

Contextual note – SESAR Solution description form for deployment planning

Purpose:

This contextual note introduces a SESAR Solution (for which maturity has been assessed as sufficient to support a decision for industrialization) with a summary of the results stemming from R&D activities contributing to deliver it. It provides to any interested reader (external and internal to the SESAR programme) an introduction to the SESAR Solution in terms of scope, main operational and performance benefits, relevant system impacts as well as additional activities to be conducted during the industrialization phase or as part of deployment. This contextual note complements the technical data pack comprising the SESAR deliverables required for further industrialization/deployment.

Improvements in Air Traffic Management (ATM)

Bad weather brings unwelcome disruption to flight schedules and is the cause of approximately 13 %¹ of Europe's primary delays. Yet the impact can be mitigated by the timely sharing of the appropriate meteorological information so that effective recovery strategies can be put in place.

The key aspects of Solution #35 "Meteorological information exchange" enable users to have access to **trusted** MET information (regulated, registered and verified); and access to the **best available information** (e.g. resolution, timeliness), this has been achieved through the use of the 4DWxCube:

- The 4DWxCube shall accept information from registered MET Service Providers only through defined interfaces. The 4DWxCube shall deliver information to ATM Users only through defined MET Services.
- The majority of ATM Users require the provision of regulatory product to support aviation needs within the scope of their operational role: local, regional, network, long term, medium term, short term, very short term and execution stages. To support this, the 4DWxCube shall provide access to MET Products through very simple services with minimum tailoring capabilities.
- A minority of ATM Users and other users (e.g. defence) will require provision of complex, non-regulatory products to support innovation in environments such as long term planning. To support this, the 4DWxCube shall provide access to tailored MET Products through sophisticated services that provide flexibility in how they deliver the information to the end user.

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

¹ <http://www.eurocontrol.int/news/weather-resilience-forum-2015>
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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.

SESAR has developed a platform 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 based 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.

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.

This solution is 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 Pilot Common Project.

Operational Improvement Steps (OIs) & Enablers

Solution #35 is a technological solution which addresses the following OI steps and Enablers:

OI Step

- MET-0101: Enhanced MET observations, nowcasts and forecasts provided by ATM-MET systems for Step 1 (coverage = full)

Enablers

- METEO-03b: Provision and monitoring of real-time airport weather information, Step 1
- METEO-04b: Generate and provide MET information services relevant for Airport and final approach related operations, Step 1

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- METEO-05b: Generate and provide MET information relevant for TMA and En-route related operations, Step 1
- METEO-06b: Generate and provide MET information relevant for Network related operations, Step 1
- METEO-08b: All-weather remote sensing of high resolution 3D aerodrome wind field, Step 1

The applicable Integrated Roadmap Dataset is DS 15.

Background and validation process
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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.

The validation exercises utilised MET information developed within SESAR1 are described below:

- EXE-06.06.02-VP-513 de-icing: Aimed to explore the impact and improve the planning phase for de-icing operations through the use of a de-icing management tool (DIMIT). The enhanced Winter Weather Information (WWI) supports de-icing management better than conventional ICAO products. The usefulness of enhanced WWI to de-icing coordinators has been assessed with benefits to all users.
- EXE-13.02.03-VP-700 Short-Term ATFCM: Aimed to integrate MET information hazards to the Network Manager tool. This utilised the MET-GATE to successfully deliver MET information and enabled better anticipation on sector capacity overload.
- EXE-06.03.01-VP-669 A-CDM: Aimed to improve stakeholder's workloads to ensure better surface movements and runway throughput. This was done through high resolution MET information and MODE-S profiles.
- EXE-06.03.01-VP-757 APOC implementation: The use of OPMET services (regulated products and services such as METAR and TAF) to assist APOC in monitoring and management of the airport.
- EXE-11.01.05-VP-791 Use of ensemble weather forecast in flight planning; Integrate global ensemble weather forecasts into the regular trajectory optimization and flight planning process as well as a comparison against real flown flights.

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- EXE-09.48-VP-811 AIS/MET Services and Data distribution; Showing the benefits of up-linking MET information to onboard systems using now casts to improve situational awareness.

WP11.2 contributed also some Large Scale Demonstrations (LSD). LSDs are still running, so final results will be described in the relevant LSD reports. A high level summary of each validation is presented hereafter:

- TOPMET/TOPLINK; Aimed to demonstrate the benefits of the deployment of System Wide Information Management (SWIM)-based services, including MET, aeronautical, corporate network and flight information services. The project aims to show the direct benefits that these advanced information services can bring to commercial airlines, air navigation service providers, and how these services can improve collaborative decision making between stakeholders
- SWIM Master Class; Demonstration of MET-GATE capabilities for real users in the fields of research, training and simulation.
- SWIM Global Demo; The MET-GATE and MET data developed in SESAR were used to assist global flights in order to highlight the benefit of MET-GATE to all SWIM users.

Results and performance achievements

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 various validations and demonstrations utilising MET information in SESAR1 have clearly shown the strong dependency all aspects of aviation have on weather and the vital role timely and accurate MET information plays in achieving optimum performance and predictability. The network understanding of weather assists all actors in behaving in a consistent way as they all have the potential to see the same information and make actions upon it. The use of enhanced weather information enabled improved trajectory prediction as well as hazard avoidance for en-route aircraft, a task that previously had variable impacts on the network as the weather situation could be invisible to some actors.

Equally at airports having an accurate weather picture can enable better handling of aircraft around the terminal; this was particularly well demonstrated by the use of winter weather and nowcast convection which allowed for better tactical planning. The use of the weather information that is tailored and consistent for all users has been shown to have a positive effect on the safety, capacity and fuel efficiency of aviation in Europe.

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Recommendations and Additional activities

There is no doubt that the validation exercises have been able to show benefit to the wider aviation community by the use of enhanced weather information for their operations. However as the research developments in SESAR 1 are taken through to Industrialisation and Deployment a number of additional recommendations should be acknowledged for these future tasks.

- Most requirements for aviation weather provision have been developed by ICAO supported by the World Meteorological Organization (WMO) and for Europe reflected in EU Regulation and EASA Means of Compliance. To ensure a regional and global uptake of SESAR 1 developments, existing standards and specifications for the provision, exchange and use of MET information need to evolve at the level of ICAO and EU;
- The Security, including cyber security of the MET infrastructure both for network and airport based operations as well as on the flight deck has been partly addressed in the Technical Specifications. However any technology or infrastructure built will need to consider how it can be protected and be resilient to security threats;
- Since MET is an enabler, it is widely recognised that attributing cost/benefit to MET information or systems in isolation has very limited usefulness. It is therefore the responsibility of each operational project to define their own cost/benefit and describe the role MET plays in this. The result will be different for each operational environment and function;
- The expected deployment activities should be undertaken with additional live trials of 'real world' operational environments. There is a dependency to ensure that the MET information services and prototypes have been verified in terms of meeting requirements, including accuracy to evaluate specific operational performances. Almost all of the aviation industry is impacted by the weather and it would be appropriate that all aspects of future validations and verifications should make use of the MET-GATE and the tools it provides.

Actors impacted by the SESAR Solution

Actors involved in producing and providing MET information:

MET Service Provider (METSP)	An organization providing MET services supporting international air navigation
Local MET Service Provider	An organization providing MET information services (including observations, forecasts and warnings) supporting ATM and airspace users with particular focus on local operations

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Local MET Expert	Provides expert MET advice in support of local operations Assists in local post-operations analysis
Sub-regional MET Service Provider	An organization providing MET information services (including observations, forecasts and warnings) supporting ATM and airspace users with particular focus on sub-regional operations
Sub-regional MET Expert	Provides expert MET advice in support of Sub-regional operations Assists in sub-regional post-operations analysis
Network MET Service Provider	An organization providing MET information services (including observations, forecasts and warnings) supporting ATM and airspace users with particular focus on network
Network MET Expert	Provides expert MET advice in support of network operations Assists in network post-operations analysis
MET-GATE Administrator	Provides a facility for maintenance and modification of the MET-GATE.

Actors accessing MET information:

Local/Regional/National	Flight Crew
Tower	Aerodrome ATC
Airport	Airport Airside Operations
Airport	Airport Operations Centre
APP ACC	En-Route / Approach ATC
Local/Regional/National	Civil AU Flight Operations Centre (FOC)
Local/Regional/National	State AU Wing Operations Centre (WOC)
Local/Regional/National	ATFCM
Regional/National	ASM

Impact on Aircraft System

None.

Impact on Ground Systems

The essential MET Ground infrastructure components such as weather radar is in place but upgrades to the components that generate the 3D-composite will be required. Dependent on the actual quality of service required for a specific deployment scenario for a specific location, upgrades to the existing observational infrastructure including Lidar and wind profilers could be required.

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Regulatory Framework Considerations

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. Furthermore, some experts working in Solution #35 are members of the ICAO MET Panel which is working on the evolution of MET service provision in general.

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.

For a limited number of airports there are already local regulations to enable better flow management. For example MET information is integrated in A-CDM at CDG and LHR). During Deployment, it should be clarified if there is a need to 'regulate' these local practices more uniformly by either establishing European or Global Rules and/or European or Global Standards.

Standardization Framework Considerations

Results from Solution #35 development phase were provided to ICAO for further consideration as was described in 'Regulatory Framework Considerations'. It is however important to note that these potential standardisation needs are expressed at the level of 'specifying the MET information requirement' and 'specifying the SWIM based MET information exchange requirements'. Any specification that considers the 'use of the MET information' was considered out of scope but still extremely relevant to consider to complete the chain of provision-exchange-use.

With respect to SWIM based MET information services, during the lifecycle of SESAR the key contributions to ICAO, WMO and OGC on the defined MET information exchange models (IWXXM and WXXM) were provided through WP8. Further standardisation needs for SWIM based MET information services are a consideration in the deployment phase.

Considerations of Regulatory Oversight and Certification Activities

By implementing the 4DWxCube and harmonised/consolidated services, the traditional State- or FIR-oriented approach to MET service provision oversight needs to be reconsidered. While regulatory oversight models for pan-European functions exist, its

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applicability on MET service provision is potentially not straightforward. These issues related to oversight and compliance in general will be considered in deployment activities.

With respect to certification, the MET information developed in the context of SESAR1 is still considered to be outside the scope of what is considered 'safety critical information'. The potential certification of information or more specifically applications that use the information was therefore considered outside of scope for solution #35.

Solution Data pack

The Data pack for this Solution includes the following documents:

- 11.02.02-D38 Technical Specification LOCAL
- 11.02.02-D39 Technical Specification SUBREGIONAL
- 11.02.02-D40 Technical Specification NETWORK
- 11.02.02-D41 Technical Specification 4DWxCube
- 11.02.02-D42 IRS 4DWxCube MET-GATE
- 11.02.02-D17 Verification Report LOCAL
- 11.02.02-D19 Verification Report SUB-REGIONAL
- 11.02.02-D21 Verification Report NETWORK
- 11.02.02-D30 Verification Report MET-GATE
- Validation report contributions, in support of release 4 & release 5 (11.02.02-D36)
- 08.03.10 D65 European ATM Service Description for METHazardEnrouteForecast Service
- 08.03.10 D65 European ATM Service Description for METHazardEnrouteObservation Service
- MET-GATE WebService Description

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