RELIABLE OPERATION IN COMS GROUND CENTERS

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ABSTRACT: The COMS ground segment will operate the geostationary satellite continuously 24h/7days and deliver processed data to end-users with respect to the predefined schedule without delay.
For reliable operation, each COMS ground center has internally dual-configuration for critical systems but impossible to every components. Any unexpected failure or regular maintenance to the single configured antenna system may lead the interruption of COMS service and operation. The natural disaster or external attack can destroy one ground center and the operation will be stopped. Therefore COMS program implements backup system remotely located in other centers. Even considering foreign geostationary systems, it's the best solution guaranteeing consistent system operation against internal failure or external disaster.

KEY WORDS: COMS, ground, operation, SOC

1. INTRODUCTION

The COMS (Communication, Ocean, and Meteorological Satellite) is scheduled to be launched in 2009 and operated on geostationary orbit embedding three payloads. The MI (Meteorological Imager) and GOCI (Geostationary Ocean Color Imager) of COMS payloads will transmit observation data to ground.

The main differences of COMS system compared with previous KOMPSAT series are summarized as follows,

1) Continuous satellite operation
2) User dissemination service via the satellite
3) Near real-time/continuous data preprocessing

While the existing KOMPSAT series has limited contact (2~4 times a day) with the KARI ground station, COMS which will be located on the geostationary orbit can contact SOC continuously.

In addition, the unique characteristic of meteorological satellites is to distribute processed data in the LRIT/HRIT coming from ground to end-users. The LRIT/HRIT is the world-wide standard format for meteorological data dissemination. The MI and GOCI data image data along with level 2 product will be included in the LRIT/HRIT.

Therefore to implement a remote backup system in other centers will get out of bounds of the internally dual-configurations and guarantee the continuous ocean and meteorological monitoring using COMS.

We can find the remote backup system in the foreign cases. Foreign meteorological satellite programs have primary and backup remote ground stations as follows;

- EUMESAT MSG: PGS (Usingen, Germany) /BRGS (Maspalomas, Spain)
- NOAA GOES: Primary CDA (Wallops Island, Virginia)/Backup CDA (Greenbelt, Maryland)

While above cases are limited to the backup ground station for satellite operation, COMS system will also have remote backup systems for image preprocessing in other ground centers.

2. COMS REMOTE BACKUP SYSTEMS

The following ground centers will perform ocean and meteorological mission of the COMS program.

- SOC (Satellite Operation Center at Daejeon)
- MSC (Meteorological Satellite Center at Jincheon)
- KOSC (Korea Ocean Satellite Center at Ansan)

The COMS systems which will have remote backup systems and its implementation place are summarized as follows and depicted in figure 1.

- SGCS (Satellite Ground Control System) at SOC/ MSC
- IDACS (Image Data Acquisition and Control System) at MSC, KOSC/SOC

As the MSC and KOSC are primary MI and GOCI data processing centers, each primary IDACS will deal with MI and GOCI, respectively. The remote backup systems for both IDACS are located at the SOC. At each ground center, one antenna system is shared by the SGCS and IDACS.

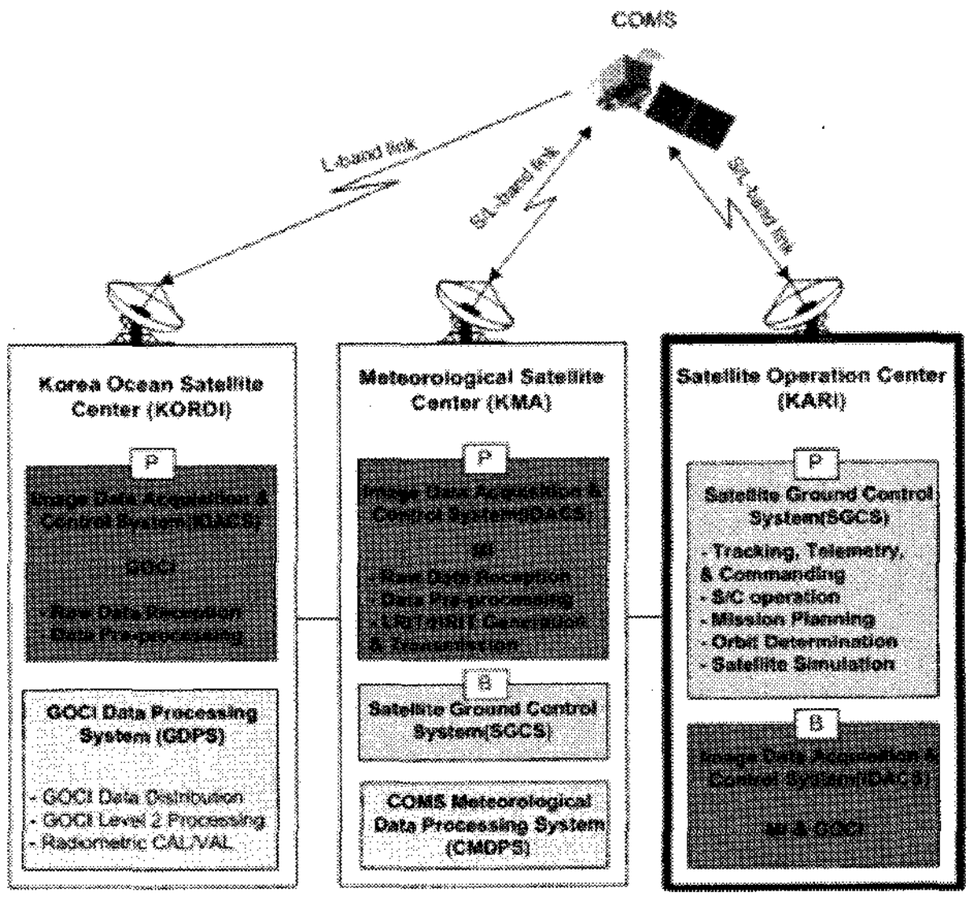

Figure 1. COMS Ground Centers Configuration

2.1 SGCS (Satellite Ground Control System)

The primary SGCS is internally dual-configured at SOC, except the antenna system. Therefore, we can arrange the backup operation using the remote MSC backup system as follows,

1) Satellite operation using MSC TTC equipment
   : remote access from SOC
2) Satellite operation using entire MSC SGCS
   : SOC operators' moving to MSC

Here, the TTC denotes antenna/RF/MODEM/BB equipment of SGCS. When any failure occurred at the SOC TTC, it is not recovered with internally dual-configured equipment, SOC can continue satellite operation using remote MSC TTC.

If failure occurs to SGCS subsystems and dual-configured one is also failed, SOC operators will move to MSC quickly and continue satellite operation using the backup SGCS at MSC. The satellite operation is only permitted to SOC operators.

2.2 IDACS (Image Data Acquisition and Control System)

To perform COMS missions, the availability of acquiring MI/GOCI raw data is considered as the most important thing. To prevent any losses of raw data reception and provide input data to the further processing system without interruption, SOC will have hot-backup operational IDACS so that it can serve MI/GOCI data to the MSC/KOSC and user dissemination service on behalf of MSC. The backup operations using the remote SOC IDACS can be summarized as follows,

1)Resuming user dissemination service using entire SOC IDACS

2)Providing backup MI/GOCI data

Here, the preprocessed data means radiometrically and geometrically corrected MI and GOCI image data. When MSC IDACS can not generate preprocessed MI data, HRIT disseminated by SOC will be input to CMDPS.

Since the IDACS is an autonomous operational system which does not need operators, MSC/KOSC operator's move is not required to operate SOC IDACS.

The use of only antenna system considered in section 2.1 is not treated in this case; 1)The transmission of huge size of image data from MSC IDACS to SOC antenna system over the ground network will lead the long delay time and high maintenance cost for the intermittent use of the broadband dedicated network. 2) The SOC also generates MI/GOCI image data thanks to the hot backup operation.

3. C&M SOFTWARE

The early failure detection can move up the starting of backup operation. The COMS program implements C&M software at SOC and MSC for early detection and fast switching to the backup system.

Both SOC and MSC where the SGCS and IDACS are crossly installed have capability of the satellite operation and user dissemination service. Therefore, when failure occurs, fast operation switching between two centers will reduce the overall service interruption time. The C&M for SGCS and IDACS are executed independently and respectively; TTC and IDACS C&M.

TTC C&M

The coverage of TTC C&M is all units of TTC equipment including antenna system. The TTC C&M at primary SGCS can also control backup TTC equipment at MSC in order to exchange TM/TC generated at SOC with the satellite through the MSC antenna system.

DATS Monitoring

The DATS C&M performs monitoring all units of DATS RF equipment and its monitoring function extends to another IDACS subsystems (IMPS and LHGS). The primary DATS C&M at MSC cannot control backup DATS equipment at SOC, only monitoring is permitted.

It can also display monitoring information of TTC C&M such as working status of antenna, U/C, D/C and LNA controller. When the request message is sent to C&M software, the IDACS status data is replied.

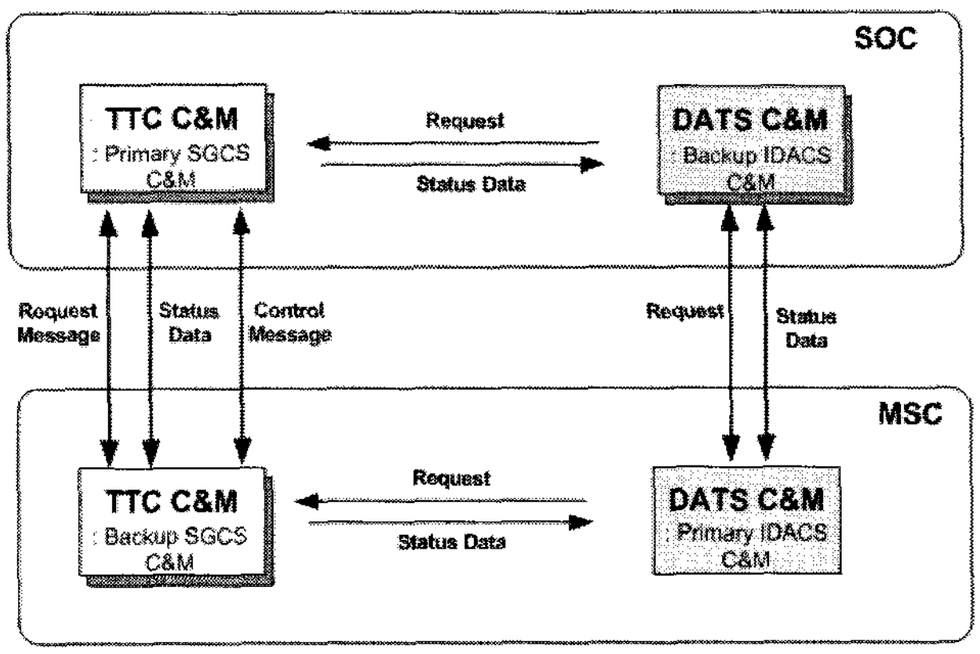

Figure 2. COMS C&M

4. BACKUP OPERATION PROCEDURE

4.1 SGCS Backup Operation

Figure 3 shows the overall SGCS recovery procedure covering internally dual-configured and remote backup system.

This section presents detailed recovery procedure which needs remote backup systems; the failure detection, starting backup operation, and the reverting to the nominal operation.

Satellite Operation using MSC TTC

a. Failure Detection/Notification

1) When any failure occurs at primary SGCS, the primary TTC C&M displays alarm/log messages on the monitor immediately. The operator checks the readiness of backup system using C&M software, in advance. Later, he or she gives a call to the MSC crew to notify SGCS backup operation start.

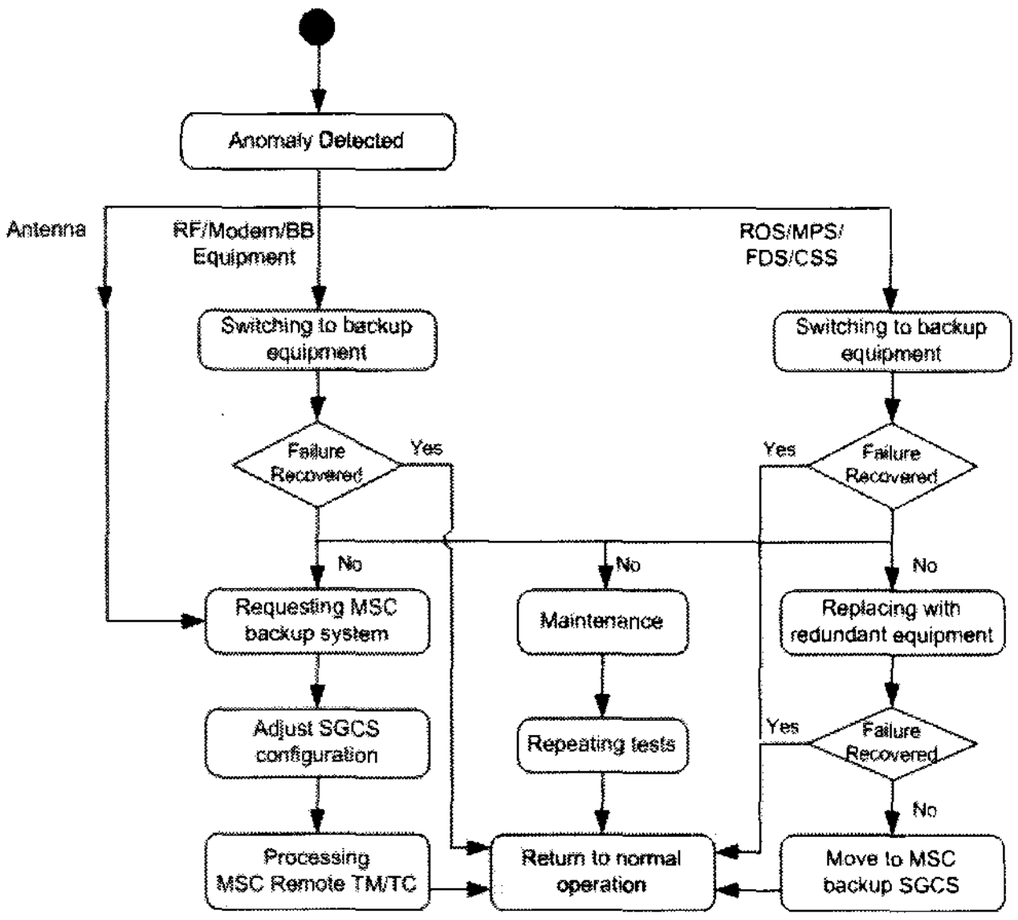

Figure 3. SGCS Recovery Procedure

2) When the antenna maintenance is scheduled, the SOC operator notifies the maintenance plan to MSC crews at least 1 month before the schedule through phone or e-mail. Even after the backup operation plan is fully exchanged between two centers, SOC operator should give a call to MSC crew before starting backup operation.

b. Starting Backup Operation

After notifying backup operation, the operator can start backup operation by changing parameters of the TTC C&M without the effort going to the equipment room.

c. Returning to the Nominal Operation

When the failed equipment is repaired, tests should be repeated to ensure the normal status. If all tests are successfully finished, SOC operator notifies MSC crews to determine operation switching time. The primary TTC C&M will finish MSC SGCS operation and start nominal operation using SOC SGCS. Because MSC SGCS will receive TM even under nominal operation, the overlapping satellite operation is not considered additionally during operation switching.

Satellite Operation using MSC SGCS

a. Failure Detection/Notification

When the warning/alarm messages display on each sub-system's monitor in the format of visual and audio, the operator would operate each internally dual-configured systems. If it is not worked out, the SOC operator gives a call to the MSC crew to notify SGCS backup operation start.

b. Starting Backup Operation

SOC operators move to the MSC in Jincheon quickly and continue satellite operation using the backup SGCS at MSC.

c. Returning to the Nominal Operation

Same as the previous case.

4.2 IDACS Backup Operation

User Dissemination Service using SOC IDACS

a. Failure Detection/Notification

The failure can be detected by the DATS C&M at SOC and MSC. If it is not recovered at MSC, both crews can raise the backup operation using SOC IDACS as shown in figure 4.

b. Starting Backup operation

The SOC operator changes the mode of transmission MODEM/BB at the DATS C&M to disseminate LRIT /HRIT through the SOC MODEM/BB and antenna system.

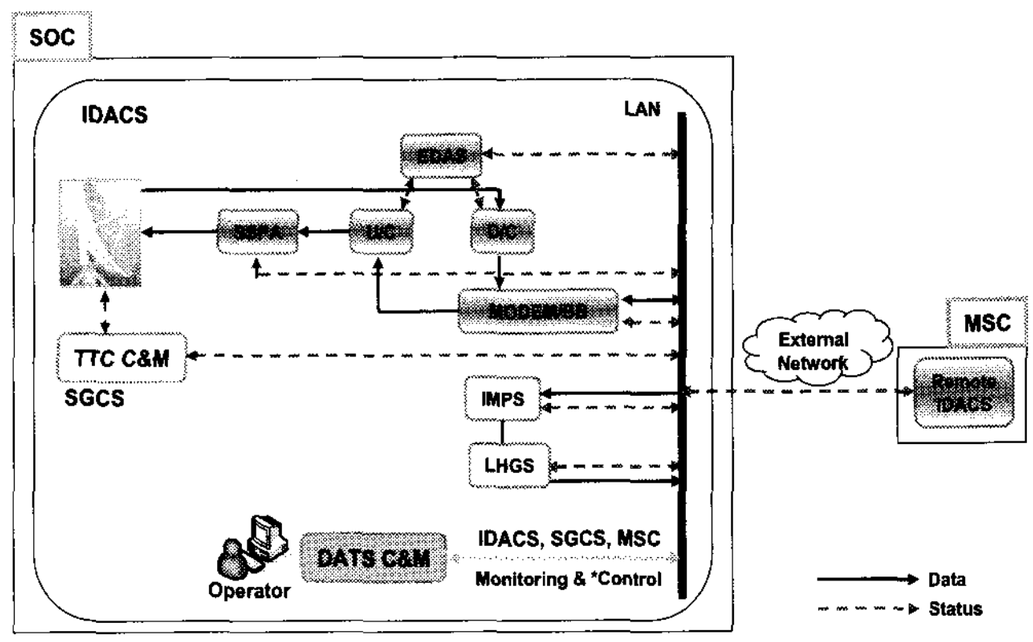

Figure 4. Coverage of DATS C&M

c. Returning to the Nominal Operation

Same as the SGCS case. When the MSC notifies failed equipment is repaired, SOC and MSC crews determine operation switching time. Not to disrupt the dissemination service, the switching should be done between dissemination periods.

Acquiring MI/GOCI Data at Backup IDACS

As remote backup system, the SOC IDACS has short-term archiving policy (maximum 2 weeks). When MSC/KOSC crews request the raw or preprocessed data observed within the recent 2 weeks, the request data will be ready at EDES (External Data Exchange Server). Then MSC/KOSC crews can acquire them via FTP service.

5. OPERATION PARAMETER SYNCHRONIZATION

5.1 SGCS

The MSC SGCS will be turned on but not operated when SOC SGCS is available, except TM reception.

The daily data synchronization for SGCS DB table (e.g., satellite orbit) and configuration parameters is planed from SOC to the MSC SGCS through the dedicated line network.

5.2 IDACS

The MSC/KOSC enables SOC IDACS to generate backup LRIT/HRIT by providing additional LRIT/HRIT data such as typhoon information, CMDPS, alphanumeric text, and GOCI image data. Whenever the operational parameters of primary IDACS are updated, updated information will be delivered to the SOC IDACS in order to generate backup data with identical quality. The interfaces and data format for transmitting IDACS synchronization data are described in SOC-MSC/KOSC ICD.

6. CONCLUSION

The paper dealt with the COMS operational plans for reliable and continuous satellite using remote backup operation. It overcomes the limits of single configured systems and effects from any internal or external troubles.

The COMS GS operational manual will be generated and used for training ground centers' crews. The nominal and backup operation which needs the cooperation of other ground centers will be fully trained and qualified during the COMS system level test before the launch.

The two C&M software used for the quick failure detection and safe switching will also bring compact and efficient operation organization by reducing the number of operators. In the next program of COMS, unified and central C&M software will be developed for more reliable and autonomous operation.

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