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SERVICE AND NETWORK OPERATION OF THE MULTIBEAM SWITCHING SATELLITE COMMUNICATIONS SYSTEM

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ABSTRACT

A multibeam switching satellite system technology have started localized development to overcome the limitation of the frequency resource and geostationary orbit existing relay type satellite transponder and the required performance of the spot beam, and looked around the configuration and functions of the multibeam switching satellite communication system. This paper proposed that operation scheme and network control features for service definition, network architecture, transmission method of the natural disaster service network and public communication service network using this system.

Keywords: multibeam, switching, satellite, network, service, operation

1. INTRODUCTION

This paper proposed the communication services and the communication network operation using switching function between the remote terminals within the beam or between the beams for providing communication services for natural disaster such as prediction, prevention, recovery service and the satellite multimedia service such as Internet via satellite, remote-medicine, distance learning in the multibeam switching satellite network composed with a hub station and several remote terminals.

But it is indispensable that one should enlarge the satellite capacity for satisfying the increasing needs on the satellite services as satellite frequency resource and satellite orbit are restricted in comparison with the needs of the satellite services. In advanced countries in the satellite communications field an on-board switching satellite uses the multibeam which means several independent beams divided a desired coverage by space (Hoder & Bergamo 1996).

It is different to communicate between satellite terminals by the distributed weak signal along with the beam size in case that the satellite beam covers wide area or higher signal is needed. For overcoming this problem, one should make the size of terminal large, so should pay more for system construction.

This paper looks around the configuration and functions of the multibeam switching satellite communication network, defines appropriate services in the service network, and proposed service operation and network control functions.

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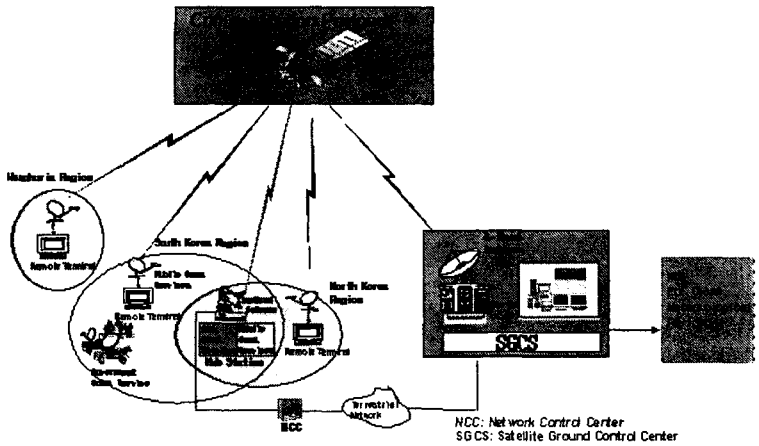

Figure 1. Conceptual architecture of multibeam switching satellite network.

2. CONFIGURATION OF MULTIBEAM SWITCHING SATELLITE NETWORK

2.1 General Information

A multibeam switching satellite communication system consists of Ka-band communication payload, Ka-band test earth station and geostationary orbit satellite ground control system (SGCS). Ka-band satellite communication payload consists of transponder subsystem which supports transponder channel in redundancy and antenna subsystem that supports three beams to the service coverage. Ka-band test earth station system is composed of a central hub station and several remote terminals. Central hub station performs the functions of service network management and control as well as communications service using remote terminals. Satellite control system performs the functions of the communication with the satellite spacecraft to monitor the spacecraft status and control the equipments of the spacecraft and the function of the interface with the central hub station and/or the network control center for control of communication payload (Lee et al. 2004).

As shown in Figure 1 service coverages for the system are three region named by beam A, B and C. Beam A will be assigned to S. Korea for national disaster service network and satellite multimedia service network, while beam B and C will be assigned to N. Korea and North-east (NE) of China respectively for satellite multimedia service network same network as that of S. Korea.

2.2 Configuration and Functions of the Multibeam Switching Satellite

Switching satellite system consists of an antenna subsystem which receives the uplink RF signal from an originating satellite terminal and transmits the downlink RF signal to a destination satellite terminal, a satellite receive subsystem which filters and amplifies the desired signal from received signal via antenna subsystem and converts the amplified signal to the intermediate frequency (IF) band required in a microwave switch, a microwave switch matrix (MSM) which switches incoming three channels IF band signals to outgoing channels IF band signals, a satellite transmit subsystem which adjusts the gain of the received signal to output the switched IF band signal in proper level and amplifies the adjusted signal to the amplitude required in the downlink to pass it to antenna subsystem, an output multiplexer which multiplexes the amplified signal to transfer to antenna subsystem

Moreover switch controller and network control station would be added for control of the satel-

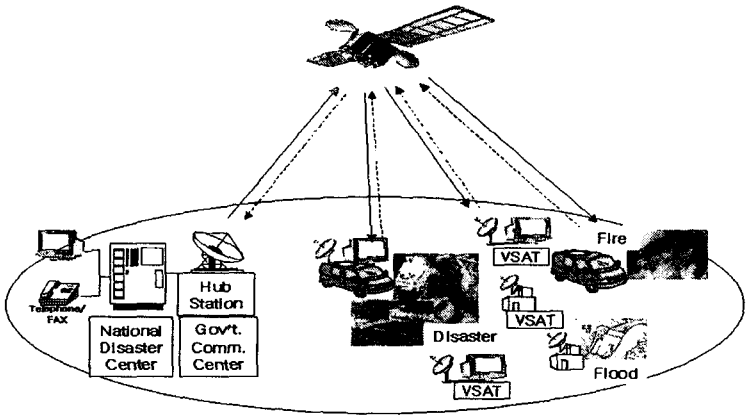

Figure 2. Conceptual diagram of government communication network.

lite transponder and on-board switch. Switch controller controls and monitors the operation of all switches in microwave switch matrix, and network control station monitors and controls the switch controller in real time.

3. SERVICES AND OPERATIONS

3.1 Services and Networks

Services provided by the multibeam switching satellite are classified to the natural disaster service using government communication service network and the satellite multimedia service using public communication service network.

In government communication service network, the target information rate shall provide 10 Mbps (Megabit per second) (maximum) in bi-directional link, for forward link (Hub station to Remote terminal) and return link (Remote terminal to Hub station). In public communication service network, the target information rate shall provide 155 Mbps (maximum) for forward link and 10 Mbps (maximum) for return link (Sin et al. 2003).

3.2 Government Communication Service Network

The government communication service includes voice and medium-low speed data service required to the prediction and recovery for natural disaster, and image information service for investigating the status of damage area in the center. It is anticipated to contribute to construction of the systematic disaster recovery and management system by providing various information for the damage area with the type of voice, data and image via satellite system as shown in Figure 2.

Transponder for the government communication service will be a bent-pipe type, and service coverage will cover S. Korea only. Especially the government communication service will provide back-up function for the emergency communication network against the terrestrial communication network.

3.3 Public communication service network

Providing full information of high-speed Internet service, distance learning and remote medicine

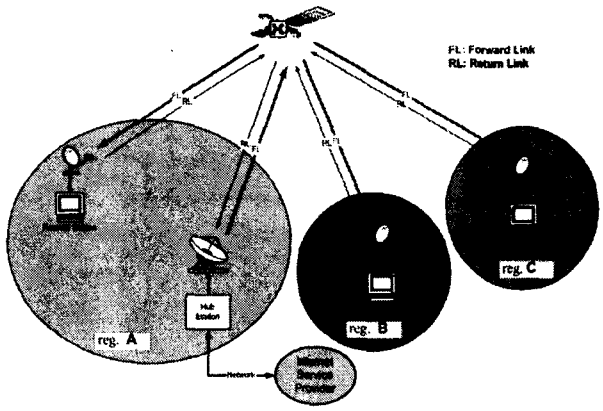

Figure 3. Conceptual diagram of the public communication network.

service to the residences of the islands and rural areas, medical center and technical education college (Open University, technical academy, etc) via satellite can be contributed to the upgrade in the quality of life. A conceptual diagram of the public communication network is shown in Figure 3.

Transponder for the public communication service will be a multibeam on-board switching type, and service coverage will cover S. Korea, N. Korea and NE of China. The system enables to switch the signal between 3 beams. Such coverage prepares to construct the NE area communication network in the future and to contribute to the recovery of culture homogeneity providing the Korean culture to our compatriots resident in that area with Internet service via satellite and distance learning, etc.

3.4 Network Control Operation

Network control functions (NCF) perform transponder operation for communication satellite payload and monitor status of the satellite communication service network.

NCF monitors and controls operational conditions of all equipments consisting of satellite transponder (CH Amp, TWTA, ...). NCF uses ground control station TM/TC interface channel for TM/TC communication with satellite transponder. This is because NCF does not have dedicated TM/TC interface channel directly to the satellite transponder.

NCF monitors transponder spectrum and checks violation of service frequency and output power of earth station from the preassigned value. If any violation is found, NCF will do proper actions to service provider.

The interconnection diagram between NCF and SGCS is shown in Figure 4.

4. CONCLUSIONS

We started localized development of the multibeam switching satellite system technology developed in the advanced countries to overcome the limitation of the frequency resource and geostationary orbit existing relay type satellite transponder and the required performance of the spot beam, and looked around the configuration and functions of the multibeam switching satellite communication system. In this paper it was proposed that operation scheme and system network control features for service and network architecture, transmission method of the government communication service

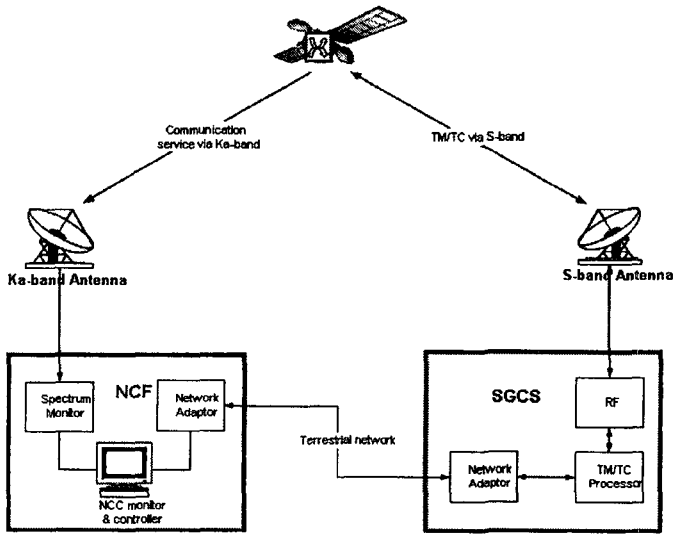

Figure 4. Interconnection between NCF and SGCS.

network and the public communication service network using this system.

Monitor and control function for the satellite enables to operate multibeam switching satellite system and communication networks on the best condition as it is.

Hereafter monitor and control functions of the multibeam switching satellite proposed in this paper will be used to develop the network control station system for active satellite communication system.

REFERENCES

Hoder, D., & Bergamo, M. 1996, International Journal of Satellite Communication, 14, 161

Lee, Y. M., Lee, S. P., Eun, J. W., & Choi, K. S. 2004, in Proc. of 10th Ka and Broadband Communications Conference, 509

Sin, C.-S., Choi, K. S., You, M. H., & Lee, S. P. 2003, in Proc. of 5th Conference on Electronics and Information Communication, 355