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STATUS OF PREPARATION OF MSG

This paper reports on the current MSG programme development status including plan for transition to the new services.

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1 INTRODUCTION

An overview of the mission objectives and basic capabilities of the MSG system was presented in a previous paper (Reference (1): CGMS-XXV EUM-WP-04). The development status was also presented and kept updated in the successive releases of this paper. The status of the development programme in August 2000 and the actual plans for preparing the transition from Meteosat to MSG are presented in this report.

2 MSG - MISSION OBJECTIVES AND CAPABILITIES

The programme is under full development in line with the Mission Objectives already highlighted in Ref. (1) and summarised in table 1 (see annex). The End Users Requirements Document (EURD) has been updated in 1999 to include requirements covering the products and deliverables developed by the Satellite Application Facility (SAF) on Support to Nowcasting and Very Short Range Forecast (VSRF), following the successful Requirements and Architectural Design Review of this particular SAF. Also the Data and Information Services Chapter has been extensively modified to remove items To Be Defined following the Architectural Design Review of the Unified Meteorological Archiving and Retrieval Facility. The EURD is planned to be further updated to capture products and services offered by other SAFs.

At its 42nd meeting in June 1999, the EUMETSAT Council approved the procurement of two additional instruments Global Earth Radiation Budget (GERB) instruments for flight on MSG-2/3 and provision of the related operational data service by the Rutherford Appleton Laboratories, UK. Capitalising on the GERB development carried out by RAL in response to an ESA Announcement of Opportunities, this decision ensures continuity of the GERB mission beyond MSG-1 and secures an important contribution of MSG to Climate Monitoring.

In parallel, a world-wide MSG Research Announcement of Opportunity (MSG RAO) was jointly released by EUMETSAT and ESA in 1999. This MSG RAO provides a structured framework for demonstrating the value of the MSG mission to innovative research in various Earth Sciences disciplines and for investigating the potential implications for the evolution of the operational services.

43 projects were jointly selected by ESA and EUMETSAT in November 1999, following a peer evaluation process initiated in February of the same year. These projects involve about 190 researchers from ESA and EUMETSAT Member States including Belgium, Canada, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain and the United Kingdom. Another 42 researchers belong to other countries including Botswana, Central Africa, Ghana, Israel, Japan, Mozambique, Namibia, Russia, Senegal, Sri-Lanka, the U.S.A. and Zambia. The first MSG PI Workshop was held in Bologna, Italy, in May 2000, starting the dialogue between the Investigators, ESA and EUMETSAT.

3 STATUS OF SPACE SEGMENT

The cooperation with ESA for the procurement of the space segment is governed by a Programme Implementation Plan (PIP) which was signed in December 1997.

Following the Critical Design Review (CDR) of the Satellite held in the last quarter of 1998, the

Qualification Result Review (QRR) was held in the first half of 2000. Some actions remained open

and are expected to be closed out prior to the Flight Acceptance Review (FAR). The FAR will extend between August and October 2000.

The Engineering Model of the Satellite has ended the nominal test programme and presently runs additional tests to confirm the resolution of open QRR issues. The fist part of compatibility tests with the MSG Ground Segment (System Validation Test–1) has been started. The subsystems Flight Models and SEVIRI FM have also been delivered, the Satellite FM has been Integrated and the testing programme is largely completed.

The production of the MSG-2 and MSG-3 satellites is also well advanced: the SEVIRI FM 2 will be delivered around September 2000.

Ariane-4 has been baselined for the launch of MSG-1 whilst Ariane-5 remains the baseline for MSG-2 and MSG-3. Further tests are planned to confirm and document the compatibility of the MSG-2/3 satellites with the second batch of Ariane-5 launchers.

The MSG-1 satellite mass at launch is slightly above 2030 kg.

The SEVIRI EM and FM tests have indicated very promising results regarding performances. Table 2 below presents the expected in-orbit radiometric performances at SEVIRI End Of Life (EOL) (i.e. including ageing of hardware and contamination effects). The EOL estimations of table 2 are based on SEVIRI FM test results complemented by analyses allowing to predict the in-flight performances by extrapolation from on-ground testing. The impact of Electro-Magnetic Compatibility (EMC) effects on the estimated radiometric performances in-orbit at EOL is included.

Channel	**Noise specification**	**In-orbit, EOL performance estimate without margin**
HRV	1.07 at 1.3 W/(m² sr µm)	0.93 at 1.3 W/(m² sr µm)
VIS0.6	0.53 at 5.3 W/(m² sr µm)	0.37 at 5.3 W/(m² sr µm)
VIS0.8	0.49 at 3.6 W/(m² sr µm)	0.37 at 3.6 W/(m² sr µm)
IR1.6	0.25 at 0.75 W/(m² sr µm)	0.25 at 0.75W/(m² sr µm)
IR3.9	0.35K at 300K	0.24K at 300K
WV6.2	0.75K at 250K	0.40K at 250K
WV7.3	0.75K at 250K	0.48K at 250K
IR8.7	0.28K at 300K	0.17K at 300K
IR9.7	1.5K at 255K	0.24K at 255K
IR10.8	0.25K at 300K	0.15K at 300K
IR12.0	0.37K at 300K	0.22K at 300K
IR13.4	1.80K at 270K	0.30K at 270K

Table 2: Radiometric performance estimate

Except for channel NIR1.6, the predicted in-orbit radiometric performances at EOL are better than the requirements. As expected, due to the EMC perturbations, the performances of the SEVIRI FM are slightly worse than those measured on the SEVIRI EM, as the latter measurements did not include EMC effects. This is particularly evident for all solar channels.

Regarding channel NIR1.6, further to the effect of EMC perturbations, the predicted degradation of the detector performance due to the heavy ions is the main reason for being just compliant at EOL and

much worse than presented for SEVIRI EM.

The SEVIRI FM performance test campaign has also shown compliance of the SEVIRI design with spectral requirements and with Modulation Transfer Function (MTF) requirements.

The FM test results indicated also a good pointing stability when the instrument is submitted to temperature variation. This will improve the quality of images acquired during eclipses.

The GERB-1 flight instrument, after a complete calibration campaign, has been integrated into the MSG spacecraft. The GERB ground segment has successfully passed the CDRs for both the UK and Belgium part. After approval by the EUMETSAT Council of the other two GERB instruments (and related services) to be embarked on MSG-2 and MSG-3, the Kick-Off for the GERB-2/3 activities was held beginning of July 1999. GERB-2 has been very recently delivered to the Satellite Integration. Either instrument (GERB-1 or GERB-2 can fly on MSG-1). This allows swapping if required.

4 STATUS OF GROUND SEGMENT, SYSTEM ENGINEERING AND OPERATIONS PREPARATION

After the GS CDR was successfully held between December 1998 and February 1999, the ground segment development has entered the production and tests phases at facility level and the preparation for system integration at EUMETSAT. The Central Facility, the Primary Ground Station and the Image Processing Facility have encountered delays beyond 6 months during the system test phase at the contractor premises, despite the recovery actions intervened, including important increase of resources at the contractors. These delays are postponing the start of the Ground Segment integration and affect the MSG-1 launch date.

The Central Facility has experienced severe performance issues, causing in some critical area the need to revisit the design. In particular, implementation of a pre-existing Monitoring and Control Commercial and Off The Shelf Software (COTS) product has proved to be much more complex than anticipated. As a result, the version of the Central Facility capable of supporting the satellite commissioning and initial operations cannot be ready before spring 2001, approximately one year late than planned.

The Primary Ground Station is also experiencing the similar problem with this COTS product, although implementation is different from the CF. Work around solutions has been defined with staggered deliveries of the Central Monitoring and Control System and their implementation is now proceeding.

The Image Processing Facility (IMPF) has shown continuous slippage causing the need of re-establishing the baseline planning and redefining the team roles and size. This Facility is now on the critical path of the MSG programme, as a final delivery is around mid 2001. The contractor team has been now well reinforced and additional infrastructure has been procured to allow paralleling of activities.

The development of Meteorological Products Extraction Facility (MPEF) and of the Back-up and Ranging Ground Station (BRGS) has been recently successfully completed, the relevant (Provisional) Facility Acceptance Reviews have been passed. The Data Acquisition and Dissemination Facility

(DADF) is also well advanced in the system tests phase and is approaching the PFAR. The Space and Ground Simulator Facility (SSF) development is also under control after difficult development steps related to the internal software infrastructure and the simulation of the satellite on board software.

The System Critical Design Review was held at EUMETSAT during November and December 1999 involving ESA and was declared successful. This was the first System Review of the MSG programme. The plans for the system verification and its validation were analysed and found appropriate, the full traceability of requirements between the Programme segments to the EURD was demonstrated, the supportive interface documentation and engineering analyses were provided, without identifying any major flaws. The schedule criticality towards the originally foreseen October 2000 launch date was noted, leading to a recommendation for revisiting the launch date also with a view to optimise the lifetime.

The first part of the System Validation Tests with the Ground Segment and the Satellite was successfully conducted in February 2000 (SVT-1/1), followed by a second session in May 2000 (SVT-1/2). The Final System Validation Tests (SVT-2) are planned approximately four months before the launch.

The overall situation makes it impossible to launch in October 2000 as originally planned. EUMETSAT has analysed various options, aimed at optimising the selection of the postponed launch date with respect to the MSG-1 lifetime and came to the conclusion that January and July were optimum. Currently end of January 2002 is the earliest possible launch date.

5 USER STATIONS AND TRANSITION OF SERVICES

The detailed design, development and tests phase has been completed as part of the DADF development. The design documentation for the user stations has been made available for potential manufacturers starting from beginning of 1999 on the MSG Web, and than updated to reflect the successful tests of the MSG Users Station Baseband Module (part of the DADF development). Discussions have progressed with EUMETSAT Council aimed at revisiting the High Rate Information Transmission–Low Rate Information Transmission data streams contents, increasing the overall data disseminated and making the two data streams more complementary, whilst keeping the LRIT service attractive. The current baseline are shown in table 3 attached.

Users have been informed about these possible changes, as HRIT users may wish to procure Users Stations with both HRIT-LRIT receiving capability.

Currently the transition period with parallel operations of Meteosat-7 and MSG-1, starting from the commissioning of MSG-1 in 2002, extends until the end of 2003. It is technically possible to further extend the overlap until 2004 assuming continued nominal operations of Meteosat-7.

Annex

Mission	**Characteristics**	**Note**
Imaging For basic imagery, airmass analysis and high-resolution imagery	Channel HRV VIS0.6 VIS0.8 IR1.6 IR3.9 WV6.2 WV7.3 IR8.7 IR9.7 IR10.8 IR12.0 IR13.4	
	Imaging area Visible and infra-red channels: Full earth disc from geostationary orbit High-resolution visible: full North-South scan of earth disc; (adjustable) half earth disc in East-West	
	Sampling distance (at sub-satellite point) Visible channels: 3 km Infra-red channels: 3 km High-resolution visible: 1 km	
	Image repeat cycle 15 minutes full earth disc	
Data Dissemination	High Rate Information Transmission (HRIT) 1000 kbps of full image data, products, DCP and foreign satellite data etc.; lossless compression envisaged; encryption possible Reception with dedicated user station of minimum 12 dB/K Low Rate Information Transmission (LRIT) 128 kbps of reduced image data, products, DCP and foreign satellite data etc.; lossy compression envisaged; encryption possible Reception with dedicated user station of minimum 5 dB/K	
Data Collection	210 regional channels (high band) 40 international channels up to 210 regional channels in the band of neighbouring satellite systems (as contingency; low band)	received and processed received and processed satellite relay only
Product Extraction	Key products extracted centrally, e.g. - Atmospheric Motion Vectors (AMV) - Cloud Analysis (CLA) - Cloud Top Height (CTH) - etc.	Further products developed and extracted in de-central facilities
Secondary Payloads	Scientific GERB instrument Global earth radiation coverage in three bands every 2.5 min; full data set to noise spec. every 15 min GEOSAR message relay Reception of distress signals at 406 MHz from most of the earth disc and downlink on 1544.5 MHz	Accommodation approved Accommodation approved

Table 1: Mission Objectives Overview

Annex

Table 2: Current baseline for HRIT and LRIT dissemination

The current baseline can be summarised as:

- HRIT containing the full set of SEVIRI image data (lossless – apart from HRV);
- LRIT containing the full set of Foreign Satellite Data (lossless), a subset of lossy SEVIRI image data, DCP data, MDD data and meteorological products.

In more detail the data content of LRIT and HRIT is:

LRIT		**HRIT**
SEVIRI 1.5		**SEVIRI 1.5**
VIS (0.6)	lossy (30 mins)	All channels lossless (apart from HRV) full Earth disk, 15 mins
IR (6.2) WV	lossy (30 mins)	
IR (10.8)	lossy (30 mins)	
[NIR (1.6)	lossy (30 mins)]*	
[IR (3.9)	lossy (30 mins)]*	
Foreign Satellite Data Lossless 3-hourly Images (full set)		
Meteorological Products** MPEF AMV MPEF CTH MPEF CLAI		
DCP** All DCP data		
MDD** All MDD Data		

Summary of differences with respect to previously agreed baseline:

HRIT

- SEVIRI 1.5 data: no change (just more space for uncertainty in compression factor)
- FSD: moved to LRIT
- Meteorological Products: moved to LRIT
- DCP: moved to LRIT
- Bulletins from GTS (i.e. MDD): moved to LRIT

LRIT

- SEVIRI 1.5 data: 3 of original 5 channels unchanged / 2 of original 5 channels to be included if space available
- FSD: now full set and lossless (transferred from HRIT)
- Meteorological Products: augmented set from HRIT
- DCP: no change
- MDD: no change

* Denotes channels to be included if space is available

** DCP, MDD and Meteorological Products could be moved back to HRIT if the 3 core SEVIRI channels on LRIT cannot be accommodated