DESIGN OF MI DECOMPOSITION MODULE FOR THE COMS IMPS

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ABSTRACT:
COMS has two imaging payloads, MI (Meteorological Imager) and GOCI (Geostationary Ocean Colour Imager). In GOCI case, data are packaged per each slot - one part of 16 two-dimensional arrays for imaging sensors - so its generation algorithm is simple. But MI case, data are made up with sequences of 480 bit blocks and are transmitted to its ground station sequentially. Moreover there is no time information in each 480 bit MI block, so a system in its ground system should be attaching time information at received MI blocks. DM (Decomposition Module) is one module of IMPS that receives Raw Data from DATS and generates Level 0 Products that include time tagging. This paper explains DM design for MI of COMS payloads.

KEY WORDS: COMS, IMPS, DM, MI, ITT Imager

1. INTRODUCTION

The COMS, to be launched in year 2008, will be the first geostationary observation satellite in Korea. The COMS mission primary objectives are a meteorological service, ocean monitoring, and Ka-band satellite communications.

The COMS IMPS is one part of the COMS IDACS and provides the capability to process decomposition, radiometric correction, navigation and registration, and products management of data. COMS IMPS are composed of 4 modules; DM, IRCM, INRSM, and PMM.

DM (Decomposition Module)
The DM classifies raw data from the DATS (Data Acquisition and Transmission Subsystem) into two types of raw data, MI raw data and GOCI raw data. Each sensor data will be went over channel or slot classification. Finally result of the DM is LV0 Products composed of image (PXL, pixel) and auxiliary (AUX) data.

IRCM (Instrument Radiometric Correction Module)
The first image processing applied to LV0 Products are radiometric correction. The purpose of applying radiometric correction is to reduce the influence of any non-linearity of instrument detectors and equalize the different response of each detector. As a result, LV1A Products are generated in the IMPS.
First of all, raw data received from the DATS are separated into MI and GOCI raw data. Since raw data contains all observation data including image and auxiliary data, extraction of LV0 Products which are needed for further processing is performed.

INRSM (Image Navigation & Registration Software Module)
After radiometric correction, LV1A Products are geometrically corrected by the Image Navigation and Registration S/W Module (INRSM). The corrected image is referenced as LV1B image. For the processing in the INRSM, the INRSM should process data from the primary SGCS (Satellite Ground Control System), witch includes extracted TLM (Telemetry) data, flight dynamics data and so on. It also interfaces with the PMM (Product Management Module) for the geometric quality check on LV1B images. The INRSM is designed and developed by ASTRIUM SAS, so this paper is not concerned in the INRSM.

PMM (Product Management Module)
The PMM will manage all of product in the IMPS. Therefore the PMM is interfaced with the other IMPS modules - DM, IRCM, and INRSM - and monitors status, interface, and quality of the modules. In addition to monitoring, the PMM provides functions of real time Quick-Look on generating data for user convenience.

Figure 1 shows the IMPS overall organization on a viewpoint of the IMPS modules.

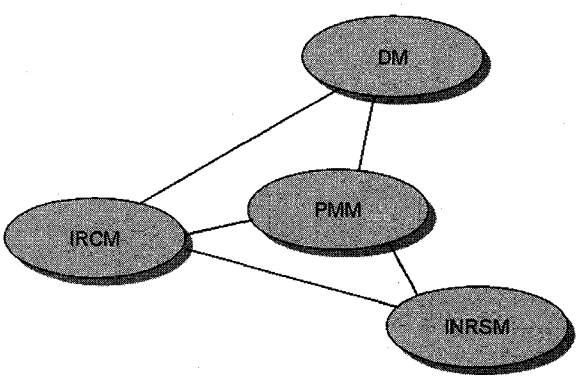

Figure 1. Overall Organization of the IMPS

2. DATA FORMATS

2.1 Sensor Data

Sensor Data are defined that transmitted data from the COMS to the Ground Segment for transmitting of imager observation data. Sensor Data are received as CADU (Channel Access Data Unit) bit streams and are converted to Raw Data in the Modem/BB (Modem Base-Band) of the COMS GS.

2.2 Raw Data

Raw Data are defined that data blocks transmitting from the DATS to the IMPS. That is made up of MODEM/BB specific header, VCDU (Virtual Channel Data Unit), and MODEM/BB specific Trailer. Raw Data are not including fill packet data of VCDU. File names of Raw Data shall be defined as 4 kinds of information.

- File kind : RAW_MI_ or RAW_GCOI_
- Data Reference : Data/time of the 1st 1,168 byte Raw Data reception, dd-mmm-yyyy-hhh-mn-ss-ms_
- Raw Data file number of day : Raw Data file number receiving from the midnight of every day, starting at 0000
- File type : fixed to .raw

Table 1. Detailed Raw Data Format

Start Position	Length	Contents	Remarks
0	4	Preamble	1234567890_{10}
4	4	Message Size	1168 = 64 + 1,100 + 4
8	4	User Configurable	Set to 0
12	4	Number of Sec elapsed since Jan. 1st 00:00:00:000 of current year (long)	
16	4	Number of milisecond elapsed since current sec (float)	
20	4	Sequence Counter	4 byte Ring Counter
24	4	Frame Check Result	Error Correction Result
28	4	Frame Sync Status	Frame Sync Status
32	4	Bit Slip	Bit Slip Status
36	4	Telemetry Delay	Telemetry Delay Info.
40	4	Frame Length	Frame Length = 11,000
44	4	Syn Word Length	Sync Word = 0x1ACFFC1D
48	4	Frame Status	Frame Check & RS Status
52	4	Transmitted Data	Shows Registry Setting
56	4	Unused	-
60	4	Unused	-
64	1,100	Data	VCDU
1,164	4	Postamble	-1234567890_{10}

Figure 2 shows construction of the Raw Data format. Detailed format of the Raw Data is explained at Table 1.

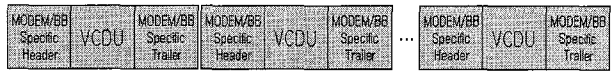

Figure 2. Raw Data Format

Raw Data are generated from three kinds of CADU; MI CADU, Fill CADU, and GOCI CADU. MI CADU is made up with sequences of one MI source packet header and 38 MI data blocks. Detailed packet contents are specified in the ITT Imager Operational Reference Manual.

2.3 Level 0 Product

LV0 (Level 0) Product are defined that decomposed data from the DM of the IMPS. That is made with PXL (Pixel) files and AUX (Auxiliary) files. For MI case, the PXL files of the LV0 Products are channel combined block unit files. Wideband telemetry information of MI imager is contained at the Auxiliary file of MI LV0 Product. File names of LV0 Product shall be defined as 4 kinds of information.

- File kind : MI_LV0_
- Data Reference : Starting data/ time of the LV0 product generation , dd-mmm-yyyy-hhh-mn-ss-ms_
- Observation number of day : Observation number in the MI observation schedule, starting at 0000
- File type : .pxl (PXL file) or .aux (AUX file)

MI PXL files of LV0 Product can be made by simplified re-assembling of pixel information in the Raw Data, but Auxiliary files need more complicated format. So 5 kinds of structures are proposed in this paper. Detailed format of structures will be explained at the next paragraph.

3. STRUCTURES FOR MI LV0 PRODUCT

Five structures are designed for AUX file of MI LV0 Products.

strHeaderTrailer structure is designed to store header information and trailer information per each scan line for MI image. The strHeaderTrailer structure has TMI ring counter for time stamping. Each line has one header and one trailer, and has a lot of fixed number of pixel information. So, TMI Ring Counter can be generates receiving time per each scan line.

strActiveScan structure is designed to store pixel information for VIS (Visible) and IR (Infra Red) band image, and for additional information like IMC and scan motor errors.

strTelemetry structure is designed to store wideband telemetry and command echo, and strEcal structure is designed to store electric calibration information. The last structure strScanReversal is made up with 4 kinds of structures that explained already. Table 2 shows defined structures of MI LV0 product.

4. MI LV0 AUX FILE FORMAT DESIGN

MI LV0 AUX files are made up with composition of structures of MI LV0 AUX files. Table 3 shows designed MI LV0 AUX files format and Table 4 shows defined information id for MI LV0 AUX files.

ID 0x00 indicates that contained information are header and scan reversal information per each scan line. ID 0x01 means Space Look information, ID 0x02 means Black Body information, and ID 0x03 means Star Sense information. All of MI LV0 AUX files are made up with structures that defined at Table 2.

Table 2. Structures of MI LV0 Product

Structure Name	Contents
strHeaderTrailer	TMI Ring Counter
	scan flag #1
	scan flag #2
	scan flag #3
	S/C Attitude
	E-W Present Scan Add
	N-S Present Scan Address
strActiveScan	VIS#1 pixels
	VIS#2 pixels
	VIS#3 pixels
	VIS#4 pixels
	IR1 A&B
	IR2 A&B
	IR3 A&B
	IR4 A&B
	E-W Error
	E-W IMC
	N-S Error
	N-S IMC
strTelemetry	Proportional Command Echo
	Telemetry Word #1
	Telemetry Word #2
strEcal	VIS#1 pixels
	VIS#2 pixels
	VIS#3 pixels
	VIS#4 pixels
	IR1 A&B
	IR2 A&B
	IR3 A&B
	IR4 A&B
	E-Cal step #
strScanReversal	strActive[3]
	strHeaderTrailer
	strActiveScan[15]
	strTelemetry[39]
	strEcal[160]

Table 3. Designed MI LV0 AUX file format

Classification	Explanation
File Length	MI Auxiliary File Size
Information ID No.	No of Information ID in MI Auxiliary File
Information ID	Information ID (See Table 2)
Information Length	Length of Information
Information Contents	Contents of Information (See Table 3)
Information ID	Information ID
Information Length	Length of Information
Information Contents	Contents of Information
...	
Information ID	Information ID
Information Length	Length of Information
Information Contents	Contents of Information

Table 4. Information ID of MI LV0 AUX files

Info. ID	Contents
0	Header and scan reversal Information per each scan line
1	Space Look Information
2	Black Body Information
3	Star Sense Information

5. DM DESIGN FOR MI DATA

5.1 Time limitation for DM processing

Raw Data from the DATS are converted to LV0 Product in the DM of the IMPS. Time limitation is one of important issue in MI LV0 Product generation. Because of the DM is the first part of IMPS, so speedy processing is required. For the processing time limitation, follows equation is proposed.

$$\text{Processing Time Limitation} = PT + (\text{VIS\_Scan\_Line\_No} / 1{,}100) * TT \text{ [Sec]}$$

Here, VIS_Scan_Line_No means received VIS channel scanning line number in the Raw Data. *PT* is required time for MI LV0 generation and *TT* is required time for MI LV0 transmission via LHGS (LRIT HRIT Generation Subsystem) and the DATS of the IDACS (Image Data Acquisition and Control System Specification). *PT* and *TT* will be conformed after doing some analysis for processing and transmission time together with LHGS of IDACS.

5.2 Functional Design

Main functions of the DM are Raw Data receiving, LV0 Product generation, LV0 Product transmission and archiving, and status display and transmission. Figure 3 shows functions of the DM.

Raw Data Receiving is first step for DM processing. In Raw Data receiving processing, DM should be extract MI data blocks that made up with 480 bit per each data block. Every 38 MI data blocks have 6 bytes primary packet header that contains Satellite ID, virtual channel ID, virtual channel data unit counter, and signalling field. Detailed information are specified in the ITT Imager Operational Reference Manual.

The DM should have function of LV0 Product generation that convert Raw Data to LV0 PXL file and

LV0 AUX file. Format of MI LV0 PXL files and AUX files are explained already. And the DM should have function of LV0 Product transmission and archiving. Generated MI LV0 Product are transmitted to the IRCM (Image Radiometric Correction Module) of IMPS for next step, image radiometric correction and archived during 2 weeks in the disk of DM.

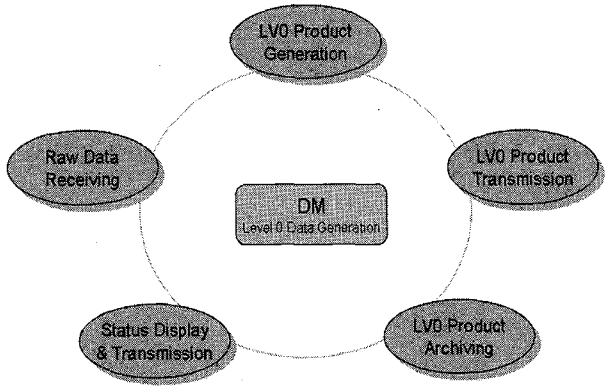

Figure 3. Main functions of DM

Status of DM are extracting and transmitting to the PMM of the IMPS for status monitoring and module control. Defined core status of DM are Raw Data processing status and LV0 processing status, and additional status are will be defined as DM core status.

For growing up system performance, the DM can be considered separated system for MI and GOCI processing, respectively. So, the DM shall be capable of processing that has capability of classification for data type, MI, GOCI, or fill data. All of Data generated in the DM are composed to two file, PXL files and AUX files except fill data. The PXL files are made with only observation data from imager and the AUX files are made with the others additional information, for data of radiometric calibration, data of geometric correction, data of time calculation, and so on.

5.3 Interface Design

DM is receiving Raw Data from the DATS of the IDACS and is transmitting LV0 Product to the IRCM of the IMPS. So Interface design of the DM is very simple. Design of data interface for the DM is summarized that input data of DM is Raw Data from the DATS and output data is LV0 Product to the IRCM.

6. CONCLUSIONS

This paper explains design of MI DM of the IMPS. First of all, data format was introduced that is defined format for Sensor Data, Raw Data, and LV0 Product. For the next step, Structures of LV0 Product and AUX file format was explained. Finally designed DM for MI data was mentioned based on time limitation, function, and Interface. The results of this paper will be reflected on the documents of COMS GS CDR (Ground Segment Critical Design Review).

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