Development of the KOBAS2 for monitoring the health status of KOMPSAT-2

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The number of satellite under operation is being on the increase, however, because the number of operator is limited the reliable control system is necessary for stable mission operation. Especially it is necessary that error event indication such as colour or sound should be displayed with high reliability for intuitional monitoring. The limit range of KOBAS2 provides realistic value that is defined with in-orbit value and related document. It makes it possible for operator to monitor a number of telemetry data easily through single screen system instead of monitoring each mnemonics. The development and operation experience of KOBAS2 will contribute to the development of the evolved automatic telemetry monitoring system for future mission.

KEY WORDS: KOMPSAT-2, Telemetry, KGS, KOBAS2

1. Introduction

KOMPSAT-2 is an Earth Observation Satellite which is equipped with high resolution camera called MSC(Multi Spectral Camera). For monitoring of SOH(Status Of Health), satellite transmits telemetry data via S-band frequency and operator monitors this status using a telemetry page at SOS(Satellite Operating Subsystem). To increase the availability of telemetry monitoring system, KGS had developed the KOBAS2(KOmpsat BAckup Sos 2) as a backup system of SOS. KOBAS2 is a window-based program and user-friendly program which has several upgraded items comparing to SOS that is based on UNIX. The first key item is an analog and discrete colour alarm function that shows a SOH as green, yellow and red colour with a limit database in accordance with satellite's sub mode. And second key item is the single screen alarm system that shows an abnormal telemetry status through one screen.

The single screen concept lends itself to automation because the operator does not need to monitor every concerned telemetry item. A process runs continuously that monitors the telemetry processing in the background process. If an alarm condition occurs it is displayed on the alarm screen.

2. Software implementation and operation

2.1. K2 Telemetry processing scheme

Generally Ground station consists of domestic sites and foreign sites. As domestic sites within KGS(KARI Ground Station), KARI is operating two antenna system for KOMPSAT-2 LEOP period. As foreign sites, KGS has K02 antenna system in Antarctic area where Korea has science research station called SEJONG station. And for normal external station during K-2 LEOP, KARI operated KSAT antenna system that belongs to one of the Norway satellite agency.

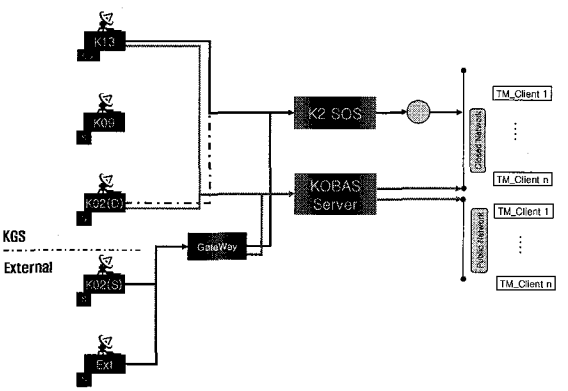

Fig 1. Telemetry Processing Data flow

Figure 1 shows that KGS is operating K13 antenna system as primary system and K02 antenna system as backup system. SOS system is a command/telemetry processing system based on UNIX and KOBAS is a telemetry processing system based on Windows that is developed by KGS itself. Both systems make a link connection to Cortex of which role is a front-end-processor for telemetry processing. KOBAS makes a connection to all available antenna system and distributes telemetry from first available link to client, in contrast to SOS that makes only one connection at a time. For external TTC connection, both systems make a connection via gateway system. Gateway transforms data format from external TTC into compatible data format for SOS and KOBAS. i.e. variable data format such as CADU format, Randomized and RS-encoded data is changed to 288byte data(Cortex header 64 byte + VCDU 220 byte + Cortex tailor 4 byte). Control center is physically isolated in network concept and KOBAS can distribute telemetry to a client within closed network as well as public network in contrast to SOS which is available only in closed network.

The best feature of KOMPSAT-2 telemetry processing is that bus uses fixed scheme using Grid and payload uses flexible scheme using packet format. Grid is a data table

that shows a byte location with 32 second cycle. And packet scheme is that the every downloaded frame has packet number and GS extract telemetry referring database using packet ID.

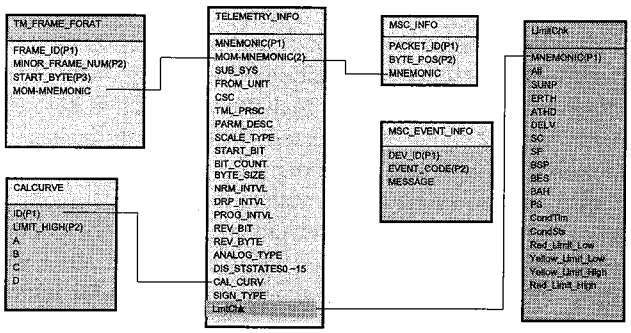

Fig 2. Database structure for telemetry processing

Figure 2 shows the database structure for telemetry processing. TELEMETRY_INFO table provides essential information about specific mnemonics and TM_FRAME_INFO table provides a byte location out of one frame for bus telemetry. In case of MSC telemetry, software gets the information of Mom mnemonic and packet ID through the MSC_INFO table. Analog value is extracted to EU(Engineering Unit) value through applying calibration curve and, discrete value is expressed to EU value via the information of TELEMETRY_INFO table. One of the TELEMETRY_INFO field is for checking the limit check and, in case of out-of-limit, this EU value is expressed using a colour such as green, yellow and red. At this time limit range is different with satellite's sub-mode as the LimitChk table. All filed is checked in case of same limit value in the all sub-mode. MSC_Event_Info table is used to show the MSC event log that is dumped from MSC onboard by monitoring the MSC itself such as command acknowledge, voltage and temperature anomaly status etc. The above database is implemented with text file to access easy and fast.

2.2. KOBAS2 function

KOBAS2 is the dedicated program for telemetry processing based on PC/Windows that is developed by KGS itself and very user-friendly software that implements key user-needed item. And also, operator can change the limit value easily so that they can monitor the real time anomaly status and long term variation.

The key feature of KOBAS2 is as followings.

- **High reliability for Telemetry Link connection**

KOBAS2 makes a link connection to all available Cortex system and the first available telemetry data is distributed to all clients. Especially, Control center has closed-network system for security and virus protection from external network. KOBAS server has two network cards so that it can provide telemetry data to internal users as well as external users.

- **Easy Telemetry page generation**

Operator should generate telemetry page to monitor specific telemetry items. At this time, SOS should re-run application software to show the new generated telemetry page but KOBAS2 can show the new generated telemetry without re-running a software. In KOBAS2 software new telemetry page is able to be generated by the embedded page generation function or general text editor.

- **User defined colour alarm function**

KOBAS2 can define different limit value in accordance with satellite's sub-mode and it is possible to define the limit value in analog value as well as discrete value. Therefore, operator can recognize that satellite's status is normal through no red colour alarm without some knowledge about telemetry.

- **Quick look mnemonic description**

Operator can see the description of telemetry in bottom of telemetry page by locating mouse pointer over the telemetry mnemonic. Operator is able to modify the description easily and in case of critical telemetry, it provides the number of operation procedure as well as ready command sequence.

- **Single Screen alarm system**

A process runs continuously that monitors the telemetry with background concept. If an alarm condition occurs it is displayed on the single screen page. It also provides the description about telemetry including quick action information about how to do immediately.

- **RAW data file archive at local PC**

While telemetry is displayed, it is stored in specific directory of local PC for quick trend analysis by operator.

2.3. KOBAS2 operation

The definition of alarm value is as followings;

- Analog value
  - Red Low : Min value -2
  - Yellow Low : Min value -1
  - Yellow High : Max value + 1
  - Red High : Max Value + 2

Min/Max value is derived from real in-orbit value that is calculated for several days as average value during stabilized phase after launch. However, some item such as tank pressure value is set very tightly to monitor a fuel leakage.

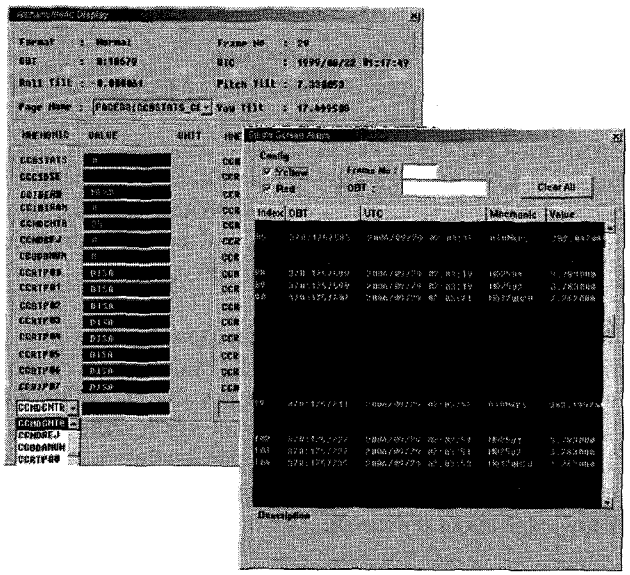

Fig 3. Telemetry/Single Screen System page

It was difficult to recognize the value variation as colour alarm such as voltage and temperature because the provided limit value is the design value that has the difference from real in-orbit value. However, limit value is re-configured with real in-orbit value including a tight margin so that operator is able to recognize the satellite's status easily. Usually the anomaly of some unit causes the temperature or current increase. And as life time goes by and degradation occurs, it causes temperature increase so that it is able to be used to monitor the long term performance.

- Discrete value
  - Yellow : Information (Concerned All value Green while Imaging)
  - Red : Critical Error

For discrete value, it is set up as green while normal operation such as imaging phase or nadir pointing. When some change item happens, this value indicates its status as yellow colour for operator to recognize the satellite status. In case of red colour, it indicates satellite's unexpected situation.

The above items is monitored through one page called single screen system and when the event occurs, analog value is displayed as yellow or red colour and discrete value is displayed as red. The single screen concept lends itself to automation because the operator does not need to monitor every concerned telemetry item. A process runs continuously that monitors the telemetry processing in the background process. If an alarm condition occurs it is displayed on the alarm screen.

3. Conclusion

The number of satellite under operation is being on the increase but with the limited number of operators the reliable control system is necessary for stable mission operation. Especially it is necessary that error event indication such as colour or sound should be displayed with high reliability for intuitional monitoring. The limit range of KOBAS2 provides realistic value that is defined with in-orbit value and related document. It makes it possible for operator to monitor a number of telemetry easily through single screen system instead of monitoring each mnemonics. The development and operation experience of KOBAS2 will contribute to the development of the evolved monitoring system for future mission.

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