Development of SOC DATS C&M (Control and Monitoring) S/W

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ABSTRACT : COMS SOC is supposed to operate IDACS as a backup of MSC. For the backup operation, there is a route between SOC and MSC for exchanging current version such as radiometric calibration for IMPS, dissemination schedule, encryption key and conversion table for LHGS. DATS C&M S/W is basically designed to control and monitor DATS equipment. However, its capability is extended to monitor the working status of IMPS, LHGS and even MSC IDACS. In addition, DATS C&M S/W can display discrepancy between MSC and SOC when applied version is different each other. This paper presents detailed description on the development of DATS C&M S/W.

KEY WORDS: COMS, IDACS, DATS, C&M

1. Introduction

COMS(Communication and Ocean and Meteorological Satellite) Satellite Operation Center is supposed to operate IDACS(Image Data Acquisition and Control System) as a backup of Meteorological Satellite Center. For the backup operation, subsystem synchronization of between MSC and SOC is essential.

IDACS consists of 3 subsystems: DATS (Data Acquisition and Transmission Subsystem), IMPS (Image Preprocessing Subsystem), and LHGS (LRIT/HRIT Generation Subsystem).

IDACS provides the capability to process the received raw data (Meteorological Imager and Geostationary Ocean Color Imager) and disseminate the processed MI data (LRIT/HRIT) to users via a satellite.

DATS C&M is software module implemented in DATS which is one of three subsystems of IDACS. It performs to control and monitor operational parameters and status of all units in DATS equipment and its monitoring function covers even the IMPS and LHGS status. And, DATS C&M can monitor the working status of remote IDACS. Besides that, DATS C&M checks the synchronization of version between MSC IDACS and SOC IDACS.

In this paper, we present Functional Requirement, Operational Concept, and System Design.

2. Functional Requirement

DATS C&M basically collects status from IDACS sub-systems per each polling rate and displays data such as status message, alarm message regarding mismatched version.

DATS C&M provides following 4 functions to support the control and monitoring of IDACS besides monitoring of remote IDACS.[1]

2.1 DATS equipment control and monitoring

DATS equipment is designed to receive request and control command from DATS C&M and to transmit its status to DATS C&M. The related equipment is as followings;

- S-Band 1:1 SSPA assembly
- S-Band 1:1 U/C assembly with controller
- L-Band 1:2 LNA assembly controller
- L-Band 1:2 D/C assembly with controller
- MODEM/BB

Regarding the type of interface, S-Band 1:1 U/C assembly with controller, L-Band 1:2 LNA assembly controller, and L-Band 1:2 D/C assembly with controller will equip only RS-232 interface. That is why a kind of equipment to transform the RS-232 interface to TCP/IP is needed. Therefore, a terminal server which can convert RS-232 serial communication to TCP/IP socket is placed between those equipment and DATS C&M. And DATS C&M communicates with RF Equipment through the terminal server.

Remote equipment, S-Band 1:1 SSPA assembly and MODEM/BB will be directly routed to DATS C&M via TCP/IP.
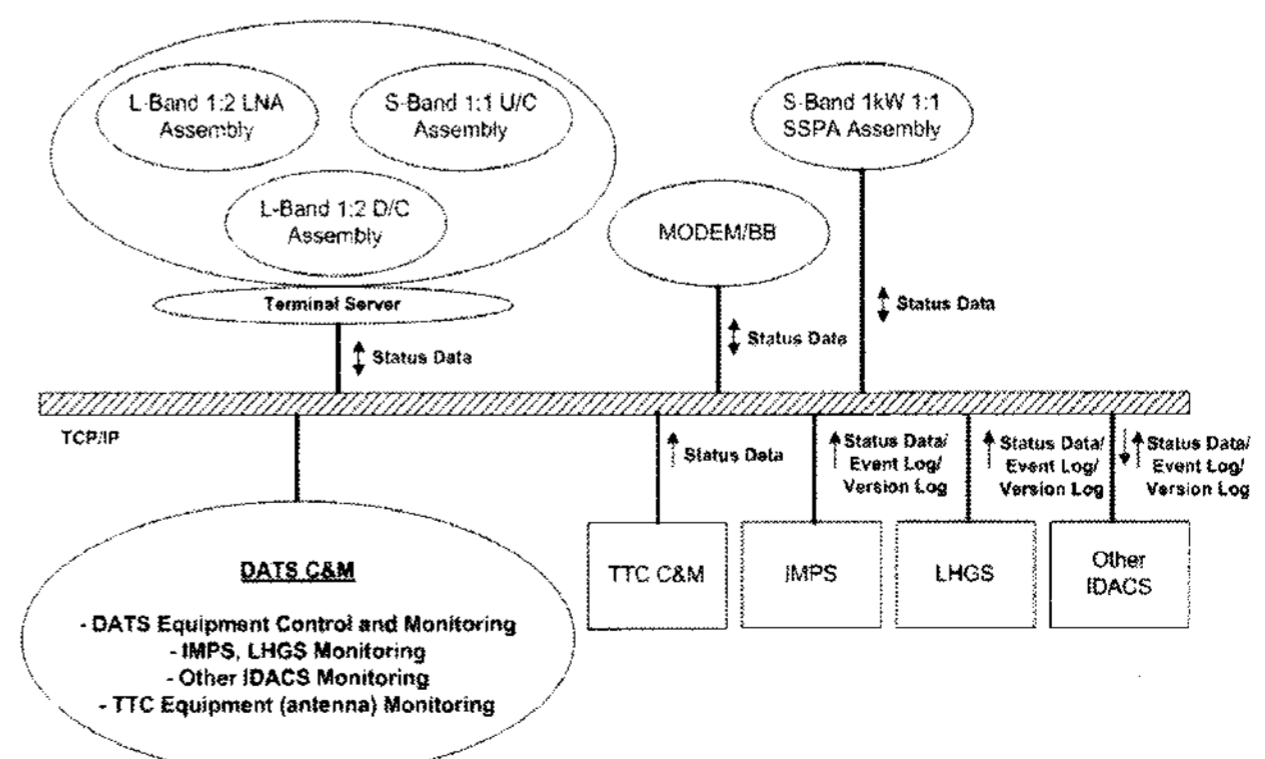

Fig 1. DATS C&M interface configuration

2.2　IMPS, LHGS monitoring

DATS C&M performs the IMPS/LHGS monitoring. Access of DATS C&M for control purpose is not available. Indeed, IMPS and LHGS are capable of a control and monitoring of its status, inherently. However, IMPS and LHGS should notify their major status to DATS C&M which is only route to communicate with IMPS, LHGS in remote IDACS.

Due to the feature of software system, status data, event log and version log are delivered from IMPS and LHGS. Event log and version log should be handled without request command and it means DATS C&M should recognize event log and version log from status data. But, status data dose not.

PMM of IMPS collects the status of DM, IRCM and INRSM and then sends them to DATS C&M while SMM of LHGS collects the status of data pre-processing module, LRIT/HRIT file generation module, compression module, encryption module and CCSDS(Consultative Committee for Space Data Systems) processing module.

2.3　Remote IDACS monitoring

To perform the monitoring of remote IDACS, carbon-copied DATS C&M in remote IDACS should send the status data and event/version log to the counterpart DATS C&M. It helps synchronization between SOC and MSC.

Figure 2 shows the interface configuration between DATS C&M in SOC and carbon-copied DATS C&M in MSC.
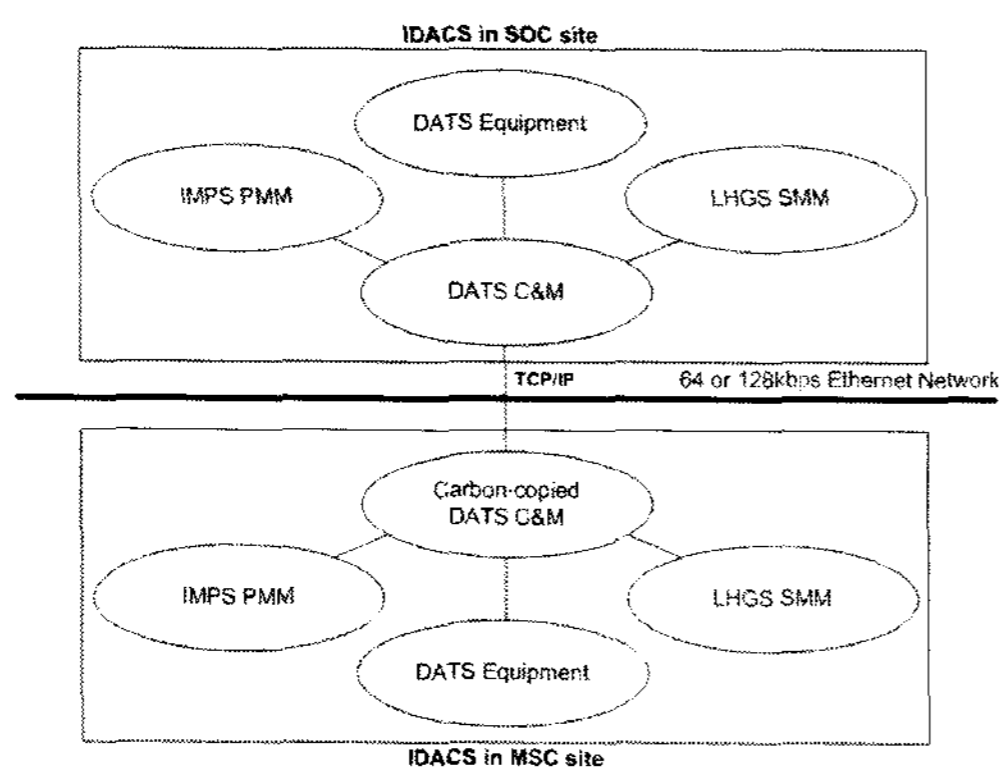

Fig 2. DATS C&M interface configuration between SOC and MSC

2.4　TTC equipment monitoring

The TTC C&M is the main function to control and monitor the equipment in TTC. It performs continuous monitoring while providing automated and manual control of the equipment in TTC. The TTC C&M computer is connected to the ground station LNA to communicate with FDS(Flight Dynamic Subsystem), MODEM/BB, and networked Laser Printer. It also has physical interconnection to the other TTC (antenna, RF, MODEM/BB and timing equipment) to control them and to monitor their status.

DATS C&M performs the monitoring of the major status of TTC equipment through TTC C&M per polling rate.

3.　Operational Concept

In internal interface, prior to the MI(Meteorological Imager)/GOCI(Geostationary Ocean Color Imager) Raw Data receiving, IMPS should send MI/GOCI Raw Data request to MODEM/BB in DATS.
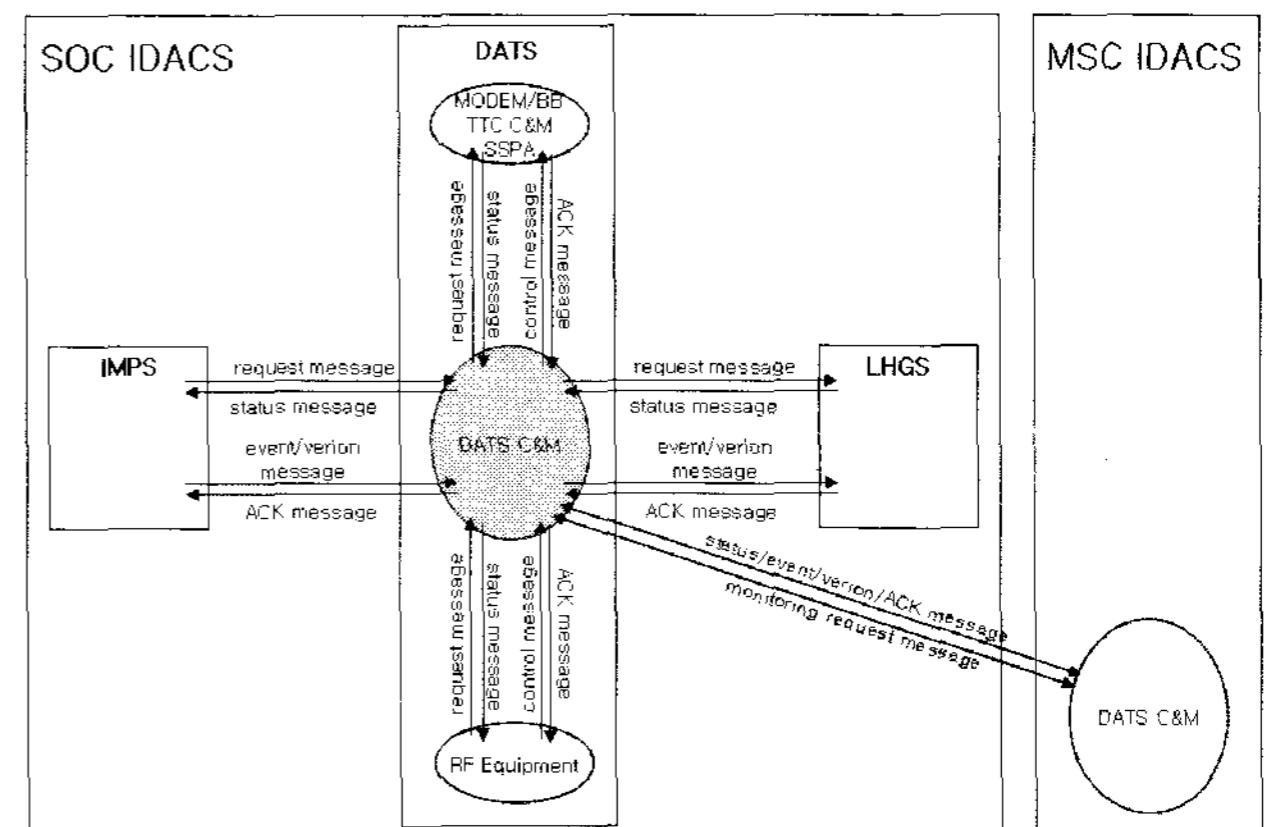

Fig 3. DATS C&M functional configuration

If the request is correct, related MI/GOCI Raw Data should be delivered to DM(Decomposition Module) in IMPS. Otherwise, negative ACK message should be returned to DM in IMPS. For IMPS monitoring, DATS C&M sends monitoring request message to PMM(Product Management Module) in IMPS.

Similarly, if the request is correct, status data of IMPS should be delivered to DATS C&M. Otherwise, negative ACK message should be returned to DATS C&M. Besides status data, event log and version log are delivered to DATS C&M whenever generated.

In the case of interface between DATS and LHGS, one frame of LRIT(Low Rate Information Transmission)/HRIT(High Rate Information Transmission) data is delivered from LHGS to DATS. LHGS waits for the ACK message before sending the next frame of LRIT/HRIT data.

Regarding LHGS monitoring, DATS C&M sends monitoring request message to SMM(Status Management Module) in LHGS. Similarly, if the request is correct, status data of LHGS should be delivered to DATS C&M. Otherwise, negative ACK message should be returned to DATS C&M. Event log and version log are delivered to DATS C&M whenever generated.[2]

Operators can control and monitor RF equipment, MODEM/BB, SSPA, TTC C&M through DATS C&M. For monitoring, DATS C&M sends request message per polling rate and receives status message in accordance with each sending message. In control case, if operators adjust item of DATS Equipment, DATS C&M sends the control message to equipment and then the equipment

sends positive/negative ACK message to DATS C&M. DATS C&M basically communicates with TCP/IP socket. But, RF equipment is performed RS-232 serial communication instead of TCP/IP. Therefore, a terminal server which can convert RS-232 serial communication to TCP/IP socket is placed between that equipment and DATS C&M. And DATS C&M communicates with RF Equipment through the terminal server.

In external interface, there is carbon-copied DATS C&M in the MSC which will be capable of exchanging the monitoring request message and monitoring data such as status data, event log, and version log.
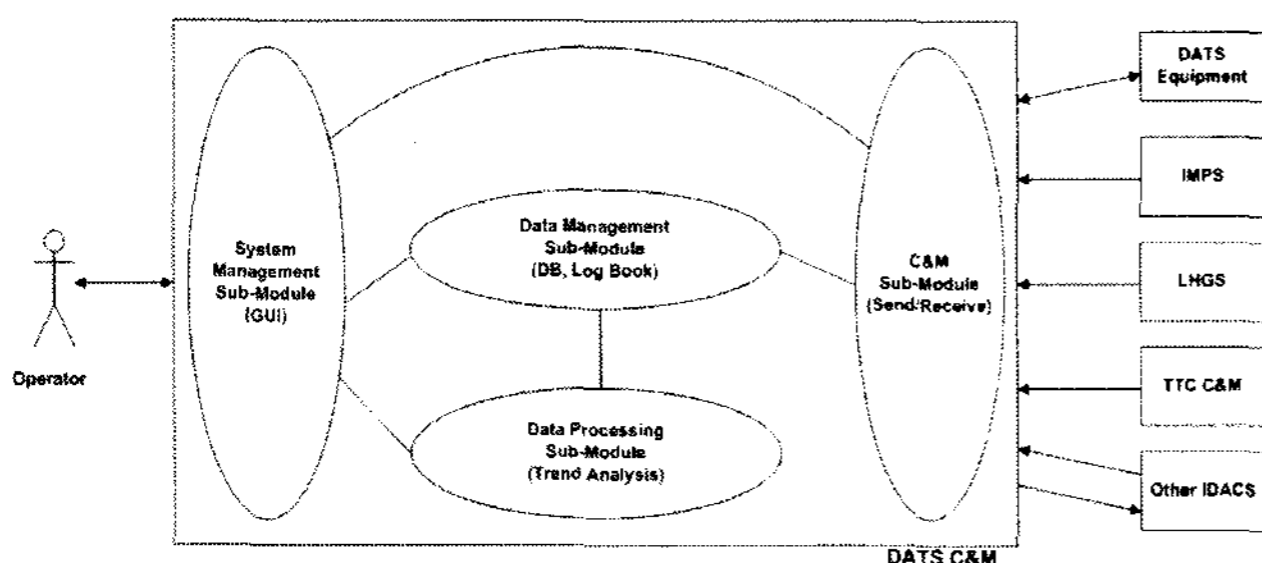
4. System Design

Fig 4. DATS C&M functional configuration

DATS C&M consists of 4 sub-modules, system management sub-module, data management sub-module, data processing sub-module and C&M sub-module.

4.1 System Management Sub-Module

System Management sub-module permits the authorized operator to change the polling rate and connection setting for the DATS equipment, IMPS/LHGS, TTC equipment and remote IDACS monitoring. From this sub-module, operators can include/modify/delete/Search old-log data in data management sub-module.
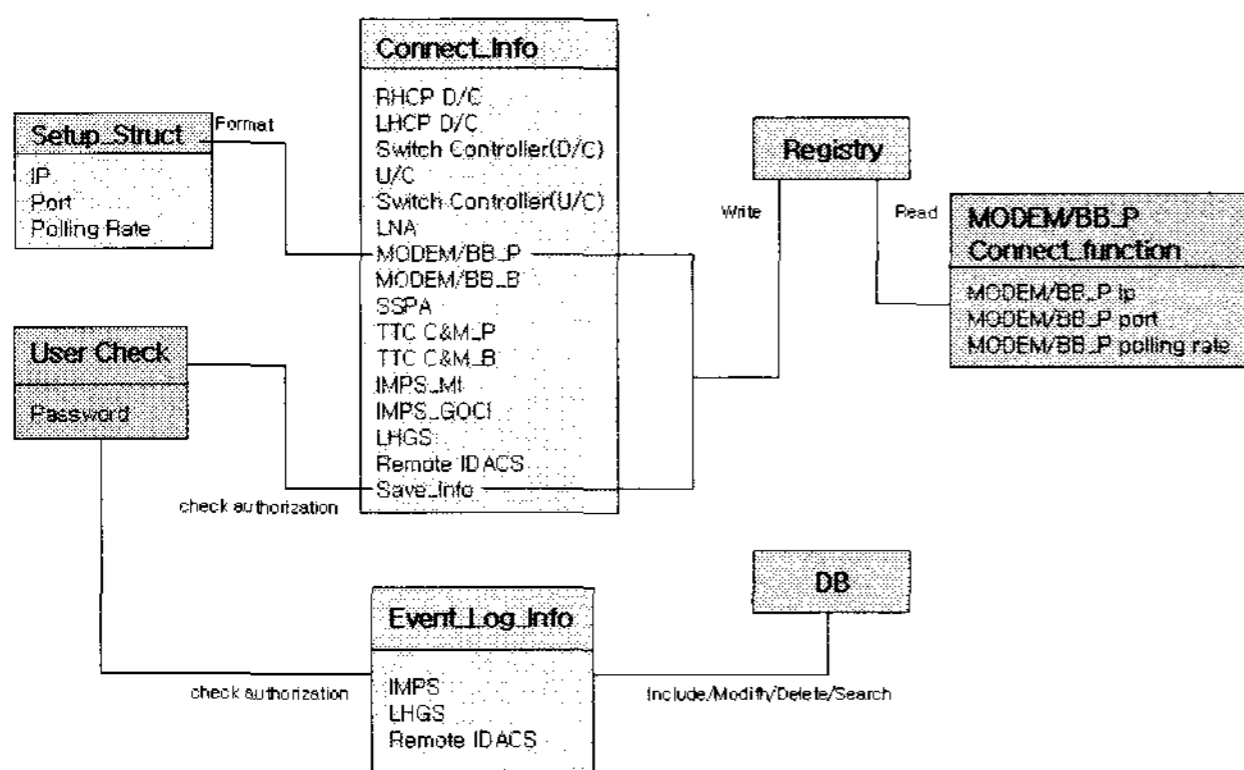

Fig 5. Connection and event log modification process

Figure 5 shows connection and event log modification process in System Management Sub-Module. DATS C&M communicates with DATS equipment and IMPS, LHGS, Remote IDACS. 'Setup_Struct' consists of IP, port, polling rate. It is used to connection between DATS C&M and IDACS sub-systems. When DATS C&M starts, the authorized operator saves parameters of connection for communication in registry. Later, those are used in C&M module. Figure 5 describes example for MODEM/BB primary connection.

And, this module supplies that the authorized operator can modify old event log which is IMPS, LHGS, and remote IDACS Event in Database.

4.2 C&M Sub-Module

This sub-module is capable of sending request message and receiving status data, event log and version to DATS equipment, IMPS, LHGS, TTC C&M and remote IDACS. The returned message related to status data, event log and version log are recognized and displayed to operators through GUI in this sub-module. Indeed, this sub-module can send control command to DATS equipment and this activity is logged in the event file in data management sub-module.

In addition, this sub-module services version management by means of comparing the version's date informed by remote IDACS and local IMPS/LHGS.
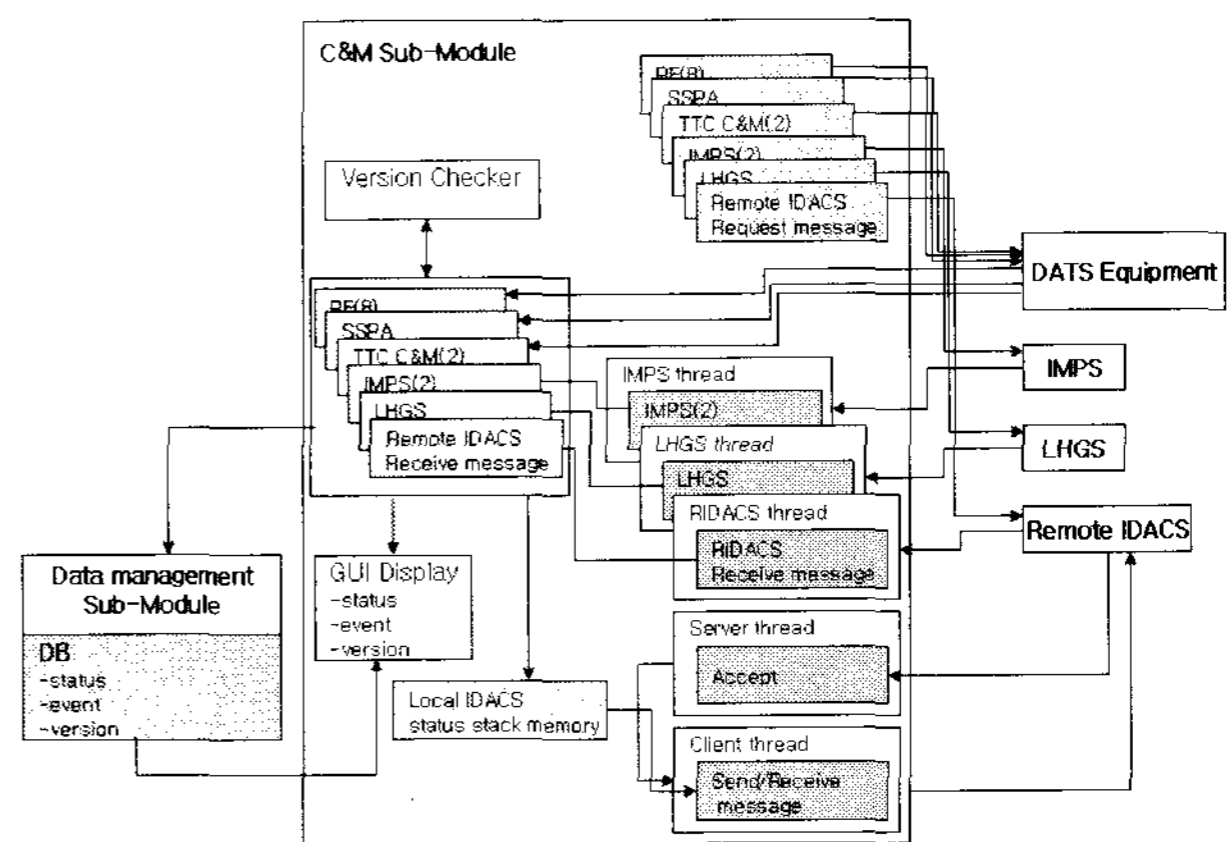

Fig 6. message communication process

Figure 6 shows message communication process in C&M sub-module. Status data is delivered from DATS equipment, IMPS, LHGS, TTC C&M and remote IDACS per polling rate.

When DATS C&M starts, it sends 'request message' to IDACS sub-systems. Concurrently, 3 different thread is running.[3] Each thread is IMPS, LHGS, RIDACS(Remote IDACS). But, DATS equipment thread does not exist. Because, event/version log delivered from IMPS, LHGS and remote IDACS, C&M module is received the log without any request. Also, format of 'request message' is different each other. 'request message' of IMPS, LHGS, Remote IDACS include polling rate information but DATS equipment does not.

Therefore, for example, if IMPS received 'request message' at once from DATS C&M, IMPS PMM module checks polling rate in the message and sends status message to DATS C&M per polling rate.

Therefore only 3 thread is running in C&M module. Otherwise, the C&M module sends 'request message' to DATS equipment per polling rate.

Received messages which are delivered from IDACS are copied to stack memory and the memory is also copied to 'Local IDACS status memory'. With reference, we use event objects to prevent several threads from reading from a shared memory buffer while a master thread is writing to that buffer.

DATS C&M sends local IDACS information to remote IDACS in this module. For this operation, server thread is running for waiting accept remote IDACS connection. If acceptance occurred to local DATS C&M, server thread creates client thread for communicating with remote DATS C&M. Client thread sends message of local information to remote DATS C&M refer to 'Local IDACS status memory'.[4] The sending messages include not only status of local IDACS but also local version of IMPS, LHGS. This route helps the synchronization between SOC and MSC for exchanging current version such as radiometric calibration for IMPS, dissemination schedule, encryption key and conversion table for LHGS.

4.3 Data Management Sub-Module

Data Management sub-module performs the saving of status data, event log, and version log every day.

Status data and version log are saved in DBMS(Database Management System) and event log is saved by text file.[5]

Especially, for trend analysis, data processing sub-module request CSV file for data management sub-module module. And then, data management sub-module creates and saves CSV file from MDB file depend on the request.

4.4 Data Processing Sub-Module

Data processing sub-module provides a capability of trend analysis on the link parameter, such as Eb/No, power level, frequency stability, etc. This sub-module is capable of extracting parameter saved in specific date inputted by operator.

When an operator inputs the selected parameter such as save item and duration, this module searches related item through Data Management module. If there is no selected item in storage disk, then message which indicates that the item is not available is displayed on GUI. Otherwise, Data Management module delivers the item to this module for trend analysis. The result of trend analysis is displayed as a type of graph or text. For drawing graph, ChartFX software is used by this module. With reference, ChartFX is COTS(Commercial Off-The Shelf) software which supplies API for drawing Chart on Visual Studio.NET, JAVA, etc. [6]

5. Conclusion

In this paper, we presented the DATS C&M developed for control and monitoring IDACS.

For backup operation, Synchronization of IDACS is important between SOC and MSC. DATS C&M monitor each sub systems of local IDACS and transmit status, event log, and version log to remote DATS C&M. Additionally, the C&M system support to control DATS equipment. Therefore, it helps synchronization for backup operation between two systems which is located in different area.

Figure 7 shows a part of DATS C&M GUI. IMPS, LHGS, TTC C&M, SSPA dialogs displayed status through communicating with simulator of IMPS, LHGS, TTC C&M and SSPA equipment. And main dialog shows architecture of local IDACS, interface of remote IDACS, and major monitoring item of local IDACS.

The development of DATS C&M will contribute to the development of the evolved control & monitoring system for future mission.
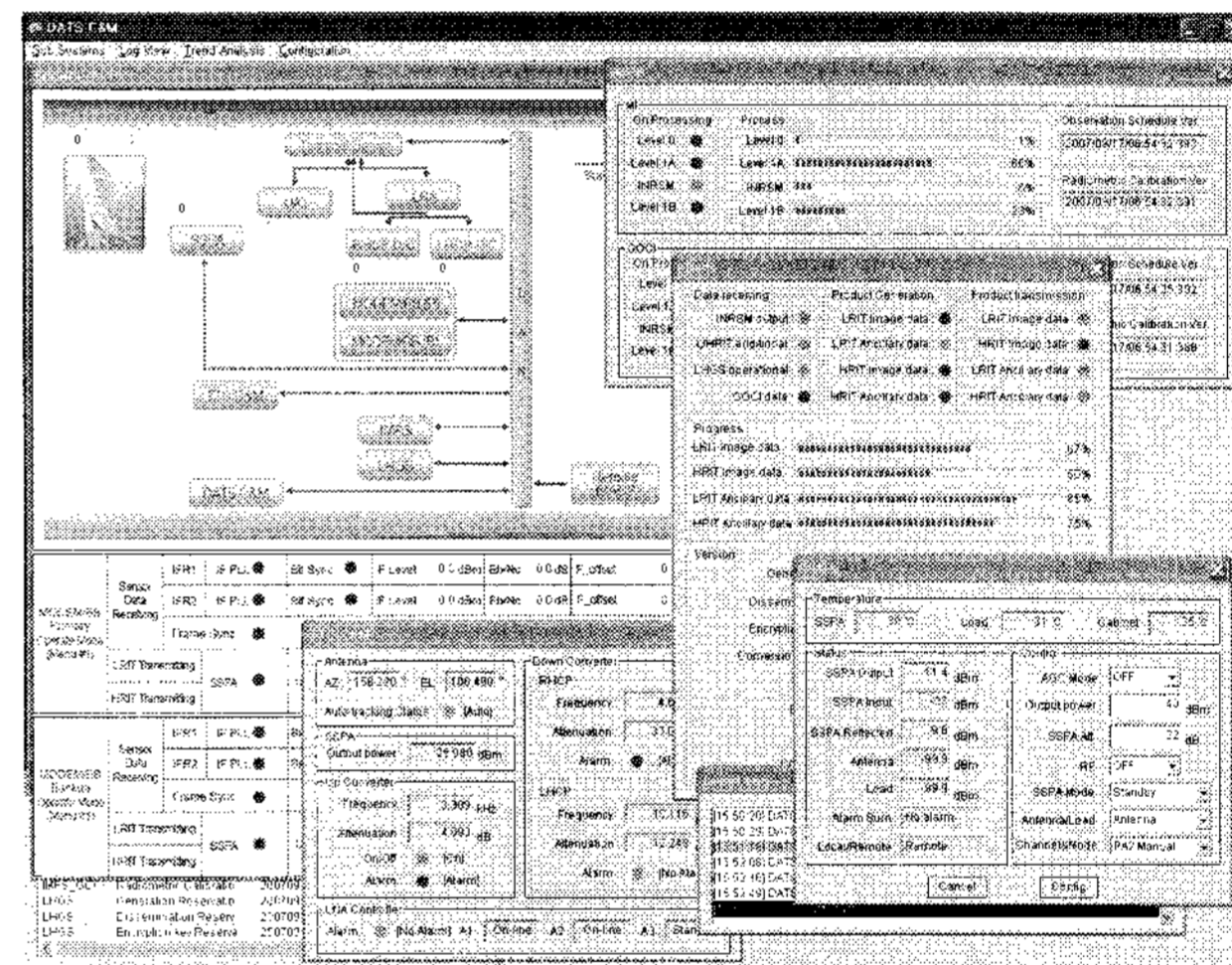

Fig 7. DATS C&M Main GUI

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