CURRENT STATUS OF COMS PROGRAM DEVELOPMENT

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ABSTRACT: COMS satellite is a multipurpose satellite in the geostationary orbit, which accommodates multiple payloads of Meteorological Imager, Geostationary Ocean Color Imager and Ka band Satellite Communication Payload in a single spacecraft platform. In this paper, current status of Korea's first geostationary Communication, Ocean and Meteorological Satellte(COMS) program development is introduced. The satellite platform is based on the Astrium EUROSTAR 3000 communication satellite, but creatively combined with MARS Express satellite platform to accommodate three different payloads efficiently for COMS. The system design difficulties are in the different kinds of payload mission requirements of communication and remote sensing purposes and how to combine them into a single satellite to meet the overall satellite requirements. The COMS satellite critical design has been accomplished successfully to meet three different mission payloads. The platform is in Korea, KARI facility for the system integration and test. The expected launch target of COMS satellite is scheduled in June 2009.

KEY WORDS: COMS, Payload, Meteorology, Ocean, Communication

1. INTRODUCTION

COMS program is a national program of Korean government to develop and operate the COMS, a pure civilian satellite of practical-use for the compound missions of meteorological observation and ocean monitoring, and space test of experimentally developed communication payload, on the geostationary orbit. The target launch of COMS is scheduled in June of 2009. The operational life of the COMS is 7 years from the end of the IOT(In-Orbit-Test) period, but the design life of the COMS shall be no less than 10 years. COMS satellite has 3 different mission payloads: Meteorological Imager(MI), Geostationary Ocean Color Imager(GOCI) and Ka band Communication Payload. The MI mission is to continuously extract meteorological products with high resolution and multi-spectral imager, to detect special weather such as storm, flood, yellow sand, and to extract data on long-term change of sea surface temperature and cloud. The GOCI mission aims at monitoring of marine environments around Korean peninsula, production of fishery information (Chlorophyll, etc.), and monitoring of long-term/short-term change of marine ecosystem. The goals of the Ka band satellite communication mission are to in-orbit verify the performances of advanced communication technologies and to experiment wide-band multi-media communication service.

Unlike spin type weather satellite, COMS satellite is 3-axis stabilization type spacecraft. The attitude control system of the spacecraft will make the stability performance possible for enough to maintain the quality of meteorological and ocean monitoring image during the observation period, while performing Ka band communication payload missions simultaneously.

The Ariane 5 launch vehicle has been selected as the launch vehicle for COMS, but the satellite is designed to be compatible with Delta launch vehicle families, Atlas launch vehicle families, Proton launch vehicle, H-IIA launch vehicle and Sea-Launch vehicle.

The mission orbit for COMS will be selected either 116.2° East or 128.2° East at the end of 2007. The stationkeeping accuracy of the COMS is ±0.05° in longitude and latitude of the nominal orbital location throughout the operational lifetime. The COMS will use the L-band, S-band frequencies for the meteorological and ocean data transmission. The S-band frequency, also, will be used for the transfer orbit operation to move the spacecraft into the mission geostationary orbit and for the normal operation in the mission orbit. Figure 1 describes the COMS system architecture. KARI is responsible for the satellite control, and each mission users(KMA, KORDI and ETRI) posses its own ground station.

2. CURRENT STATUS OF COMS SATELLITE DEVELOPMENT

The COMS satellite critical design has been finished in early this year. The satellite integration preparation activities has been performed during last several months and the COMS satellite integration is on going in KARI Assemble, Integration and Test(AIT) facility in Daejeon, Korea. The figure 2 and 3 describe the up-to-date COMS satellite configuration.

The single-wing 2-panel solar array provides about 2.5KW of the electrical power to the satellite and allows keeping a free space for the MI radiant cooler field of view towards the North. This asymmetrical configuration results in unusually large external disturbing torques due to solar pressure. However the length of the wing is kept small. The Li-Ion battery has been chosen to provide efficient battery size and ample margin. The solar array is free from any shadowing from the satellite main body on station.

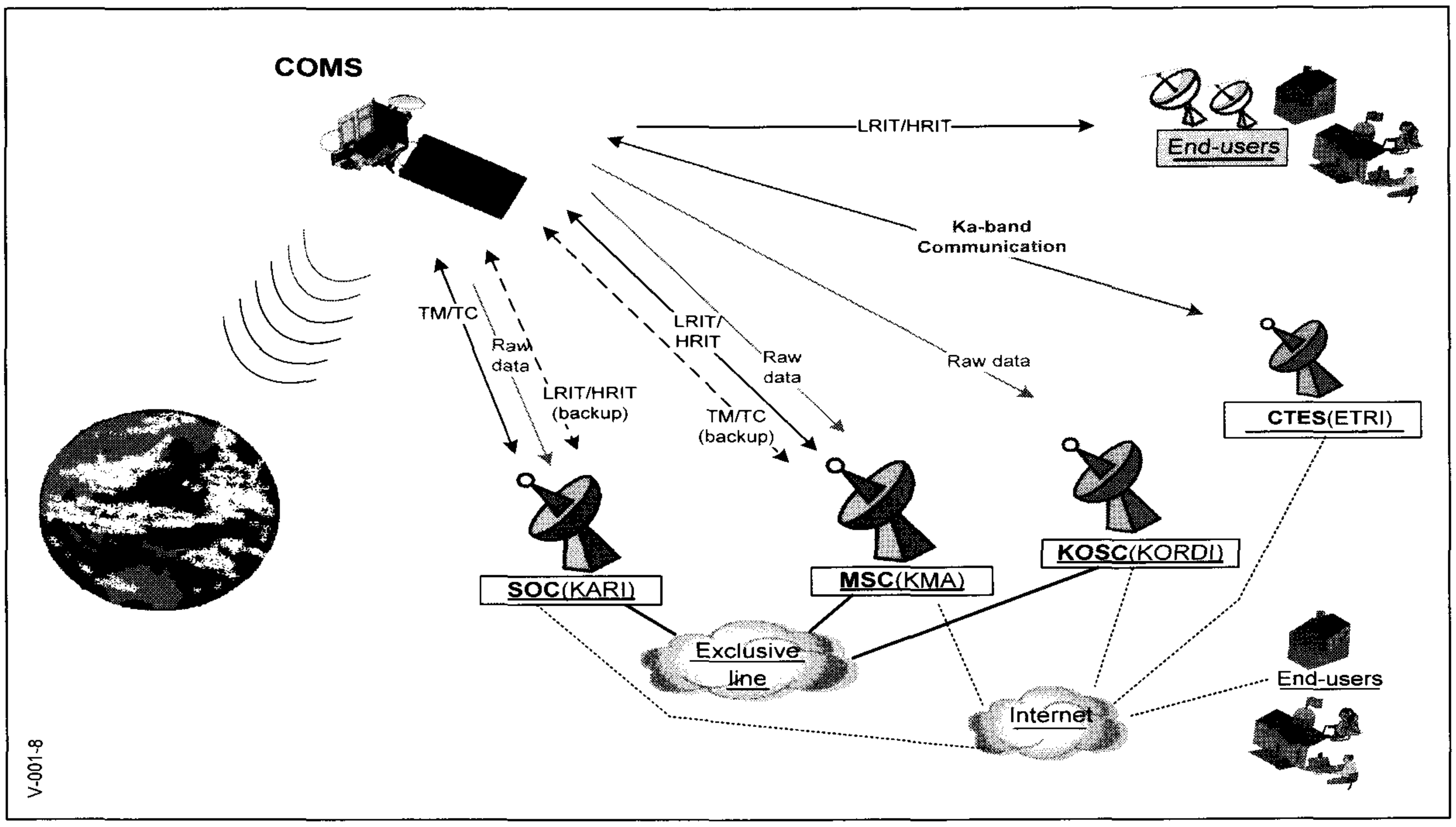

Figure 1. COMS System Architecture

All the required fields of view are easily provided to the instruments, AOCS sensors and antennas, whatever the orbital position is chose either 116.2E or 128.2E. Adequate canting of the GOCI and of the Ka band Communication Payload antenna and sources will be accurately defined after freezing of the reference orbital position. The specified possible drift of the satellite on the orbit will be compensated through adequate pointing bias around pitch axis, which will remain well within the maximum biasing capability.

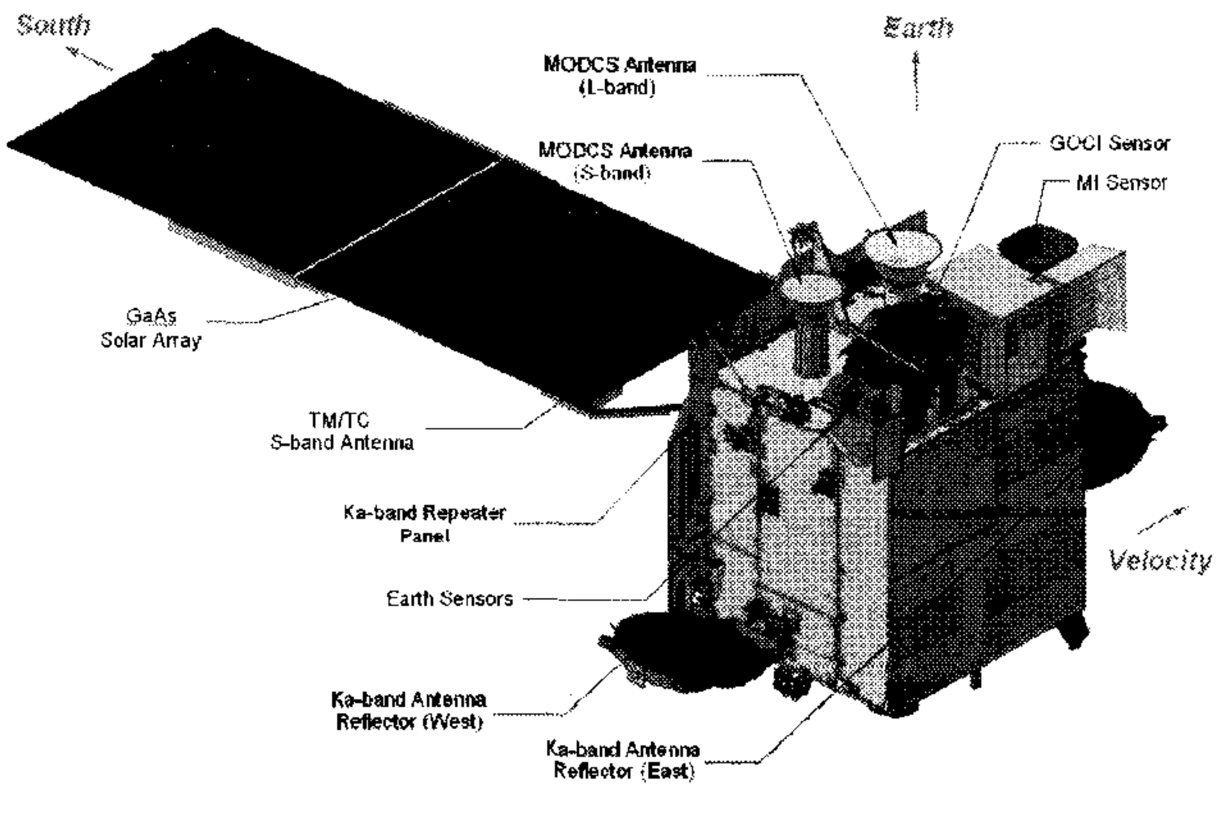

Figure 2. COMS On Station Configuration

The COMS structure is the derivative of the MARS Express satellite platform which is made of all aluminium with honey comb panels. But accurate pointing performance of the mission payload, carbon payload interface panel has been adapted for MI and GOCI payload accommodation. The qualification of the structure has been completed through Structure Model(SM) test campaign performed in KARI vibration

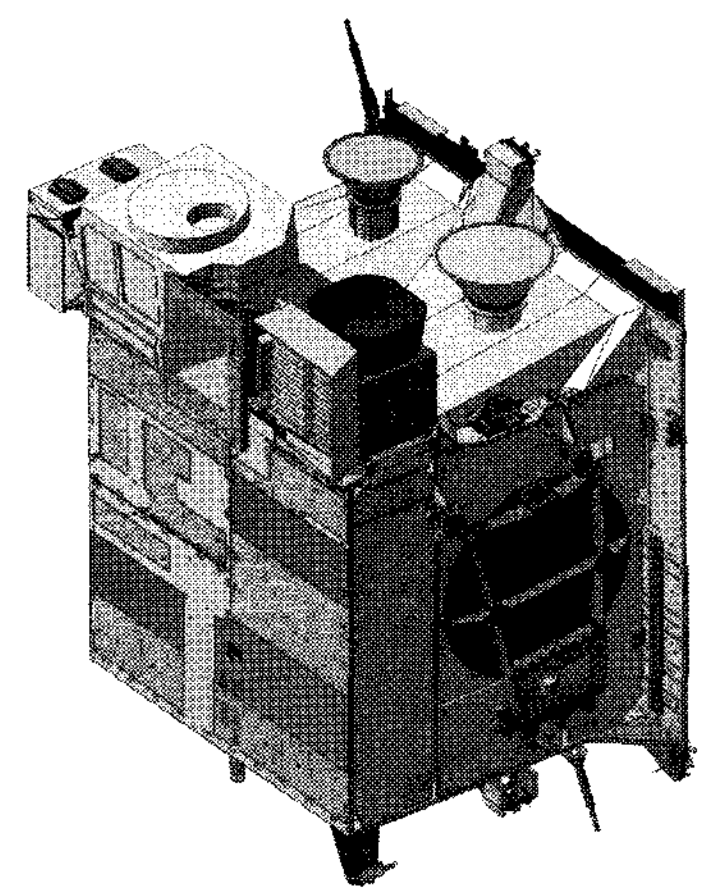

Figure 3. COMS Launch Configuration

facility in October 2006. Figure 4 shows the structure vibration test with the SM.

After the qualification of the structure, Korean Air manufactured the flight model structure and assembled the COMS structure in Kimhae factory of Korean Air. Figure 5 shows the flight model structure assembled by Korean Air. After the completion of the structure assembles, it was shipped to Stevenage, England for the propulsion subsystem assembles. The propulsion subsystem assembles with the flight structure had been completed at the end of August 2007 and shipped to Korea for System Integration and Test in KARI facility. Figure 6 shows the propulsion subsystem assemble and test in Stevenage in England.

COMS Attitude and Orbit Control System (AOCS) reuses to a very large extent the Eurostar E3000 AOCS, as far a hardware and functional architecture are

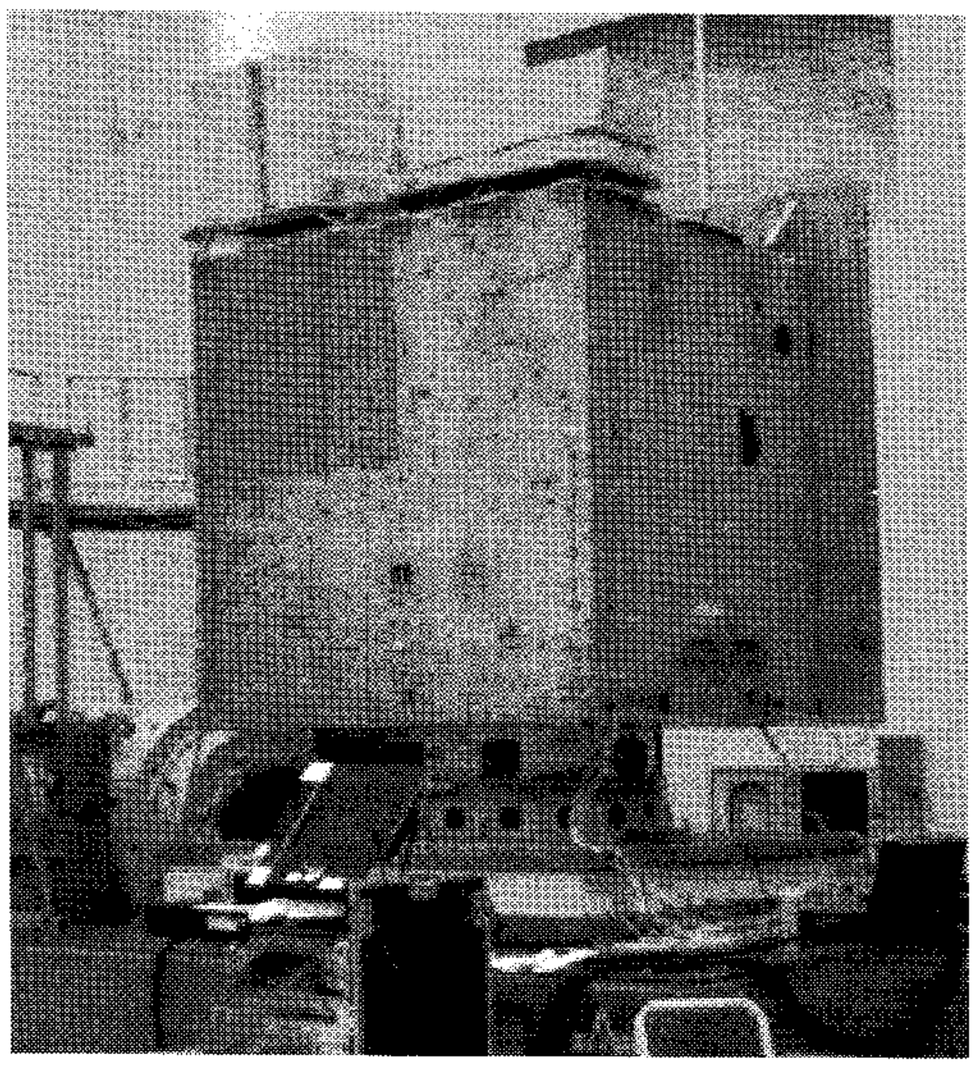

Figure 4 Structure vibration test with the SM

concerned. The Transfer and Acquisition phase is identical to Eurostar E3000 and is based on three axes stabilization. It allows simple operations of the spacecraft, without loss of safety. Station-Keeping phases permit to maintain the spacecraft orbit inclination and eccentricity and are automatically managed with a high level of on board security. East/West maneuvers and pitch momentum off-loading are automatically managed by pulsed sequences in normal mode. Figure 7 describes AOCS analysis showing attitude stabilization performance for each roll, pitch and yaw axes after wheel offloading thrusters firing. After the thrusters firing, through thrusters tranquilization, the system stability is recovered using wheels control loop.

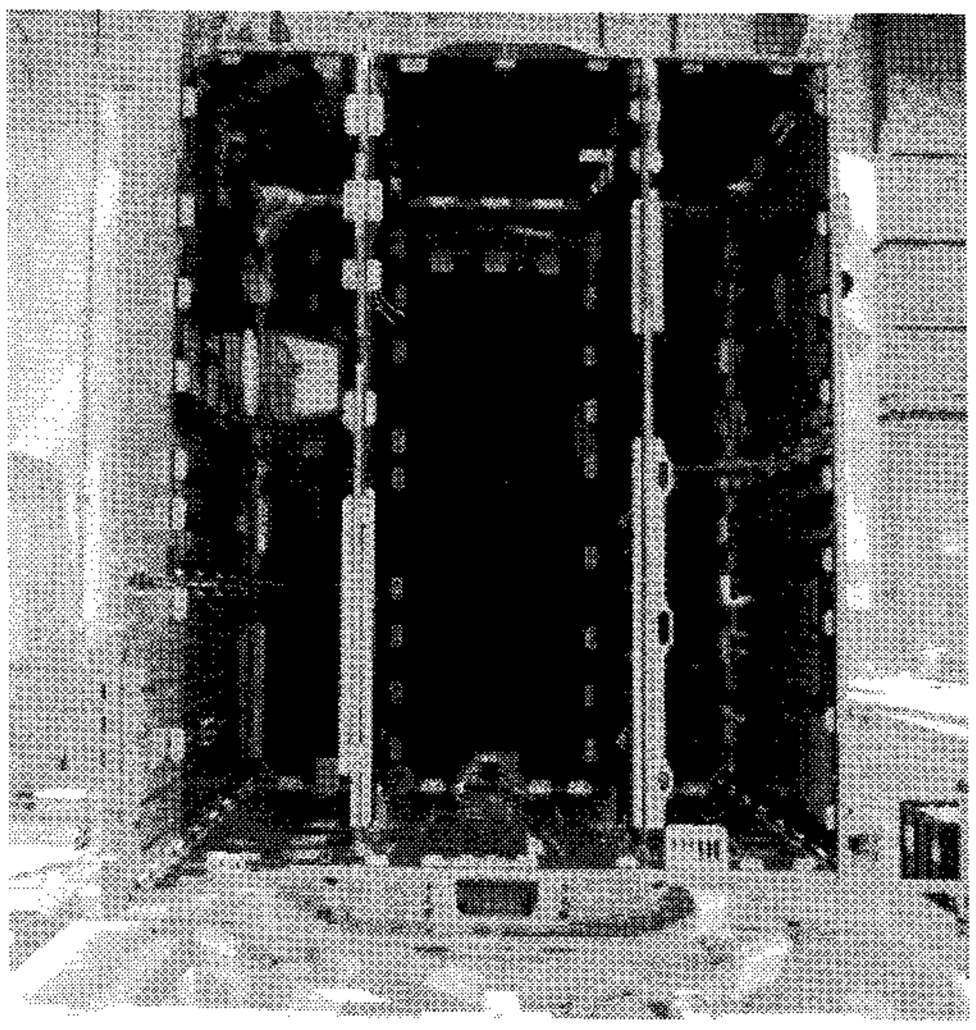

Figure 5 Flight model structure assembled by Korean Air

The platform electrical architecture provides an optimum performance and heritage of the Eurostar 3000 model. Centralized spacecraft computer and fully regulated power bus architectures have been employed based on ASTRIUM Eurostar in term of design robustness. The Telemetry, Command and Ranging and Data Handling

Figure 6 Propulsion subsystem assemble in Stevenage

function has been designed to provide full compliance with a wide range of spacecraft control approaches (4 kbps telemetry, send-verify-execute sequence, shadow mode, large telemetry channels growth margin, etc). The data transmission between the central spacecraft computer and the other key units is performed via a serial 1553B digital data bus. This provides a very flexible and standard data transmission system, which can be easily adapted and tested to specific needs, with no hardware modification. The interface of the spacecraft units to the data bus is performed either via the modular payload interface unit and the actuator drive electronics, or directly to the bus for some attitude control equipment's or power subsystem regulator. Any unit connected on that bus can be switched off if it disturbs the bus itself.

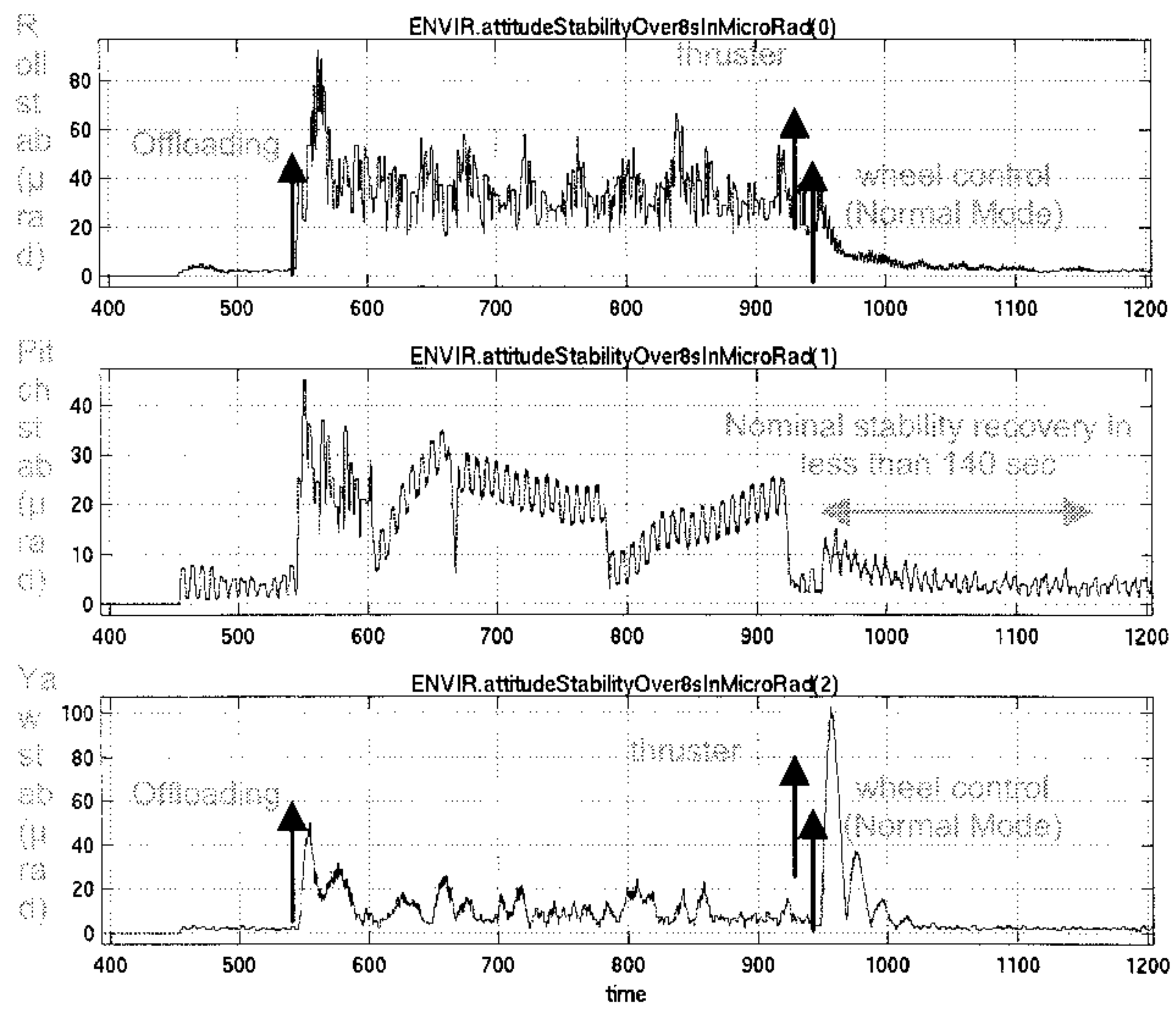

Figure 7 Wheel Offloading Performance

Currently, the COMS satellite is in KARI facility for the system integration and test. After the structure delivery to KARI, the +Y and –Y panel has been detached for the bracket mounting, harness routing and equipment installation. The bracket has been manufactured by Korean Air and the harness has been manufactured by Korea Aerospace Industry (KAI). The Figure 8 shows the COMS satellite located in KARI AIT clean room for system integration. Figure 9 shows the panel which the brackets and harness are being mounted.

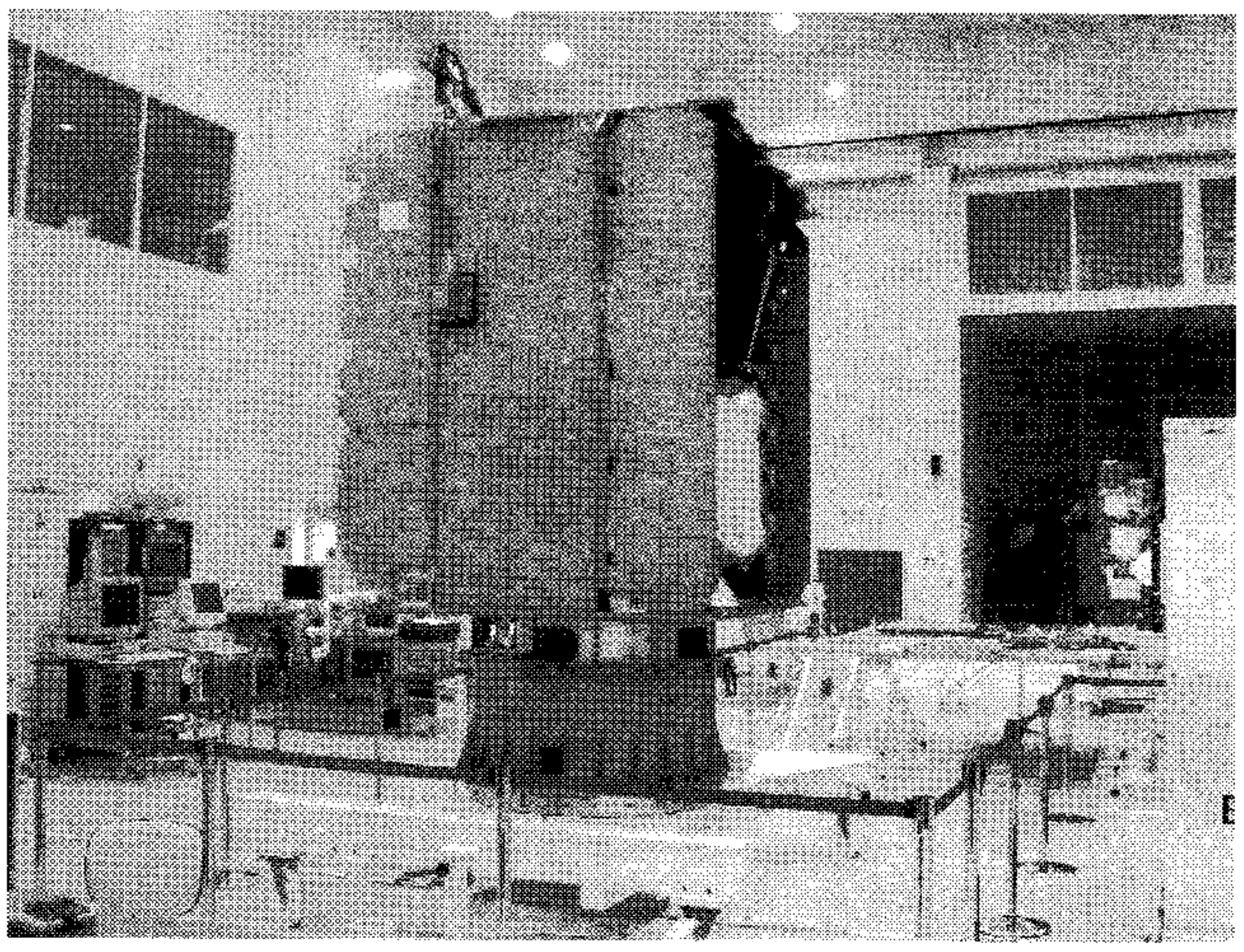

Figure 8 COMS Satellite in KARI Facility

Figure 9 Panel with brackets and harnesses

In the mean time, the Ka band payload which is developed by ETRI of Korea, the Ka band transponder components are being unit level tested in the ETRI premise and the hardware will be delivered to KARI at the end of this year to be installed in the flight model. This transponders will be tested on orbit and expect to provide wide-band multi-media communication service after successful on orbit verification of the performance. The MI payload is still in the ITT premise of U.S. for the final assemble and test. It will be delivered to KARI early next year for system integration and test. MI is a visible and infrared imaging radiometer that measures energy from Earth's surface and atmosphere. It can be considered as the quantitative observer in a system to supply environmental data and data products. The MI collects radiometric data in 5 spectral channels ranging from the visible to the thermal infrared, and useful for cloud and pollution detection, storm identification, fire location, cloud height measurement, water vapor wind vectors, ozone measurement, and surface and cloud top temperatures. It is expected to provide high quality of weather information.

The GOCI is in the Astrium premise for the final assemble and test. It will be delivered to KARI early next year for system integration and test. It acquires data in 8 visible wavebands with a spatial resolution no larger than 0.5 km over the Korean seas. The ocean data products that can be derived the measurements are mainly the chlorophyll concentration, the optical diffuse attenuation coefficient, the concentration of dissolved organic material or yellow substance, and the concentration of suspended particulates in the near-surface zone of the sea. In operational oceanography, satellite derived data products are used in conjunction with numerical models and in situ measurements to provide forecasting and now casting of the ocean state. Such information is of genuine interest for many categories of users.

3. CONCLUSION

In this paper, the current status of Korea's first geostationary Communication, Ocean and Meteorological Satellite (COMS) program is introduced. COMS satellite is a hybrid satellite in the geostationary orbit, which accommodates multiple payloads of MI(Meteorological Imager), GOCI(Geostationary Ocean Color Imager), and the Ka band Satellite Communication Payload into a single spacecraft platform. The satellite platform is based on the Astrium EUROSTAR 3000 communication satellite, but creatively combined with MARS Express satellite platform to accommodate three different payloads efficiently for COMS. The critical design has been successfully completed and currently, the satellite is in the KARI facility for the system integration and test. Throughout COMS system integration and test period, the satellite will be tested thoroughly to verify the design and performance. After the launch in 2009, COMS satellite is expected to provide high quality of weather, ocean and multi-media communication service to around the world as well as Korean Peninsular which are beneficial to all of people for better life in the future.

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