# OVERVIEW OF COMS GROUND SYSTEM AT METEOROLOGICAL SATELLITE CENTER OF KMA

Hyun-Kyoung Lee, Bong-Ju Lee, Yong-Sang Lee, Jae-Myun Shim, Ae-Sook Suh, Hong-Sic Kim*, Chang-Eon Je**

Meteorological Satellite Division, Korea Meteorological Administration, Saea Soft*, EN3**
{hklee,bjlee,yslee,jmshim2,assuh}@kma.go.kr, hskim@saeasoft.com, jecu7@lidartech.com

**ABSTRACT:** This paper describes the ground system for COMS (Communication, Ocean, and Meteorological Satellite), the first Korean multi-purposed geostationary satellite, at MSC (Meteorological Satellite Center) in Korea. The overview of COMS MI (Meteorological Imager) will be introduced as well. KMA would implement mission planning for COMS MI operation and receive, process, interpret, disseminate, and archive MI data operationally for domestic and foreign user groups. Major missions of COMS MI are mitigation of natural hazard such as typhoon, dust storm, and heavy rain, and short-term warning of severe weather to protect human health and commerce. Moreover, research of climate variability and long-term changes will be supported. In accordance with those missions, the concept and design of COMPASS (COMS operation and meteorological products application service system), the ground system for COMS MI in MSC, have been setting up since 2004. Currently, COMPASS design is being progressed and will have finished the end of 2006. The development of COMPASS has three phases: first phase is development of fundamental COMPASS components in 2007, second phase is to integrate and test all of the COMPASS components in 2008, and the last phase is to operate COMPASS after COMS In-Orbit Tests in 2009.

**KEY WORDS:** COMS, Meteorological Imager, Ground system, COMPASS, Satellite Data Processing

## 1. Introduction

COMPASS (COMS operation and meteorological products application service system would be composed of 11 functional systems such as Data Acquisition and Transmission System, Image Preprocessing System, LRIT/HRIT Generation System, COMS Meteorological Data Processing System, and Interactive Satellite Data Analysis System and so on. Section 2 introduces COMS Meteorological Imager (MI). The meteorological mission and functions of MSC are described in Section 3. The functional components of COMPASS are offered in Section 3. At last, Section 4 describes the future development plan of COMPASS and contingency plan.

## 2. COMS Meteorological Imager

MI data is main input of COMPASS. Table 1 shows the characteristic of COMS MI. The operation lifetime of the MI would be 7 years. It has 5 channels, a visible channel with 1 km resolution and 4 IR channels with 4 km resolution. The MI has 4 pre-defined observation areas such as full disk, asia & pacific in northern hemisphere, extended northern hemisphere, limited southern hemisphere, local area to fulfill the high demand of user community. MI observation modes are pre-defined as global mode, regional mode, and local mode using coordinated pre-defined observation areas as shown by table 2 and figure 1. When regional model is selected, temporal resolution would be approximate 15 minutes. When combined regional mode and local area mode as figure 2 is planned, temporal resolution around Korean peninsular would be at least 10 minutes.

Table 1 COMS MI spectral characteristics

| Channel | Bandwidth ($\mu m$) | SNR or NEdT | Dynamic Range |
|---|---|---|---|
| Visible | 0.55-0.80 | $\geq$ 10 at 5% albedo | 0-115 % |
| Short-wave Infrared | 3.50-4.00 | $\leq$ 5.7 K at 220K<br>$\leq$ 0.10 K at 300K | 110-350 K |
| Water vapour | 6.50-7.00 | $\leq$ 0.86 K at 220K<br>$\leq$ 0.12 K at 300 K | 110-330 K |
| Infrared 1 | 10.3-11.3 | $\leq$ 0.4 K at 220 K<br>$\leq$ 0.12 K at 300K | 110-330 K |
| Infrared 2 | 11.5-12.5 | $\leq$ 0.48 K at 220 K<br>$\leq$ 0.20 K at 300 K | 110-330 K |

Table 2 MI Observation mode

| Observation Mode | Observation Area | Observation Time per cycle (minutes) |
|---|---|---|
| Global | Full Disk | $\leq$ 27 |
| Regional | Full Dist | $\leq$ 27 |
| | Asia & Pacific in Northern Hemisphere | $\leq$ 10 |
| | Extended Northern Hemisphere | $\leq$ 6 |
| | Limited Southern Hemisphere | $\leq$ 4 |
| Local | Local Area | 1 |

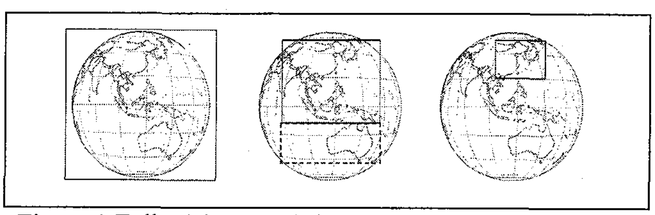

Figure 1 Full Disk Area (left), ENH Area (solid line) and LSH Area (dotted line) (center), APNH Area (right) of COMS MI

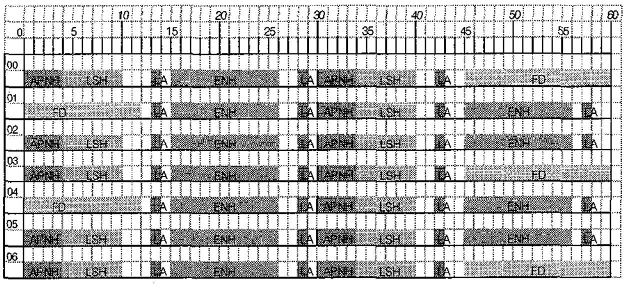

Figure 2 An example of combined Regional Mode and Local Mode of COMS MI operation planning.

## 3. MSC MISSION

MSC would have three major missions. First mission is to perform continuous monitoring and quality control of COMS MI imagery and real-time processing of meteorological products operationally. Second one is to support short-term warning of severe weather such as typhoon, dust storm, heavy rain, and so on. Last one is to support monitoring on variability and long-term change of climate.

In accordance with missions, MSC would perform a number of operational functions. MSC would receive raw data and apply radiometric/geometric correction. CMDPS would produce meteorological applications using preprocessed MI Level 1B data. The MI Level 1B data and selected meteorological applications are disseminated to users as LRIT/HRIT data format via the spacecraft. The MI images and CMDPS meteorological applications would be also distributed via Internet or off-line.

MSC provides following functions:

- Mission request for MI operation
- Reception of MI sensor data
- Radiometric and geometric correction
- Generation of LRIT/HRIT data
- Dissemination of LRIT/HRIT data to users
- Processing of meteorological application
- Analysis of COMS MI imagery and application
- Support of user community

In addition, the MSC includes backup functions for satellite control in case of emergency situation on primary Satellite Ground Control System (SGCS) at Satellite Control Center (SOC). The building of MSC has been constructed since 2004 in Jincheon, Chungbuk province located about 100 km southeast from Seoul.

## 4. COMPASS

### 4.1 Functional components of COMPASS

COMPASS of MSC is consisted of a number of functional systems. Figure 3 depicts a block diagram of functional components of COMPASS. Data Acquisition and Transmission System (DATS) performs the front-end process. It receives sensor data from the antenna system and demodulates MI raw data. It also modulates LRIT/HRIT and transmits them to COMS satellite. IMage Preprocessing System (IMPS) that receives raw data from DATS performs radiometric and geometric correction. KARI has been developed DATS, IMPS, and LHGS. Finally, it generates Level 1B data. The generated Level 1B data are sent to the LRIT/HRIT Generation System (LHGS) for user dissemination service and CMDPS for processing meteorological applications. LHGS performs the LRIT/HRIT formatting for user dissemination service.

Data Processing System (DPS) generates COMS MI imagery. CMDPS as main part of DPS produces 16-baseline meteorological applications using the Level 1B data and ancillary data, and transmits them to LHGS and satellite data analysis system. CMDPS products would be used for the various purposes for nowcasting, numerical weather prediction model as satellite data assimilation, climate monitoring, and so on. Satellite data analysis system receives meteorological products from CMDPS and ancillary data for analysis such as numerical weather prediction model. It also provides interactive analysis interface to operators.

COMS MI imagery, CMDPS meteorological products, and analysed results are delivered to user group via Internet

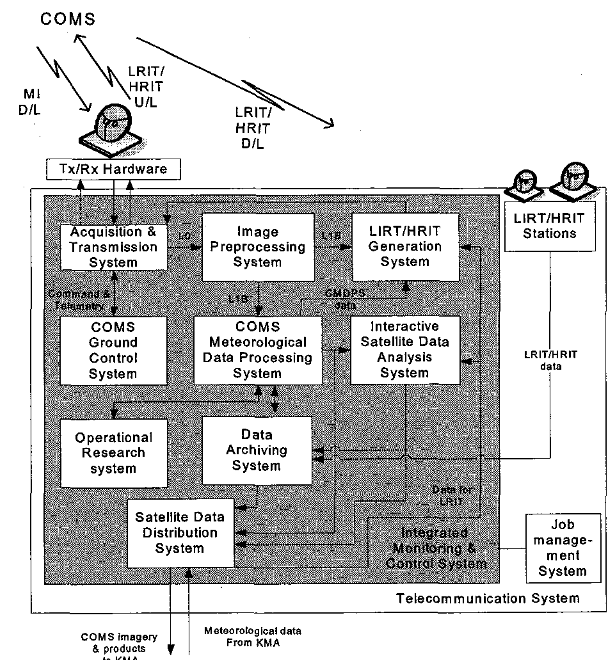


Figure 3 Functional component of COMPASS and data flow in nominal condition

### 4.2 COMS meteorological Data Processing System

One of the important components of COMPASS is CMDPS. CMDPS is designed for supporting needs of user group. It would process 16-baseline meteorological applications; atmospheric motion vector, aerosol optical depth, cloud analysis, cloud top temperature & cloud top height, land surface temperature, precipitation index, sea surface temperature, total precipitable water, upper tropospheric humidity, insolation, and fog (Ahn et al, 2006). Figure 4 shows a flow chart for the generation of those 16 baseline products at COMS MI normal observation mode. The products are separated by whether observed data is clear or not and including cloudy and contaminated by aerosol or other gases. Meteorological Research Institute (METRI) has developed CMDPS since 2003.

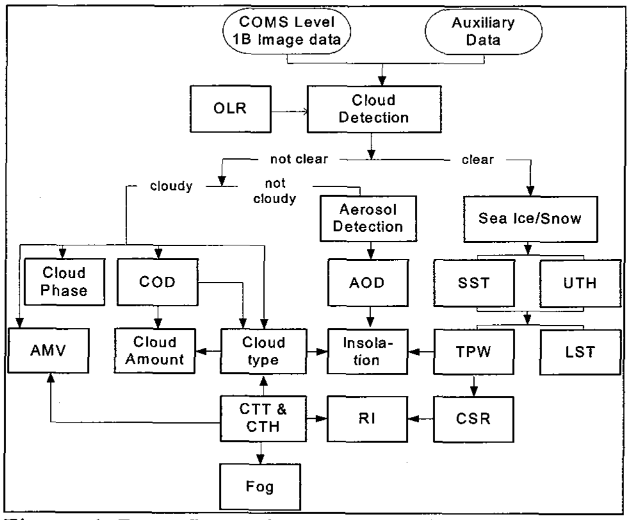


Figure 4 Data flow of CMDPS 16-baseline products separated mainly by the result of cloud detection module that defines if a pixel is clear or not clear. Contaminated pixels are sorted to cloudy ones and not cloud ones such as aerosol.

## 5. FUTURE PLAN OF COMPASS

### 5.1 Phase I

In the first phase of the development of COMPASS at 2007, the systems for MI data acquisition, transmission, preprocessing, and processing will be installed and tested to ensure the basic functionality for MSC mission; 13-Meter antenna, acquisition & transmission system, image preprocessing system, data processing system including CMDPS, operational research & development system, part of storage & data management system, and network infrastructure. Dedicated line between MSC and KMA headquarter, MSC and SOC would be set up to exchange various data such as mission request, ancillary data for image navigation and registration, MI imagery, meteorological data, and so on.

### 5.2 Phase II

The second phase aims to integrate overall COMPASS systems. Storage & data management system and network infrastructure would be extended for full service. Interactive satellite data analysis system and its software are planed to development. Data dissemination system and its user service programs such as WEB, FTP, E-mail subsystem would be developed. Integrated monitoring & control system and job management system will be prepared. Satellite Ground Control System(SGCS) developed by ETRI would be installed and verified. In addition, foreign satellite acquisition & processing system might be moved to MSC and integrated to the COMPASS. At the end of 2008, COMPASS would be got ready for COMS In-Orbit Tests (IOT).

### 5.3 Phase III

COMS would be launched at the end of 2008 and have 6-month IOT period. During this period, internal and external interface of COMPASS system will be verified and operated. In parallel, a number of training to operate and maintain COMPASS will be planned. Guidelines and troubleshooting will be prepared. MSC would get ready to COMS MI operational plan such as Global mode or Regional mode, even under emergency condition and COMPASS. Finally, after the COMS IOT period, COMS and COMPASS are set up operationally. COMS MI data and various products will be disseminated via COMS such as HRIT, LRIT and through ground line operationally.

### 5.4 Interface control between MSC and SOC

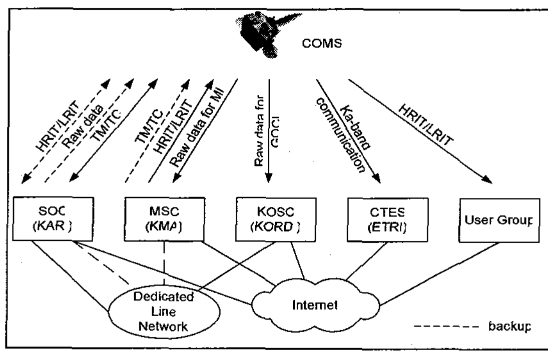


Figure 5 COMS ground segment architecture

COMS loaded with a meteorological imager, an ocean color imager, and a Ka-band Communication payload is the first Korean multi-purposed geostationary satellite. To support the mission, COMS Ground Segment (GS) consists of four ground centers: Meteorological Satellite Center (MSC), Korea Ocean Satellite Center (KOSC), Communication Test Earth Station (CTES), and Satellite Control Center (SOC) (KARI, 2006). Figure 5 shows the schematic overview of COMS GS. KOSC would receive its ocean sensor data, process, and disseminate them for research activities. CTES would monitor RF signals to check the status of Ka-Band communication system. SOC would perform the satellite operation and monitoring.

To prepare continuing COMS payload operation and data processing, KMA and KARI has been defined the interface between MSC and SOC not only under nominal condition but also under backup condition of each center, when MSC is unavailable or when SOC is unavailable.To perform assigned missions, the COMS Ground Segment is functionally consisted of a number of systems. At MSC and SOC, cross configuration of following systems will be installed.

- SGCS for the satellite operation
- Image Data Acquisition and Control System that composed of DATS, IMPS, and LHGS for MI data processing.

As shown in figure 6, MSC would have primary DATS and IMPS system and backup SCGS. The same configuration of both systems would be placed at SOC. Backup DATS will be operational when MSC DATS is not available. Detailed interface would be defined at the end of this year.

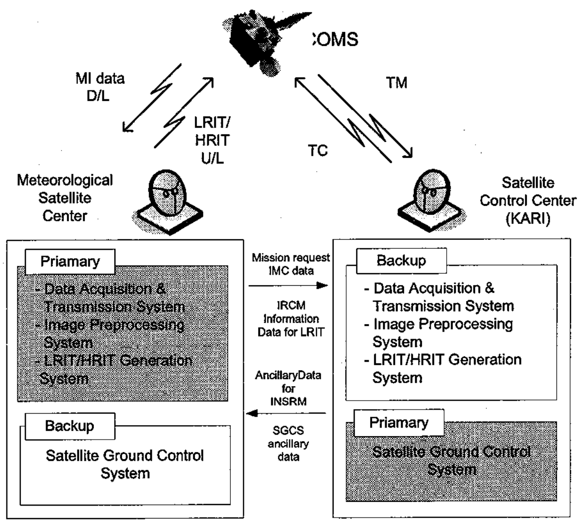


Figure 6 Functional systems between MSC and SOC

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