CGMS

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Plans for Post-EPS

This document presents the status of the Programme Preparation of the EPS Second Generation (EPS-SG), currently in Phase A.

The roadmap for approval of the Programme at EUMETSAT and ESA level has been consolidated, and interactions with the International and European National Partners intensified to negotiate draft cooperation concepts and agreements.

The ESAS industrial competitive studies would start by January 2011, addressing Phase A and Phase B1, and aiming at their completion in late 2012.

The major decisions expected in 2011 at EUMETSAT level include the approval of the EPS-SG Preparatory Programme covering the EUMETSAT Phase B (2012-mid 2014) and the approval of the EPS-SG Payload Complement to be used as baseline for the Phase B studies and the preparation of the full Programme Proposal covering the Phases C/D/E.

Action/Recommendation proposed:
CGMS to take note of the Status of the Preparation of the EPS-SG Programme.

Plans for Post-EPS

1 INTRODUCTION

This document presents the status of the Post-EPS Programme Preparation.

The Post-EPS Phase A started in January 20is running and will be completed in December 2009 with the Planned Mission Definition Review. The Phase A activities will start at conclusion of the MDR and will address the feasibility studies at mission, system, space and ground segment level.

The main Post-EPS planning elements and constraints are as follows:

Post-EPS Programme Phasing Elements	Date
Post-EPS Phase 0	2004-2009
Post-EPS Mission Definition Review (MDR)	Q4 2009
Post-EPS Phase A	2010-Q1 2012
Post-EPS System Preliminary Requirements Review (PRR)	Q1 2012
Post-EPS Phase B	2011-mid 2014
Post-EPS System Preliminary Design Review (PDR)	Mid 2014
Post-EPS Phase C/D	2014-2020
Launch readiness of first Post-EPS Satellite (priority missions)	End 2019
Launch readiness for the second Post-EPS Satellite	End 2020

2 EPS-SG PROGRAMME PREPARATION

2.1 Overall Status of Preparation of EPS-SG

The trade-off on the satellite configuration to be analysed in Phase A, elaborated in 2009/2010 in cooperation with ESA, and the proposed two-satellite configuration were endorsed by the EUMETSAT Council in June 2010.

The preparation of Phase A/B1 industrial studies continued; an invitation to tender for the Phase A/B1 space segment studies led by ESA has been issued on 3 August; EUMETSAT is in the process to issue an invitation to tender for the Phase A ground segment studies (addressing notional elements of the architecture) in the autumn. The studies are planned to be conducted in 2011 and, for space segment B1 activities, in 2012.

An updated roadmap of decisions leading to the approval of the EPS Second Generation (EPS-SG) Preparatory Programme and subsequent Development and Operations Programme has been elaborated in coordination with ESA and will be discussed with EUMETSAT Delegations in autumn 2010.

In line with the above roadmap and with the Council resolution on the preparation of the EPS-SG agreed at the 70th Council meeting in June 2010, work on a Preparatory Programme

Proposal has started and relevant elements documented, to be addressed to the Joint STG-AFG at its 45th meeting in October 2010.

The drafting of the Joint Polar System (JPS) cooperation agreement with NOAA progressed well, leading shared views by the two organisations addressing the system definition and areas of cooperation with a number of key points subject of current technical and programmatic discussions. An overall approach to the cooperation with all partner agencies in the future phases of Post-EPS has been elaborated taking into account the lessons learnt from EPS.

Starting with begin of Phase B, the next generation of EPS is referred to as EPS-SG (EUMETSAT Polar System, Second Generation). Documentation that refers to Phase B onwards is already using this name.

2.2 Status of Phase A Activities

Drafting of End User Requirements (EURD), System Requirements (SRD), and Space-to-Ground Interface Requirements (SGIRD) documents continued, and a review of SRD and SGIRD was done with the support of ESA. ESA used these inputs to draft in parallel and in coordination with EUMETSAT the space segment requirements, as the main technical specification to relevant Phase A/B1 industrial studies.

A meeting of the Post-EPS Mission Experts Team was held on 16-17 June at EUMETSAT. Changes and refinements proposed for the mission requirements were reviewed, and a number of driving requirements discussed in view of Phase A studies and of the applicable specifications and constraints.

At system level, a number of areas have been identified which will require to be analysed during Phase A in support of the selection of relevant solutions and confirmation of their feasibility. These areas include among others the system architecture and mission implementation concepts, the allocation of performance budgets among the various subsystems, the conventions and standards to be followed.

Particularly for the allocation of performance budgets, identification of parameters which require modelling and simulation, and of the relevant tools/models, has been addressed. A key system requirement that will drive the design is represented by the timeliness of data and products to be distributed in near real time; to support the modelling of the timeliness of a LEO Earth Observation mission to sufficient accuracy for making space and ground segment trade-offs and feasibility analyses the detailed specification of a relevant tool has been elaborated, and will be used for a relevant procurement, possibly in the form of an upgrade of an in-house available mission analysis tool.

Additionally to studies at system level, there is a need for EUMETSAT in Phase A to address the feasibility of the ground segment, drawing a conceptual design and estimating cost. These data will be complementary to those at system level and space segment level from partner organisations and allow deriving the full extent of the preliminary definition, development and operation programmes.

In preparation to Phase A Ground Segment industrial studies, work is now addressing the identification of applicable constraints mainly in terms of interfaces and of infrastructure to be possibly reused from other programmes.

The Post-EPS Ground Segment will provide mission management, spacecraft monitoring and control, payload data acquisition, processing, archiving and distribution, and associated user services. It will have a strong heritage from the existing EPS system and from other elements of the EUMETSAT infrastructure in support of current programmes, to be evolved as necessary; the data processing and generation of meteorological products will be based on a network consisting of a central processing facility at the EUMETSAT Headquarters and the EUMETSAT Satellite Application Facilities (SAFs); the functions of near real time data distribution, archiving and offline retrieval will be based on an evolution of the EUMETCast and UMARF systems.

2.3 EPS-SG Candidate Missions

The EPS-SG mission requirements baseline for the Phase A is the result of the user consultation process, the Mission Definition Review (autumn 2009), and the requirements de-scoping undertaken with the EPS-SG Mission Experts Team (PMET) until mid of 2010.

The EPS-SG Mission Requirements Document (MRD) was presented to EUMETSAT Council (EUM/C/67/09/DOC/05), and endorsed in its version V2D Draft. The outcome of the EPS-SG Mission Definition Review, recommending to study in Phase A the candidate observation missions, was endorsed by the EUMETSAT Council in 2009.

The selected mission concept for the EPS-SG Phase A encompasses a total of nine candidate observation missions, which are:

Infrared atmospheric sounding mission (**IAS**), providing hyper-spectral infrared sounding with a spectral resolution of 0.125 cm^{-1} within the spectral range from 645 to 2760 cm^{-1} at an average spatial sampling distance of 25 km;
Visible/Infrared Imaging mission (**VII**), providing moderate-resolution optical imaging in >20 spectral channels ranging from 0.443 to 13.345 µm with a spatial sampling of 250 to 500 m;
Microwave sounding mission (**MWS**), providing all-weather microwave sounding in the spectral range from 23.4 to 229 GHz, at a spatial sampling of 10 to 20 km;
Scatterometry mission (**SCA**), providing back-scattered signals in the 5.9 GHz band at a spatial resolution of 25 km;
Radio occultation sounding mission (**RO**), providing high vertical resolution, all-weather soundings by tracking GPS (Global Positioning System) and Galileo satellites;
Microwave imaging mission (**MWI**), providing precipitation and cloud imaging in the spectral range from 18.7 to 668 GHz at a spatial sampling from 8 km (highest frequency) to 12 km (lowest frequency);
Nadir-viewing ultra-violet visible near-infrared shortwave infrared sounding mission (**UVNS**), providing hyper-spectral sounding with a spectral resolution from 0.05 to 1 nm within the spectral range from 0.27 to 2.4 µm at a spatial sampling of 15 km;
Multi-viewing multi-channel multi-polarisation imaging mission (**3MI**), providing moderate resolution aerosol imaging in the spectral region ranging from ultra-violet (0.342 µm) to short-wave infrared (2.13 µm), at a spatial sampling of 2 to 4 km;
Radiant energy radiometry mission (**RER**), providing earth radiation budget measurements in three bands of the solar and terrestrial spectral domains with a spatial sampling of 10 km.

A priority ranking has been assigned to the EPS-SG candidate missions as given in Table 1.

Mission	Rank
IAS	Very High
VII	Very High
MWS	Very High
SCA	Very High
RO	High
MWI	High/Medium
UVNS	Medium
3MI	Medium
RER	Low

Table 1 – Ranking of EPS-SG Observation Missions

The IAS, MWS, VII, RO, SCA, and UVNS missions provide continuity and improvements to currently delivered EPS services. The 3MI, and MWI missions would be new services for EPS-SG, combining user experiences from other experimental or operational missions. In addition to serving the operational meteorological core user service and climate monitoring needs, the EPS-SG candidate missions will also provide services to atmospheric chemistry, operational oceanography, and hydrology.

2.4 Other Missions

Other mission part of EPS-SG baseline in phase A and documented in the PARD and MRD are:

Level 2 product extraction mission;
Support and Data services to users, including:

- Near real-time service to Users;
- Direct broadcast service to users;
- Non real-time service to Users;
- On line service to Users;

The Data Collection Mission, for collecting and transmitting observations and data from surface, buoy, ship, balloon or airborne Data Collection Platforms;
The space environment monitoring mission (SEM), which will continue the respective EPS mission to monitor space weather;
The Search and Rescue mission: similarly to EPS, the EPS-SG system will have the capability to accommodate a SAR terminal, enabling the operations of the mission under the aegis of the COSPAS-SARSAT System, should be this confirmed in Phase A by this Partner as a need.

2.5 EPS-SG Two-Satellite Configuration

The accommodation of the EPS-SG payload on the two-satellite configuration is illustrated in Table 2.

	Satellite "A"	**Satellite "B"**
Instruments	VIIS (METimage and LLI) IASI-NG ATMS (or MWS) 3MI	SCA MWI-Precip. MWI-Cloud ARGOS-4

	Sentinel-5 CERES follow-on (TBC) RO	S&R (TBC) SEM (TBC) RO
Dry Mass (kg)	2,500	2,000
Launch Mass (kg)	2,900	2,300
Power (kW)	2.2	1.6
Solar Array Size (m^2)	13	12
Data-rate (daytime, Mbit/s)	60	1.2

Table 2 – Satellites Configuration

Both satellites will fly in a sun synchronous, low earth orbit, at 817 km altitude and 09:30 descending equatorial crossing time (mid-morning orbit). The two satellites will be separated from each other within the orbit of typically 25 minutes, in order to separate visibility periods and perform routine operations from the same ground station(s). The orbit chosen is the same of EPS/Metop; this not only represents a good compromise among the observation requirements of the different missions but follows also the principles of data continuity which are mostly important for climate monitoring. The observations are complemented, within the JPS, by those of the US satellites flying in the afternoon and early morning orbits (14:30 ascending and 05:30 descending equatorial crossing times respectively).

3 CONCLUSIONS

CGMS is invited to take note of the Status of the Preparation of the EPS-SG Programme.