**UPDATE ON NATIONAL OR REGIONAL MET/ATM**

**MODERNIZATION PROGRAMME DEVELOPMENTS**

 *(Submitted by ET-ISA Co-chairs)*

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| **Summary and Purpose of Document**This document provides a brief on the three large programmes for ATM modernization, SESAR in Europe, NextGen in the USA and CARATS in Japan, and their MET-related activities. A short overview of the Australian project named ‘One Sky’ is also included. It is recommended to refer to presentations done during the 2nd ET-ISA/ASC meeting for more information. |

**ACTION PROPOSED**

The meeting is invited to:

1. note the information contained in this paper;

1. consider the implications of the developments within the referred national or regional MET/ATM modernization programmes on the work plans of ET-ISA and, where applicable, ET-ASC

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1. **EXECUTIVE SUMMARY** (to be included in the final report)

1.1 *<Text to be developed based on the discussion>*

1.2 …

1. **DISCUSSION**

**2.1 SESAR, NextGen and CARATS**

**2.1.1 SESAR in Europe**

[Refer to presentation]

SESAR is one of the largest programmes in the world for ATM modernization. Its acronym stands for ‘Single European Sky ATM Research’. This programme encompasses a vast set of initiatives for modernization of the European-wide air traffic management system, in order to implement the Single European Sky regulation package from a technological point of view. The three phases of the programme are considered in the following with a focus on activities related to meteorology within each of them.

2.1.1.1 In SESAR1 (2008-2016) meteorology was addressed mainly under Work Package 11.02 ‘Meteorological Information Services’. WP11.02 commenced in May 2012, with the aim of bringing dedicated MET expertise, technology and information to the SESAR programme. Recognising the critical dependency that the SESAR Programme has on weather and the environment, WP11.02 presented an opportunity to integrate weather in its strategy, plans and projects in order to enhance the likelihood of success in the final outcome of the SESAR Programme and the consequential deployment of the future air transport system.

2.1.1.2 To this end, the EUMETNET Consortium undertaking WP11.02 has united 7 National Meteorological Services, with 3 industry partners (Belgocontrol, NLR and Thales). The coordinating member of the Consortium, undertaking the role of work package leadership has been EUMETNET EIG. The work package was divided into three constituent projects: 11.02.00 for Management & Coordination, 11.02.01 for Requirements & Raising awareness, and 11.02.02 for Prototype Development, Verification & Validation.

2.1.1.3 Meteorological (MET) information is currently available in several message formats and also in the form of maps or charts and plain text. Although end users are accustomed to these formats, they limit the opportunity to use the data effectively and more automated, for example to prioritise key information or highlight relevant weather phenomena. Besides format issues, access to more precise MET information data can assist decision making when it comes to flight planning, resource planning and route planning, and can help to avoid unnecessary delay.

2.1.1.4 SESAR WP11.02 has developed a platform(1) by which meteorological information generated by European meteorological service providers can be seamlessly made available and therefore integrated by stakeholders in the form of SWIM compliant information services; this is known as the four-dimensional weather cube (4DWxCube). The 4DWxCube is a (virtual) repository of shared, consistent and translated meteorological information, produced by multiple meteorological service providers (METSPs) and made available to stakeholders via its system-wide information management (SWIM) compliant MET-GATE. This platform has been registered as Solution #35 within the SESAR (technological) Solutions catalogue (2).

2.1.1.5 Sharing this MET information and its integration within the air traffic management decision-making process enables airspace users, airports and air navigation service providers to stay up to date with the latest weather situation, and to plan accordingly and effectively for the weather to come. The meteorological information exchange uses SWIM to enable seamless interchange of meteorological data with different partners, and involves SWIM-compliant services such as legacy products (METAR/TAF/SIGMET) and new ones such as hazardous weather (convection, turbulence, icing) developed under the scope of this solution.

2.1.1.6 The SESAR Technological Solution has been validated through a series of validation activities under the leadership of a number of operational projects. In regards to the MET information utilised in the validation tasks, this varied from canned data of specific weather situations and basic MET currently already available through to real time use of the products and services developed in SESAR1. The MET Information was verified during its initial development against observations, while in the validation exercises this information was generally used to support the tactical decisions being trialled. WP11.02 contributed also to some Large Scale Demonstration (LSD) exercises or events, such as TOPMET/TOPLINK, the SWIM Master Class and the SWIM Global Demo.

2.1.1.7 Qualitative analysis of the results of MET contribution to these validation exercises and Large Scale Demonstrations show that the use of enhanced MET products in future ATM will bring significant added value for end users and it has potential to increase the predictability of mission trajectory, improve situational awareness of all stakeholders, and improve flight efficiency. The use of the weather information that is tailored, consistent and shared between all users has been shown to have a positive effect on the safety, capacity and fuel efficiency of aviation in Europe.

2.1.1.8 During the development of the SESAR Solution regular liaison with international bodies regarding international MET, including EASA and ICAO has been maintained. These bodies are fully aware of the development work currently ongoing both in Europe and the US with a view to understanding how this may impact future regulatory frameworks ensuring global interoperability. This solution builds on ICAO Annex 3 standards and recommendations, EC 216/2008, EU 1035/2011 and contributes to the definition of future Rules and Standards for MET service provision. It should however be recognised that current Regulation (e.g. Annex 3, EC216/2008) is based on a State- or FIR-oriented approach to MET service provision. With the capabilities developed related to the 4DWxCube and harmonised/consolidated services, this may need to be revisited at the level of ICAO and EC/EU. The ICAO MET Panel is working on such a revisited model for MET service provision.

2.1.1.9 As a summary, the two main MET requirements that raised and were grounding the work in SESAR1 WP11.02 are:

* The MET information shall be consistent in time and across the different European aviation users’ environments: the MET services shall provide a unique and consistent vision of the present state of the atmosphere and of its future evolution
* One single SWIM-compliant access point for MET information shall allow users to access this consistent MET information. Benefits to the ATM community would be:
* Guarantee a consolidated view of the observed and forecasted MET situation.
* Hide the complexity of the MET system infrastructure
* Facilitate the integration of MET in ATM systems (B2B)

2.1.1.10 This solution #35 is now in the pipeline for delivery. The initial 4DWxCube and underpinning capabilities such as consolidated European Hazardous Weather information service provision will be deployed as part of initial SWIM, in accordance with the European Union Implementing Regulation EU n°716/2014 adopted by the EC in June 2014, also known as the Pilot Common Project.

2.1.1.11 The Pilot Common Project aims at organizing and facilitating the implementation of the European ATM Master Plan, and in this aim, defines six main ATM functionalities (AF) to be implemented. One of those functionalities, the “AF5 - initial SWIM”, includes meteorology requirements under Family 5.4.1 ‘Upgrade/Implement Meteorological Information Exchange system/service’. The European Commission has mandated the management of these ATM functionalities deployment activities to the SESAR Deployment Manager (SDM) while the financing process is managed by the European agency ‘Innovative & Networks Executive Agency’ (INEA).

2.1.1.12 Some of the NMSs involved in SESAR1 WP11.02 are now contributing to four SESAR deployment projects that were submitted under the INEA Call CEF 2015 and were granted co-funding by the INEA and the SDM in July 2016. Those deployment projects intend to industrialize and deploy for operational use the technical solutions that were prototyped in SESAR1. All projects (except project n°IP137) are EUMETNET-led with a technical leadership handled by one NMS:

* Project n°IP067 ‘European Weather Radar Composite of Convection Information Service’ led by the UKMO. Partners: DWD, Météo-France, Eurocontrol. 10/2016-06/2020.
* Project n°IP068 ‘European Harmonised Forecasts of Adverse Weather (Icing, Turbulence, Convection and Winter weather)’ led by the DWD. Partners: FMI, Météo-France, UKMO, Eurocontrol. 10/2016-12/2019.
* Project n°IP069 ‘European MET Information Exchange (MET-GATE)’ led by Météo-France. Partners: DWD, Météo-France, UKMO, Eurocontrol and the DFS (German ANSP). 10/2016-12/2020.
* Project n°IP137 ‘European Meteorological Aircraft Derived Data Center (EMADDC)’ led by the KNMI. Partners: UKMO.

Other deployment projects led by a NMS or an ANSP have been submitted and granted under INEA Calls 2014 & 2015, with a MET component. The majority of these are aimed to implement (I)WXXM and SWIM components.

2.1.1.13 In parallel to the SESAR Deployment activities, the second phase of the SESAR Research and Innovation programme known as SESAR2020 was launched in 2015 after the European Parliament voted in June for a 8-year SEASR Joint Undertaking’s extension and a financing of this extension partly under the Horizon2020 programme. SESAR2020 is split into three main parts: Exploratory Research, Industrial Research & Validation, and Very Large Scale Demonstrations. Accordingly, the work breakdown structure contains several projects under each of these three parts that address the SESAR Key Features: High Performing Airport Operations, Optimised ATM Network Services, Advanced Air Traffic Services, Enabling Aviation Infrastructure.

2.1.1.14 As neither the European National Met Services nor EUMETNET EIG are official SESAR partners, the contribution on meteorology to the Industrial research and VLSD parts of the programme has to be done through partnership with any industrial or air navigation provider involved in individual projects. Through this partnership, the MET community would attempt to ensure that meteorology is taken into account at an early stage of the projects for the design of the prototypes/solutions that use MET information, for the definition of MET requirements and in the validation exercises, for a better integration of MET information into ATM decision-support or aid systems.

2.1.1.15 Projects in which some NMSs are involved are:

* PJ04 Total Airport Management,
* PJ06 Free Routing,
* PJ07 Optimized Airspace Users Operations,
* PJ08 Advanced Airspace Management,
* PJ09 Advanced Demand & Capacity Balancing,
* PJ10 Separation Management En-route & TMA, and
* PJ24 Network Collaborative Management.

***2.1.2 NextGen in the USA***

[Refer to presentation]

2.1.2.1 The United States Next Generation Air Transportation System (NextGen) programme is a multi-department effort aimed at increasing capacity and reliability in the National Airspace System, improving safety and security, and minimizing the environmental impact of aviation. Primary leadership for the weather component falls to the Federal Aviation Administration (FAA) as the Meteorological Authority for aviation weather. The FAA depends on the National Weather Service (part of the National Oceanic and Atmospheric Administration or NOAA) to provide meteorological products and services, but the FAA also has weather programmes in development for NextGen. This section summarizes FAA and NOAA contributions to NextGen weather.

2.1.2.2 To support the aviation weather needs of the NextGen era, the FAA has developed an architecture to provide specific, consistent products and services to operators and air traffic management. Components of this architecture include the NextGen Weather Processor (NWP), the Aviation Weather Display (AWD), Common Support Services - Weather (CSS-Wx). The NWP ingests information from numerous observation platforms and numerical forecast models, provides a consistent weather picture from the sources, and translates that weather picture into airspace constraints for integration into air traffic decision-making. The AWD consolidates weather information from various displays into a single display. CSS-Wx ensures products from both the FAA NWP and from NOAA are available to and useable by FAA systems.

2.1.2.3 The FAA NWP focuses on aviation-specific products such as precipitation and echo-top mosaics, microburst and terminal wind analyses, and dedicated air traffic decision-making products. Underlying many of these products are observations and forecasts from NOAA. These include numerical forecast model output; forecasts of atmospheric turbulence and icing; alphanumeric products such as METAR, TAF and pilot reports; and satellite imagery. To support the NextGen weather effort, NOAA/NWS has launched a number of efforts to improve dissemination, provide digital aviation services (improves consistency), enhance observational capability (expand ceilometer range), and provide near-real time verification of weather elements important to aviation (meet FAA quality management requirements).

***2.1.3 CARATS in Japan***

[Refer to presentation]

2.1.3.1 CARATS was established in September 2010, to develop, maintain, and facilitate its implementation of long-term vision for future air transportation system until 2025, with a variety of members from government, industry, and academia. CARATS has its steering committee and working groups for detailed discussion in the relevant field, such as ATM, AIM, PBN, and MET (see figure 1).

2.1.3.2 CARATS have seven domain goals relating improvement of safety and efficiency (refer table1). In order to establish it, CARATS has number of task for renovation of ATS systems, such as implementation of trajectory based operation (TBO), enhancement of performance based navigation (PBN).

2.1.3.3 CARATS have identified eight directions for renovation of ATS system, such as TBO, improved predictability, PBN, Satellite Navigation, improved situation-awareness, maximized human and instrument capability, information sharing and CDM, high density operation in/around congestive aerodromes/air space. Advanced MET information and services are considered as one of the essential enablers for such improvement.

2.1.3.4 In the CARATS meteorology WG, below items have been discussed. Many of these items are expected to be implemented some time in near future, while in nature it depends on the groups’ discussion. And some items have been implemented so far.

* Sharing MET information via SWIM, including IWXXM
* Meteorological Database
* Improved observations, including Himawari-8 products
* Improved forecasts, including high-resolution NWP, probabilistic forecast and aircraft observation assimilation.
* MET Integration to ATM decision making support system
* Utilization of aircraft observation data via data link



Figure 1. Structure of CARATS



Table 1. Domain goals of CARATS

**2.2 Other known/relevant developments**

***2.2.1 CMATS Project ‘One Sky’ in Australia***

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