Contextual note – SESAR Solution description form for deployment planning

Improvements in Air Traffic Management (ATM)

The Aeronautical Digital Map Common Service (COSER) provides users the capability to retrieve graphical representation of aeronautical data / information. The output is a standardized / harmonised graphic information that can be retrieved by individual requests demanding specific geographical areas. The retrieval can be performed using regular internet protocols or through SWIM services.

The business case for Aeronautical Digital Map COSER has a link with the Pilot Common Project which mandates *Aeronautical information exchange* on iSWIM over the yellow profile among the ATM sub-functionalities that need to be implemented by a selected set of European ANSPs.

The Capabilities can be considered to be provided through standardisation, outsourcing, consolidation or partnerships. It can also be deployed at a single location (centralised service) or at multiple locations (distributed services).

The following subsection describe the different deployment scenarios and architecture options.

- **Most beneficial option: Regional Level Deployment:**
- Not analysed in detail due to scope of SESAR: Worldwide Deployment:
  Providing aeronautical information for the entire world, i.e. service provision for European and international ANSPs.
- Less beneficial options:
  - Local Deployment:
    In this scenario, an ANSP runs the Aeronautical Information Service on local infrastructure per country. It can connect to regional AIM services, other national AIM services (partners) and other AIM services.
  - Sub-Regional Level Deployment:
    At a sub-regional level: providing static aeronautical data within a sub-region (could be a FAB, grouping of countries or grouping of ANSPs)

The TRL-2 Business Model includes the initial views on the CBA deliverable. Only qualitative impacts have been assessed so far for TRL-2. TRL-4 assessed the different scenarios, which could result in discarding some of the scenarios from further processing and add

quantification of benefits as far as possible. TRL-6 produced a final assessment in terms of expected benefits, as described into the table below:

KPA (KPI)		Performance Benefits Expectation Local deployment	Performance Benefits Expectations Sub-Regional Level deployment	Performance Benefits Expectations Regional Level deployment	Performance Benefits Expectations Worldwide Level deployment
Predictability (Flight Duration Variability, against RBT)		None	None	None	None
Flexibility		None	None	None	None
Safety	**Mitigation of safety risk**	Low	Low	Low	Low
Human Performance		None	None	None	None
Interoperability		None	None	None	None
Cost Efficiency	**Cost of operation**	Low	Medium	High	High
Cost Efficiency	**ATCO Productivity**	None	None	None	None
	Technology Cost	Low	Medium	High	Very High

Numerical analysis is included in the related CBA deliverable for V3/TRL-6, maturity level and demonstrated that only the Regional Level deployment provides the expected benefits.

Regional Level Deployment

Note: Regional deployment was **identified as the commercially most advantageous option** in the CBA.

In this scenario, the Aeronautical Information Service is operated resiliently for a complete region (e.g. ECAC area) similar to the EAD service today. It can connect to other regional AIM services or other national AIM services (partners).

Airspace User Operational Centres, ASM centres, Airports, Towers or other ATC systems connect to a single regional system as data originators, data providers and / or as data users to a single regional service.

The national AIS (Aeronautical Information Service) offices connect to the regional deployment for all regional information.

Worldwide deployment was **not considered** in detail in the project as the scope of SESAR only considered Europe.

Please note that naturally, the data contained in a regional, sub-regional or even local deployment would have a global scope, as potentially every information service may be used by airspace users with world-wide flights. Therefore, the data scope is not limited in any way. However, it was concluded that – even though this is technically and operationally feasible in the given architecture – the provision of a service that is also used by international clients was not in scope of SESAR 2020 and therefore not analysed in detail.

Advantages:

- optimal handling of regional inconsistencies, improvements possible for global
- improvement regarding inconsistencies amongst all members of the region
- reduced infrastructure cost compared to local deployments and to sub-regional deployments
- less cost for resilience, as all ANSPs in a region share a common system
- cost optimization due to sharing of investments in a complete region
- simplest management
- data users only need to contact a single service for a whole region

Disadvantages:

- central system needs to be scalable
- risk of inconsistencies across region borders
- cross-border conflicts across region borders
- multiple services need to be contacted in order to get a complete global picture

- difficult cross-border evaluation across regions as every service takes into account only the regional data set

Operational Improvement Steps (OIs) & Enablers

- SDM-0406 – Aeronautical Digital Map Common Service (Business Improvement), linked to the Enabler EN SVC-039.

Background and validation process

- Validation has been performed according the Business Cases Defined in the Business Model
- Development of a Business Model and a High Level Architecture following the Common Service Method as defined in the TRL3
- Validations performed in V2 and V3 produced a global outcome on the definition of a general Data Flow Model, applicable to the different deployments.

Results and performance achievements

This Common Service (COSER) offers mainly:

- Cost reduction: it reduces the operating costs of using the Aeronautical Information.
- Standardisation: it provides output in digital format.

An initial TRL-2 CBA Chapter identifying up to 3 different Solution Scenarios (COSER at Regional level, COSER at Sub-Regional FAB level, COSER by Industry Tool) has been performed. The Scenarios are defined and compared using 4 key characteristics:

1. The capability provision.
2. Number of ANSPs that will have the capability by 2040.
3. Degree of collaboration among ANSPs for consuming the capability.
4. Time to deploy IOC/FOC.

The analysis demonstrates that the benefits increase with the degree of cooperation. These scenarios has been further refined in more detail in TRL-4 and TRL-6. At TRL-2, no monetisation of the benefits was possible.
Assuming that users could consume the capability from a series of competing providers available within Europe, provision of Aeronautical Information deploying a COSER could result in:

- the requirement to deploy fewer engineered capabilities - ANSPs will only bear a cost consistent with the services they receive,
- service improvement roadmap across Europe is consistent and the associated costs are spread across common service ANSP consumers,
- facilitation of the extension of the PCP requirements to other States not originally addressed by the Implementing Rule.

Consequently, the benefit relates to:

- cost reduction through lower number of system deployments and technical systems to be securely maintained in operation. The TRL-2 CBA presents this cost reduction in the form of cost ratios. Depending on the degree of collaboration assumed, the cost savings ratio ranges from 6% in the conservative case to 81% in the most optimistic evolution,
- synchronisation of the evolutionary roadmap enabling consistency of concept and
- increased geographical coverage of the Solution because new incentives,
- increased safety due to increased data consistency within and amongst stakeholders due to harmonisation and consistent application of identical quality standards

The benefits however should grow incrementally according to the spread of deployment of the common service: a local deployment will offer less benefits especially in terms of costs than a wider deployment at European or Worldwide level.

Starting from the TRL-2 phase, and going through the TRL-4 and TRL-6 phases, the primary SESAR KPA addressed is Cost-Efficiency. The Focus Area is G2G ANS Cost Efficiency and the corresponding KPI is CEF3 – Technology Cost. However, through the availability of a cost-efficient and validated COSER, additional ANSPs to those obliged by the PCP are encouraged to consume the service and a quicker implementation of Static Aeronautical Data capabilities could be envisaged. This could have temporary benefits on other SESAR KPIs additional to cost reduction. This approach has been agreed with PJ19-04 and has been further refined in subsequent maturity phases of the CBA.

As result, TRL-6 CBA demonstrated that only the Regional Level deployment provides the expected benefits.

Recommendations and Additional activities

With respect to the TRL4 validation an improvement on the Infrastructure Validation has been performed towards TRL6 in terms of the prototypes (service interfaces) are defined, developed and integrated into appropriate Industry Based Platforms (IBP) and validated in a research (non-operational end-to-end) environment. A specific analysis of the Traceability with the Business cases defined in the Business Model is also provided with a specific phase of flight (UTM, Flight prep and ground system).

The progress done guarantees mature enough results for TRL-6 version of the solution scenario for the performance assessment, thus to enabling an industrialization of the SESAR solution with a different Environment (Local, Regional, Sub-regional and Worldwide).

One recommendation for all stakeholders is to promote the use of Open Architecture and standardized service interfaces and providing the same (or improved) range and Quality of Service (QoS) of the current representation of the Aeronautical Data.

During Wave 1, the Digital Map Service was not directly used by operational projects in validation exercises. Even though aeronautical information is required and provided by multiple other projects, tight budgets and timelines of the programme meant that these projects had to focus on their own core tasks. Some examples can be represented by the following projects:

- projects related to airport/aerodrome which provide or require maps and geographical information about the runway, taxiway or apron layout and also graphical depictions;
- projects related to airspaces which require/provide the airspace geometry and information about events affecting these airspaces (reservations, closures, limitations).

The provision or use of aeronautical information was not validated with PJ15, but rather simulated by using pre-defined test datasets. Naturally, this requires much less effort for validation, coordination and implementation and is therefore a valid means for ensuring the project efficiency.

However, in an operational scenario it does not make sense to keep redundant management of aeronautical information, as this leads to inefficiency and possible safety risks due to inconsistency in the data.

Therefore, in Wave 2 and beyond, the interfaces between PJ.15-11 and operational projects should be included in validation exercises of operational projects in order to ensure that all technical and operational aspects that may impact operations have been duly considered.

Actors impacted by the SESAR Solution

From a Business viewpoint, the Common Service Provider, ATS units (ACC, APP, TWR) and all further potential consumers of the data that need to visualize aeronautical map (e.g. AIM units, ATC / ATM units, data integrators, aircraft operators, airports, data originators,

procedure designers, airspace designer, procedure designer, UAV pilot) are impacted. No change in concept of operations is envisaged.

More detail is included into the technical document regarding the comparison between this solution and EAD.

Impact on Aircraft System

n/a

Impact on Ground Systems

As described in the High Level Architecture for the Common Service, the Aeronautical Digital Map capability will be delivered by a Common Service provider which need to be consumed by the consuming systems, i.e. mainly ATS Systems.

Main impact is on the adaptation of interfaces of the consuming systems.

Regulatory Framework Considerations

Implementation of exchange of aeronautical information in terms of Aerodrome mapping data and Airport Map using the yellow SWIM TI Profile is required by regulation IR 716/2014 (PCP).

Standardization Framework Considerations

Solution PJ.15-11 (aeronautical Digital Map Service) relies on AIRM and ISRM to be standardised to the greatest extent possible.

AIRM describes the payload / content to be transmitted over SWIM. This payload needs to be defined in detail in order to allow SWIM nodes / connected systems to seamlessly exchange information. For this purpose, the data format (syntax) and also the business rules governing the information need to be defined and standardised. As AIRM is a complex and flexible data model, in addition to formal rules, also a standardisation in terms of information harmonisation needs to be taken into account. Harmonisation concerns the fact that operators are free to choose to encode syntactically correct information in different ways, which still make it difficult for users to interpret it correctly. An example for this is the encoding of organisations / units providing services on airports or airspaces. This can be encoded correctly in different ways, but a common approach would be helpful for users.

ISRM describes the service model, i.e. the available functions that every compliant system has to support in order to interoperate with other compliant systems. ISRM standardisation is necessary in order to ensure that the same way of accessing a certain type of information is possible with every actor in a compliant system in order to allow seamless interoperability.

An example for such an interface is the definition of a query function for a data type with its parameters (data type, sequence), return values and pattern for executing.

In addition to the transport mechanism and payload, also visualisation standards that can guarantee global airspace users a standardised depiction with standardised symbology, contents scale levels, units, colours etc. are necessary.
A reliable data and service model are prerequisites for PJ.15-11 in order to achieve interoperability.

The standardisation of SWIM in general is very important for PJ.15-11 as its main communication channel to consumers of the service and to other services.

For SWIM in addition to the AIRM and ISRM also the infrastructure including profiles (e.g. Yellow Profile, Purple Profile, Blue Profile) needs to be standardised in order to ensure that all nodes are capable of supporting the communication patterns and standards (web-services, AMQP etc.) required for SWIM interoperability.

Furthermore, standardisation needs to take into account international standardisation:

- ICAO: Annex 15, 10, 4, DOCS, PANS AIM
- European Union: ADQ IR 73/2010
- EASA: NPA 2016-02
- EUROCAE: ED-153
- EUROCONTROL guidance and standards

Considerations of Regulatory Oversight and Certification Activities

Challenges in terms of compliance are expected due to the fact that not all necessary SWIM standards are fully defined and usable yet.

Industry therefore had to make assumptions and interpretations which can be detrimental to interoperability and reflect unilateral interpretations, which do not necessarily have to be shared by all stakeholders.

This applies to compliance with AIRM and ISRM.

Due to the complexity of the matter, it is difficult for ANSPs to pre-determine the compliance of a component with the SWIM standards. This potentially leads to difficulties when systems from different vendors need to be integrated.

Certification of systems can be challenging as the ADQ IR and the EASA NPA require a high maturity of software development processes and standards. The proof of such mature products and processes can be more difficult for existing COTS products than for new developments.

The certification can lead to additional unplanned costs and delays due to the assurance and certification process implied by the high standards safety standards and process maturity required.

Solution Data pack

The Data pack for this Solution includes the following documents:

- PJ.15-11 Aeronautical Digital Map Service BM TRL-6
- PJ.15-11 Aeronautical Digital Map Service CBA TRL-6
- PJ.15-11 Aeronautical Digital Map Service HLA TRL-6
- PJ.15-11 Aeronautical Digital Map Service SDD TRL-6
- PJ.15-11 Aeronautical Digital Map Service TVALP TRL-6
- PJ.15-11 Aeronautical Digital Map Service AN TRL-6
- PJ.15-11 Aeronautical Digital Map Service TVALR TRL-6

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