KOREASAT Technology Development and Services Plan

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INTRODUCTION

Mugunghwa is the first commercial satellite for the Republic of Korea. It uses the advanced digital technology for direct broadcasting and fixed satellite services in Korea. It will provide basic satellite communications facilities with small low-cost remote stations for rural and remote areas presently having inadequate or no telecommunication facilities. It will also provide high speed data and video distributions for business television and other professional program services such as tele-educational video

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networks. High quality color television and high definition TV services will also be available anywhere in Korea.

1. Implementing the KOREASAT System

(1) Manufacturing of KOREASAT

KOREASAT System is designed to provide Ku-Band satelliute communications services for the Republic of Korea. KOREASAT Contract, concluded between the Korea Telecom and Martin Marietta Overseas Corporation, defines the terms and conditions for the procuring of primary and secondary spacecraft, ground control system and technology transfer plans including On-the-Job-Training ("OJT") for the korean engineers. As well, it includes detailed technical specifications regarding the performace specification, test plans, product assurance plan, technology transfer items and other related issues.

KOREASAT system is currently designed and developed by the Martin Marietta Astro Space ("MMAS") team and Korean partners in accordance with the KOREASAT Contract. The MMAS team consists of Martin Marietta Astro Space in U.S. as the prime contractor and Matra Marconi Space ("MMS") in England as the subcontractor. Korean partners comprise of Glodstar Information & Communications and Korean Air Aerospace in Korea.

With experience in all aspects of commercial communications satellites for more than 20 years, MMAS is responsible for the spacecraft antennas, spacecraft bus and ground segment software. MMS is responsible for the spacecraft payload and the ground control facilities. Goldstar and Korean Air are responsible for the backup ground control facilities , spacecraft bus structure for the solar panels.

(2) Launching of KOREASAT

McDonnell Douglas in U.S. will provide the DELTA II launch vehicle for launch services to deliver two KOREASAT spacecraft to the geosynch-

roonous orbit in accordance with the KOREASAT Launch Services Contract signed between Korea Telecom and McDonnell Douglas. This contract also contains various technology transfer plan. Halla Engineering & Heavy Industries, Korean partner, will participate in the design of the launch vehicle hardware.

Table 1. KOREASAT SYSTEM CHARACTERISTICS

Items	Specification	
Orbital Location	116 ◦ East at Geostationary	
Launch Mass (Dry Mass) (kg)	1459 (614.8)	
Life of Design	12 Years	
In-Orbit Reliability	0.744668	
Total Payload DC Power (W)	1213.4	
Antenna Size & Type	Type: Offset Gregorian Reflector Size: Main Reflector 1.524 * 1.828 (m) Sub Reflector 67.64 * 62.18 (cm)	
	FSS	DBS
Frequency Band (GHz)	Up:14.0-14.5 Down:12.25-12.75	Up: 14.5-14. 75 Down: 11.7-12.0
Polarization	F1: Tx. Ver Rx. Hor F2: Tx. Hor Rx. Ver	LHCP
Transponder Bandwidth (MHz) # of Channels	36 12	27 3
Transponder Power (W)	14.6 (BOL)	120 (BOL)
EIRP (dBW, EOC)	50.2	59.4
G/T (dB/K)	13.5	13.0
Minimum Gain (dBi, EOC)	Tx. 41.4 Rx. 42.0	Tx. 40.4 Rx. 41.0
Beam Coverage (Including Beam Pointing Error)	Tx. 0.86 ◦ *0.86 ◦ Cir Rx. 0.74 ◦ *0.74 ◦ Cir	Tx. 1.06 ◦ *0.86 ◦ Elp Rx. 0.82 ◦ *0.67 ◦ Elp

(3) Jurisdiction and Control by Korean Government

Korean government shall bear the international responsibility, in accordance with the Article 6 of the Treaty on principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies in 1967,[1] especially regarding the conducting of space activities to be done in the context of the KOREASAT peoject, and the launching of the KOREASAT. With respect to the obligations based on these, Korean government has assured in a proper way its jurisdiction and control. Both contract for KOREASAT manufacturing and launching service has been approved after thorough review on the content by the Ministry of Communication and other competent authorities in Korea. Furthermore, or to registration of the frequency and orbital location to be used by the KOREASAT, Korean government will ensure that the process will be made in accordance with the ITU Radio Regulations.

2. KOREASAT Services Plan

KOREASAT is intended to provide a variety of satellite business services over The territory of the Republic of Korea by utilizing advanced digital technologies.

The DBS transponder provides three active plus three spare 27 MHz channels, each of which consists of high power, high efficiency TWTA, a channel amplifier, and input and output channel multiplexer filters. This transponder employs two 14/11 GHz wideband receivers (one active and one spare) with low noise high linearity to perform the frequency translation between the receive and transmit bands.

The range of FSS services covers low/medium speed data transfer by the very small aperture terminal (VSAT), low speed voice and data circuits by the demand-assigned multiple access/single channel per carrier

1) 610 U.N.T.S. 205 (entered into force, Oct. 10, 1967)

(DAMA/SCPC) method, and high speed integrated services by the TDMA technique. The primary Telemetry, Tracking and Command station collocated with a Satellite Control Center and Network Control Center supports the KOREASAT Services. The Communications System Monitor at the primary TTC monitors all transponder activities of two KOREASAT spacecrafts and optimizes the use of communications network for all service links.

(1) VSAT Services

The VSAT networks are arranged in star configurations, usually having a corporate headquarters or other centralized data center at the host site, with the branch offices or other remote sites connected to the host by the satellite links. The VSAT system uses four FSS channels to provide a low/medium spped data communications system between a host computer and a large number of dispersed remote computer terminals or between two remotes via the VSAT central station for a cost effective bypass of terrestrial facilities. This system is especially suitable when the data flow is generally large from the host to the remote systems for low speed data transfer, facsimile and digital voice.

The satellite station associated with the host computer uses a reasonably large antenna up to 8 meters in diameter, while the VSAT remote station uses a very small antenna down to 1.2 meters in diameter. The VSAT system supports inbound and outbound data rates up to 64 Kbps and a transmission bit error ratio of better than 10-E8. The VSAT central station hardware is capable of supporting up to 40 outbound and 120 inbound carriers depending upon the sizing, types of carriers, antenna sizes, satellite performace, etc. One VCS system is able to terminate the traffic from 20 to 500 VRS systems and designed to allow modular growth up to 4,096 VRSs.

(2) DAMA/SCPC Services

The DAMA/SCPC system is planned to use two (2) FSS channels to support fully meshed communications among the remote stations with a

single satellite hop. This system is a satellite based digital voice and data communications network suitable for thin-route connections among a large number of earth stations. These telecommunication services include digital telephony managed on a dynamic call-by-call basis and data circuits via SCPC communication paths between earth stations anywhere in the system.

(3) High-Speed Data Services

The high speed integrated services use the three (3) FSS channels for video relay and three (3) FSS channels for high speed transfer of voice, data and video. The video relay includes CATV, TV receive only (TVRO), TV relay, and satellite news gathering (SNG). CATV provides one-way video transmission from the central programming station to the local stations which then distribute the received video programs to the local users through the coaxial cable. TVRO also provides cost-effective one-way video transmission to business owners, religious organizations and educational systems. TV relay is two-way video transmission between the central station and the local stations to provide large distributed video services.

The high speed data transfer services between stations are an integrated services for transmission of voice, data and video, and include high speed computer file transfer, high speed facsimile, telegraph/telex, digital voice, and video conferencing. These services also provide vital communication links for rural and remote areas, temporary backup transmission of data due to outage of terrestrial lines or traffic overflow, and temporary com-munication links for sports or special events. These equipment for the high speed integrated services will be developed by Korean industries.

3. On-the-Job-Training Plan

MMAS and MMS perform the OJT to provide Korean engineers from the beginning of the design phase to the post-launch phase with indepth, hand-on learning experiences in all activities of the KOREASAT spacecrafts, payloads, and ground equipment. 30 engineers form various Korean indus-

tries and korean research institutes are assigned for OJT during design, construction, and test phases, three engineers during launch phase, and three engineers during operation and maintenance.

The communication antenna, the bus subsystems, and the mission analysis and operations OJT is performed at the MMAS facilities in East Windsor, Ner Jersey, U.S.A. The payload and ground equipment OJT is performed at the MMS facilities in Portsmouth, Bohramwood and Watford, England. OJT for final spacecraft integration, assembly and tests will also be completed at the MMAS facilities.

Korean engineers team with MMAS and MMS engineers and contribute to the system and subsystem design, analyses, manufacturing, integration, testing, launch, and mission operation activities. They will participate in (i) preparation of system and subsystem performance specification documentation, (ii) design review documents for systems, subsystems, and components, and (iii) performance analyses. After completion of the spacecraft and ground station integration and test, a small group of OJT engineers will contribute to the prelaunch and launch activities.

MD also performs the OJT program to provide 24 korean engineers with the technology of launch services and hand-on experiences at the MD premises in order for them to gain sufficient and comprehensive knowledge and technical know-how in the field of launch vehicle design and assembly, launch and mission integration, and launch operations.

At the Huntington Beach facility in California, Korean engineers assists in the overall tasks including (i) development of the mission peculiar support drawings and documentation for two spacecrafts, (ii) development of mission specification, (iii) compatibility analyses. At the Pueblo facility, Colorado, they will participate in the launch vehicle assembly, production, check-out, and quality control activities. At the Cape Canaveral launch site facility in Florida, they will be involved in launch vehicle processing, spacecraft integration, and launch operations.

It is recognized that through the OJT program Korean engineers will be able to acquire commercially available technology and experience in

design, manufacturing, and integration of the communication satellites and launch vehicles as well as satellite operations and launch operations to pave the way for the next generation of KOREASAT.

4. Plans for Assuring the Success of Program

Like any other space ventures, the KOREASAT project would not be exempted from some risk, especially in a technical sense. For the purpose of encountering this kind of problem, Korea Telecom has undertaken various preventive measures.

Firstly, as to potential malfunction of the spacecraft, various provisions are included in the contract so as to specify in a clear manner the contractual obligations assumed by the manufacturer regarding the warranty of the performance specification, delivery schedule, and other relevant technical issues.

Secondly, Korea Telecom implements very extensive program monitoring on the KOREASAT manufacturing process which consists, more actively than any other program, in "a real time verification on the conducting of manufacturing activities to ensure that the conducting of the manufacturing activities is done in a perfect manner and that any potential problem is detected earlier and get resolved."[2)]

CONCLUSION

Since the launching of the Early Bird in 1964, based on Arthruru C. Clarke's concept of global communication, space technology and its applications have demonstrated the potential for using satellite systems as a powerful tool in socio-economic development.

In this sense, the success of the KOREASAT program will be the key to the socio-economic development in Korea.

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2) Francois Truck, "l'Evolution des obligations contractuelles du constructeur vis-a-vis de son client," in "L'Exploitation Commerciale de l'Espace," Ed. LITEC, Paris, 1992, p. 207