

THE INTERFACE CONFIGURATION OF OVERSEA STATIONS AND OPERATION PLAN FOR KOMPSAT-2 LEOP

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ABSTRACT:

The Korea Multi-Purpose SATellite-2 (KOMPSAT-2) will be launched into a circular sun synchronous orbit in Dec. 2005. For the mission operation of the KOMPSAT-2 satellite, KARI Ground Station (KGS) consists of the Mission Control Elements (MCE), Image Reception & Processing Elements (IRPE) and the overseas stations. For the overseas stations, the Kongsberg Satellite Services (KSAT) is the prime supplier of support service. KSAT has the capability to provide Tracking Telemetry and Commanding (TT&C) nominal, contingency and anomaly support for every single orbit for most polar orbiting satellites. Also KSAT provides nodal service through the network management functionality for all overseas ground stations. This paper describes the overseas stations and the support for Launch and nominal TT&C services for KOMPSAT-2 and the operation plan for KOMPSAT-2.

KEY WORDS: KSAT, KGS, Interface, KOMPSAT-2

1.0 Introduction

The Korea Multi-Purpose SATellite-2 (KOMPSAT-2) will be launched into a circular sun synchronous orbit in Dec. 2005. The purposes of the mission are to collect earth panchromatic images (1m) and multi-spectral images (4m). For the mission operation of KOMPSAT-2 satellite, KARI Ground Station (KGS) consists of the Mission Control Elements (MCE), the Image Reception & Processing Elements (IRPE) and the overseas stations.

Major roles of overseas ground stations are to receive/transfer the telemetry data in real time and to send bent-piped commands from KGS to KOMPSAT-2. KARI selected KSAT as a primary overseas ground station during KOMPSAT-2 LEOP considering benefits of station location and its successful service records. KSAT has the capability to provide Tracking Telemetry and Commanding (TT&C) nominal, contingency and anomaly support for every single orbit for most polar orbiting satellites. Also KSAT provides the network management center functionality for all overseas ground stations.

This paper describes the overseas stations and the support for launch and nominal TT&C services for KOMPSAT-2 and the operation plan for KOMPSAT-2.

2.0 The configuration for KOMPSAT-2 LEOP

The purposes of overseas ground station are summarized as followings

1. During LEOP, external overseas ground stations will be used in order to increase contact time between

KOMPSAT-2 and the ground.

2. Major roles of overseas ground station are to receive/transfer the telemetry data in real time and to send bent-piped commands from KGS central center to KOMPSAT-2.
3. KARI will probably use overseas ground stations connected to KGS in case of the satellite contingency during normal operations.

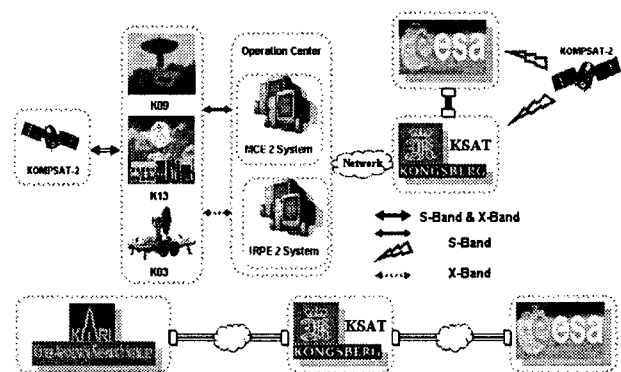


Figure 1. The operation plan for KOMPSAT-2

The KSAT Svalsat will provide access to two fully operational Datron 13 (SG3) and 11 (SG2) meter antenna systems with a generic back-end. These antenna systems serve as multi-mission antennas, and both systems have capability of S-Band TT&C. The Svalsat SG3 will after the three first orbits continue as the single and prime overseas ground station. KSAT will also provide tracking support from the Svalsat SG2 antenna in order to provide additional confidence in the ability to track and locate KOMPSAT-2 in case the satellite is not injected

correctly in orbit. The Svalsat SG2 is also a hot backup antenna for SG3 (the antenna can be switched into the SG3 backend).

KSAT TNOC offers network management for overseas ground stations that will support KOMPSAT-2 launch. The ESA Malindi station will be used for KOMPSAT-2 orbit #1. TM/TC data will be routed through the Tromso Network Operation Center (TNOC) communication node to KGS. The Malindi station will provide ranging data after pass. The ESA Maspalomas station will be used for KOMPSAT-2 orbit #2, #3. TM/TC data will be routed through the TNOC communication node to KGS. The Maspalomas station will provide tracking data like the Malindi station.

After three orbits the support will be limited to only one polar ground station. The two southern hemisphere station configurations will however be kept for one month after launch so that emergency support can be given to KOMPSAT-2 in this period.

3.0 The network configuration of overseas stations

KSAT will provide the network management center functionality for all overseas ground stations. The network management center will be coordinating all operational and management aspects of KOMPSAT-2 LEOP during the three first orbits. KSAT will participate and conduct rehearsals and simulations in order to prepare for KOMPSAT-2 launch. We have envisaged the following number of tests.

1. Connectivity test
2. Simulation test of KSAT Svalsat
3. Simulation test of ESOC
4. Network rehearsal
5. Launch rehearsal

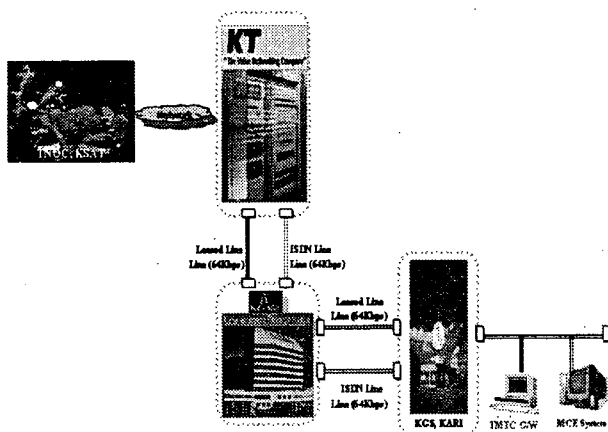


Figure 2. The Network configuration for KOMPSAT-2

Voice communication between KGS and the overseas stations is expected to be based on the use of ISDN phone lines. TNOC will arrange a conference voice network for all overseas ground stations including KGS.

4.0 The Test of network configuration on overseas stations

The test of overseas ground station is summarized as follows.

1. Interface requirements between KOMPSAT-2 and overseas ground stations
2. Interface requirements between KGS and overseas ground stations
3. Physical Interface
4. Telemetry message format
5. Telemetry request and symbol
6. Tele-command message format
7. Tele-command request and symbol
8. KARI-KSAT Kick-Off Meeting : 10/11, May 2004
 - ✓ KOMPSAT-2 characteristics
 - Uplink/Downlink Frequency
 - Ranging & 2-Way Doppler
 - ✓ KARI Cortex-NT Configuration
 - Video/Direct-PCM Demodulation Channel
 - Uplink Path (IFM & TCU)
 - Ranging Unit Parameters (RAU)
 - Telemetry Request Message (CH-0 & CH-1)
 - ✓ Voice Procedure
 - ✓ Pass Activation Procedure

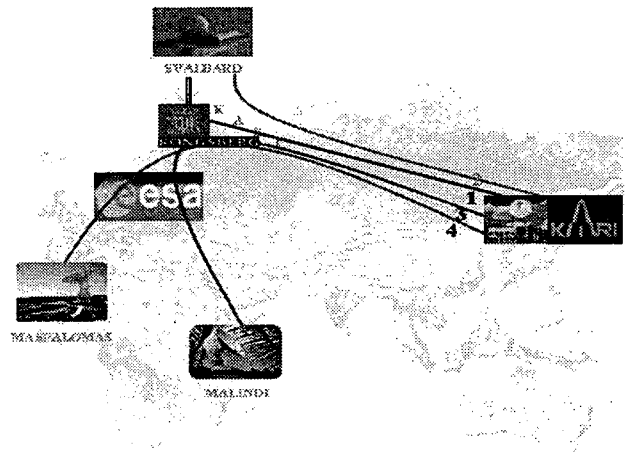


Figure 3. The Network configuration Test for KOMPSAT-2

KSAT is responsible for the intra-communication within the overseas LEOP network.

1. TNOC & KGS Router & ISDN setup
 - ✓ ISDN configuration setup : 22, Oct 2004
 - Host name/User name
 - ISDN number
 - ISDN IP Address
 - Ethernet IP address in router
 - Port number
 - ✓ KSAT TM/TC G/W IP address changed
 - 5, Nov 2004
 - ✓ FTP account setup & access : 16, Nov 2004
 - Server address

- User name
 - Login Password
2. TNOG & KGS Interface Test
 - ✓ ISDN connection test : 11, Nov 2004
 - Confirmed ISDN configuration setup
 - Ping test was successfully
 - ✓ Cortex TM/TC Port connection test
 - 11, Nov 2004
 - Connection SG3 Ch-0 & SG3 Ch-1
 - Confirmed TM/TC Port Connection
 - Confirmed Ground ACK form TNOG
 3. KOMPSAT-1 Support & Ranging Test through KSAT
 - ✓ KOMPSAT-1 support test : 17, Nov 2004
 - Turned on the S-Band Carrier
 - Confirmed SG3 ANT Tracking
 - Received ANT Tracking file through FTP
 - ✓ KOMPSAT-1 Ranging & 2-Way Doppler test
 - 18/19, Nov 2004
 - Changed Coherent Mode
 - Received Ranging & 2-Way Doppler data through FTP
 4. TNOG & ESOC Interface Test
 - ✓ ISDN configuration setup : 16, Jan 2005
 - ✓ TM/TC Port connection test
 - 17/18/19, Jan 2005
 5. KOMPSAT-1 Support & Ranging Test through ESOC
 - ✓ KOMPSAT-1 support test : 9/10, Mar 2005
 - ✓ KOMPSAT-1 Ranging & 2-Way Doppler test
 - 22/23/24, Mar 2005
 - 29/30, Aug 2005
 6. TNOG & KGS Leased Line Test
 - ✓ Lease Line Test Schedule
 - 10/11/12, Oct 2005

5.0 The operation plan for KOMPSAT-2

5.1 The Stations of KOMPSAT-2 LEOP

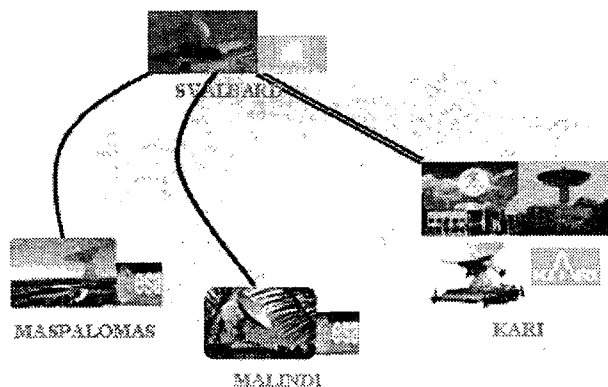


Figure 4. The KOMPSAT-2 LEOP stations

Formal KOMPSAT-2 LEOP stations are summarized as following

1. The ESA Malindi ground station

2. The ESA Maspalomas ground station
3. The Svalsat SG3 and SG2 systems
4. The KGS 9M and 13M systems

5.2 The Events of LEOP

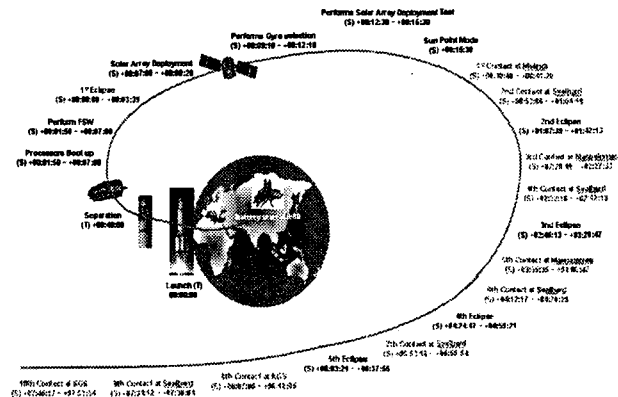


Figure 5. The KOMPSAT-2 Initialization

The events of KOMPSAT-2 LEOP are summarized as following.

1. Battery boot up
2. Launch
3. Separation
4. Processors boot up
5. Perform FSU
6. 1st Eclipse
7. Solar Array Deployment
8. Performs Gyro selection
9. Performs Solar Array deployment test
10. Sun Point Mode
11. 1st Contact at Malindi of ESA
12. 2nd Contact at Svalbard of KSAT
13. 2nd Eclipse
14. 3rd Contact at Maspalomas of ESA
15. 4th Contact at Svalbard of KSAT
16. 3rd Eclipse
17. 5th Contact at Maspalomas of ESA
18. 6th Contact at Svalbard of KSAT
19. 4th Eclipse
20. 7th Contact at Svalbard of KSAT
21. 5th Eclipse
22. 8th Contact at KGS
23. 9th Contact at Svalbard of KSAT
24. 10th Contact at KGS

5.3 The orbits of LEOP

The mission orbit of KOMPSAT-2 is a sun-synchronous circular orbit with altitude 685.13 km \pm 1 km. Orbit inclination is 98.13° \pm 0.05° and eccentricity is 0 to 0.001. Also, the satellite operates in a nominal 10:50 AM \pm 10/-15 min local time of ascending node.

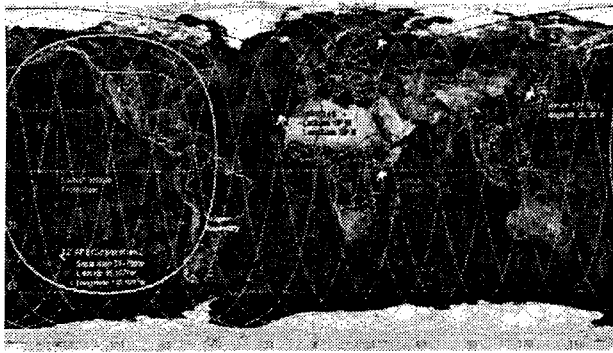


Figure 6. The LEOP orbits for KOMPSAT-2

5.4 The pass operation plan for KOMPSAT-2 stations

The Operation Plan of KOMPSAT-2 stations is summarized as following.

1. 1st Contact at Malindi of ESA
 - ✓ Link must be established
 - ✓ TC
 - NOOP
 - XMTR Ranging on/off
 - ✓ TM
 - Verify Telemetry of KOMPSAT-2
 - 3 Processor boot up status
 - Performs FSW
 - Solar Array Deployment
 - Performs Gyro
 - Sun Point Mode
 - ✓ Reserve Ranging & 2-Way Doppler
2. 2nd Contact at Svalbard of KSAT
 - ✓ Link must be established
 - ✓ Verify Telemetry of KOMPSAT-2
 - ✓ XMTR Ranging on/off
3. 3rd Contact at Maspalomas of ESA
 - ✓ Verify EPS Telemetry for Eclipse
 - ✓ XMTR Ranging on/off
4. 4th Contact at Svalbard of KSAT
 - ✓ XMTR Ranging on/off
 - ✓ Perform OBT set (week, quarter seconds)
5. 5th Contact at Maspalomas of ESA
 - ✓ Verify EPS Telemetry for Eclipse
 - ✓ XMTR Ranging on/off
 - ✓ Perform TCS Mode Change
6. 6th Contact at Svalbard of KSAT
 - ✓ XMTR Ranging on/off
 - ✓ Ephemeris Activation
7. 7th Contact at Svalbard of KSAT
 - ✓ Verify EPS Telemetry for Eclipse
 - ✓ Turn CES on & Enable CES #1, #2
 - ✓ Perform GPS Activation & Checkout
8. 8th Contact at KGS
 - ✓ Verify EPS Telemetry for Eclipse
 - ✓ Perform GPS Checkout
9. 9th Contact at Svalbard of KSAT

- ✓ Perform GPS Checkout & Upload Almanac
 - ✓ FSS data processing enable
10. 10th Contact at KGS
 - ✓ Perform SADE Activation & Checkout

After 10th passes, KGS will be received the telemetry data in real time and send bent-piped commands to KOMPSAT-2 such as Earth Search Mode, RWA activation & checkout, Science Coarse Mode, STA activation & checkout, Science Fine Mode, MSC activation & checkout and so on.

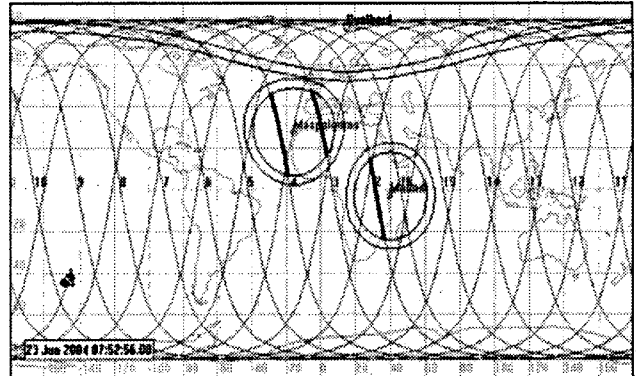


Figure 7. The Operation for KOMPSAT-2 stations

6.0 Conclusion

The external overseas ground stations will be used in order to increase contact time between KOMPSAT-2 and KGS. Major roles of overseas ground stations are to receive/transfer the telemetry data in real time and to send bent-piped commands from KGS to KOMPSAT-2.

KARI will probably use overseas ground stations connected to KGS in case of the satellite contingency during normal operations. KARI selected KSAT as a primary overseas ground station during KOMPSAT-2 LEOP.

The KSAT Svalsat will provide access to operational SG3 antenna systems. SG3 antenna systems serve as multi-mission antenna and have capability of S-Band TT&C. The Svalsat SG3 will after the three first orbits continue as the single and prime overseas ground station. The ESA stations will be used for KOMPSAT-2 orbit #1, #2, #3. TM/TC data will be routed through TNO communication node to KGS.

After launch, KGS has to communicate with the KOMPSAT-2 and KGS will check for KOMPSAT-2 such as processor boot up, performs FSW, Solar Array Deployment, Gyro Selection, Sun Point Mode, Earth Search Mode, Science Mode and so on during each contact.

7.0 References

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