통해기 위성통신시스템의 운용계획

최 경 수*, 신 천 식, 이 성 팔

Operation Plans of the Satellite Communications System for COMS

Kyung Soo Choi*, Cheon Sik Sin and Seong Pal Lee

요 약

본 논문은 통신해양기상위성(이하 통해기위성) 위성통신시스템(Ka 대역 통신탑재체 시스템, 정지궤도 위성관제 시스템 및 위성시험지구국으로 구성)의 운용계획에 대해 기술한 논문이다.

위성통신시스템(SATCOM)을 구성하는 Ka 대역 통신탑재체, 시험지구국 및위성관제국 각각의 임무계획 및 제공서비스 종류를 기술하며, 각 시스템간의 인터페이스에 대한 구성 및 기능에 대해서도 기술한다. 특히 위성통신시스템을 구성하는 각각의 서브시스템에 대한 운용상의 항목 및 기능을 도출하고, 그리고 운용계획을 기술하였다. 또한 통해기위성 통신탑재체를 감시 및 제어하고, 통신서비스망을 감시하기 위한 PCS(Payload Control System)의 기능정의,구성도 및 운용계획을 제시하였다.

키워드 : 위성통신, 통신탑재체, 탑재체제어센터, 운용계획

ABSTRACT

This paper describes operation plans for satellite communications system (SATCOM) which is consisted of Ka band communication payload, geostationary satellite control system and communication test earth station system for the communication, ocean and meteorological satellite system (COMS).

Also this paper describes the communication service and mission plans by each system of the SATCOM, and configurations and functions of the system interface between each system. Especially this paper proposes operational items, functions and their configuration diagrams, touches their operational plans. This paper describes function definitions, configuration diagram and operation plans of the PCS (Payload Control System) for monitor and control of the communication payload and communication service network of the SATCOM.

Key words: : satellite communications, communication payload, payload control center, operation plan

1. Introduction

A Korea geostationary satellite project was started early 1990s. Koreasat 3 is operating for communication and broadcastingsatellite services for the moment. Frequency band in satellite by variety of satellite services, broadband and drain of the existing frequency band, is gradually spreading to Ka band. But the active payload for this band is promoting for development in high quality service and needs for increase of satellite capacity.

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It was developed a beam switching satellite for its capacity enhancement and frequency reuse. There are two types of switch control scheme, one is satellite itself control and the other control scheme by ground control. SATCOM (SATellite COMmunication System of Communication, Oceanic and Meteorological Satellite) development target is to overcome the disadvantages of the existing bent pipe transponder, and performs the space proven technology verification of the self developed communication payload for upgrading service quality and enlarging satellite capacity. It is also to put a practical use of the high quality satellite multimedia services using test earth station system which is developing with the pure domestic technology for verification of the satellite switch function and performance of SATCOM.

This paper proposes a direction how to operate the system in practical phase after the completion of the SATCOM development, launch and in orbit test.

2. SATCOM Configuration and Mission

2.1 SATCOM Configuration

SATCOM system consists of ka band active communication payload (COPS), geostationary satellite ground control system (SGCS) and Ka band communication test earth station system (CTES) as shown in Figure 1.

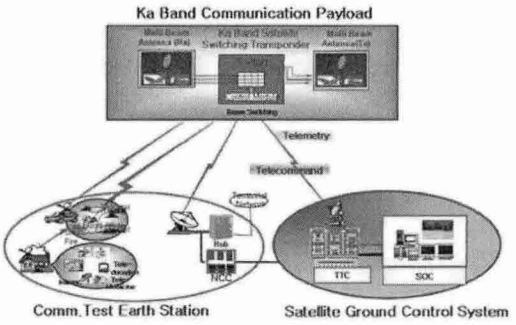

Figure 1. SATCOM System Configuration

Ka band communication payload composes satellite switching transponder and multibeam antenna, geostationary satellite ground control system consists of hardware component and software component. Ka band communication test earth station system comprises a central hub station and several remote terminals, and includes IOT (In Orbit Test) equipments for in orbit test of the communication payload and CSM (Carrier Spectrum Monitoring) equipments for monitoring carrier status of the communication service network using SATCOM system. In case of the IOT and CSM antenna, it will share the Ka band hub antenna in the test phase, but may separate to operate from hub station system depending upon the network operation organization in practical phase.

2.2 SATCOM Mission

SATCOM system will meet the following mission for satellite coverage and service:

- SATCOM system provides two coverage areas in Korean peninsula using Ka band communication payload, also provides another coverage area for reservation.
- SATCOM system provides communication services for public applications in the coverage areas using Ka band communication payload, especially administrative service and high speed multimedia service for South Korea area and high speed multimedia service for North Korea and reserved area.

■ Ka-Band Payload System (COPS) Mission

Ka band payload system basically reduces a noise of the received signal from transmitting earthstation on the ground and performs it switching to the corresponding coverage. It amplifies the switched signal and sends the amplified signal to the receiving earth station on the ground. COPS performs the following missions:

- Ka band active payload provides three transponders with satellite switching function and one bent-pipe transponder, also two

multibeam antennas.

- Ka band active payload has a beacon transmitter system for easy installation of the earth station system. It provides uplink frequency band in 29.6 GHz~30.0 GHz (400MHz), downlink band in 19.8~20.2 GHz(400 MHz)and beacon frequency band in 19.8 GHz.
- Ka band active payload secures a space technology for its components and provides practical communication services using three 100MHz frequency band. It also provides a rain attenuation compensation function via satellite switching operation and multibeam antenna.

■ Satellite Ground Control System (SGCS) Mission

- Satellite ground control system provides monitor and control functions for COMS (communication, ocean and meteorological satellite system) locating in geostationary orbit.
- SGCS is developing to provide more flexible, compact and high precision control functions than the existing ground control system.
- SGCS receives and transmits tele-command and tele-metry data for COMS system components. And it also provides interface function for information transmission between Ka band communication payload system and payload control center in the ground.

■ Test Earth Station System (CTES) and Service

Communication test earth station system shall provide necessary functions for verification of the Ka band communication payload performance using test earth hub station and remote terminal systems, also provide disaster communication services and satellite internet service etc.

CTES provides performance verification functions of Ka band communication payload andan adaptive communication system. It also provides public communication services like a satellite internet and administrative communication services like a disaster communication service. CTES provides data speed on 8 Mbps ~ 155 Mbps for forward link and 8 Mbps for return link.

3. COPS Operation Plan

This chapter describes COPS configuration, functions and operation plans for SATCOM System.

3.1 COPS Configuration and Functions

Ka band communication payload consists of satellite switching transponder and multibeam antennas as shown in Figure 2. Satellite switching transponder provides 4 channels and frequency conversion makes down 20 GHz to 3.4 GHz again up to 30GHz. Multibeam antenna is composed to two reflectors, one reflector connected one feeder, another connected to two feeders.

Satellite switching transponder receives the signal from a transmitting earth station on the ground through the receiving satellite antenna, reduces the noise from received signal and converts 20GHz frequency band of the received signal to 3.4 GHz frequency band of the signal. It also performs the switching to route the appropriate service coverage and converts this signal to 30GHz frequency band. And then it amplifies the converted signal predefined level and sends the amplified signal to a receiving earth station on the ground through the transmitting satellite antenna.

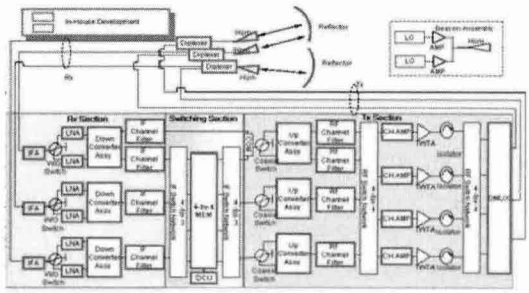

Figure 2. COPS Configuration Diagram

3.2 COPS Operation Plans

- The operation mode of COPS is classified in bent-pipe mode and satellite switching mode. In bent-pipe mode, COPS receives and amplifies

the signal from earth station, converts it to intermediate frequency by down-converter and converts again it to downlink frequency by up-converter without route switching.

- In satellite switching mode, DCU in COPS receives the information for change of the satellite switch configuration from the communication payload control center (PCC) on the ground and changes MSM (Microwave Switch Matrix) configuration.
- For the various RF switches, COPS operates redundantcomponent using W/G switches or coaxial switches via TM/TC data from PCC in order to switch the failure module with the redundant module.
- In case that the reception sensitivity of the CTES by the various noise in satellite link, COPS improves the performance of the satellite component changing the output of the right component, especially Channel Amplifier controlled by PCC via TM/TC.
- COPS provides TM/TC data to MPIU in COMS spacecraft bus according to request for status information in COPS components for monitor and control of those components.
- COPS is operated in mode of the FGM (Fixed Gain Mode) and AGC (Automatic Gain Control) in the power level in each transponder channel providing against rain attenuation.

4. PCC operation plan

4.1 PCC functions

PCC (Payload Control Center)performs controlling and monitoring of the communication payload (COPS) in COMS. PCC also monitors Ka band communication service link against over power from earth terminals in the SATCOM communications service network. PCC consists of Ka band antenna and RF equipment, PCS (Payload Control System) and SGCS interface. In Test phase PCC share the antenna and RF equipment with central hub station, and in practical phase it will be implemented apart from central hub station.

The monitor and control functions of the OBS satellite communications system are classified into communication payload management and communication link monitor. The former should monitor and control the operation status of the various components (Channel Amplifier, TWTA, etc.) consisting of communication payload, and the latter monitors whether the frequency spectrum and operating output level of the satellite transponder assigned to each service network meet with the predefined level or not.

PCS interfaces to the satellite ground control system (SGCS) to manage spacecraft bus and payload using terrestrial network, also interfaces to the communication test earth station in RF level for monitoring of the spectrum for management of Ka-band satellite communication link. So it should be installed in same building as in a hub earth station.

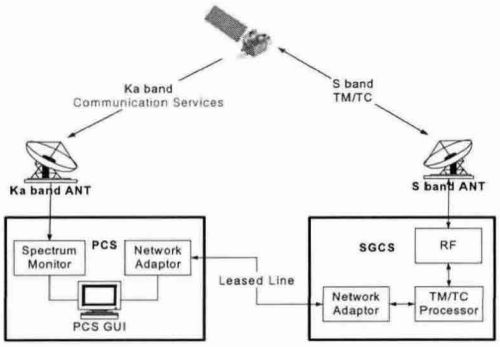

Figure 3. Interface Diagram between PCS and SGCS

4.2 PCS Operation Plans

- The status information of the Ka band communication payload (COPS) components is exchanged between MPIU and SGCS using S band frequency.
- SGCS transfers TM/TC data for monitor and control of the COPS to be analyzed them by PCS from MPIU.
- PCS sends new mode sequence table information to the satellite switch controller (DCU) via the predefined communication protocol, after it analyzes the information from DCU of the OBS satellite for switch point failure report.

- PCS monitors many parameter of the earth station system through Ka band communication satellite hub system in test phase.
- PCS displays and prints all information for COPS monitor and control functions in the GUI of the operator terminal.

5. Conclusion

This paper describes operation plans for satellite communications system (SATCOM) which is consisted of Ka band communication payload, geostationary satellite control system and communication test earth station system.

Also this paper describes the mission plans and system service by each system of the SATCOM, and configurations and functions of the system interface between each system. This paper describes function definitions and configuration diagram for operation plans of the PCS (payload control System) for monitor and control of the communication payload and communication service network of SATCOM. This operation plans will be reflected to operation procedures in design phase.

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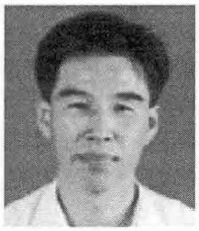

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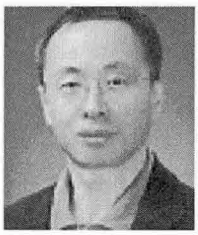

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