CGMS

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Status of the EUMETSAT Broadcast Services for EPS-SG

EUMETSAT is defining the EPS Second Generation (EPS-SG) satellite system, which is planned to be operational by end of this decade, and provide observations in the mid morning orbit as part of the Joint Polar System (JPS) set-up in coordination with NOAA. Instrument observation data will be broadcast directly by the satellites in real time. This paper addresses the status of the plans of the broadcast service for EPS-SG, and the transition from the current service.

Status of the EUMETSAT Broadcast Services for EPS-SG

1 INTRODUCTION

EUMETSAT is defining the EPS Second Generation (EPS-SG) satellite system, which is planned to be operational by end of this decade as part of the Joint Polar System set-up in coordination with NOAA, to provide continuity of observations from the Initial Joint Polar System and enhanced capabilities in the mid morning polar orbit.

Instrument data with global coverage from EPS-SG satellites will be acquired and processed within the ground infrastructure and made available in near real time to the users.

Instrument data from the observation areas of the relevant instruments will be broadcast directly by the satellites in real time. This paper addresses the status of the plans of the broadcast service for EPS-SG satellites.

2 EPS-SG BROADCAST SERVICE

2.1 Candidate Instruments

An overview of the plans for EPS-SG is provided in CGMS-39 EUM-WP-07.

The following two tables show the candidate instruments of the two EPS-SG satellites which are relevant to the broadcast service, and the amount of raw data generated, based on the current status of their design in Phase A and relevant margins.

Instrument	Data Rate [Mb/s]	
	day	night
METimage	19.500	6.800
ATMS	0.032	0.032
IASI-NG	6.000	6.000
3MI	6.800	0.000
RO	0.400	0.400
S-5	30.000	3.000

Table 1 – EPS-SG Candidate Payload with Direct Broadcast on Satellite A

Instrument	Data Rate [Mb/s]	
	day	night
SCA	4.000	4.000
MWI	0.099	0.099
ICI	0.030	0.030
RO	0.400	0.400

Table 2 – EPS-SG Candidate Payload with Direct Broadcast on Satellite B

2.2 Relevant Space – Ground Interface Characteristics

The baseline for the EPS-SG broadcast service is to use the 7750-7850 MHz frequency band (X-band), supporting a data-rate up to 140 Mb/s. Extension of the band up to 7900 MHz is expected to become effective after the World Radio-communication Conference in 2012.

Coordination of the use of this band is done among EUMETSAT, NOAA and CMA within CGMS, and within the broader context of the Space Frequency Coordination Group (SFCG).

The G/T of the user station must be sufficient to receive error-free data under different operating conditions. It will be confirmed based on the satellite design, however from the preliminary link budgets values are proposed that are consistent with the NPP/JPSS-1 specification (22.7 dB/K at 5 degrees of elevation), so that the goal of an EPS-SG broadcast service based on a ground station that supports NPP/JPSS reception as well can be set.

The use of efficient modulations is a must for allocating the required data rate with moderate spectrum occupancy (e.g. 4D-TCM-8PSK).

A number of aspects of the interface to be specified can be the focus of a global specification by CGMS, such as:

the radiofrequency specifications of the ground station (with a view to building the capability to receive data from different satellites, using common equipment, this should be based on the most demanding antenna G/T);
the modulation characteristics (allowing flexibility in the implementation by the different satellite systems);
the formatting of the data (to support common or interchangeable solutions for data handling and processing).

2.3 Transition from EPS to EPS-SG

The EPS Metop Direct Readout Service uses the Advanced High Resolution Picture Transmission (AHRPT) format and L- frequency band with the following characteristics:

1699.05-1709.25 MHz frequency band notified for Metop within the 1675-1710 MHz MetSat band;
1701.3 MHz and 1707.0 MHz (backup) carrier frequencies;
4.5 MHz bandwidth.

It should be noted that the data generation rate of the EPS-SG instruments is more than 20 times higher than the EPS/Metop data rate. This high data rate is a direct consequence of the stringent EPS-SG user requirements, and cannot be reduced without user community consultation. The amount of data that could be transmitted in the L-band used by Metop is limited and would not exceed 20 Mb/s approximately, largely below the data-rate that is required to support EPS-SG, which points to the use of the X-band with its wider bandwidth as a feasible alternative.

A second EPS service was originally provided in parallel to the AHRPT, the Low Rate Picture Transmission (LRPT) in the 137-138 MHz frequency band, which allowed the transmission of selected data on a low data rate channel. This mission was discontinued shortly after the

Metop-A launch due to a component failure on-board and interference with the HIRS instrument. It is not intended to re-introduce it for EPS-SG.

The higher data rates of EPS-SG also represent an important satellite design driver. Maximum flexibility is being allowed on the satellite side, i.e. no ground station heritage or commonality requirements are currently being imposed on the satellite design. In practice, this means excluding the re-use of existing ground station designs or equipment, and that a new ground station infrastructure is needed for EPS-SG. Re-use in particular of EPS user antennas and front-ends is not possible, and the re-use of other processing elements is unlikely.

The European user community has stressed the need to provide data from EPS-SG instruments in full resolution, and has not expressed any need for continuing a broadcast service for a subset of the data or for data in lower resolution, implied by the continuation of the HRPT service in L-band. Therefore the current EPS-SG baseline is that all direct broadcast data will be transmitted in X-band; L-band transmissions will be stopped, and new EPS-SG X-band stations will be needed.

3 INTEROPERABILITY OF EPS-SG AND JPSS BROADCAST SERVICES

The realisation of broadcast services within JPS which can be used with a common ground station is a goal of EUMETSAT, acknowledging however that the systems need to optimise the satellite design.

The use of the same frequency range is recommended for commonality of front-end equipment (antenna feed, LNA, downconverter). NPP/JPSS-1 will use a carrier centred at 7812 MHz, occupying 30 MHz for 15 Mb/s. The separation of the morning orbit of EPS-SG from the afternoon orbit of NPP/JPSS-1 and the extension of the MetSat X-band to 7900 MHz, with the resulting available bandwidth for EPS-SG, will facilitate the above goal.

The use of efficient modulations is a must for allocating the required data rate with moderate spectrum occupancy. JPSS will use OQPSK; 4D-TCM-8PSK might be considered for EPS-SG.

The specification of a common EPS-SG and JPSS broadcast reception station would have to impose the most demanding antenna G/T requirements and support the demodulation of the different signals.

These aspects and the formatting of the data can be the focus of a global specification by CGMS, as an evolution of the AHRPT global standards for its applicability to the 7750-7900 MHz band.

4 CONCLUSIONS

The realisation of broadcast services for JPS satellites which can be used with a common ground station is a goal of EUMETSAT, acknowledging however that the systems need to optimise the satellite design. The use of the same frequency range within the MetSat X-band is recommended for commonality of front-end equipment, to be combined with the specification of a reception station with the most demanding antenna requirements. The broadcast interface can be the focus of a global specification by CGMS, as an evolution of the AHRPT global standards for its applicability to the MetSat X-band.