ABSTRACT

The MSG mission started its operational service at the beginning of 2004, after commissioning activities were successfully completed in December 2003 and the satellite repositioning was done in January this year. This paper briefly summarises the major events and steps which took place following the launch of MSG-1, it then focuses on the current status of the MSG mission and the future plans. The on going activities in the framework of the routine operations are described, the plan for MSG-2 preparation, its launch and commissioning, and the key milestones are addressed. With the launch and commissioning of MSG-2, the nominal in orbit configuration will be established; the transition plans from the old MOP/MTP system to the new Meteosat Second Generation are presented.

1. METEOSAT SECOND GENERATION (MSG) – HIGH LEVEL MISSION OBJECTIVES AND IMPLEMENTATION ASPECTS

The MSG mission constitutes the European contribution to the Global Observing System (GOS) of the World Weather Watch (WWW), as part of the global system of geo-stationary satellites. It fulfils the new user’s requirements in the timeframe from the year 2000 associated with the new weather forecasting methods, meteorological observations and climate monitoring.

In support to these objectives the MSG system provides Multi-spectral imaging of cloud systems, Earth surface and atmospheric emissions with significantly improved capabilities versus the existing systems, Extraction of meteorological products, Dissemination of images and data to the users. The primary mission of the MSG system is in fact an observation mission, relying on the Spinning Enhanced Visible and Infrared Imager (SEVIRI) imaging radiometer to derive Multi-spectral Imagery, Airmass Analysis and High-Resolution Imagery. Supporting missions of the MSG system are data processing and product extraction, data dissemination, and archiving/retrieval of data and products. Furthermore, the MSG system also offers a Data Collection capability and supports two additional missions, the Geostationary Earth Radiation Budget (GERB) experimental mission embarking the dedicated GERB instrument and finally the Search and Rescue mission, embarking the dedicated transponder to capture and relay distress signals.

The capabilities of the MSG system target major improvements in two disciplines of operational meteorology, Nowcasting and Very Short Term Forecasting (VSRF), and Numerical Weather Prediction (NWP). Major performance improvements produces about 20 times more data than Meteosat: the imaging frequency is increased from 30 to 15 minutes, the twelve spectral channels of the imager observes the Earth-atmosphere system with a spatial sampling distance of 3 km (1 km for the High Resolution Visible channel). The shorter repeat cycle of 15 minutes for full-disk imaging provides unprecedented multi-spectral observations of rapidly changing phenomena (e.g. deep convection) and better and more numerous wind observations from the tracking of cloud features. This enables a better characterisation of rapidly evolving weather patterns, supported by improved discrimination between surfaces and clouds. More information is also made available from some infrared channels on the vertical structure of the atmosphere.

Fig.1 Comparison between the Meteosat satellites of the First and Second Generation

The MSG system is established as a result of the cooperation between ESA and EUMETSAT. ESA was responsible for the development of the MSG-1 prototype satellite and acts as procurement agent for the MSG-2/3/4 satellites on behalf of EUMETSAT. EUMETSAT has finalised and maintains the End User
Requirements, has contributed one third of the MSG-1 funding, funds the procurement of MSG-2/3/4, procures all launch services, and operates the MSG system after having developed the Ground Segment. The Rutherford Appleton Laboratory (RAL), UK, is the third partner of the Programme, providing GERB instruments for flight on all four MSG satellites and associated data services. The first GERB instrument flying on MSG-1 was selected under an ESA Announcement of Opportunity, its development and operations are funded by NERC, whilst the procurement of additional instruments for MSG-2/3/4 and the associated data service are funded by EUMETSAT.

2. MSG-1 LAUNCH AND COMMISSIONING

The final activities leading to the start of the MSG-1 launch campaign were particularly intense. Residual uncertainties on Ground Segment (GS) readiness were mitigated by implementation of an initial GS version (V0). This was sufficient for performing the satellite in orbit testing phase. It was based on the Image Quality Ground Support Equipment (IQGSE) for image rectification and a dedicated system for relaying data to other ground segment facilities. Delays/non availability of the possible co-passengers caused the change to the Launcher baseline from Ariane 4 to Ariane 5 less than 6 months before the planned launch date. A task force involving EUMETSAT/ESA/Arianespace/Alcatel (the satellite prime contractor) established then the means to attenuate the A5 Generic shock levels in March/April 2002. Based on the task force results, the consent to ship the satellite for the launch campaign was released by EUMETSAT to ESA on 12 April 2002.

MSG-1 was launched on 28th August 02 at 22h 45min UTC. The very accurate injection in orbit achieved by Ariane 5 (Perigee 0.3%, Apogee 0.1%, Inclination 0.3%), together with an high initial inclination of 1.98° resulted at the end of the drift phase into a fuel lifetime limit significantly extended, by about 2 years.

After the Launch and Early Orbit operations (LEOP) phase, satellite operations were handed over from ESOC to EUMETSAT on 25 September 2002 to perform the satellite and system commissioning. Commissioning is the final phase of verification of the performance of the complete system versus the applicable requirements, involving both the space and ground segments. It encompasses validation of the procedures to be used during the routine operations, calibrations of the instruments in space and tuning of the facilities on ground, validation of the meteorological products against agreed methods - e.g. comparison with other satellite measurements, in situ measurements etc. In view of GS development, the MSG-1 commissioning work was split into a Phase A, oriented to satellite in orbit testing, and a Phase B, addressing the final calibration and validation of the mission products.

Failure of 1 Solid State Power Amplifier (SSPA) on board on 17 October 2002 caused commissioning activities to be put on hold, pending initial outcomes of the investigations. Commissioning activities resumed on 26 Nov. 02, following interim Inquiry Board (IB) conclusions (no switch to redundant SSPA, SSPA’s use restricted to raw data downlink), implying that the dissemination mission and the Data Collection Service missions were not available on MSG-1. On 28 Nov. 02, 12.00 UTC the first SEVIRI images acquired and on 12 Dec. 02 the first GERB images were also acquired.

Fig. 2 First MSG-1 images on 28 November 2002

Fig. 3 First GERB images on 12 December 2002

Commissioning Phase B started in July 2003, following successful hand-over of the GS Version 1 embedding the final Image Processing Facility (IMPF). In the meantime an alternative dissemination system, based on EUMETCast, was defined and approved by the EUMETSAT Council in March 2003, with an upgrade 1 in Ku-Band for dissemination to Member and Co-operating States and a subsequent upgrade 2 in C-Band to include dissemination over Africa. On 30 April 03 the dissemination of SEVIRI rectified images started via EUMETCast in a trial mode. Towards the end of August 03 IMPF started delivering rectified images to
3. PERFORMANCE OF MSG-1 SYSTEM AT RORR AND CURRENT STATUS

The assessment of the compliance status of the end-user services was performed at SCRR/RORR leading to the following results:

Concerning the real-time services:

- The SEVIRI Image Rectification and Dissemination service is compliant, except:
  - Availability of “HRIT” service lower than specified (95.6 vs 99%);
  - Lack of coverage of South America
    The availability of the HRIT service has visibly improved thanks to various changes done in the meantime (mainly software related) on EUMETCast, the spec is now met. The lack of coverage of South America is due to the non-availability of the direct dissemination on board MSG-1. Technical interactions have been initiated with the affected Met Service to support the establishment of alternative dissemination capability, which are in fact fully feasible.

- Foreign Satellite Data Service: service is compliant, except coverage of South America.

- Meteorological Product Extraction and Distribution Service: service is compliant, except:
  - Validation of some products planned for completion in February 04, in time for the Image Product Validation Review (IPVR) Close Out

Current status shows that the planned work has been largely done now, IPVR was in fact successfully completed in early March 04. After the validation work was done, the decision was taken to delay dissemination of the Global Instability Index (GII) product, apart from the Precipitable Water (PW) component, implementing a product based on a physical retrieval method. Work is currently in ongoing with a target readiness of the product by the end of 04/early 05.

- Availability of disseminated products marginally below specification (96.8 vs 98.5%) at RORR: this has improved since then.

- Some residual problems were identified with height assignment of low-level VIS and medium-level IR
winds: this, considered part of normal work, has been largely addressed in the meantime.

− Data Collection and Retransmission Service: compliant with the understanding that the DCP mission is fulfilled by Meteosat-7 until MSG-2 will become available and the retransmission service is fulfilled via EUMETCast.

− Meteorological Data Dissemination (MDD): service is compliant except coverage of South America, due to absence of onboard direct dissemination.

− GERB Raw Image Data Service (to RAL): service is compliant.

− Support service to Search and Rescue (SAR): service is compliant. The MSG Search and Rescue performance evaluation recently provided by COSPAS-SARSAT concluded that the test data from the different ground stations are consistent and that the MSG system performance is considered stable both in terms of satellite behaviour and in terms of mature stage of ground stations development. In addition, the operational (real alert) data provided by France shows that the MSG complements the existing C/S services, providing useful and essential data to assist in SAR missions. 41 persons were reported to have been rescued in the period January-March 04, also thanks to MSG: in about half of the cases MSG-1 was the first mean of alert, and in more than 10% of the cases it was the only means of alert.

Concerning the Off Line Services:
− Archive and Retrieval Service compliant, except for:
  − some meteorological products not yet available for archiving at RORR (now all disseminated products are available),
  − the on-line interface to U-MARF which will not be available until last Q 2004 when the firewall is due to be implemented in response to security concerns (now under implementation),
  − restrictions on size of user data retrieval requests, 500MB orders were not possible within the timeliness requirements: retrievals possible via offline interface (i.e. as for MTP). (Significantly improved since then)
  − Satellite Data Dissemination via Internet under acceptance testing. Now it is operational

− User Support Service: compliant

4. MSG-1 (METEOSAT-8)
ROUTINE OPERATIONS: STATUS AND PLANS

The operational geostationary service provided by EUMETSAT is now made by satellite of the first and second Meteosat generation. Meteosat-8 operates at 3.4°W, in parallel with Meteosat-7 (at 0°). Meteosat-6 is at 10°E in rapid scanning (ensuring also the backup for the DCS mission) while, Meteosat-5 is above the Indian ocean at 63°E.

All MSG mission components are operational but the DCS mission due to the SSPA failure, which is continued by Meteosat-7 until MSG-2 will become available. All meteorological products are validated except for GII and Total Ozone (O3). For GII, after decision to implement the physical retrieval, dissemination is currently limited to PW; for O3 the optimum estimation retrieval is still planned for implementation in 2004: development work has been now completed, dissemination is planned during IV Q this year. For the various products, full performance assessment over one seasonal cycle is continuing.

![Fig. 5 Previous transition with current configuration](image-url)

The real-time dissemination with EUMETCast (both in KU and C-Band) is now the agreed baseline for MSG-1/2/3/4. As result of the modification implemented to the SSPAs, on board dissemination will also be available from MSG-2 onwards: interaction with EUMETSAT Council concluded in using the LRIT transmission with contents TBC, keeping the HRIT as back up of EUMETCast if required. Contents of the LRIT transmission will be discussed with EUMETSAT Delegates in the autumn 04 session of delegate body meetings.
The MSG-2 launch is planned in Feb-Apr 2005, establishing the “hot back up” in orbit configuration to MSG-1. The precise launch slot definition (i.e. month of the launch) had to be postponed from July to September 2004 in agreement with Arianespace, due to uncertainties both on the launcher and co-passenger readiness.

Following the launch of MSG-2 and its commissioning, the next planned satellite transition is presented in Fig. 7. To be noted that this plan is associated with an extension of the Meteosat Transition Programme up to 2008 which is subject to EUMETSAT Council approval and that the Meteosat-8 position at 3.4ºW from 2007 onwards is to be confirmed.

Following the decision of the 52nd EUMETSAT Council in March 2003 to initiate industrial activities associated with the MSG-4 satellite and GERB-4 Instrument, the MSG Programme Extension to include MSG-4 has been fully approved at the 55th EUMETSAT Council in June 2004. The MSG Programme Extension with MSG-4 includes a fourth recurrent satellite, embarking the GERB and SAR missions, provision for development of a Hydrology theme on Satellite Applications Facilities (SAFs), the MSG-4 Launch and LEOP services, Commissioning activities and Routine Operations ensuring the extension of Geostationary operational service until 2018. The MSG-4 satellite will enter into storage in 1st half 2007, with tentative launch in 2010/2011.

An overview of the in-orbit plans of the EUMETSAT Geostationary Programmes is presented in Fig. 8. After the launch of MSG-2 in the first half of 2005 and following the start of its routine operations in 2006, the geostationary service over Europe will be provided by satellite of the Meteosat Second Generation.

Fig. 6 EUMETCast – Ku and C-Band coverage

Fig. 7 Planned satellite transition
Note1: Extension of Meteosat Transition Programme up to 2008 is subject to EUMETSAT Council approval.
Note2: Meteosat-8 position at 3.4ºW from 2007 onwards is to be confirmed

Fig. 8 EUMETSAT Geostationary Programmes - in-orbit plans