INTRODUCTION TO THE COMS PROGRAM AND ITS APPLICATION TO METEOROLOGICAL SERVICES OF KOREA

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ABSTRACT

Korea has been developing a multi-purpose geostationary satellite, Communication, Ocean, and Meteorological Satellite (COMS), under the National Plan for Long-term Space Development, which will be the first satellite with the meteorological payload in Korea. COMS is a pure civilian satellite of practical-use for the three major missions including meteorological observation, ocean monitoring, and space test of communication payload in the geostationary orbit. There are two satellites scheduled to accommodate the satellite demands under the National Plan. The first is planned to launch in 2008 and the second multi-purpose geostationary satellite in 2014. Korea Meteorological Administration (KMA) is responsible for the meteorological mission, and has been establishing two major activities that are acquisition of meteorological payload and preparation of the ground facilities to perform the meteorological mission such as observation, data receiving and processing, and distribution and utilization.

For the meteorological purpose, COMS will be mainly used for real-time monitoring weather phenomena, providing improved input data for numerical weather prediction models, and monitoring climate change. The operational schedule will include full disk observations and regional observations on regular basis, and fast scan modes under urgent situation such as flash flood, tropical cyclone and heavy snowfall. The data, imagery and derived products will be freely available to both domestic and international communities in real-time or near real-time basis through direct broadcasting or landlines. With the development of COMS system, KMA has been focusing its effort on utilizing the COMS data and the foreign satellite data as well. For the purposes, KMA has been developing the COMS Meteorological Data Processing System (CMDPS). The COMS program structure, important milestones, preliminary operation schedule, and baseline products from CMDPS will be outlined.

1. Introduction

A long-term plan of the National Space Program was established in 1996 and revised in 2000 to accommodate the public and civilian demand for satellite utilization and keep the continuity of satellite services. The plan prospects the details of the future space activities of Korea until 2015 and serves as a basis for space development in Korea. The Korea Meteorological Administration (KMA) has been developing the Communication, Ocean, and Meteorological Satellite (COMS) in conformity with the National Space Development Plan. The COMS program is the only geostationary satellite program with the meteorological mission in Korea. There are two geostationary satellites planned in the National Space Development Plan. The first COMS is planned to launch at the end of 2008, and the second one is planned in 2014.

Four Ministries in Korea government are involved for COMS development. Each Ministry is responsible for individual requirements and development objectives such as the Ministry of Science and Technology (MOST) for satellite system and BUS development, Ministry of Information and Communication (MIC) for communication payload and satellite control system development, Ministry

of Maritime Affaires and Fisheries (MOMAF) for ocean color sensor development, and KMA for meteorological payload development.

2. COMS Missions

COMS is going to be launched with three payloads, which are operated simultaneously, aiming three major missions. The first mission is a real-time observation and early detection of severe weather phenomena from Meteorological Imager (MI), which provides observation data taking account of weather forecasting and monitoring of climate change on the geostationary orbit for the public services. The second is monitoring of marine environment ecosystem from Geostationary Ocean Color Imager (GOCI) around the Korean peninsula, and the third is the in-orbit verification of the space technology, which is developed for the communication payload. The concept of the COMS mission is shown in Figure 1.

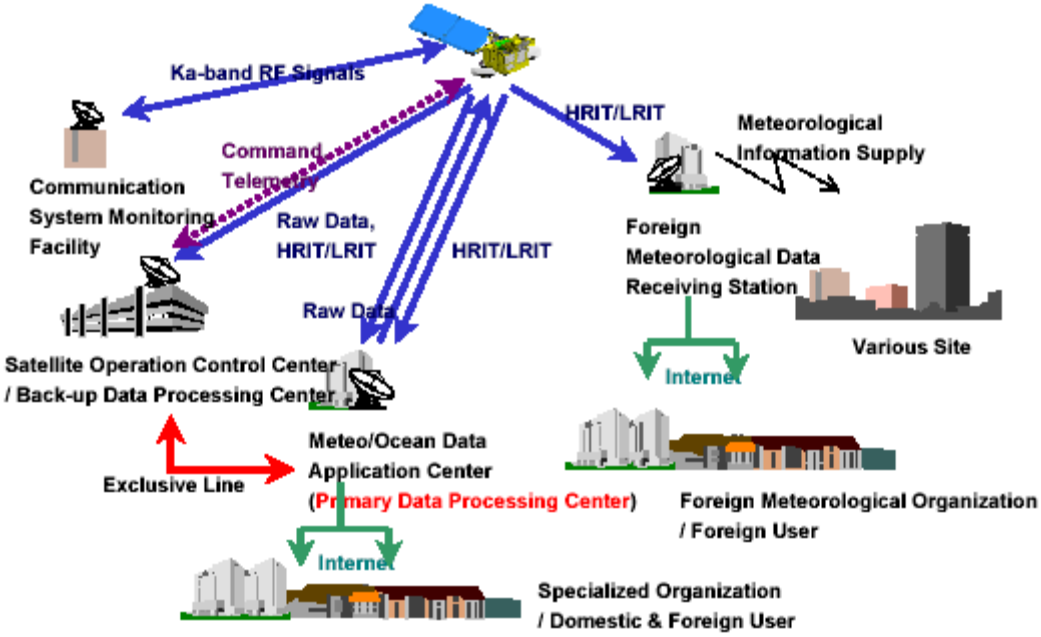

Figure 1. Concept of the COMS missions.

3. Schedule for COMS development

The feasibility study for COMS has begun in 2001, and the preliminary analysis started in 2002 is followed by the main COMS development period lasted until 2008 as shown in Figure 1. The scope of the feasibility study includes establishment of the user's requirement, mission concept, operation concept, and performance requirement as well as cost, schedule and risk estimation. The COMS conceptual design, generation of system requirements and establishment of the cooperation plan with foreign manufacturers have been performed in the preliminary analysis.

Since the COMS program has started in September 2003, the EADS Astrium of France has been selected in May 2005 as a main COMS manufacturer, and several review meetings for the COMS design, performances, manufacturing as well as assembly, integration and test have been scheduled. Figure 2 shows the major COMS milestone for development.

Figure 2. Milestone for COMS program.

4. COMS Systems

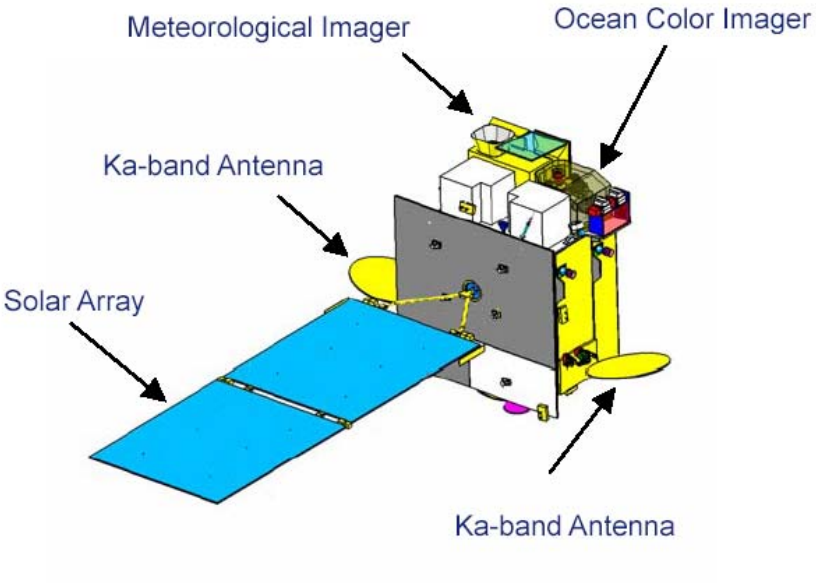

Figure 3. COMS configuration.

Figure 3. shows the COMS configuration. COMS has three payloads, MI, GOCI, a communication payload, and single solar array. There is no sail for balance, and COMS is going to keep its balance by suitable arrangement of payloads and bus system. The major COMS system requirements are summarized in Table 1. COMS is geosynchronous and three-axis stabilized satellite. Its dry mass is estimated 2500 kg, 3 kW of electrical power. The expected operation life is more than 7 years with 0.75 reliability at the end of the life. The three payloads loaded on COMS should be operable simultaneously without any interference and performance degradation. The observed images and

processed meteorological data are going to be distributed to users with the HRIT/LRIT format within 15 minutes after the image acquisition.

Table 1. COMS system requirements.

Contents	Requirements
Size	2.4 m x 2.4 m x 2.6 m
Weight	2500 kg
Power	3 kW
Orbital location	Geosynchronous at 116.2 E or 128.2 E with approval of ITU
Lifetime	More than 7 years for operation More than 10 years for design life
Spacecraft stabilization	3-axis stabilization
Stationkeeping accuracy	±0.5° in lon/lat
Reliability	More than 0.75 for Mi and GOCI at the end of life More than 0.85 for Communication payload
Payload	MI, GOCI, Comm. Payloads operable simultaneously without interference and performance degradation
MET data format & distribution	HRIT/LRIT within 15 min. after image acquisition

5. Characteristics of Meteorological Imager (MI)

MI is a 5-channel Imager, which includes one visible channel with 1-km spacing and four infrared channels with 4-km spacing (Table 2). Five channels observe the earth full disk and regional areas at least every 30 minutes. There are five observation modes including one full disk mode, three regional modes and one local area mode as shown in Figure 4 and Table 3. Especially, the local area mode will be operated under any urgent situation such as severe storms over the area of 1000 km x 1000 km around the Korean peninsula as a fast scan mode.

Table 2. Spectral channels characteristics of MI providing central wavelength, bandwidth, dynamic range, and IFOV of the channels.

Channel no.	Channel	Center(㎛)	Bandwidth(㎛)	IFOV(km)
1	VIS	0.675	0.55~0.80	1
2	SWIR	3.75	3.50~4.0	4
3	WV	6.75	6.5~7.0	4
4	WIN1	10.8	10.3~11.3	4
5	WIN2	12.0	11.5~12.5	4

Table 3. COMS observation modes with observation interval and duration. (FD: Full Disk, APNH: Asia-Pacific Northern Hemisphere, ENH: Extended Northern, LSH: Limited Southern Hemisphere, LA: Local Area)

Obs. Mode	Global	Regional			Local
Area	FD	APNH	ENH	LSH	LA*
Interval	30 min.	30 min.	30 min.	30 min.	10 min.
Duration	< 27 min.	Depends on Global Scan Mode			1 min.

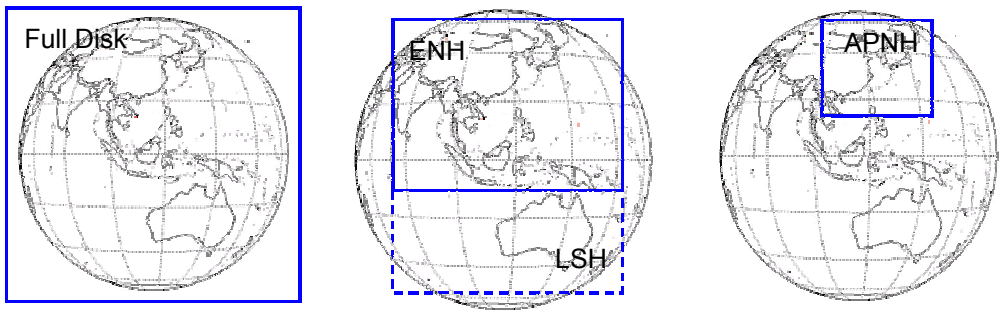

Figure 4. Observation areas of COMS observation modes.

6. COMS Ground Segment

KMA is responsible for MI mission operation after launch. In order to perform the mission, KMA has been preceding a separated project to establish the ground systems as well as main building construction for COMS operation. The ground systems consist of an antenna system with RF instruments, a preprocessing system for radiometric calibration and image navigation and registration, systems for data archiving, distribution, and meteorological product extraction mainly, and satellite control system as a backup system of COMS control center (Figure 5). The COMS ground segment will be established at JinCheon in the middle of Korea, and will be ready for a full range of test before launch.

7. COMS meteorological data processing system (CMDPS)

With the development of the COMS system, KMA has been focusing its effort on utilizing the COMS observed data and the foreign satellite data as well. For the purposes, KMA has been developing the CMDPS within the frame of COMS program. The major functions of the CMDPS are extraction of meteorological products from the calibrated and geo-located level 1.5 data and development of calibration algorithm for monitoring and upgrading. There are 16- preliminary baseline products planned as shown in the flow of CMDPS in Figure 6. The product chains are aligned mainly according to priority of product sequences, time limit for operation, and interaction between the 16-baseline products

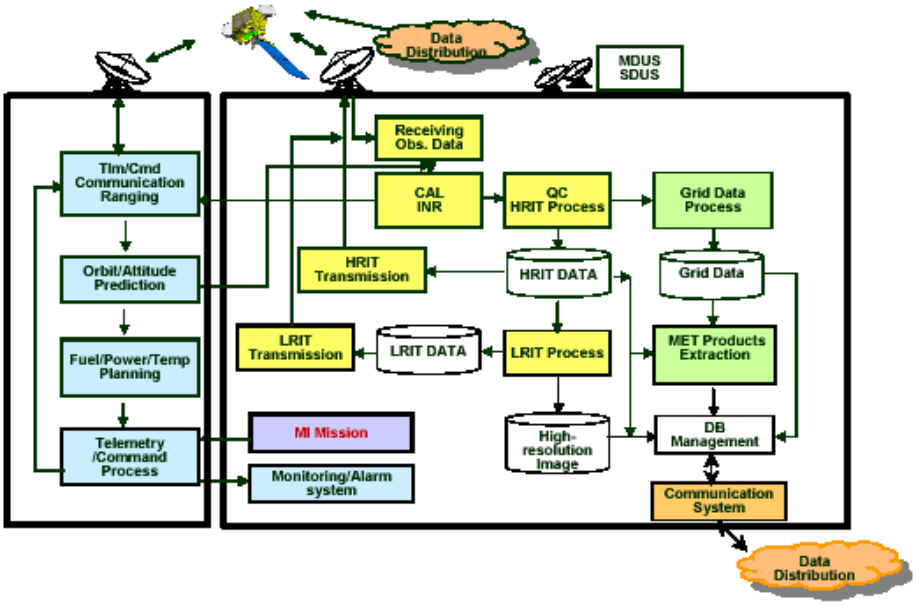

Figure 5. Overview of COMS ground system.

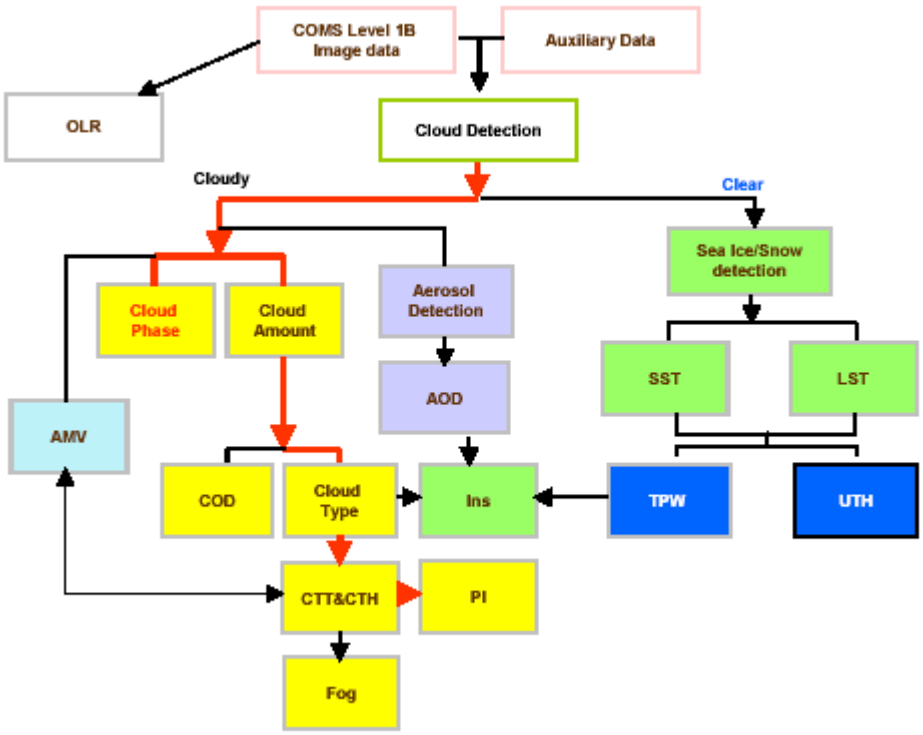

Figure 6. Flow chart of the CMDPS 16-baseline products.

In the CMDPS milestone, the conceptual design has been prepared in the first project year, which is based on the algorithm development strategy, annual progress, integration/optimization strategy, implementation of CMDPS in the COMS operation system, and preparation for operation. During the third project year of 2005-2006, the prototype S/W modules for the 16-baseline products are going to be completed with the interface design concept between the modules. The CMDPS will be brought

to completion after standardization and optimization of the modules, performance test by a specially produced data set for assessment, interfacing into the COMS ground system, and setting for the real-time operation.

8. Summary and future plan

The first geostationary satellite with a pure civilian purpose has been developing in Korea and is scheduled to launch in 2008. Multi-missions of COMS are intended as not only meteorological and oceanic observation for the public welfare, but also in-orbit test of the developed communication payload to be used for the next geostationary satellite. With the development of the COMS system, establishment of the COMS ground segment has been started according to the phase of the COMS development.

It is anticipated that COMS contributes as a part of Global Observing System (GOS), and the observation data from COMS are distributed to world-wide users and utilized for weather monitoring, climate change monitoring, and so on to save human lives and properties.