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A PROPOSED HIGH AVAILABILITY ARCHITECTURE FOR COMS GROUND CONTROL SYSTEM

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ABSTRACT

A satellite ground control system (SGCS) which monitors and controls a geostationary satellite 24 hours a day has to achieve the system architecture assuring high-level availability and redundancy scheme. The SGCS for Communication, Ocean, and Meteorological Satellite (COMS) is currently being developed in Korea, which will be implemented to satisfy high availability (HA), expansibility, and compatibility in design. In order to implement the system architecture to meet these characteristics, the SGCS for COMS introduces the concept of the real-time distributed system structure based on redundancy scheme for high availability, data replication and sharing, and CORBA middleware.

Keywords: high availability, redundancy, fault detection and recovery, COMS

1. INTRODUCTION

The COMS project is a new project that develops a satellite system which performs multi-mission such as communications services, ocean and meteorological data acquisition on the geostationary orbit (Yang 2004). In ground segment, the SGCS consists of five subsystems, Real-time Operations Subsystem (ROS), Flight Dynamics Subsystem (FDS), Mission Planning Subsystem (MPS), Hybrid Simulator Subsystem (HSS), Tracking, Telemetry, and Command (TTC) subsystem. Especially, the ROS can be said the essential core of the SGCS in the sense that it performs the real-time processing of monitoring and controlling the satellite. Functions of the ROS provide full real-time control of a spacecraft, archives, retrieves and displays spacecraft telemetry (Mo, Lee, & Lee 2000). Figure 1 shows the overall subsystems of the SGCS. The SGCS which operates the satellite on the geostationary orbit has to be able to monitor the state of satellite and transmit control telecommand 24 hours a day. If a satellite signal is unlinked, the worst situation of losing the satellite may happen. Therefore, the architecture of the mission-critical SGCS must be considered as the distributed system with HA and redundancy scheme from design phase.

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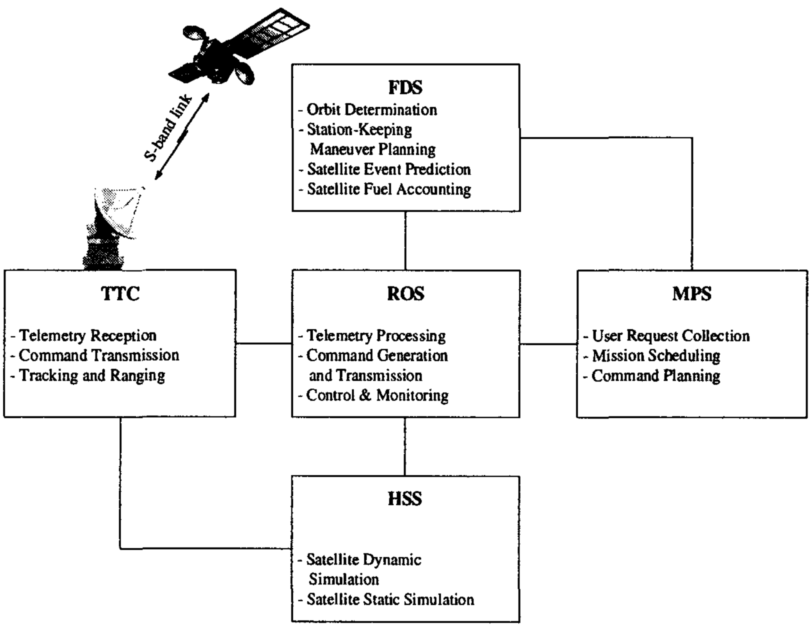


Figure 1. SGCS overall configuration.

2. DESIGN CONSIDERATIONS

Key functions required by SGCS are fault detection, service redundancy mechanism, and data replication technology to guarantee high availability.

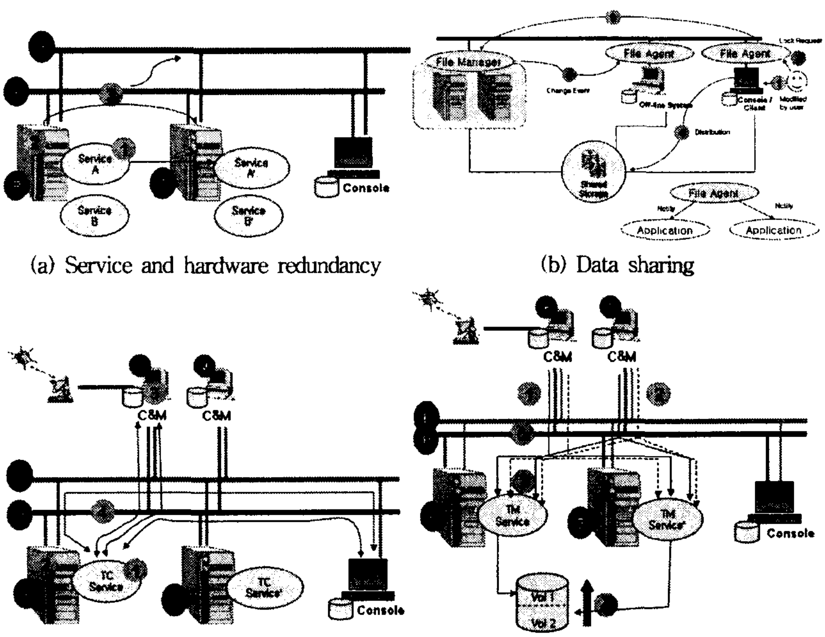
2.1 Fault detection

Fault detection means the way to identify whether the health of system and status of process service are normal or not. HA system generally detects the fault using the heart beat signaling. The first target of fault detection is hardware anomaly such as CPU, network card, disk I/O, etc. The second one is the customized software area such as process error, system environment, application error. Finally, the fault of commercial application such as DBMS if used has to be detected.

2.2 Service redundancy When a process fails, the others are not allowed to affect by this result, while the role of failed process shall be taken over by a backup process. Therefore, service redundancy is the essential factor for defining hardware and software architecture. To take over the process with fault into the other process in one second, the SGCS will adopt the distributed architecture integrated with Fault Tolerant-CORBA and/or commercial HA middleware.

2.3 Data replication and sharing

As data replication is a method of internal data management in the subsystems of SGCS, it is implemented through the data mirroring between primary server and backup server, and so the disk of primary and backup server always has been synchronized. Data sharing is the function for exchanging data between each subsystem. For example, the shared data is such as TAD, CAD, Stored telemetry, command plan and so on. The SGCS is able to efficiently manage the data by data replication and sharing.



(a) Service and hardware redundancy (b) Data sharing

(c) Telecommand redundancy scheme (d) Telemetry redundancy scheme

Figure 2. Fault recovery scheme.

3. FAULT RECOVERY MODELS

Figure 2 describes fault recovery schemes to be applied to COMS SGCS. we assume that network is dual line, primary and backup. Primary network is mainly used for data transmission and backup one is secondarily used to transmit data when the primary is failed. the backup is also used for heartbeat signaling. (a) If it is detected by checking the heartbeat signal that the services and hardware components have a fault, all services is taken over to backup hardware. (b) Data sharing is accomplished by inter-operation between file manager and file agents. In case of changing data file agent requests the write protection to file manager and then file manager only authorizes the file agent. when work is finished, the file manager announces the change of data to all file agents. (c) If telecommand service is failed, backup telecommand service wakes up in stead of primary telecommand service. All clients have to re-connect to backup server. (d) Telemetry is simultaneously received through the primary and backup servers. Even though the primary is disconnected by anomaly, telemetry data can be archived without a lose of data.

4. SYSTEM ARCHITECTURE

The COMS SGCS that fault detection and recovery is considered as was stated above has a overall configuration like Figure 3. As a computing environment is the distributed architecture, we have a plan to apply the Free CORBA, TAO to implement this architecture. The distributed computing using CORBA supports the multi-platform and ensures re-configuration of service objects, easy management and operation, a saving of implementation time. Each subsystem loads the Windows

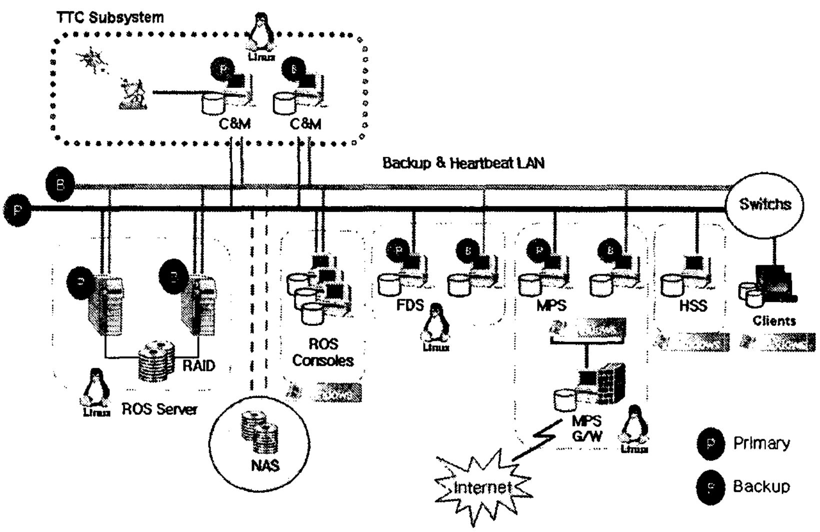


Figure 3. Overall system configuration of COMS SGCS.

or Linux Operating system according to its characteristics. The computer system needs real-time processing, stability, security installs Linux, while the computer of subsystem has its characteristics such as non real-time processing, client console, graphic display adopts Windows operating system

5. CONCLUSIONS

Detailed architecture for obtaining high availability from 24-hour operation satellite ground control system has been presented in this paper. Because the SGCS uses the PC server, free corba, file system, operating system for PC, we can realize a down-sized, low-cost control system. Due to redundancy scheme and data replication and sharing, the SGCS provides high availability and reliability. This architecture will be reflected to implement the SGCS for COMS. After this architecture is verified through the COMS, it will be able to serve as a basic architecture applicable to various geostationary satellites.

REFERENCES

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