Proceedings of International Conference on Astronomy and Space Science
Celebrating 20th Anniversary of Korea Space Science Society, Jeju, 2004

DEVELOPMENT OF THE KOMPSAT-2 SATELLITE MISSION CONTROL SYSTEM

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(Received September 25, 2004; Accepted October 1, 2004)

ABSTRACT

KOMPSAT-2 satellite mission operations and control system has been developed by ETRI. The system functional architecture, analysis and design, implementation, and tests are presented in this paper.

Keywords: satellite operations and control, telemetry, tracking and command, orbit determination, mission planning, satellite simulation, KOMPSAT-2

1. INTRODUCTION

The KOMPSAT-2 will be launched in 2005 for high-resolution imaging of Korean peninsula. Satellite mission operations and control will be conducted by the Mission Control Element (MCE) located in KARI. The MCE has been developed by ETRI, and the system consists of four subsystems; Telemetry, Tracking and Command (TTC) subsystem, Satellite Operations Subsystem (SOS), Mission Analysis and Planning Subsystem (MAPS), and satellite SIMulator subsystem (SIM). This paper presents the MCE system functional architecture, system design features, system implementation, and tests.

2. SYSTEM FUNCTIONAL ARCHITECTURE

KOMPSAT-2 MCE monitors and analyzes status of the satellite, plans the mission, and controls the KOMPSAT-2. The MCE receives telemetry from the satellite, and send telecommand via S-band. The standard CCSDS data format is used for telemetry and command. Figure 1 shows the functional schematics of the MCE. The TTC receives telemetry from the satellite, transmits telecommand and implements the antenna tracking and ranging. The SOS provides telemetry data processing, telecommand generation, and telecommand transmission to the TTC or to the SIM (Jung et al. 2002). The MAPS analyzes the orbit and attitude of the satellite, and plans the mission and command schedule (Lee et al. 2002a, Lee & Kim, 2003). The SIM validates telecommand, simulates the KOMPSAT-2, analyzes spacecraft anomalies, and trains the KGS operators (Lee et al. 2002b).

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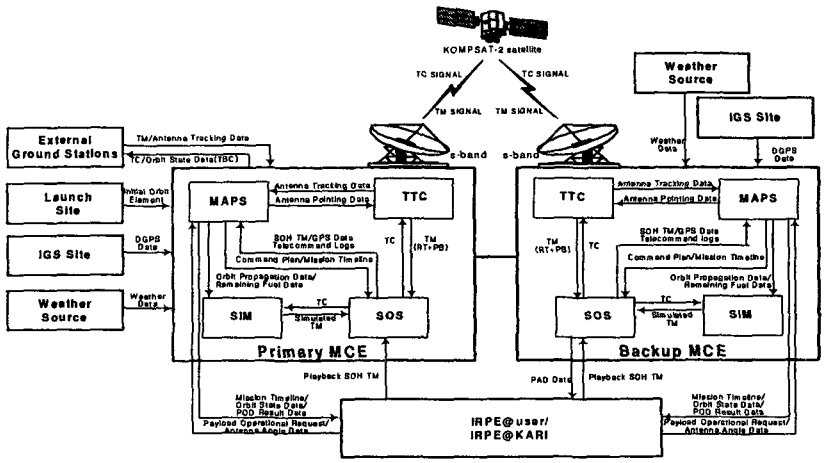

Figure 1. Functional schematics of the KOMPSAT-2 MCE.

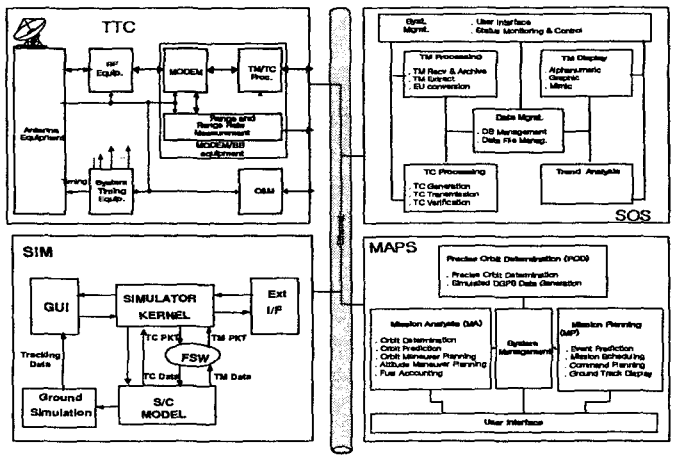

Figure 2. Subsystem functional configuration.

3. SUBSYSTEM ALLOCATIONS AND DESIGN

The TTC is a hardware oriented subsystem which comprises antenna equipment, RF equipment, IF equipment, time and frequency reference, telemetry and telecommand processing equipment, ranging equipment and a C&M computer. The other subsystems such as SOS, MAPS, and SIM are the software oriented subsystems which comprises application software, operating system, and computer. Figure 2 shows the functional configurations of the four subsystems in KOMPSAT-2 MCE.

The Object-Oriented Analysis and Design (OOAD) methodology is applied to the subsystem design for maximizing the code reusability, functional extensibility, and system reliability. Subsystem analysis is composed of Use-Case Model and Domain Model (Pooley & Stevens, 1999). Subsystem design consists of user interface design and architecture design. Logial view, Implementation view,

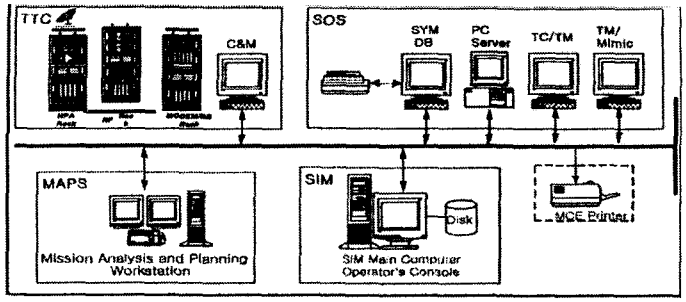

Figure 3. System H/W configuration.

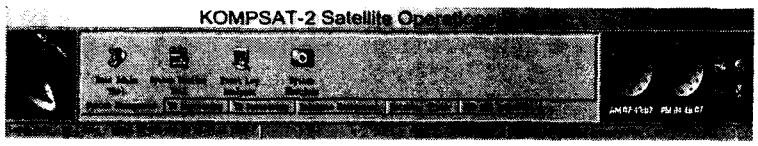

Figure 4. Top level user interface for SOS.

Figure 5. Top level user interface for MAPS.

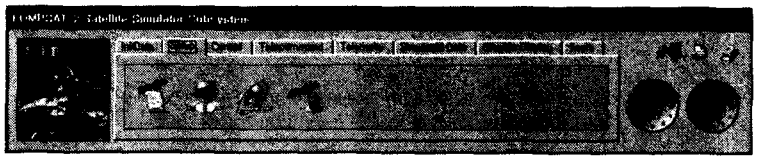

Figure 6. Top level user interface for SIM.

Process view, and Deployment view are the four views of the architecture design (Kruchten 1995).

The hardware and software architectures are designed in order to satisfy the requirements for the functions, interfaces, performances, and quality assurances described in the system and subsystem specifications. Figure 3 presents the hardware configuration of the KOMPSAT-2 MCE. HP-C3750 workstations with UNIX O/S are used for TTC C&M, SOS, and MAPS. Windows 2000 O/S on PCs are used for SIM and SOS telemetry display.

4. SYSTEM IMPLEMENTATION AND TESTS

The KOMPSAT-2 MCE TTC was implemented for the redundancy of the system operation. TTC MODEM/BB and system timing equipment was supplemented on the KOMPSAT-1 TTC equipment. Multi-mission operations capability was implemented for the possible operations of the KOMPSAT-

2 and KOMPSAT-1.

Object-Oriented programming language was used for the implementation of the software design. Qt was applied for programming the graphical user interface (Trolltech 2004). Figures 4 to 6 present the user interface menu for SOS, MAPS, and SIM.

A series of formal tests were performed by the Integrated Test Team (ITT). Bottom-Up test processes including subsystem test, subsystem interface test, system test, primary-backup interface test, system site installation test, KGS interface test, and system acceptance test were conducted and successfully completed. The MCE system is now in a pre-operational state. The MCE-KOMPSAT-2 compatibility test and end-to-end test will be conducted by KARI in next year when the Integration and Test (I&T) of the spacecraft are completed.

5. CONCLUSIONS

The entire development process of the KOMPSAT-2 mission operations and control system has been successfully completed. The object-oriented analysis and design methodology was applied in the system design phase. Comprehensive test processes were conducted. The MCE system is now ready for the KOMPSAT-2 operations.

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