PJ.15-10 Aeronautical Information Service High Level Architecture Description

Deliverable ID:	D.6.2.070
Dissemination Level:	PU
Project Acronym:	PJ.15 COSER
Grant:	734160
Call:	H2020-SESAR-2015-2
Topic:	PJ.15-10 Aeronautical Information Service
Consortium coordinator:	INDRA
Edition date:	09 Dec 2019
Edition:	01.03.03

Authoring & Approval

Authors of the document

Name/Beneficiary	Position/Title	Date
Hannes Brunner / Frequentis SESAR Partners	PJ.15-10 Solution Member	06/12/2019

Reviewers internal to the project

Name/Beneficiary	Position/Title	Date
Carlo Andreotti / ENAV	PJ.15-10 Solution Lead	06/12/2019
Borja MARTÍNEZ FERNÁNDEZ / EUROCONTROL	PJ.15 Project Content Integration Lead	06/12/2019
Alberto ANGUITA JIMÉNEZ / INDRA	PJ.15 Project Coordinator	06/12/2019
Mustapha ELMIZEB / Thales	PJ.15-10 Solution Member	06/12/2019
Leonardo PEINADO / ENAIRE	PJ.15-10 Solution Member	06/12/2019
Luigi MAZZUCCHELLI / ENAV	PJ.15-10 Solution Member	06/12/2019
Christine DRIESSEN / SITA	PJ.15-10 Solution Member	06/12/2019
Susanne BUCHHOLZER / Frequentis	PJ.15-10 Solution Member	06/12/2019
Carlo Andreotti / ENAV	PJ.15-10 Solution Lead	06/12/2019

Approved for submission to the SJU By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date
Carlo Andreotti / ENAV	PJ.15-10 Solution Lead	09/12/2019
Borja MARTÍNEZ FERNÁNDEZ / EUROCONTROL	PJ.15 PCIL / PJ.15-01 Solution Member	09/12/2019
Alberto ANGUITA JIMÉNEZ / INDRA	PJ.15 Project Coordinator	09/12/2019
Mustapha ELMIZEB / Thales	PJ.15-10 Solution Member	09/12/2019
Leonardo PEINADO / ENAIRE	PJ.15-10 Solution Member	09/12/2019
Luigi MAZZUCCHELLI / ENAV	PJ.15-10 Solution Member	09/12/2019
Christine DRIESSEN / SITA	PJ.15-10 Solution Member	09/12/2019
Susanne BUCHHOLZER / Frequentis	PJ.15-10 Solution Member	09/12/2019

Rejected By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date

Document History

Edition	Date	Status	Author	Justification
00.00.01	13/07/2017	Draft	Hannes Brunner	First draft of the document
00.00.02	21/09/2017	Draft	Hannes Brunner	Submission to Solution Team
00.01.00	29/09/2017	Final	Hannes Brunner	Version for submission
01.00.00	25/10/2017	Final	Hannes Brunner	Update after alignment with Mega – Version for submission to SJU
01.00.01	30/10/17	Final	Hannes Brunner	Update to address Standardisation needs on high level and description of impacted Functional Blocks
01.00.02	30/01/18	Draft	Hannes Brunner	Inclusion of the following SJU comments: • Needs for standardisation, challenges expected in terms of compliance, certification • Traceability between business models and architectural options (and vice versa) needs to be made much stronger. Business model considerations needs to elaborated for each architectural option. • The architectural options should also compare versus the reference architecture and clearly indicate what is modified, what is not and the reason for it in terms of performance benefits (at the level required for v1) • Executive summaries of the common service solutions

				worked out have now been added but they remain vague and little focussed on the holistic impact, the options, the costs+benefits. Without this it makes it hard to debate at management and governance levels. (a try out based on the current status of deliverables made us fail) and add should serve to summarize all considerations that are needed to assess the need to continue more detailed service definition work, and if so, in which architecture.
01.01.00	31/01/18	Final	Hannes Brunner	Delivery to SJU
01.02.01	25/01/19	Draft	Hannes Brunner	Implementation of SJU comments
01.02.02	08/02/19	Final	Carlo Andreotti	Formal review
01.03.00	31/07/19	Draft	Hannes Brunner	Update for TRL-6
01.03.01	30/09/19	Final	Carlo Andreotti	Formal review
01.03.02	08/11/19	Draft	Hannes Brunner	Updates after SJU Feedback – rename to Aeronautical Information Service
01.03.03	06/12/19	Final	Hannes Brunner	Update after Gate TRL6

PJ.15 COSER

[PJ.15 COMMON SERVICES]

This High Level Architecture Description is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 734160 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document describes the High Level Architecture for the Aeronautical Information Service Common Service.

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Executive Summary

Solution 10 or Project 15, Common Services, is the Aeronautical Information Service. The Aeronautical Information Service was renamed from Static Aeronautical Data Service to more clearly reflect its purpose: To serve as a common Information Service for different kinds or aeronautical information.

It is a common service that allows the collection, processing, storage and distribution of static and dynamic aeronautical information in accordance with AIRM based on well-defined standards.

The aeronautical information follows the SWIM standards for information payload (i.e. AIRM / AIXM) and for the service definition (i.e. ISRM). The SWIM Yellow profile is the most relevant for the Aeronautical Information Service, but other profiles can be supported as well.

Even though due to efficiency reasons of the overall SJU programme not all of the possible connections could be validated within the project, the information managed within the Aeronautical Information Service is relevant in different disciplines of ATM and is required by a broad range of actors. These include e.g. airspace users or RPAS operators (requiring e.g. information about the status or geometry of airspaces, obstacles, runways or other airport surfaces, procedures etc.), data integrators (requiring similar information on behalf of the airlines), ATS or ATC units (e.g. requiring the airport layout, active procedures, airspace closures, airspace information etc.) on the one hand while data originators (airports, procedure designers, mobile phone companies or energy companies for providing obstacles or getting building permissions in the vicinity or airports) provide information that is required by the other actors. Therefore, even though a specific information flow may not have been validated explicitly as part of SESAR 2020 (e.g. potential partner systems may have just simulated the availability of information instead of actually implementing and testing an interface), that does not mean that in an operational scenario these interactions are not required. To the contrary: the duplication of information causes potential safety threats and is detrimental to he efficiency of the overall ATM system and in an operational scenario needs to be avoided where ever feasible.

AIM units and the Service Provider make sure that the information flow between the producers and consumers of that information is performed smoothly and safely.

The Aeronautical Information Service therefore is a hub that enables these services.

EAD, the European AIS Database is a predecessor of the Aeronautical Information Service and shares many of its goals. A detailed gap analysis detailing on the evolutionary upgrades that are provided by the Aeronautical Information Service in comparison to EAD has been developed as part of the project. The Aeronautical Information Service is not seen in contrast or competition to the EAD, but it defines a possible evolution of the EAD.

In the context of the project, different deployment options were analysed. A Cost-Benefit-Analysis (CBA) has concluded that one common centralised system is commercially more beneficial than having multiple sub-regional systems or individual national systems due to the streamlining of efforts and costs that can be avoided by avoiding duplication. Moreover, safety benefits from operating a common service have been identified as it provides an efficient means to consolidate information and to detect any possible discrepancies.

1.2 Purpose of the document

This document describes the High Level Architecture for the Aeronautical Information Service. It follows the architecting approach defined in the Common Services Foundation Method [1] from SESAR 1 and uses the Business Model [2] previously produced in PJ.15-10 to provide the definition of operational, service and system architectures for the Service.

1.3 Intended readership

The intended audience for this document is the SESAR Joint Undertaking, the members in the SESAR 2020 Programme, the ATM stakeholders (e.g. Airspace Users, ANSPs, Airports, and manufacturing industry) with those third parties directly affected by its findings and the contributions having dependencies with the Solution.

Other transversal projects, such as PJ19, and tasks within the SESAR 2020 Programme may also have an interest.

The document also provides inputs for future work in PJ.15-10 regarding the service definition activities.

1.4 Inputs from other projects

The basic notions of the Aeronautical Information Service are described by PJ.15-10 in its Business Model document [2], including the potential customers of the service, the value propositions and the information flows needed between the stakeholders.

The reference architecture, including its individual elements, are from the EATMA Repository, which is maintained by using the MEGA modelling tool [4] and can be accessed via the European ATM Portal [5].

1.5 Glossary of basic concepts

Term	Definition	Source
Capability	The ability of one or more of the enterprise's resources to deliver a specified type of effect or a specified course of action to the enterprise stakeholders.	SESAR2020 PJ19.05 EATMA Guidance Material Version 9.0
Capability Configuration	A Capability Configuration is a combination of Roles and Technical Systems configured to provide a Capability derived from operational and/or business need(s) of a stakeholder type.	SESAR2020 PJ19.05 EATMA Guidance Material Version 9.0
Common Service	A service providing a capability in the same form to consumers that might otherwise have been undertaken by themselves.	SESAR B04.05 D02
Consumer	A user of a service	SESAR B04.05 D02

Term	Definition	Source
Customer	A consumer of a service under a specific contract.	SESAR B04.05 D02
Demand and Capacity Balancing	Assessment and balancing of demand and capacity at network and airport level to provide the NOP/AOP for the day of operation.	EATMA V9 - ATM Capability Model
Flow Manager	The Flow Manager is a role performed at sub-regional level which contributes to the Network Management Function.	SESAR2020 Concept of Operations Edition 2017
Node	A logical entity that performs activities. Note: nodes are specified independently of any physical realisation.	SESAR2020 PJ19.05 EATMA Guidance Material Version 9.0
Operational Node Interaction Description (NOV-2)	Defines the nodes and describe information exchanges and (services between nodes). Mapping capability and nodes. In EATMA it is a high level communication material	SESAR2020 PJ19.05 EATMA Guidance Material Version 9.0
Service	The contractual provision of something (a non-physical object), by one, for the use of one or more others. Services involve interactions between providers and consumers, which may be performed in a digital form (data exchanges) or through voice communication or written processes and procedures.	SESAR2020 PJ19.05 EATMA Guidance Material Version 9.0
Service contract (SLA)	A service contract represents an agreement between the stakeholders involved for how a service is to be provided and consumed. A service contract is specified through the service interface, the QoS and Service policies.	SESAR B.04.03 – Working method on service
Service instance	Service which has been implemented in accordance with its specification in the service catalogue (during the SESAR Development Phase, the service definitions are available in the ISRM) by a service provider (by itself or contracted to a third party).	SESAR B.04.03 – Working method on service
Service Provider	An organisation supplying services to one or more internal or external consumers.	SESAR B.04.05 – D02
Service taxonomy	The service taxonomy describes the categorisation of services provided between ATM stakeholders. It is used to organise the responsibilities of the service design as well as to provide a means of identifying services in the run-time environment.	SESAR B.04.03 – Working method on service
Stakeholder	A stakeholder is an individual, team, or organization (or classes thereof) with interest in, or concerns relative to, an enterprise (e.g. the European ATM). Concerns are those interests, which pertain to the enterprise's development, its operation or any other aspect that is critical or otherwise important to one or more stakeholders.	SESAR2020 PJ19.05 EATMA Guidance Material Version 9.0
System Interface Description (NSV-1)	Links together the Operational View and the System View by depicting which systems and system connections realize which information exchanges. It is based on the definition of Capability Configurations and describes the assets, both	SESAR2020 PJ19.05 EATMA Guidance Material Version 9.0

Term	Definition	Source
	technical and human which are required in order to provide capability.	

Table 1: Glossary of basic concepts

1.6 Acronyms and Terminology

Term	Definition
ACC	Area Control Centre
A-CDM	Airport Collaborative Decision Making
ADQ	Aeronautical Data Quality
AIC	Aeronautical Information Circulars
AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
AIXM	Aeronautical Information Exchange Model
AIRAC	Aeronautical information regulation and control
AIMSL	AIM Service Layer
AIRM	ATM Information Reference Model
AMC	Airspace Management Cell
AMDT	Amendment
ANSP	Air Navigation Service Provider
AOR	Area of Responsibility
APP	Approach
ARES	Airspace Reservation
A-SMGCS	Advanced Surface Movement Guidance and Control System
ATCO	Air Traffic Controller
ATM	Air Traffic Management
AIC	Aeronautical Information Circular
ATS	Air Traffic Services
AU	Airspace Users
AUP	Airspace Use Plan
CADF	Centralised Airspace Data Function
CDR	Conditional Route
COSER	Common Service
CTA	Controlled Airspace or Controlled Time of Arrival

Term	Definition
CWP	Controller Working Position
DMAN	Departure Manageer
EAD	European AIS Database
EATMA	European ATM Architecture
eAUP	Electronic AUP
EFB	Electronic Flight Bag
EIBT	Estimated In-Block Time
E-TMA	Dynamic Extended TMA
eUUP	Electronic UUP
FAB	Functional Airspace Block
FMS	Flight Management System
GIS	Geographical Information System
GML	Geographical Markup Language
IFR	Instrument Flight Rules
INO	International NOTAM Operations
ISRM	Information Services Reference Model
iSWIM	Initial System Wide Information Management
NAF	NATO Architecture Framework
NFR	Non-Functional Requirement
NM	Network Manager
NOP	Network Operations Plan
NOTAM	NOtice To AirMen
NOV	NAF Operational View
NSV	NAF System View
OPMET	Operational aeronautical meteorological data
PAMS	Published AIP Management System
PCP	Pilot Common Project
PCP IR	Pilot Common Project Implementing Regulation
PERM	Permanent
RGA	Route Generation Algorithm
SaaS	System or Software as a Service
SDD	Static and Dynamic Data Management
SDO	Static Data Operations

Term	Definition
SESAR	Single European Sky ATM Research Programme
SID	Standard Instrument Departure
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
STAR	STandard ARrival
SUP	Supplement
SWIM	System Wide Information Management
TLDT	Target Landing Time
TRAMON	Temporary Restricted Aera Monitoring
TSAT	Target Start Up Approval Time
TTL	Total Estimated Elapsed Time
TTOT	Target Take-Off Time
UUP	Updated Airspace Use Plan
VPA	Vertical Path Angle
XML	Extensible Markup Language

Table 2: Acronyms and Terminology

2 Scope of the High Level Architecture Description

The main objective of the high level architecture is to describe the main architecture elements and their relationships across the different architecture layers of the Aeronautical Information Service. This description starts with the business and operational needs, and goes down to the system resources that will need to collaborate with each other to meet these needs, supported by the services that enable the actual exchange of data.

In order to clearly define the borders of this architecture description, some working assumptions have been made regarding the modelling activities and for this document. These are described later in this chapter. Before presenting them, it is necessary to understand the aspects of the Common Service that have motivated these assumptions.

2.1 Aeronautical Information Service Business Aspects

Although the complete definition and the underlying principles of the Aeronautical Information Service can be found in the Business Model [2], some extracts are provided below to better understand the scope of this document.

The function of the "Aeronautical Information Service" is to provide static and dynamic aeronautical information in digital form to be used by different ATM systems. The output is an AIXM-compliant dataset whose subsets can be retrieved by individual requests demanding specific geographical areas, attributes or functional features.

The purpose of this service is very close and even overlapping the already identified "AeronauticalInformationFeature" service in the EATMA. It is also very close to the service requested in the PCP (EU IR 716/2014 [7]) for "Aeronautical information exchange" on the Initial System Wide Information Management (iSWIM) over the yellow profile and defined as:

> Aeronautical information feature on request. Filtering possible by feature type, name and an advanced filter with spatial, temporal and logical operators.

The main task of the Aeronautical Information Service is to provide static and dynamic information like the last operational status of airspace or route activation, and to deal with permanent or long term data. This service will provide static information traditionally available in the AIP. This includes the PERM NOTAMs as static data changes. PERM NOTAMs are in fact Static Data that are published by NOTAM only because they do not fit into the traditional publication cycle. Such changes are usually incorporated in the sequent AIP amendment. Using a digital service would allow to include such information as far as it is available.

The Service has evolved in the TRL-6 phase to provide also dynamic information in the AIXM format (Digital NOTAM). This was successfully validated during the TRL6 validation.

2.1.1 Service Scenarios / Architecture Options

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.

For TRL-6, the Regional Level Deployment has been identified as the most commercially advantageous and most efficient option due to the synergies of co-utilizing assets by multiple clients in parallel. The remaining options are documented in Annex A but are not taken into account for the further evaluations.

2.1.1.1 Regional Level Deployment

At a regional level: providing static and dynamic aeronautical data within a region (e.g. the whole ECAC area)

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

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

2.2 High Level Architecture assumptions

The following assumptions have been made regarding the high level architecture description presented in this document:

- The service will be hosted centrally
  - Rationale: central hosting is envisaged due to efficiency reasons and in order to avoid duplication of resources. Duplication also leads to more complex synchronisation issues.
- There will be one service provider organisation taking care of the harmonisation and data validation beyond what can be done automatically
  - Rationale: a service provider organization will be required as not all conflicts can be resolved automatically, but require coordination of stakeholders. The service provider organization will facilitate and enforce the consensual resolution of potential data conflicts.
- The system will be used by AIM units, who process information from data originators (i.e. Data Originator → AIM Unit → Aeronautical Information Service)
  - Rationale: The stakeholders listed correspond to the stakeholders that are served currently by the similar service EAD. Additional stakeholders were identified as part of the detailed architecture and in the SDD.
- The system will be used by airspace users supported by data integrators potentially also with the ANSP AIM unit in the loop (i.e. Aeronautical Information Service → (AIM Unit) → Data Integrator → Airspace User)
  - Rationale: Practically, some data users are connected directly while others use a data integrator like Jeppesen, Lido or NavBlue
- All information exchange between the service and its users / consumers will take place via SWIM using the SWIM infrastructure
  - Rationale: supporting SWIM is seen as a mandatory core requirement for the service in order to facilitate the direct connection with ATM partner systems / services.

2.3 Impact Assessment on Functional Blocks

A potential impact of PJ15-10 on the following functional blocks in EATMA or a potential impact of the following functional blocks on PJ15-10 is analysed in the sub-chapters of this chapter. The impact can be a direct usage of the functional block within the project or a communication relationship / dependency.

The sub-chapters below include the current description of the functional block from Mega plus a short assessment of the impact.

Not necessarily all of the identified potential impacts will materialize.

2.3.1 Aeronautical Data Collection

Data collection which ensures that the required up-to-date information is received from the appropriate authorised originating sources, e.g. Government Agencies, ANSPs, Airport Operators, CNS providers, METEO providers, etc.

Data Maintenance

Impact:

- Functional block required by 15-10 (used by 15-10)

2.3.2 Aeronautical Data Storage and Management

This functional block represents functionalities ensuring the completeness, coherence and up-to-date of the Aeronautical Information data base.

Impact:

- Functional block required by 15-10 (used by 15-10)

2.3.3 Aeronautical Data Validation and Verification

Data Quality Management which ensures that the data received from the data originators is verified against the quality requirements (i.e. accuracy, resolution, integrity, traceability, timeliness, completeness and format) before being committed (validation) into the database. Data Quality Management in this functional block includes all the processes and actions necessary to ensure that the delivered data meets the relevant data quality criteria.

Impact:

- Functional block required by 15-10 (used by 15-10)

2.3.4 Aeronautical Information Distribution

In the scope of this Functional block the term “product” represents the information delivered to the end user. It can be in printed or electronic form, being the result of a standard or customised query.

The Functional block covers the activities necessary to make the required aeronautical information available to the end user in different form and formats (i.e. paper, file format (e.g. PDF file), text or digital message and dataset).

It provides following functionalities:

- Information Delivery which retrieves the data to deliver the required product (e.g. AIP in paper or electronic form, result of database query) containing the most up-to-date information. This sub-function is responsible for updating the products according either to required production cycle timeframe (e.g. AIRAC cycle) or to evolution in the production tools (e.g. maintenance of standard queries in relation with database evolution).
- Quality Management which ensures that the data produced meets the relevant data quality standards

Impact:

- Functional block required by 15-10 (used by 15-10)

2.3.5 AIM Product Assembling

This functional block represents the data assembly into a product ensuring the quality aspects of aeronautical data within the various products. To reflect the difference in the production of the various types of aeronautical data, following functionalities have been identified:

· Production of Static Data (e.g. those used in AIP, AIC, SUP, Charts and Digital Data sets);

· Production of Dynamic Data (e.g. NOTAM and Digital NOTAM);

The data covered are the aeronautical data (i.e. those specified by Annex 15 and related ICAO SARPS, Guidance Documents and Procedures). Depending on local implementation it may include datasets (e.g. Terrain, Obstacles, Airspace, Aerodrome Mapping). This breakdown does not address the granularity in which the data are established (raw / integrated), nor the form (Digital / paper / semi-digital) in which they are produced / published.

Impact:

- Functional block is fed by information from 15-10 (Functional Block uses PJ.15-10)

2.3.6 AIM System Management

This functional block represents following functionalities:

· Technical Monitoring and Control which ensure that the tools used in the data production chain, as well as in the AIS Provision chain are working properly in accordance with user requirements and service level agreement specifications.

· Quality Management System which is a collection of business processes focused on achieving the policy and quality objectives in order to meet customer requirements expressed in various international standards regulating the provision of aeronautical data/information. It is expressed as the organizational structure, policies, procedures, processes and resources needed to implement quality management.

Impact:

- Functional block required by 15-10 (used by 15-10)
- Will be modified in the project to match the scope of PJ.15-10

2.3.7 Airport Surface Navigation

Lateral navigation assistance on the ground.

Impact:

- Functional block requires information from 15-10 (uses 15-10)

2.3.8 Cooperative Airspace Design

This FB groups all functions related to Airspace Design. These functions support the development and co-ordination of design activities (at local and regional levels) of the ATS Route Network and ATC Sectors, in en-route and terminal airspace.

The Airspace design activities occur in the strategic phase (months before operations) with 3 time horizons:

Annual short-term improvements to develop remedial proposals to alleviate airspace problems and bottlenecks that become evident during the peak summer period

Medium-term airspace improvement to eliminate structural bottlenecks that require a more radical airspace re-organisation

Long term airspace improvement to develop a reference/target ECAC airspace structure (the current one has been established in 2010 and it is named Advanced Airspace Scheme (AAS).

In all cases, Airspace Design follows an iterative process based on 4 steps:

Step 1: Identify the problems. The design work highlights the problem areas and their causes in the airspace structure

Step 2: Build airspace structure proposals (both route segments and Air Traffic Control (ATC) sectors) to accommodate major traffic flows and balance ATC workload.

Step 3: Within this defined framework, detailed proposals of airspace structure are elaborated with their “modus operandi”, consolidated and validated through regional expert groups. The result of local studies feeds back into the initial proposals in an iterative process.

Step 4: A phased implementation programme is agreed and carried out.

Successful European airspace design is achieved through a coordinated and integrated approach for the collective benefit of all Member States and airspace users. National borders and Flight Information Region (FIR) boundaries should not be factors in the design process and Upper, Lower and Terminal Airspaces across Europe should be treated as a single continuum.

The design of airspace with regard to its structure, classification and utilisation has to be accomplished through a unified approach between local, sub-regional and regional levels.

Impact:

- Functional block requires information from 15-10 as basis and (uses 15-10)
- Functional block provides results (e.g. procedure design, airspace geometries) in the context of Procedure / Airspace Design (used by 15-10)

2.3.9 Cooperative Airspace Management

This FB groups all functions for Airspace management, at local, sub-regional and regional levels. These functions support the development and co-ordination of planning activities (at local and regional levels) related to the use of the Airspace (ATS Route Network and ATC Sector configuration), in en-route and terminal airspace.

In terms of time-horizon, Airspace Management activities start after the Airspace Design activities, taking into account the civil and military demand (in terms of airspace reservations and flight plans) as it becomes available: The main output is an airspace usage plan, on a daily basis. The functions related to the tactical activation of the elements of this plan (e.g. change of a sector configuration) are not parts of this FB: they are parts of the FB "Demand and Capacity Balancing".

Airspace Management is to improve capacity optimisation and flexible utilisation of airspace structures through functions such as:

Impact assessment of the military airspace requests

elaboration of the daily airspace and route usage plan decisions (including danger areas)

enable interoperability with local and regional Airspace Management tools (via B2B Web services)

inform users on changes to airspace usage plan (via B2B and B2C services)

Assessment of the impact of sector configuration changes according to traffic patterns

Airspace Management allows the maximum shared use of airspace through enhanced civil/military co-ordination. The application of the Flexible Use of Airspace Concept ensures that any airspace segregation is temporary and based on real use for a specified time period.

Airspace Management plans the use of pre-defined flexible airspace structures that are suited to temporary use:

Conditional Routes (CDRs) - non-permanent Air Traffic Services (ATS) routes or route-portions

Temporary Segregated Areas (TSAs) and Temporary Reserved Areas (TRAs) - areas temporarily reserved for the exclusive use of specific users

Cross-Border Areas (CBAs) - TSAs or TRAs established over international boundaries

Reduced Co-ordination Airspace (RCA) and Prior Co-ordination Airspace (PCA) - procedures enabling General Air Traffic (GAT) to operate outside the ATS route structure

Impact:

- Functional block requires information from 15-10 as basis and (uses 15-10)
- Functional block provides results (e.g. procedure design, airspace geometries) in the context of Procedure / Airspace Design (used by 15-10)

2.3.10 Data Analysis

'Data Analysis' deals with all data that relates to the Airspace User's operations and the corresponding activities for inspecting, cleaning, transforming, and modeling of the data.

Impact:

- Functional Block required by 15-10 – modifications and adaptations expected to cover 15-10 requirements

2.3.11Data Management

'Data Management' contains Functions for the retrieval, processing, and storage of all data required in the other Functional Blocks. Moreover, Functions are provided to access the data.

Impact:

- Functional Block required by 15-10 –
- Needs to be modified to match the scope of PJ.15-10

2.3.12Databases

Onboard A/C databases (e.g. airport, navigation and terrain data bases). Some may require periodic updates based on AIRAC cycle

Impact:

- Functional Block directly or indirectly requires information coming from 15-10

2.3.13Flight Data Support Management

Flight Data Support Management’ consolidates the functions and capabilities that are supporting the FBs Flight Planning, Flight Operations Management and Post Flight Analysis. This includes the maintenance of navigation data, the management of flight constraint data, the overflight permission handling and the management of aircraft configuration data.

Main Functions of this FB are:

- Navigation Data Maintenance

- Take-off and Landing Constraints

- Overflight Permission Handling

- Flight Constraints Management

- Aircraft Configuration Management

Impact:

- Functional Block directly or indirectly requires information coming from 15-10

2.3.14 Flight Management

'Flight Management' covers all activities within FOC system that deal with a particular flight. The activities are executed in the short-term planning and the execution phases of the flight.

Main Functions of this FB are:

- Flight and Trajectory Planning

- Flight Monitoring

  o Data Monitoring

  o Trajectory Adherence Monitoring

- Flight Deck Support

  o Briefing

  o Dynamic Data Provision

Impact:

- Functional Block directly or indirectly requires information coming from 15-10

2.3.15Flight Plan Management

Management of FMS 4D Trajectory (e.g. active/secondary/alternate flight play waypoints, turn/holding patterns, etc)

Impact:

- Functional Block directly or indirectly requires information coming from 15-10

2.3.16Information and Communication management

'Information and Communication Management' is responsible for interfacing with other technical systems. Data from external systems such as aeronautical information, meteorological information, tactical data and surveillance data is received, parsed and provided to other FBs of the WOC System for further processing. Vice versa, planning data is provided to other systems including Aircraft. Also, reports are sent to other systems. Finally, this functional block transfers the mission planning data set required by the Aircraft to a data carrier.

Main Functions of this FB are:

- Aeronautical Information Parsing

- Weather Information Parsing

- WOC Air/Ground Communication

- WOC Ground/Ground Communication

- Data Carrier Management

- Secure Exchange Gateway

Impact:

- Functional Block directly or indirectly requires information coming from 15-10

2.3.17SWIM Messaging

Provides interoperability between distributed systems with varying degrees of decoupling and including features for effective and reliable communication. following features:

· Support for a variety of Messaging Technologies & Protocols, Such as SOAP, RTPS, XML, HTTP(s), AMQP

· Support for a variety of routing mechanisms. The routing will determine where a message will be delivered as well as define through which communication paths a message will reach its intended destination or destinations.

· Support for a variety of distribution mechanisms.

· Support for filtering mechanisms. The filtering allows the elimination of messages based on filtering criteria.

· Support of a variety of Quality of Services (QoS), including reliable delivery, best effort delivery, durable subscriptions, transaction management and message handling specification according to priority and response time requirements.

· Support for Protocol Bridge. The Protocol Bridge performs the transformation from source messaging protocol and underlying stack into an output messaging protocol and underlying stack

· Support for Data Management. The SWIM-TI Data Management is in charge of operations on the data that is transported by the SWIM-TI Messaging.

Support for Data Validation. Data Validation function is able to check data payload against the expected format prior to the service execution and allow or deny a service access or to check response data payload prior to further usage of the data in the same way described above for the provider but does not cover semantic checking that requires domain knowledge

Impact:

- Functional Block required for SWIM compatibility of 15-10

2.3.18SWIM Recording

Recording includes the ability to collect, store and on demand retrieval of information related to: communication being performed via the SWIM Interfaces; supervision actions and events.

This function collects the communication session data based on predefined configuration and can include: Service execution time stamp; Service name; Service requestor and provider identity information (user name, security token); Data payload (possible encrypted); Data payload signature

Impact:

- Functional Block required for SWIM compatibility of 15-10

2.3.19SWIM Registry

The Registry is the shareable function to retrieve meta-information about the Services and the ATM Information they provide. It covers:

· Discovery Functionality enabling to identify registered resources, obtain their descriptions, identify related resources and follow up their evolution.

· Registration Functionality enabling the controlled and structured registration of resources in the registry.

· Security Functionality ensuring that only authorized users are able to view or edit certain information in the registry

System Interface Functionality enabling the registry to exchange information with other systems

Impact:

- Functional Block required for SWIM compatibility of 15-10

2.3.20 SWIM Security

Security FB provides technical functions enabling the Access Control (Authentication and Authorization), Audit and Data Protection in a federation of security domains, This is used to control and to protect services and resources in the whole security chain (ATM specific and SWIM-TI). Access Control relies on Authentication (authentication of a Digital Identity - refer to a process used to achieve sufficient confidence in the binding between the entity and the presented identity), on Authorization (authorization of an authenticated Digital Identity to use a given resource - refer to the granting of rights and, based on these rights, the granting of access.) and on Identity Management (provisioning, mapping and federation - refer to a set of functions and capabilities (e.g., administration, management and maintenance, discovery, communication exchanges, correlation and binding, policy enforcement, authentication and assertions) used for assurance of identity information (e.g., identifiers, credentials, attributes); assurance of the identity of an entity and supporting business and security applications.

Impact:

- Functional Block required for SWIM compatibility of 15-10

2.3.21 SWIM Shared Object

Shared object Functional Block allows the sharing of data across multiple SWIM Nodes. This capability uses publish/subscribe and request/reply messaging pattern and allows multiple operations on an agreed data model: · Creation, update, delete, search; · Request for service; · Restore data; · Recovery Every shared object has a manager. If a participant has the manager role, it is responsible of the shared object and it is the only one allowed to update and delete that shared object. Every shared object has a distribution list. The distribution list is the list of participants interested in a shared object. The Shared Object function uses data validation to perform compliance checking of message payload.

Impact:

- Functional Block required for SWIM compatibility of 15-10

2.3.22 SWIM Supervision

Supervision supports all SWIM related supervision functions instantiated in a system - hardware, software, processes, service status

Impact:

- Functional Block required for SWIM compatibility of 15-10

2.4 Standardisation Needs

PJ 15-10 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.

A reliable data and service model are prerequisites for PJ15-10 in order to achieve interoperability.

The standardisation of SWIM in general is very important for PJ15-10 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 (webservices, AMQP etc.) required for SWIM interoperability.

Furthermore, standardisation needs to take into account international standardisation like e.g.:

- ICAO: Annex 15, 10, 4, DOCS, PANS AIM
- European Union: ADQ IR 73/2010
- EASA: NPA 2016-02
- EUROCAE: ED-153
- EUROCAE: ED-76A "Standards for processing Aeronautical Data"
- Eurocontrol guidance and standards

2.5 Challenges expected in terms of Compliance and Certification

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.

3 Aeronautical Information Service Architecture

3.1 Introduction

The Business Model describes a number of users that play a role in Aeronautical Information Service, either as provider or consumers of the service.

3.2 Business Architecture

Please refer to the Business model for details on the business architecture.

3.3 Operational Architecture

3.3.1 Aeronautical Information Service Provider

The service provider supervises the hosting of the system and the IT Service provision. It reviews, consolidates and harmonises the incoming data, aids the data validation where human intervention is necessary and supports the other actors in their work. The Service Provider has special access rights in order to allow it to do its task.

3.3.2 AU – Airspace User Operations / Airspace User Ops Support

Commercial airline, General Aviation, private pilots, drone operators, business jet companies etc. require information from the Aeronautical Information Service to plan their flight and to get briefings.

3.3.3 Data Integrator

Commercial entities that prepare information from AIM Units / ANSPs, especially for the use in commercial aviation. Examples are NAV Blue, Jeppesen and Lufthansa Systems. Data Integrators retrieve information from the Aeronautical Information Service (potentially for a charge) and prepare the data for FMS, aeronautical charts, EFBs etc.

Data Integrators can directly retrieve the FMS dataset from the service (see Figure 3: Component Architecture) and act in this case as service consumers on behalf of the airspace users.

Theoretically, airspace users can retrieve the FMS dataset also directly. In a future scenario in which FMS directly support AIXM / AIRM data without filtering or conversion this could potentially allow a direct link between airspace user and the service without a data integrator in between.

3.3.4 ATS Operations

Air Traffic Services Operations is a function of ANSPs concerned with the handling of flight plans / flights in different stages. ATS Operations requires aeronautical information for the validation of route information, airspaces, short term events (digital NOTAMs) and other information that may potentially impact the flight.

3.3.5 Aerodrome ATS

Aerodrome Air Traffic Services Operations is a function of ANSPs concerned with the handling of flight plans / flights at the aerodrome / airport. Aerodrome ATS Operations requires aeronautical information for the validation of route information, airspaces, short term events (digital NOTAMs) and other information that may potentially impact the flight.

3.3.6 Airport Operations

Airport Operations requires information regarding the facilities at the aerodrome / airport, e.g. runways, taxiways, parking positions, gate stands, lighting, markings, aprons etc. and short term changes thereto.

3.3.7 Data Originators

Data Originators are sources of information which deliver it to the AIM units of the ANSP. Examples are: Surveyors, Airports, Mobile Phone companies for obstacles, Geographical organisations, building companies or ANSP internal data originators.

3.3.8 AIM

AIS (Aeronautical Information Services) or AIM (Aeronautical Information Management) units receive information from data originators, collect, validate and distribute the information. They produce aeronautical publications like charts and AIPs and are the authoritative source of aeronautical information.

3.3.9 Airports

Airports are an example for data originators and also require aeronautical information for their operation. Airports collect a large portion of the aeronautical information

3.3.10Procedure Designer

Procedure designers can be AIM internal entities or they can be part of an airline or airport organisation or can be external consultants. Procedure designers require terrain and obstacle information, information about the runways, NAVAIDs, airspaces etc. and use this information to design safe approach and departure procedures.

Figure 1 below depicts the interactions between the different Nodes, according to the information flows defined in the Business Model. These information flows have been modelled as Information Elements. Where possible, existing Information Elements in EATMA have been reused.

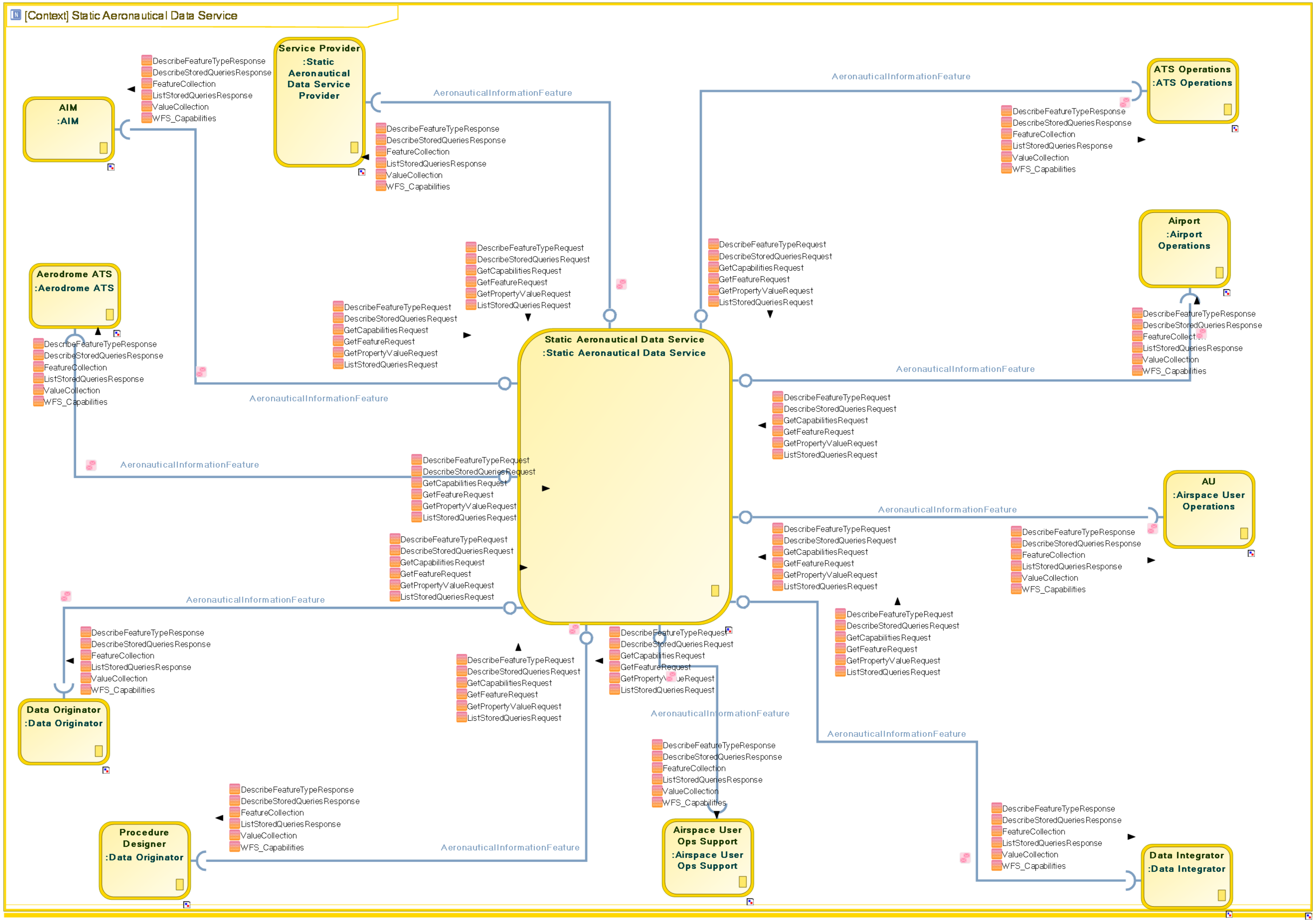

Figure 1: NOV-2 – Operational Node Context Diagram

3.4 System Architecture

The image below reflects the system architecture in line with the NSV-1 view. The system architecture does not differ in terms of high level architecture concepts between the usecases for (1) local deployment, (2) regional deployment and (3) European centralized deployment. The same nodes and capability configurations will be involved, regardless where the service is physically executed.

Please note, that there is a certain overlap with functionality covered by the EAD, however, there are significant improvements and differences between PJ.15 and EAD, which are summarized in an Appendix to the SDD (Service Definition Documentation).

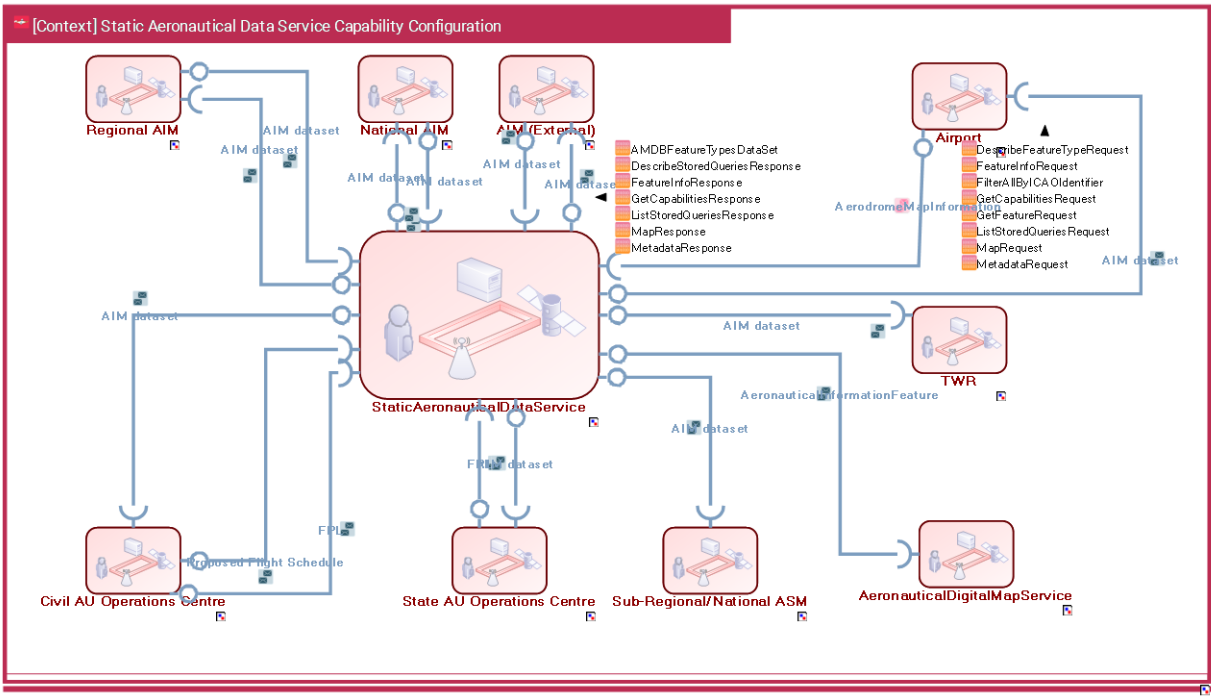

Figure 2: NSV-1 – System Interface Description

3.4.1 Component Architecture

The components below correspond to an initial idea for a component architecture (currently kept local in the project and not yet reflected in Mega).

3.4.1.1 Digital Map Common Service

The Digital Map common service from Solution 11 is one of the prime users of the Aeronautical Information Service.

It connects to the AIXM Distribution and Selection Component to retrieve Information to go on the digital Map.

3.4.1.2 Aeronautical Information Service HMI

The Aeronautical Information Service HMI is used as an end-user HMI used to manage, input and retrieve aeronautical information and is used to drive operational processes. It utilizes the AIXM Distribution and Selection Service to retrieve and store information.

3.4.1.3 AIXMDistributionSelection

This component is the main business logic for selecting and distributing aeronautical information from the AIRMAIXMDatabase. It is the main service interface for consumers and the HMI and implements special queries like the preparation of ATC Datasets and FMS Databases.

3.4.1.4 AIRMAIXM Database

This is the main data repository implementing the AIXM AIRM information model and taking care of the persistence of the information. It implements the extensible AIXM information model and supports geospatial storage and spatial querying.

3.4.1.5 AIXM Busines Rule Validation

Business Rule validation engine for automatically validating and verifying aeronautical information against a set of business rules.

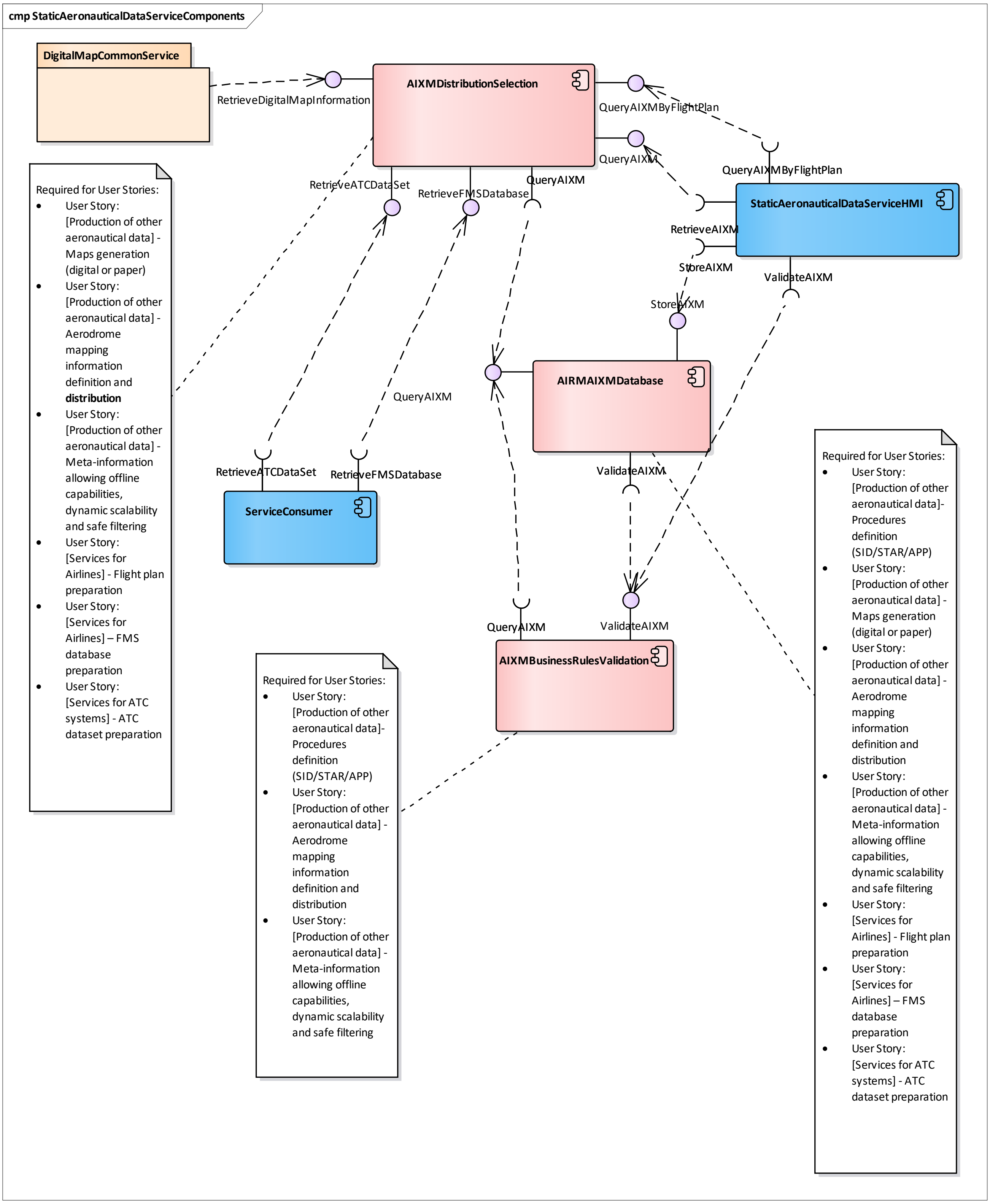

Figure 3: Component Architecture

4 Safety

No dedicated safety case of safety evaluation has been performed for the Aeronautical Information Service, however, it is assumed, that the Aeronautical Information Service will have a positive impact on safety compared to the current state, as it addresses some shortcomings of current systems by better solutions, which will contribute to safer air traffic management. The following sub-chapters try to summarize these safety arguments, which will have to be confirmed and substantiated by a formal safety analysis.

4.1 Compliance with standard data model

Currently, Aeronautical information is stored and distributed in different formats. The only binding standard currently is the dissemination in paper form in the AIP.

Industry standards like AIXM in different generations have improved the interoperability and the degree of automation, but the diversity of data formats and data models and the complexity of collecting and storing all the aeronautical information has so far led to a situation that not all required information is available in standardised formats and data models.

Even the existing centralised information management system EAD currently only requires a minimum dataset as mandatory, which is required for NOTAM and Flight Plan validation. However, e.g. details about the aerodrome runway and taxiway geometry, SID / STAR / IAP or detailed obstacles are not part of this mandatory dataset. Some ANSPs provide it, but not all.

The reason for this situation is that currently there is only an incentive to load the full into EAD for such ANSPs, which utilize all EAD client modules including the chart production and AIP production modules. If these modules are used, loading a full dataset into EAD has a big operational advantage as the generation of the products can be automated.

Such ANSPs, who do not use the EAD publication tools typically choose to only load the so called minimum data set, as that is required for NOTAM validation and flight plan validation and provides immediate tangible benefits.

As a result, airspace users had to make use of other, non-integrated and potentially inconsistent information (potentially inconsistent, as different data repositories with different versions of the truth may contain overall inconsistent information).

Compliance with AIRM / AIXM of the Aeronautical Information Service as a common service will help to harmonise this information and will make all of the data available.

With the introduction of PJ15, it will be possible to directly integrate the service with other ATC systems using SWIM and a common data model. Therefore, ANSPs will have an incentive and direct benefit of loading a complete data set and PJ15 will thereby ensure the availability of a quality assured dataset containing all required information.

As a result, the risk of human errors or undetected data inconsistencies, which may potentially lead to negative safety impacts, is reduced.

4.2 Standardised Interoperability / ISRM

Currently, aeronautical information is made available as data files or in paper form. Within the AIM domain, information is partially exchanged in digital form, but there are currently no standardised interfaces, which leads to interoperability problems.

As a result, some information exchanges are limited in scope to a minimum or in some cases do not occur in an automated way at all, but require human intervention.

By implementing standardised service interfaces, the information is made accessible and can be exchanged automatically. By avoiding having to use alternative data sources, which may be inconsistent and by avoiding human intervention potential data errors can be avoided.

4.3 Direct Integration into ATM / ATC

Currently, information maintained in AIM is only used for information exchange between AIM units but currently not in all cases directly shared with other ATM / ATC units. Instead, the required information is maintained manually or ingested from alternative sources.

By implementing a SWIM based information exchange, a seamless integration can be achieved. This integration avoids safety threats coming from inconsistencies, data errors and human error by automation and direct integration.

In addition to the technical benefits of using SWIM for direct seamless information exchange between PJ.15 and ATM / ATC systems, also other operational concerns may in some cases prevent the direct usage of the data. E.g. the data currently managed in AIS / AIM units is managed for the AIRAC cycle, which may not in all cases be sufficiently timely for ATC / ATM systems, which require quicker updates.

For those cases, were the missing interoperability is the reason and no other operational reasons, the integration clearly does improve safety by avoiding inconsistent replica and manual interventions.

For those cases, where timeliness and controlled intermediate updates are the reasons for missing direct integration, PJ.15 also provides better support due to the improved temporality of AIXM 5, which also allows short term changes in contrast to the AIXM 4.5 data model used for EAD, in which short term changes are communicated as non-structured NOTAM information intended for human consumption.

4.4 Potential Risks and Mitigations

Risks affecting the Aeronautical Information Service can be categorized into 3 classes:

- Information Discrepancy: Information items or sets are inconsistent between actors or nodes in the operational context.
- Information Corruption – Items or datasets are corrupted from their originally intended value due to errors or malicious activities
- Information Unavailability – Information items or data sets are fully or partially missing, delayed or otherwise lost

4.4.1 Risk: Aeronautical Information is valid but corrupt

4.4.1.1 Description of Risk / Hazard

Aeronautical information is consistent with rules and data formats and seems valid, but is actually incorrect or corrupt. This class of hazard cannot be detected solely by applying business rules or by correlating aeronautical information.

4.4.1.2 Mitigation

In order to mitigate such risks, an additional level of review for plausibility and correctness by human operators in the context of statistically relevant data quality reviews can be used to detect consistent and valid but incorrect information. The use of visualization (in PJ.15-11) supports human actors in identifying such errors.

4.4.2 Aeronautical Information distributed to Consumers is incomplete

4.4.2.1 Description of Risk / Hazard

Due to transmission errors or malicious activities, not all information reaches the information consumers or users.

4.4.2.2 Mitigation

By applying technical means to detect missing information (e.g. checksums, hashes, etc.) in the communication infrastructure and on application level, such risks can be addressed automatically.

SWIM ensures that the transmission of information is safe, secure and that transmission errors can be detected and mitigated.

4.4.3 Loss / Partial loss of Aeronautical Information

4.4.3.1 Description of Risk / Hazard

Substantial and relevant amounts of information are lost either during transfer or when stored in the systems. The reasons for such hazards can be system faults or failures or malicious intruders.

4.4.3.2 Mitigation

- Strong integrity and completeness checks
- State of the art cyber security
- Consequent management of access rights and authorizations
- Back-up with point in time recovery mechanisms
- Redundancy in systems and management
- SWIM ensures that the transmission of information is safe, secure and that transmission errors can be detected and mitigated.

4.4.4 Discrepancy in cross-border information

4.4.4.1 Description of Risk / Hazard

Aeronautical information that concerns more than one country or area of responsibility is inconsistent between the countries where each party is responsible for a sub-set of the information, which is consistent, but inconsistent overall. Example: discrepancies of information on data between adjacent state boundaries.

4.4.4.2 Mitigation

Automated data quality rules that are applied to the overall information set are able to detect such discrepancies. Such quality checks can be implemented much more easily and reliably when a functionally or physically integrated information repository is available, i.e. a Common Service like the Aeronautical Information Service.

4.4.5 Aeronautical information at Consumer is inconsistent

4.4.5.1 Description of Risk / Hazard

Aeronautical information – while consistent and complete in the common service may become inconsistent or incomplete when it reaches the information consumer. Such a hazard could e.g. occur as a result of transmission errors, malicious intruders or erroneous interpretation or processing of the downstream systems (correct information is received, but it is visualized or presented incorrectly due to errors).

4.4.5.2 Mitigation

SWIM ensures that the transmission of information is safe, secure and that transmission errors can be detected and mitigated.

By utilizing PJ.15-11, the aeronautical digital map service, it can be ensured, that a harmonized and correct representation of information is used.

By directly accessing the information from the Aeronautical Information Service instead of locally caching aeronautical information, errors coming from unavoidable replication conflicts (errors resulting from the fact that the consistency of information in distributed information repositories can not always be guaranteed) can be mitigated.

5 References and Applicable documents

[1] SESAR B.04.05 D15 Common Service Foundation Methodology, Edition 00.02.01

[2] SESAR2020 PJ.15-10 Aeronautical Information Service High Level Architecture Description, edition 00.02.00, 27/09/2017

[3] SESAR B.04.02 D106 Transition ConOps SESAR2020, Edition 01.00.00

[4] MEGA Web Access: https://www.srvs.nm.eurocontrol.int/mega_prod/hopex/megaauthentication.aspx

[5] https://www.eatmportal.eu/working/signin

[6] ICAO Doc 9854, Global Air Traffic Management Operational Concept, First Edition – 2005

[7] EU IR 716/2014: Pilot Common Project

[8] Grant Agreement GA-734160 – PJ15 COSER, edition 01.00.00, 27/10/2016

Annex A – Additional Deployment Options

In the course of the project, the team has analysed different deployment options for the service.

The HLA for TRL-2 included the following options:

- Local Deployment → no longer considered due to unfavourable risk / benefit ratio and unfavourable cost/benefit ratio
- Sub-Regional Level Deployment → no longer considered due to unfavourable cost/benefit ratio
- Regional Level Deployment → selected deployment
- Worldwide Level Deployment → currently not being considered due to the focus of SESAR 2020 on Europe

For completeness purposes, this annex describes the other options, which were not selected. Please refer to the Cost-Benefit Analysis document for further details on the commercial viability of the different deployment options.

A.1 Local Deployment

At a local level: providing static and dynamic aeronautical data within a local area (typically a country).

In this scenario, an ANSP runs the Aeronautical Information Service. It can connect to regional AIM services, other national AIM services (partners) and other AIM services.

An Airport or multiple Airports would be connected as data originators and as data users to the local service.

Towers or other ATC systems would connect to the local service.

Airspace User Operational Centres would need to connect to multiple local deployments of Aeronautical Information Services. Regional, Subregional and national ASM centres would also need to connect to potentially multiple Aeronautical Information Service instances.

The Aeronautical Digital Map Service would connect to the local deployment for local information. If multi-national visualisation is required, multiple services need to be contacted.

Advantages:

- distributed solution, multiple parallel services
- ownership of local service
- load sharing amongst multiple instances

Disadvantages:

- Difficult cross-country alignment

- risk of inconsistencies
- cross-border conflicts
- high infrastructure cost
- each individual service needs to be disaster resilient, otherwise a part of the complete set is inaccessible
- data users need to use a registry to find valid services
- multiple services need to be contacted in order to get a complete picture
- difficult cross-country evaluation as every service takes into account only the national data set

KPA (KPI)		Performance Benefits Expectation Local deployment
Predictability (Flight Duration Variability, against RBT)		None
Flexibility		None
Safety	**Mitigation of safety risk**	Low
Human Performance		None
Interoperability		None
Cost Efficiency	**Cost of operation**	Low
Cost Efficiency	**ATCO Productivity**	None
	Technology Cost	Low

A.2 Sub-Regional Level Deployment

At a sub-regional level: providing static and dynamic aeronautical data within a sub-region (could be a FAB, grouping of countries or grouping of ANSPs)

In this scenario, instead of a single ANSP a group of ANSPs runs the Aeronautical Information Service. It can connect to regional AIM services, other national AIM services (partners) and other AIM services.

An Airport or multiple Airports would be connected as data originators and as data users to one or more sub-regional services.

Towers or other ATC systems would connect to sub-regional service instead of a local service.

Airspace User Operational Centres would need to connect to multiple sub-regional deployments of Aeronautical Information Services. Regional, other Subregional and national ASM centres would also need to connect to potentially multiple Aeronautical Information Service instances.

The Aeronautical Digital Map Service would connect to the sub-regional deployment for sub-regional information. If multi-national visualisation beyond the sub-region is required, multiple services need to be contacted.

Advantages:

- distributed solution, multiple parallel services
- load sharing amongst multiple instances
- simplified handling of inconsistencies
- improvement regarding inconsistencies amongst the members of the sub-region
- reduced infrastructure cost compared to local deployments
- less cost for resilience, as several ANSPs share a common system

Disadvantages:

- Difficult cross-country alignment
- risk of inconsistencies across sub-region borders
- cross-border conflicts across sub-region borders
- higher infrastructure cost than regional or global deployments
- each individual subregional service still needs to be disaster resilient, otherwise a part of the complete set is inaccessible
- data users need to use a registry to find valid services
- multiple services need to be contacted in order to get a complete picture

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

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

A.3 Worldwide-Level Deployment

Worldwide: providing static and dynamic aeronautical data for the entire world

In this scenario, the Aeronautical Information Service is operated resiliently for a complete region (e.g. ECAC area) similar to the EAD service today. In addition to the regional deployment, the goal is for the worldwide level deployment, a worldwide data set is kept on the regional system and also service provision for world-wide clients is included.

So potentially, it can provide also services to users beyond the regional boundaries, e.g. airspace users coming from the US, Africa or Asia could still connect to the European system for getting a complete picture.

It can connect to regional AIM services, other national AIM services (partners) as data sources and seamlessly exchange information with other global AIM services.

Airports would be connected to a single system as data originators and as data users to a single service.

Towers or other ATC systems would connect to a single service.

Airspace User Operational Centres would only need to connect to a single deployment of a Aeronautical Information Service in order to get a global picture. Regional, other Subregional and national ASM centres would also need to connect to a single Aeronautical Information Service instance for global data.

The Aeronautical Digital Map Service would connect to the global deployment for all worldwide information.

Advantages:

- optimal handling of regional and global inconsistencies
- optimal regarding inconsistencies amongst all members of the region and global partners
- reduced infrastructure cost compared to local deployments and to subregional 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 the whole world

Disadvantages:

- central system needs to be scalable
- multiple global services need to be synchronised → complexity

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