace Research Institute	**Contractor**
By :_____	By:_____
Name : Dr. Gwang-Rae CHO	Name :
Title : President	Title :

APPENDIX A. General GEOS-C File Format for LEOP TT&C Service

* Common Data Area

Seq No	Position	Description	Size	Data Type	Contents
1	1-7	Satellite ID	7	Integer	9933322:default
2	8-9	Measurements type	2	Integer	73:ANG, 33:DOP 23:RNG
3	10-11	Time System indicator	2	Integer	03:default
4	12-16	Reception code number	5	Integer	B4441, B is Blank
5	17-18	GMT, Year	2	Integer	YY, 01 for 2001
6	19-21	GMT, DOY(Day Of Year)	3	Integer	DDD
7	22-26	GMT, SEC of Day	5	Integer	SSSSS
8	27-32	GMT, msec	6	Integer	Fraction of SEC

* Range Measurement Data Area

Seq No	Position	Description	Size	Data Type	Contents
9	33	Ionospheric refraction correction flag	1	Integer	0 or 1 1: default
10	34	Trospheric refraction correction flag	1	Integer	0,2,4, for corrected 1,3,5 not corrected 1: default
11	35	Transponder delay correction flag	1	Integer	0 or 1 1: default
12	36-45	Range value, km	10	Double	F10.0, example, if range value is 1895.43425km: BBBBBB1895
13	46-54	Range value, m	9	Double	xxx.xxxxxx, example, if range value is 1895.43425km: 434250000
14	55	Speed of light	1	Integer	3 default
15	56	Transponder channel	1	Integer	1 for coherent 2 for non-coherent B: default
16	57-60	Surface pressure, millibars	4	Integer	BBBB: default
17	61-63	Surface Temperature, degrees K	3	Integer	BBB: default
18	64-66	Relative humidity at surface, percent	3	Integer	BBB: default
19	69-73	Measurement standard deviation	5	Integer	10000 default
20	74	Range ambiguity indicator	1	Integer	B: default
21	76-80	Trospheric refraction correction	5	Integer	BBBBB: default
22	81	New line character	1	Character	

* Range Rate (Doppler) Measurement Data Area

Seq No	Position	Description	Size	Data Type	Contents
9	33	Ionospheric refraction correction flag	1	Integer	0 or 1 1: default
10	34	Trospheric refraction correction flag	1	Integer	0,2,4, for corrected 1,3,5 not corrected 1:default
11	35	Receiver Mount Type	1	Integer	3: default, AZ/EL

12	36-42	Counting Interval for avg data	7	Double	xxxxx.xx BBBBBB1: default
13	43-49	Range rate, km/s	7	Double	xxxx.xxx example, if value is –2137.111328km/s, BB-2137
14	50-55	Range rate, mm/sec	6	Double	xxx.xxx
15	56	Speed of light	1	Integer	3 is default
16	57	Transponder Channel	1	Integer	1 for coherent 2 for non-coherent B: default
17	58-66	Reference Station ID	9	Integer	4441BBBBB:defailt
18	69-73	Measurement standard deviation	5	Integer	10000 default
19	74	Reference station mount type	1	Integer	B: deafult
20	75-77	Receiver antenna axis displacement	3	Double	xx.x BBB: default
21	78-80	Ref station antenna displacement	3	Double	xx.x BBB: default
22	81	New line character	1	Character	

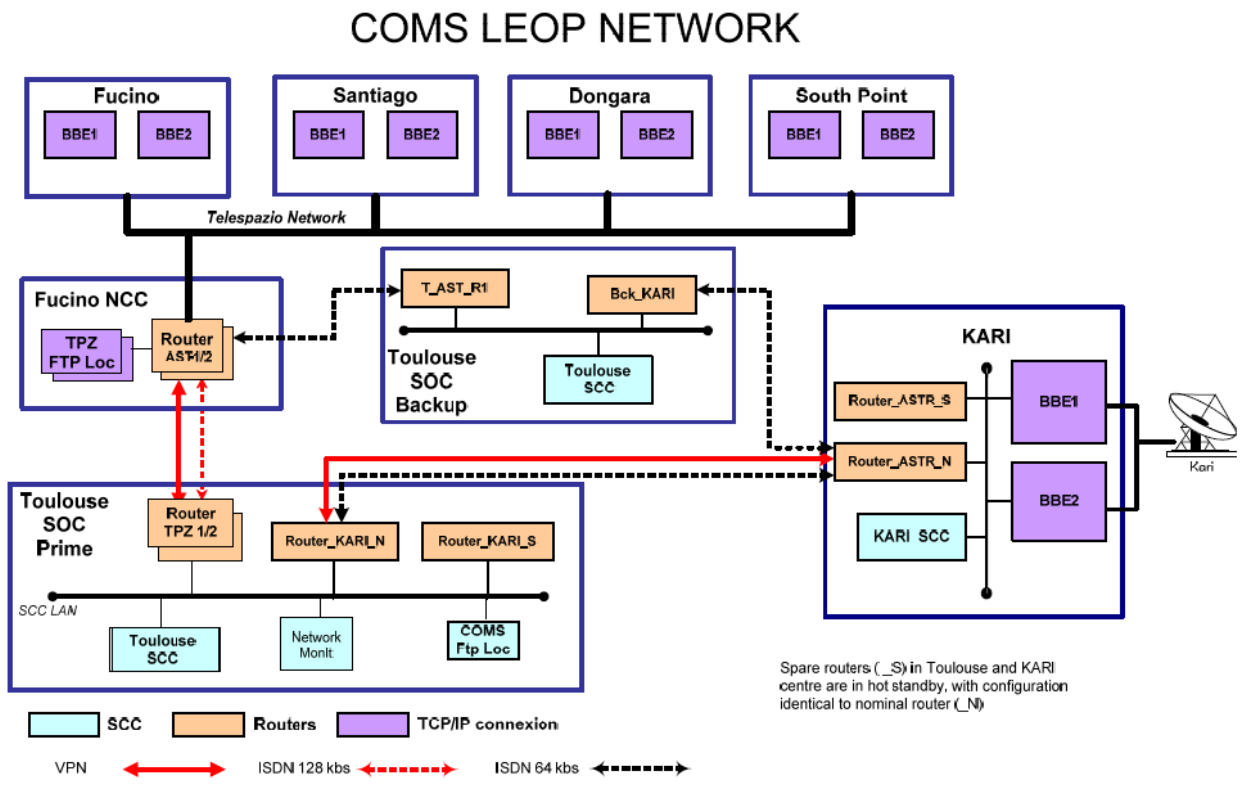
Position 67,68 is blank

* Angle (AZ, EL) Measurement Data Area

Seq No	Position	Description	Size	Data Type	Contents
9	33	Ionospheric refraction correction flag	1	Integer	0 for corrected 1 for not corrected 0: default
10	34	Trospheric refraction correction flag	1	Integer	0,2,4, for corrected 1,3,5 not corrected 0: default
11	36-38	AZ angle, degree	3	Integer	
12	39-40	AZ angle, arc minute	2	Integer	
13	41-45	AZ angle, arc second	5	DP	xx.xxx
14	47-48	EL angle, degree	2	Integer	
15	49-50	EL angle, arc minute	2	Integer	
16	51-54	EL angle, arc second	4	Double	xx.xx
17	58-61	Standard deviation in azimuth	4	Double	xx.xx 0300: default
18	62-65	Standard deviation in elevation	4	Double	xx.xx 0300: default
19	67-71	Tropospheric refraction correction to azimuth	5	Double	xxx.xx BBBBB: default
20	72-76	Tropospheric refraction correction to elevation	5	Double	xxx.xx BBBBB: default
21	77	New line character	1	Character	

Position 35, 46, 55-57 66-76 is blank.

APPENDIX B. COMS Ground Network (Information Only)



APPENDIX C. GEOS-C File Format for Overseas Ranging Service

* Common Data Area

Seq No	Position	Description	Size	Data Type	Contents
1	1-7	Satellite ID	7	Integer	9933322:default
2	8-9	Measurements type	2	Integer	23:RNG
3	10-11	Time System indicator	2	Integer	03:default
4	12-16	Reception code number	5	Integer	Bxxxx, B is Blank, xxxx is provided by GK2 FDS
5	17-18	GMT, Year	2	Integer	YY, 01 for 2001
6	19-21	GMT, DOY(Day Of Year)	3	Integer	DDD
7	22-26	GMT, SEC of Day	5	Integer	SSSSS
8	27-32	GMT, msec	6	Integer	Fraction of SEC

* Range Measurement Data Area

Seq No	Position	Description	Size	Data Type	Contents
9	33	Ionospheric refraction correction flag	1	Integer	0 or 1 1: default
10	34	Trospheric refraction correction flag	1	Integer	0,2,4, for corrected 1,3,5 not corrected 1: default
11	35	Transponder delay correction flag	1	Integer	0 or 1 1: default
12	36-45	Range value, km	10	Double	F10.0, example, if range value is 1895.43425km: BBBBBB1895
13	46-54	Range value, m	9	Double	xxx.xxxxxx, example, if range value is 1895.43425km: 434250000
14	55	Speed of light	1	Integer	3 default
15	56	Transponder channel	1	Integer	1 for coherent 2 for non-coherent B: default
16	57-60	Surface pressure, millibars	4	Integer	BBBB: default
17	61-63	Surface Temperature, degrees K	3	Integer	BBB: default
18	64-66	Relative humidity at surface, percent	3	Integer	BBB: default
19	69-73	Measurement standard deviation	5	Integer	10000 default
20	74	Range ambiguity indicator	1	Integer	B: default
21	76-80	Trospheric refraction correction	5	Integer	BBBBB: default
22	81	New line character	1	Character	

APPENDIX D. Compliance Matrix

Bidder shall submit the following Non-Conpliance Table with respect to the any non-compliance or deviations from the requirements of this RFP and the Non-Compliance Table shall list in numerical order, every Section and subsection of the RFP. The statement of Non-Compliance Table shall be included in Technical Proposal and General Terms and Conditions of Proposal.

Non-Compliance Table

RFP Section (Section #)	REQ # for Technical Requiremnt (Article # for General Terms and Conditions)	Description	Proposal Section	Compliance (C/PC/NC)	Remarks

[Note]

- C : Compliance
- PC : Partial Compliance
- NC : Non Compliance

APPENDIX E. Price Proposal Form

The Bidder shall provide the Price Proposal using the following form and the Price Proposal shall include any specific statement to describe how the price has been calculated.

Price for GK2A and GK2B Overseas Ranging Service in nominal operation (This price is optional item.)

[Preparation Cost]

Category	Satellite	Direct Labor	Overhead	Subcon./Mate./Purch.	Others	Profit	Sub-Total (Currency)
LEOP TT&C Service	GK2A						
	GK2B						
Sub-Total							
Overseas Ranging Service	GK2A						
	GK2B						
Sub-Total							
Total							

[Service Cost]

Category	Satellite	Direct Labor	Overhead	Subcontracts	Others	Profit	Sub-Total (Currency)
LEOP TT&C Service	GK2A						
	GK2B						
Sub-Total[1)]							
Overseas Ranging Service	GK2A						
	GK2B						
Sub-Total[2)]							
Total							

1) Sub-Total Cost /57,600minutes = unit price per minute
2) Sub-Total Cost /8,640times = unit price per pass

- For the Cost of LEOP TT&C Service, the service duration for GK2A and GK2B is 480 hours for each satellite.(24 hours per day, 20 days)
- For the Cost of Overseas Ranging Service, the number of ranging measurement for both GK2A and GK2B is 8,640times (24times per day, 30days per 1month, 6 months, 2 satellites)

[Service Cost for Optional Item]

Regarding the Optional Item, please propose the unit price per pass.