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FLIGHT SOFTWARE DEVELOPMENT FOR THE KODSAT

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ABSTRACT

This paper presents the flight software of KoDSat (KSLV-1 Demonstration Satellite) which performs demonstrating the KSLV-1 (Korea Space Launch Vehicle-1)'s satellite launch capability. The KoDSat Flight Software executes in a single-processor, multi-function flight computer on the spacecraft, the OBC (On Board Computer). The flight software running on the single processor is responsible for all real-time processing associated with : processor startup and hardware initialization, task scheduling, RS422 handling function, command and data handling including uplink command and downlink telemetry, attitude determination and control, battery state of charge monitoring and control, thermal control processing

Keywords: flight software, satellite, on-board computer

1. INTRODUCTION

The KoDSat flight software is responsible for providing the on orbit computational, command and communications capability in support of the spacecraft subsystems and the KoDSat payload (Choi & Park 2004a). The flight software supports the KoDSat's following missions: acquisition of KSLV-1 induced environmental data in the fairing, measurement of orbit injection capability of KSLV-1, acquisition of satellite separation video images and communication the uplink command and telemetry downlink via UHF or S-Band (Choi & Park 2004b).

The software controls each subsystem's hardwares, gathers and transmits telemetry and performs uplink command. A block diagram of the flight software is shown in Figure 1.

2. FUNCTIONAL DESCRIPTION

The KoDSat OBC contains the 80386 CPU (Central Processing Unit) running at a clock speed of 12 MHz, with 512 Kbytes of RAM (Random Access Memory) with error detection and correction protection (Choi & Park 2004b). Figure 2 describes the KoDSat's the hardware and software interfaces. The RS422 Bus is utilized for communication between the OBC and DAU, TAM0, TAM1, GPS receiver.

The major functions of flight software consist of the following functions:

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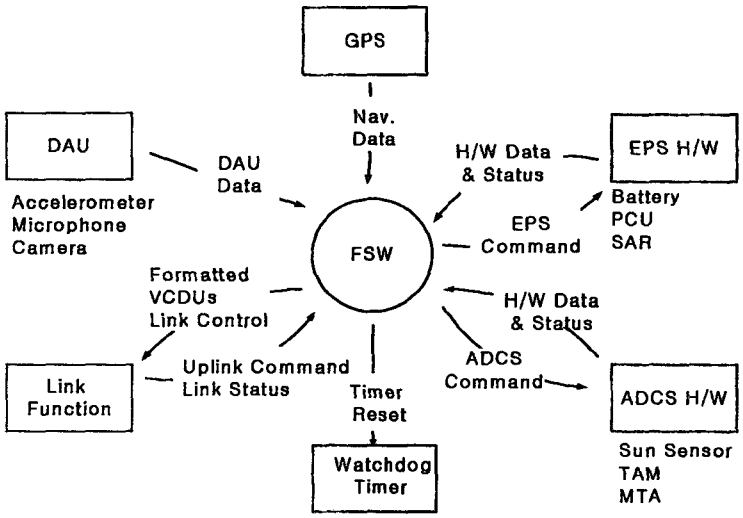

Figure 1. KoDSat flight software context diagram.

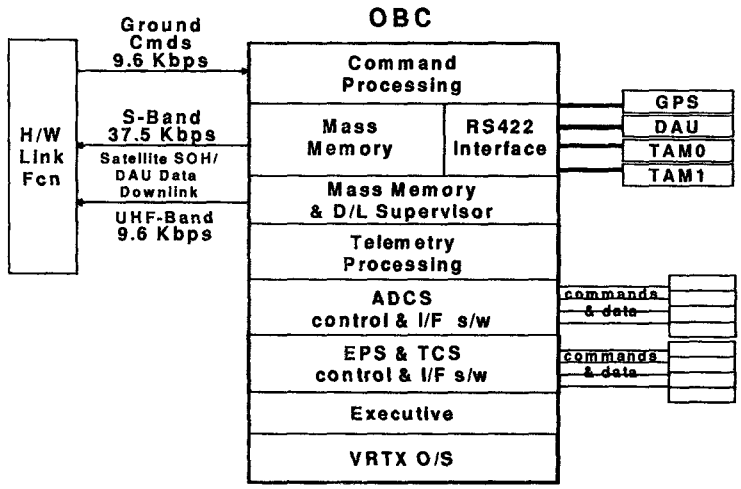

Figure 2. Hardware & software interfaces.

• Executive: This function performs the processor startup and hardware initialization, task scheduling, clock updates, RS422 interface setting. The VRTX (Versatile Real-Time eXecutive kernal) is chosen to provide proven COTS multitasking support, priority-based scheduling, and real-time control (Wertz & Larson 1991).

• Utilities: Utilities performs the functions for common use functions as well as for low-level drivers, such as serial interfaces, bilevel interfaces, RS422 interface functions. Especially, DAU (Data Acquisition Unit) and GPS receiver via RS422 use the FIFO buffer for processing many data quickly.

• Command&Communication Interfaces: This function processes the uplinked ground commands in CCSDS (Consultative Committee for Space Data System) Command Link Transmission Unit

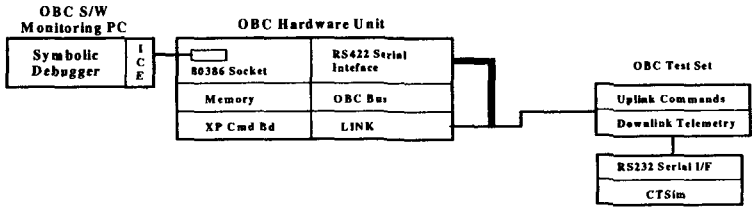

Figure 3. Flight software build test configuration.

(CLTU) format.

• Stored Command Processor: For the KoDSat, there are three kinds of commands such as RTC(Real Time Commands), ATC(Absolute Timed Commands), RTCS(Relative Timed Command Sequences). *Stored Command Processor schedules and extracts ATCs at their execution time,* and maintains the RTCS in the Stored Command Sequence Area.

• Command Distribution Supervisor: CDS includes all real-time command functions. The KoDSat has the almost 200 real-time commands.

• Data Acquisition: This funtions acquires telemetry parameters coming from serial, analog and bilevel ports and formats telemetry data according to current TFT (Telemetry Format Table).

• Mass Memory & Downlink Management: The KoDSat has the 64Mbits Mass memory for recording SOH (State of Health) and DAU data. The DAU data is stored in mass memory when the maximum 2 Kbytes FIFO buffer interrupt occurs. The playback data frames are 4 or 17 frames as UHF (9.6 Kbps) or S-band (37.5 Kbps).

• Attitude Determination Control Subsystem: This function determines the KoDSat position and orientation by processing the sensor data: GPS, CSS (Coarse Sun Sensor), TAM (Three Axis Magnetometer). This generates commands for the actuator: MTA (The Magnetic Torquer Assembly).

• Electrical Power Subsystem: This software checks the status of the battery and choose the battery charge scheme.

• Thermal Control Subsystem: This function checks the temperature of the satellite and selects operating temperature and controls the S/W controlled satellite heater.

3. SOFTWARE TEST

The KoDSat flight software is tested and debugged in detail on the target board (OBC) in ETB (Engineering Test Bed) using the equipments such as ICE (In-Circuit Emulator), OBC Test Set, CTSim (Command & Telemetry Simulator), etc. The overall configuration is shown in Figure 3 and Figure 4 shows the ETB. The ICE provides both assembly level and source level debugging capability through the emulating processor in target board. The ICE is inserted in the OBC in replacement of Intel 80386DX chip and driven by its debugger s/w executed on the OBC Monitoring PC. CTSim plays a role to transmits the command to OBC and receive the telemetry from OBC through OBC test set RS422 serial communication.

4. CONCLUSIONS

This paper presents the KoDSat flight software's overall configuration, functional description and test environment. Currently, We finished CDR (Critical Design Review) for flight software

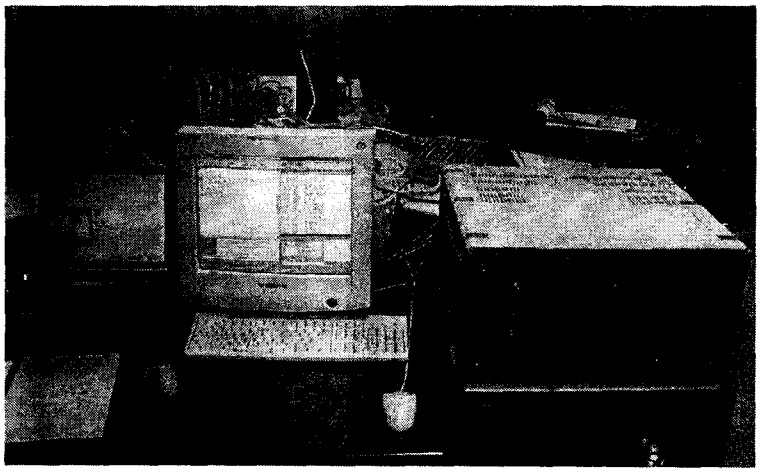

Figure 4. Flight software build test configuration.

and continuing overall build to the modification items during the ETB test. The flight software modification history are maintained through the software configuration management.

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