

# System design consideration for the Digital Onboard Processor of the data relay satellite

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**Abstract**— This paper provides design considerations for developing satellite digital onboard processor (OBP) for data relay purpose. The satellites considered in this paper are GEO satellites. Since various relay scenarios are expected depending on the relay source and destination, the design concept of OBP considering various purposes is necessary. The proposed OBP structure adopts a modular structure, and provides considerations for design and manufacturing.

**Keywords**— satellite, relay, GEO, digital onboard processor

## I. INTRODUCTION

With the development of satellite launch vehicle technology, the utilization of LEO satellites for monitoring and communication purposes is increasing. As the observed image resolution increases, the transmission capacity of LEO satellites is increasing. However, if the LEO satellites are not in the global service LEO satellite group, the time during which the LEO satellites can communicate with the ground station is limited. When there is an effective time of data, such as video for military purposes, the problem of delay becomes bigger.

The GEO data relay satellite system is a method of using a GEO satellite as if it were a ground station floating in space, even though communication with the ground station was intermittent 24 hours a day. Its main purpose is to perform inter-satellite communication relay or satellite-to-terrestrial communication relay [1]. Figure 1 is a conceptual diagram of using GEO as a data relay satellite. The GEO satellite receives the necessary information from the LEO satellite and delivers it to the ground station. A LEO satellite group may always be able to communicate with a ground station via ISL. However, if a problem occurs in the LEO satellite that needs to be relayed, normal service is impossible. Therefore, a GEO data relay satellite is necessary for reliable data transmission.

In order to process the acquired information transmitted from various satellites and transmit it to the ground station, a digital onboard processor (OBP) that can digitally process the signal and modulate the information according to the communication system with the ground station is required.

In this paper, we propose a modularization-based OBP structure for relay satellites and examine design considerations.

## II. TERMINAL STRUCTURE

Fig. 2 shows the proposed modular structure digital OBP shape. It is mainly composed of three modules. The modem module digitizes, modulates and demodulates the signal received through the RF interface. The network module

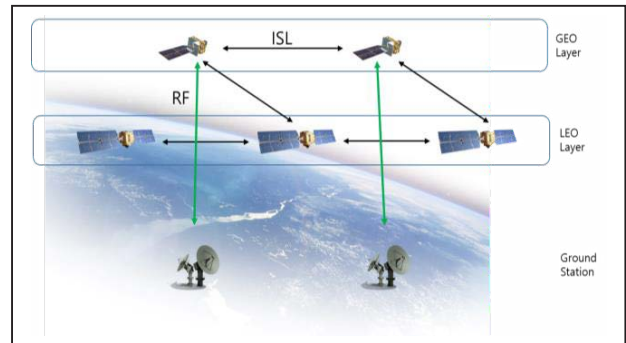


Fig. 1. Structure of the proposed digital OBP

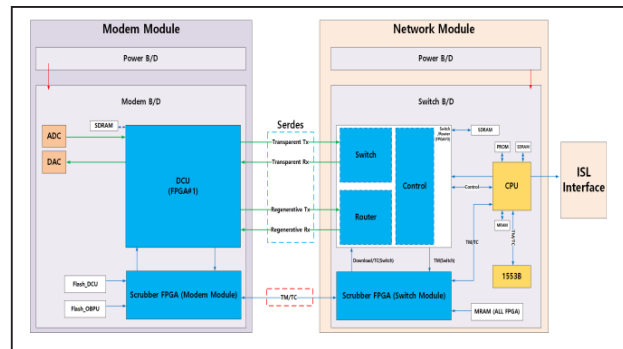


Fig. 2. Structure of the proposed digital OBP

receives terrestrial signals and transmits them to the ISL link or vice versa. The ISL interface functions to communicate with the ISL equipment by interworking with the network module.

When designing an OBP for a relay satellite, the first thing to be considered is the performance of the EEE parts. In the case of parts for GEO satellites, the performance is lower than that of COTS parts, so this should be considered. When the communication signal capacity between modules increases, the number of modules increases, which is a major problem in the development of satellite payloads.

Also, one of the big issues is the network interworking according to the communication method with the ground station. There is no problem when data is transmitted through a single relay station. However, if the information needs to be transmitted to multiple relay stations, the network synchronization method is different depending on the communication method. As a result, there are limitations in HW design. When designing a system, it is possible to consider the use of a feeder link for relay signals.

Protocol design is also an important research topic. The efficiency of communication relay can be increased by designing a protocol for interworking of various types of communication networks.

### III. CONCLUSION

In this paper, a modular structure for OBP for data relay satellite is proposed. In addition, considerations for OBP design are described. The need for data relay satellites is

increasing as the number of LEO satellites increases, but research on this is still lacking. Various studies for network connection between LEO and GEO satellites and ground stations should be conducted. In particular, it is thought that more research is needed from the design point of view considering the limitations of HW.

### REFERENCES

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