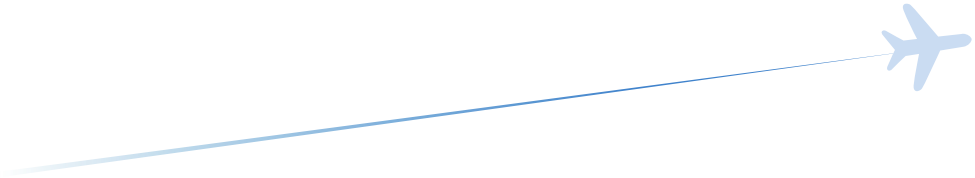

Business Model of the E-AMAN Common Service TRL6 / V3

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Copyright Statement

COSER

COMMON SERVICES

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Abstract

The present document is the third out of the three Business Models to be delivered, *Business Model (V3),* as part of the *V3 Data Pack D3.2.045* – under the task *T.3.100 Business Modelling development* for Work Package WP3 "E-AMAN"[1] of PJ.15. The business model aims to capture and reflect the expectations from the stakeholders regarding the provision of an E-AMAN Common Service. It highlights the proposed value, the potential consumers and customers, the quality of service and analysis the performance benefits among others.

This document builds upon the Deliverable D3.1.060 Business Model (V2) [1].

[1] By request of SJU, the name of the solution was changed from „Delay Sharing" to „E-AMAN"

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1 Executive Summary

The E-AMAN Common Service[2] provides capabilities necessary to operate Arrival Management with an extended horizon. PJ.15-02 will describe ways of improved overall Cost Efficiency for delivering the necessary capability as a Common Service to the stakeholders involved. This document describes the Business Model for the E-AMAN Common Service in V2 for PJ.15-02.

The following scenarios for the E-AMAN Common Service have been developed:

Colocation of E-AMAN

The capability provided by the Common Service here is the provision of a consolidated technical E-AMAN capability on a local (ANSP) level. The output of the Common Service is delivered to the end-users (e.g. adjacent ACCs / UACs) by the consolidated capability itself. No relocation or distribution of functions between stakeholders is performed, relocation and redistribution of functions is performed only at an ANSP scale (see Chapter 5.1).

Federation of E-AMAN

The capability provided by the Common Service here is the capability of harmonising the output of local E-AMAN technical capabilities on different geographic or organisational levels (ECAC, FAB), however any other scaling could be considered in principle. The output of the Common Service is delivered to the end-users (e.g. adjacent ACCs / UACs). By this, relocation of functions between stakeholders is performed (see Chapter 5.2).

Conclusions

The business case for Extended AMAN common services is based purely on cost reduction. In particular, the Pilot Common Project (PCP, [1]) mandates E-AMAN deployment in 25 major European airfields (Including Istanbul). The expectation is for a SWIM based solution. A small number of ANSPs have deployed AMAN systems and there have been a number of E-AMAN enhancements.

Assuming that few competing providers are available within Europe, provision of E-AMAN, based on a SWIM foundation, deploying a common service results 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

Consequently, the cost benefit relates to:

- lower number of system deployments

[2] Also referred to as „Delay Sharing Common Service“. The „Delay Sharing“ is an advanced concept of E-AMAN which is not mature enough to be currently considered in PJ15-02

- lower number of technical systems to be securely maintained in operation
- synchronisation of the evolutionary roadmap enabling consistency of concept

There are no proposed primary benefits in terms of SESAR KPIs other than cost reduction. However, through the availability of an economically attractive Common Service, a quicker implementation of E-AMAN capabilities could be envisaged. Further, more ANSPs will be triggered to implement Extended Arrival Management. Both have a secondary effect on other SESAR KPIs than cost reduction.

Resulting in a fewer number of endpoints for accessing E-AMAN information by the deployment of E-AMAN Common Services, the number of Point-To-Point connections between stakeholders is reduced. By this, deployment of the capability can be significantly accelerated, as efforts for establishing, testing and maintenance of the connections are significantly reduced.

The theoretical geographical scope of ECAC wide coverage of any of the three E-AMAN Common Service scenarios is not seen as feasible and was removed.

The Validation Activities of PJ.15-02 are covering aspects of the two scenarios “Colocation” & “Federation”.

The feasibility of E-AMAN Common Service was validated on a technical and economical basis (see E-AMAN Common Service TVALR [19] & E-AMAN Common Service CBA [21]). Industrialisation of the E-AMAN Common Service can be started. Each Industry partner, ANSP or group of ANSPs (Corporations, FABs, Consortiums) should consider the Common Service approach for E-AMAN, validating the best deployment option (Federation, Co-location) based on their requirements and CBAs.

2 Introduction

2.1 Purpose of the document

The concept of a Common Service was introduced in SESAR to address the need to reduce the cost of European Air Traffic Management (ATM) [3]. ATM is highly fragmented with each State having their own Air Navigation Service Providers (ANSP). Cross border provision of Air Traffic Services being limited to only a few local examples. As each ANSP provides much the same type of service, they all have similar capabilities and deployed systems. Common Services can potentially reduce the overall cost of ATM by making it possible for similar organisations to consume a service from one provider by giving them the same capability they would normally have provided themselves, but at a much lower cost. This benefit can either be realised by the direct consumer, in many cases the ANSPs, or by their customers by broadening their choice of supplier.

2.2 Intended readership

The intended audience for this document is the SESAR Joint Undertaking, the partners in the SESAR 2020 programme, the ATM stakeholders (e.g. airspace users, ANSPs, airports, airspace industry) with those third parties directly affected by its findings and the contributors having dependencies with the solution such as PJ19.

Other architectural projects and tasks within the SESAR 2020 programme may also have an interest.

2.3 Glossary of Basic Concepts

Term	Definition	Source
Business case	A tool to provide decision makers with the information they need to make a fully informed decision on whether funding should be provided and/or whether an investment should proceed	SESAR P16.06.06
Business model	A framework for creating economic, social, and/or other forms of value. The term' business model' is thus used for a broad range of informal and formal descriptions to represent core aspects of a business, including purpose, offerings, strategies, infrastructure, organizational structures, trading practices, and operational processes and policies.	EUROCONTROL ATM Lexicon
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 10.0
Centralised (service) - a particular type of Common Service	A Centralised Service is an ANS support service exercised at pan-European and central network level for harmonisation and cost-efficiency purpose avoiding multiplication of investments, leading to reduced infrastructure costs, supporting the ANSPs and the Member States of the EU to come closer or actually achieving the EU cost efficiency performance targets.	EUROCONTROL

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
Cost Benefit Analysis	A Cost Benefit Analysis is a process of quantifying in economic terms the costs and benefits of a project or a program over a certain period, and those of its alternatives (within the same period), in order to have a single scale of comparison for unbiased evaluation. A CBA is a neutral financial tool that helps decision-makers to compare an investment with other possible investments and/or to make a choice between different options / scenarios and to select the one that offers the best value for money while considering all the key criteria for the decision. A CBA is a tool used within the Business Case Process to provide financial inputs	16.06.06-D68-New CBA Model and Methods 2015-Part 1 of 2
Customer	A consumer of a service under a specific contract.	SESAR B04.05 D02
Deployment Package	Deployment Packages comprise Operational Improvement Steps and Enablers selected to satisfy Performance Needs of Operating Environments in the European ATM System by providing performance benefits confirmed by validation results.	SESAR WP C, though un-reviewed
Node	A logical entity that performs activities. Note: nodes are specified independently of any physical realisation.	SESAR2020 PJ19.05 EATMA Guidance Material Version 10.0
Security and safety in the context of a Common Service	Non-Functional Requirements (NFR) and Quality of service (QoS) requirements can be specified at various levels of maturity and from different viewpoints such as from the collaborative enterprise, the logical level, technology and engineering perspectives. Conceptually, NFR and QoS are not always distinguishable. Common Services will focus at the first two viewpoints	ISRM – Modelling guidelines
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 10.0
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	SESAR B.04.03 – Working method on service

	the ISRM) by a service provider (by itself or contracted to a third party).	
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 10.0

Table 1: Glossary of Basic Concepts

2.4 Acronyms and Terminology

Term	Definition
ACC	Area Control Centre
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
AMAN	Arrival Manager (Controller Support Tool)
APT	Airport
ATCO	Air Traffic Control Officer
ATSU	Air Traffic Services Unit
ATM	Air Traffic Management
ATS	Air Traffic Services
CAP	Capacity
CBA	Cost Benefit Analysis
CEF	Cost Efficiency
COP	Coordination Point
CS	Common Service
CTA	Controled Time of Arrival

DMAN	Departure Manager
E-AMAN	Arrival Management with Extended Horizon
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
EPP	Extended Projected Profile
ER-APP	En-route - Approach
ETA	Estimated Time of Arrival
EUROCAE	European Organization for Civil Aviation Equipment
FEFF	Fuel Efficiency
ICAO	International Civil Aviation Organisation
IOP	Interoperability
ISRM	Information Service Reference model
KPA	Key Performance Area
KPI	Key Performance Indicator
MTBF	mean time between failures
N/A	Not Applicable
NM	Network Manager / Nautical Mile
NPV	Net Present Value
OSED	Operational Service Environment Description
OI	Operational Improvements
PAR	Performance Assessment Report
PBN	performance-based navigation
PCP	Pilot Common Project
PENS	Pan-European Network Service
PRD	Predictability
QoS	Quality of Service

RBT	Reference Business / Mission Trajectory
SDD	Service Description Document
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme, which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme, which addresses all activities of the SESAR Joint Undertaking Agency.
STA	Scheduled Time of Arrival / Requested Time by E-AMAN
STO	Scheduled Time Over (a point) / Requested Time by E-AMAN
SWIM	System-wide Information Management
SWOT	Strengths, Weaknesses, Opportunities and Threats
TMA	Terminal Manoeuvring Area
TRL	Technical Readiness Level
TWR	Tower
TTO	Target Time Over
UAC	Upper Area Control (Center)
WP	Work Package
XMAN	Cross-border AMAN

Table 2: Acronyms

3 Scope of the Business Model

The E-AMAN Common Service was identified, described and processed in SESAR 1 B.04.05 as a pilot for Common Services [4] and [5]. It was revised and re-evaluated in SESAR 2020 PJ15-02 with a changed focus on scenarios deployment opportunities, which are envisaged as most beneficial to the partners contributing to the solution.

PJ15-02 uses the method described in SESAR B4.5 for processing of Common Services [7].

3.1 E-AMAN Common Service

The common Service itself was initially described in the BusinessModel TRL2/ V1.

3.1.1.1 Scope

The E-AMAN Common Service provides functions necessary to operate Arrival Management with an extended horizon in an environment where multiple actors are involved e.g. multiple Airports, AMANs, ACCs, UACs and other interested parties, e.g. NM (i.e. Cross Boarder Arrival Management).

The level of capability considered here is matching basic E-AMAN requirements (excl. concepts of CTA, TTO, ETA min/max, EPP, coupled AMAN/DMAN). The mentioned advanced concepts are not validated up to a level of sufficient maturity to be used in the context of Extended Arrival Management [6].

These basic E-AMAN functions are:

- Arrival Sequencing / Planning
- Arrival Management Information Distribution to all involved actors

This Service will have to provide the E-AMAN information for different consumers and purposes and will output local Arrival Planning results (e.g. total delay) aggregated to serve different purposes of the involved actors (e.g. queue management). These will be used in the planning/tactical phase (e.g. departure delay) and in real-time/operations (e.g. delay and/or speed advisories).

The E-AMAN Common Service provides the “technical” capability necessary to operate Extended Arrival Management.

3.1.1.2 Safety considerations:

The results of the Safety assessment made in SESAR P.5.6.4 on E-AMAM is applicable to E-AMAN in a Common Service scenario as well. An E-AMAN Common Service shall implement the Safety requirements are expressed in [7] and [8].

For the “Federation” Scenario, only two of the requirements are valid (SR-101, SR-102), as the E-AMAN capability itself is not part of the Common Service. The other scenario “Colocation” will have to cover the whole set of the requirements.

A detailed assessment is documented in the T-VALR TRL6 for E-AMAN Common Service [19].

3.1.1.3 Security considerations:

PJ.15-02 was rated as a “non prioritized” solution (Rating: 1.8 out of 3) [10].

Primary and supporting assets were identified and an impact assessment was performed.

Detailed results of the execution of the SECRAM process were documented in the E-AMAN TRL4 SDD [20] and for TRL6 are covered in the respective TRL6 Security material.

3.1.1.4 Regulatory impact:

Arrival Management falls under Interoperability IR 552/2004, therefore, certification of the service provider will be necessary, Arrival Management Extended to En-Route Airspace is compliant with regulation IR 716/2014 (PCP) [2].

3.1.2 Area of Coverage / Magnitude of Scale

The diagram below shows the airports, which are mandated by IR 716/2014 (PCP) [2] to have an E-AMAN capability in place, there is also likely to be a demand from smaller airports. The Common Service Approach as described can in principle be applied to any magnitude of these E-AMANs.

Figure 1: Mandated E-AMAN airports

The Common Service could be scaled from a local level up to various levels of coverage (see Scenarios). Table 3 below displays various levels considered.

Scale / Coverage	Explanation
Many ANSPs	The biggest magnitude of scale considered here is the full ECAC area
Few ANSP	Few ANSPs, either grouped due to geographical reasons or others reasons (same system suppliers, political alliances…)
Local level	One ANSP

Table 3: Common Service areas of coverage

As stated above, the E-AMAN Common Service could theoretically be provided ECAC wide as identified in the V1 Business Model. However, the feasibility of this option is not really seen. The E-AMAN Common Service can be provided on a local level up to a scale of few ANSPs.

3.1.3 Quality of Service

The figures stated here are based on expert judgement and have been reviewed having in mind existing requirements of operational E-AMAN implementations, as e.g. London Heathrow XMAN.

3.1.3.1 Availability

All figures are meant for expressing availability to one customer. As not safety critical, no 100% availability is required. The following numbers are only given to illustrate this.
A service uptime of minimum 95% is required with a maximum system downtime of 24h per year (including failure & scheduled maintenance) and a mean time between failures (MTBF) of 12000h is required. Maintenance disruptions of the service are expected to take place scheduled and pre-notified during the night hours (0am to 4am local time).

3.1.3.2 Data Quality

E-AMAN should produce reasonable data that is of operational use.

3.1.3.3 Transmission Frequency

Ad-Hoc (if significant impact on the process, dependent on interface/consumer).

3.1.3.4 Max Time of Delivery:

For example <= 5 s for en-route centre, approach centre, airport (dependent on interface/consumer).

3.1.4 Common Service Pattern

The Capabilities can be considered to be provided through outsourcing, consolidation, partnerships and federation.

3.1.5 Timeframe of Opportunity

The common service is foreseen to be implemented during IR 716/2014 PCP [2] implementation timeframe. The service can be provided for an unlimited period of time from the time of deployment. When full IOP capabilities are rolled out a revision of the service taking into consideration more advanced SESAR concepts and/or IOP communication will have to be performed. The reason for this is the fact that there is an overlap of information in the CS and the information transferred through IOP as Arrival Management information is foreseen to be carried by FO-IOP as well.

3.1.6 Expected Benefits

There are two types of benefits that realisation of E-AMAN following a COSER model could deliver.

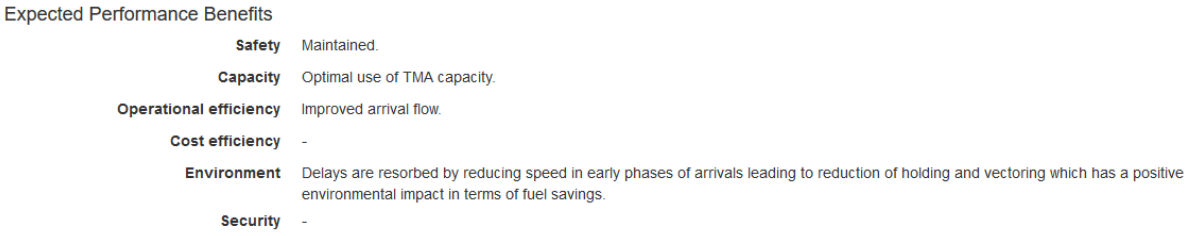
Firstly, the primary benefit that PJ15-02 delivers is in the KPA of Cost-Efficiency. Namely, it addresses the KPI CEF3 – Technology Cost.

On top of the expected benefits of Cost Efficiency, PJ15-02 Solution has two advantages that could bring benefits not limited to one particular KPA but contributing to many indeed. Further research and validation will need to confirm this point but at least for V2 PJ15-02 is believed to offer:

1. Quicker E-AMAN capability deployment because of standardisation of protocols and collaboration. This would allow to achieve Full Operational Capability earlier.
2. *"Europeanisation/Universalisation"* of the service. Some ANSPs do not consider E-AMAN deployment in their short-term strategies because of other operational and financial priorities. Having a Common Service solution available at European level could facilitate their access to the E-AMAN capability.

Following the EATMA logic that Enabling Projects / Technological Solutions (PJ15-02) enable and/or support ATM Solutions (SESAR1 #05), we can say that PJ15-02 accelerates the benefits that #05 provides.

By having a look at the Implementation View of the European ATM Master Plan Level 3 [34] or the latest information in the eATM Portal [35], Figure 2 below shows the KPA where Solution #05 contributes.


Expected Performance Benefits

Safety	Maintained.
Capacity	Optimal use of TMA capacity.
Operational efficiency	Improved arrival flow.
Cost efficiency	-
Environment	Delays are resorbed by reducing speed in early phases of arrivals leading to reduction of holding and vectoring which has a positive environmental impact in terms of fuel savings.
Security	-

Figure 2: Expected Performance benefits of Solution SESAR1 #05

Consequently, as PJ15-02 supports the faster deployment of the OI Step TS-0305-A satisfied by SESAR1 Solution #05, we can say that PJ15-02 enables benefits in Capacity, Operational efficiency and Environment for those extra years of FOC.

The following table summarises the benefits identified for the E-AMAN Common Service as described in [5].

KPA (KPI)	KPI	Performance Benefits Expectation local to Direct Consumer	Performance Benefits Expectations at Network Level (ECAC Wide)
Environment / Fuel Efficiency (Fuel Burn per Flight)	FEFF1		An E-AMAN Common Service could provide AMAN capabilities for a region where it is not economically viable to run such a service in isolation. This might lead to secondary performance contributions.
Airspace Capacity (Throughput / Airspace Volume & Time)	CAP1, CAP2		An E-AMAN Common Service could provide AMAN capabilities for a region where it is not economically viable to run such a service in isolation. This might lead to secondary performance contributions.

KPA (KPI)		KPI	Performance Benefits Expectation local to Direct Consumer	Performance Benefits Expectations at Network Level (ECAC Wide)
Airport Capacity (Runway Throughput Flights/Hour)		CAP3		An E-AMAN Common Service could provide AMAN capabilities for a region where it is not economically viable to run such a service in isolation. This might lead to secondary performance contributions.
Predictability (Flight Duration Variability, against RBT)		PRD1		An E-AMAN Common Service could provide AMAN capabilities for a region where it is not economically viable to run such a service in isolation. This might lead to secondary performance contributions.
Safety	**Mitigation of safety risk**	-		

KPA (KPI)		KPI	Performance Benefits Expectation local to Direct Consumer	Performance Benefits Expectations at Network Level (ECAC Wide)
Cost Efficiency	**Cost of operation**	CEF3	**High** Cost of Operation is significantly reduced by reduction of Human Resources (including both deployment and maintenance), necessary to operate Extended Arrival management	**Medium** Cost of Operation is overall slightly reduced. The number of Point-To-Point connections between stakeholders are reduced. By this, deployment of the capability can be significantly accelerated, as efforts for establishing, testing and maintenance of the connections are significantly reduced.
Cost Efficiency	**ATCO Productivity**	CEF2		

Table 4: Expected Benefits

3.2 Description of the OI Steps and Enablers

The Common Service does not address operational improvements itself. It is aiming at the improved cost efficiency of the provision of a necessary capability. The following created OI Step is reflecting this fact. (Text taken from EATMA Dataset 19).

3.2.1 SDM-0402 E-AMAN Common Service (Business Improvement)

The concept of Common Services (COSER) aims at addressing the high costs caused by European ATM fragmentation. The idea of sharing a common capability and offer it to different interested consumers is directed at reducing the costs of ATM provision. The Common Service can be provided at different levels, ranging from local to sub regional level, depending on the underlying business model.

The E-AMAN common Service will have to provide the E-AMAN information for different consumers and purposes and will output local Arrival Planning results (e.g. total delay) aggregated to serve different purposes of the involved actors (e.g. queue management). These will be used in the planning/tactical phase (e.g. departure delay) and in real-time/operations (e.g. delay and/or speed advisories).

The E-AMAN Common Service provides the "technical" capability necessary to operate Extended Arrival Management similar to OI TS-0305-A (SESAR 1 Solution #05). These functions are:

Arrival Sequencing / Planning

Arrival Management Information Distribution to all involved actors

It covers two deployment scenarios - "Colocation" and "Federation". The area of implementation is very wide, ranging from local ATSUs to groups of States and/or FABs.

3.2.2 SVC-004 Provision of cost-efficient E-AMAN capabilities using a Common Service

Ground systems evolve to provide "SWIM enabled" Arrival Sequence Information using common interfaces in support of cost-efficient E-AMAN capabilities.

3.2.3 Related OI Steps

The Capability which is in scope of the E-AMAN Common Service is mainly described by the following OI Step 0305-A. (Text taken from EATMA Dataset 19).

3.2.3.1 TS-0305-A – Arrival Management Extended to En-Route Airspace – single TMA

The system integrates information from arrival management systems operating out to 180-200 nautical miles from the arrival airport to provide an enhanced and more consistent arrival sequence. The system helps to reduce holding by absorbing some of the queuing time further upstream well into En-Route. Includes integration of traffic departing from within the AMAN horizon of the destination airport. Impacted En-Route sectors are expected to contribute to the sequencing towards a single TMA.

Rationale: The AMAN horizon is extended to the En-Route airspace further from the TMA and may extend across several En-Route sectors, potentially including across borders, requiring an increased

degree of cross-border cooperation and support from "distant" ATM actors to resolve problems for an airport far outside their normal sphere of operations.

The potential evolution of the common service, that means further extending the Capability provided by the Service, could cover future operational needs.

4 Business Model Approach

The Business Model Approach is described in [3] and was performed. This document is an update of the results which were performed in the overall Business Model Approach during V1 & V2 where its characteristics have not been changed. Only a revision of aspects and reassessment of results have been performed.

5 Scenarios

The following two scenarios, which are described below, were identified and described in TRL2 / V1. These two scenarios “Colocation of E-AMAN on a local level” and “Federation of E-AMAN” can be seen as an initial step towards the implementation of Common Services with the reuse of existing E-AMAN systems. They follow the Common Service Pattern of “Consolidation”.

No changes have been made to the above mentioned two scenarios compared to V2 Business Model. They are again listed here to give context to the reader of the V3 Business Model.

5.1 Colocation of E-AMAN on a local level

This scenario follows the Common Service Pattern of “Consolidation” and might apply mainly to ANSPs, which already have AMAN or E-AMAN systems in place.

The classic E-AMAN deployment pattern is to have dedicated E-AMAN systems onsite at each location of the APP Centre responsible for Arrivals towards one or more specific airports. Often the E-AMAN systems are integral part of the ER-APP ATC system itself with all dependencies, which result from this.

An ANSP who finds himself in the above situation may decide to provide the technical E-AMAN capabilities by a Common Service locally for the airports where he is in charge of. This Common Service would be realized by colocation of the E-AMAN systems at a single site, e.g. a data center location. The operational processes executed around the E-AMAN technical capability are still executed by the original APP Centre.

The driver for this scenario would be the envisaged effect of “Economy of scale” which should allow reducing maintenance costs by central system management, requirements engineering, and product management. The software development, e.g. the extension of the arrival management horizon, necessary to comply with PCP regulations, can be planned and executed more efficiently when the separate systems are part of one operating entity inside the stakeholders organization.

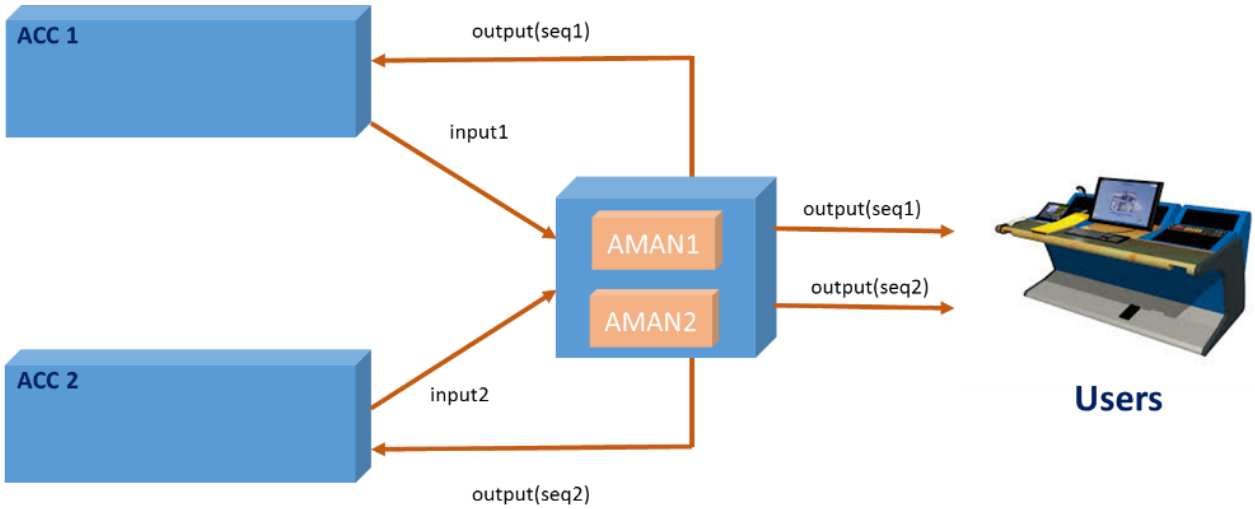


Figure 3: Overview of data flows in Collocation scenario

The data necessary to cover the extended arrival horizons of all mandated airports overlap and can be concentrated at a single site. This might lead to fewer interfaces, which need to be established. This also might lead to a reduction of infrastructure costs and necessary bandwidth. Virtualization options could further contribute to cost efficient resource utilization and thus reduced costs in providing the E-AMAN service.

5.2 Federation of E-AMAN

This scenario follows the Common Service Pattern of 'Federation' and applies mainly to ANSPs that have AMAN/E-AMAN systems in place.

The Common Service receives data from ANSPs current AMAN/E-AMAN systems and provides a Common Service based on sequences provided by ANSPs in a standardised way that can be consumed by other ANSPs.

The Common Service provider is responsible for receiving the data from the ANSP provider and providing the data to the ANSP consumer meeting any new technical standards, e.g. from EUROCAE for Arrival Management and SWIM.

The ANSP provider therefore does not need to spend money or put at risk the current operation making changes to in service systems and the ANSP consumer is able to develop systems using standard interfaces. The Common Service does not constrain ANSPs from using current interfaces directly or providing direct interfaces that meet the same standards as the Common Service Provider.

Without the Federator, an En-Route ATSU of ANSP A would need to implement legacy and SWIM interfaces, with the Federator only the Legacy interface he is capable of. An En-Route ATSU of ANSP B, with the Federator, is able to receive XMAN requests from Legacy partners, without having to implement the Legacy interface.

The Common Service allows current systems to be transitioned to new standards based interfaces in a controlled way at minimal cost whilst maintaining current capabilities as required.

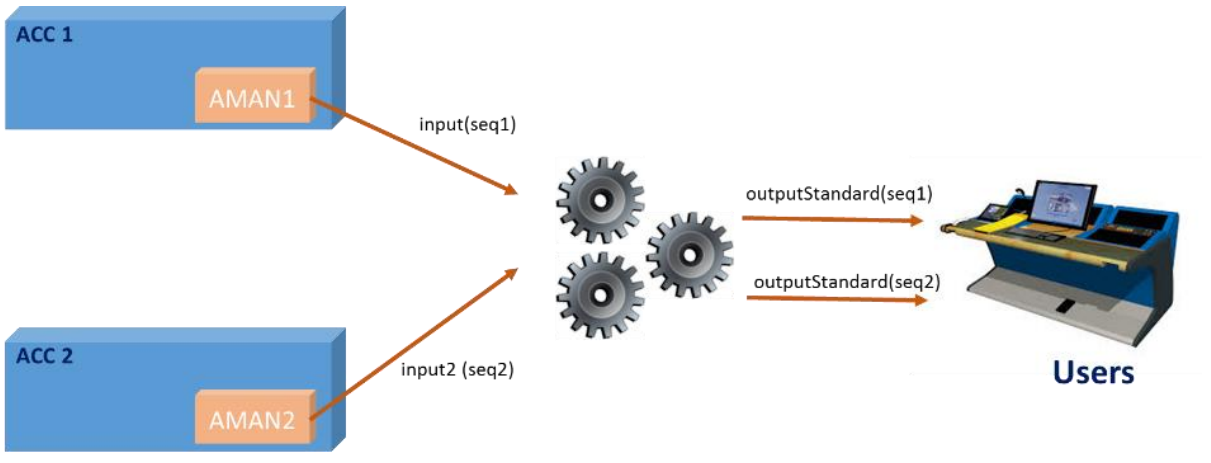


Figure 4: Overview of data flows in Federation scenario

5.2.1 Variants of Federation of E-AMAN

There are two variants of the Federator, one where the application is hosted on a traditional hardware installation and the second that runs in a cloud service. A traditional hardware installation could be hosted on an ANSP premises and take advantage of existing connectivity such as Pan-European Network Service (PENS). However, this type of installation is least likely due to cost. A cloud service installation is most likely, it could be hosted on an ANSPs cloud solution so benefits from security and connectivity but could also be hosted on a commercial cloud offering such as Microsoft Azure, Google Cloud or Amazon Cloud and run by a technology company offering a Federator Service.

6 Assessment of Feasibility

Table 5 gives an overview of the main characteristics and Feasibility of the two scenarios considered. The scoring has been made based on expert judgement and was confirmed for the V2 Business Model.

Scenario	Scale	Project ambition	Degree of cooperation	Time to FOC	Technical complexity	Political acceptance
Colocation	Local – APT/TMA areas of one ANSP	Small	Small – intra ANSP	Short	Low	Easy
Federation	Few ANSPs – e.g. FAB or Sub-Regional level	Medium	Medium – inter ANSP	Medium	Medium	Medium

Table 5: Scenarios summary

6.1 SWOT Assessment - Colocation

Criteria	Strength/Opportunity	Weakness/Threat
Cost of development	Development costs are very limited as no new AMAN system needs to be developed	n/a
Cost of operations	If a "colocation facility", e.g. a Data Center is already available at the ANSP, the additional costs for operation of the E-AMAN CS should be very low.	The introduction of a new "colocation facility" only for the E-AMAN colocation scenario could be economically not beneficial.
Operational	Quicker implementation of operational requirements,	n/a
Political	As this is internal to a single ANSP this can be implemented without any need of coordination with other stakeholders.	n/a
Regulatory Acceptability	Acceptability is fully given as no transfer of responsibility/liability is performed.	n/a
Transition risks	If once in place any update will be performed quicker with less	New endpoint for the E-AMAN CS need to be coordinated with

	efforts of coordination, implementation and testing.	the consumers, established and tested once.
Interoperability between different Industries	Standardised interfaces support interoperability.	n/a
Technical Complexity	Technical complexity is low, because the XMAN systems itself do not need to be updated significantly. Further, due to the pure local application of this scenario, the deployment and integration of the Common Service part is quite easy to achieve.	

6.2 SWOT Assessment - Federation

Criteria	Strength/Opportunity	Weakness/Threat
Cost of development	Development costs are very limited as no new AMAN system needs to be developed.	n/a
Cost of operations	AMAN systems can retain existing interface without need to upgrade.	Cost model of service depending on provider could be different, e.g. done on a per message basis or per flight basis etc.
Operational	Easy and fast to implement new standards.	The Federator approach adds another actor into the exchange of information.
Political	The Federator approach is flexible so will allow for any political constraints.	n/a
Regulatory Acceptabily	The Federator is consuming information from different AMANs and not responsible for calculations, hence the assurance argument is simplified.	n/a

Transition risks	Will allow existing AMANs to stay in service with minimal change as new data formats are introduced, hence not increasing transition risk.	Potentially distinct ANSPs would need to cooperate in order to agree a harmonised data format to be used for the provision of the Common Service. This requires to overcome potential technical difficulties and it could be moderately time-consuming
Interoperability between different Industries	The Federator approach enables interoperability between existing AMAN systems and the next generation of AMAN systems.	n/a
Technical Complexity	Technical complexity is medium, because the XMAN systems itself do not need to be updated significantly. As potentially, different protocols and formats need to be translated and an integration in a multi stakeholder environment is necessary, a significant deployment and integration effort necessary.	

7 References and Applicable Documents

7.1 Applicable Documents

[1] SESAR PJ.15-02, D3.1.60 Business Model (V2) for Delay Sharing Common Service, 00.01.04

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

[3] SESAR B4.5, D02 Options Of Common Services 00.01.00

[4] SESAR B4.5, D05 Business Model – Extended AMAN, 00.01.00

[5] SESAR B4.5, D15 Business Model of the E-AMAN Common Service TRL6 / V3, 00.02.01

[6] Final SESAR 1 Maturity Assessment Report Executive Summary, 01.00.00

[7] SESAR P05.06.07, D53 Update of 5 6 4 SPR-INTEROP - Step 1 - Edition 2, 00.01.00, Safety and Security Risk assessment, Safety Requirements, as well as Information Exchange requirements containing Safety / Security relevant aspects

[8] SESAR P.05.06.04, D34-001 Safety Assessment Report for Tactical TMA and En-route Queue Management, Edition 00.01.06SESAR

[9] P05.06.07, D49 VALR_EXE-5 6 7-VP-695, 00.02.00, Safety Assessment Plan in Appendix A

[10]Security Prioritisation 01_00_00(1.0).xls, 31.10.2017

[11] SESAR2020 CBA Template

[12]ICAO Global Operating concept Doc 9854

[13] SESAR2020 Project Handbook

[14]SESAR 16.06.06-D26_04, Guidelines for Producing Benefit and Impact Mechanisms, Edition 03.00.01

[15]SESAR 16.06.06-D26_03, Methods to Assess Costs and Monetise Benefits for CBAs, Edition 00.02.02

[16]SESAR 2020 Multi Annual Work Programme, edition V1.0, 08/07/2015

[17] B04.05 - D04 Common Services Foundation Method

[18]FABEC XMAN/AMAN Roadmap, Version 3.1, 03.11.2016

[19]SESAR PJ.15-02, TVALR TRL6 – E-AMAN, 00.01.02

[20]SESAR PJ.15-02, SDD TRL6 – E-AMAN, 00.01.02

[21]SESAR PJ.15-02, CBA TRL6 – E-AMAN, 00.01.01

7.2 Reference Documents

[22]Business Model Generation. A. Osterwalder and Y. Pigneur. Wiley, 2010.

[23]SESAR 2020 D4.0.1 S2020 Common Assumptions. Edition 01.00.00 of 17 May 2018.

[24]SESAR B.04.05-D02, Options on Common Services, Edition 00.01.00

[25]SESAR Frequently Asked Questions. Extended Arrival Manager (E-AMAN).

[26]SESAR Demonstration. Extended AMAN. Presentation at the World ATM Congress 2015, Madrid.

[27]Release 4 SESAR1 Solution #05 Extended Arrival Manager Horizon. Contextual note – SESAR Solution description form for deployment planning. Accessed on 10/04/2017 via: http://www.sesarju.eu/sesar-solutions/advanced-air-traffic-services/extended-arrival-management-aman-horizon

[28]PRB RP2 Annual Monitoring Report 2015. Volume 3 – CAPEX. Version 2.2 from 20/12/2016. Accessed on 11/04/2017 via: https://ec.europa.eu/transport/sites/transport/files/prb_annual_monitoring_report_2015_vol_3_capital_expenditures.pdf and https://ec.europa.eu/transport/modes/air/single-european-sky/ses-performance-and-charging/publications_ga

[29]European ATM Portal – Working view. Accessed on 11/04/2017 via: https://www.eatmportal.eu/working/depl/essip_objectives/map

[30]SESAR1 B.04.03 - D102 Service Method Update 2015 Report

[31]SESAR1 B.04.05 - T3 Service Identification

[32]SESAR 2020 D4.1 Performance Framework (2017)

[33]SESAR 2020 D4.5 Validation Targets (2018)

[34]European ATM Master Plan 2017 – Level 3 – Implementation View.

[35]European ATM Portal (eATM Portal). Accessed on 21/09/2018 via: https://www.eatmportal.eu/working/depl/essip_objectives/1000255

[36] PJ15-02 - 181001 - Performance Questionnaire 2018 - V1.0

[37] FABEC Performance Plan for RP2 (2015-2019). Accessed on 31/10/2018 via: https://www.fabec.eu/performance/performance-plan

[38] EUROCONTROL - European Aviation in 2040 – Challenges of Growth. Edition 2.

[39]

Appendix A Airports falling under the PCP EU Regulation

As per Article 3 of the PCP EU regulation [1], Extended Arrival Management and Performance Based Navigation in the High Density Terminal Manoeuvring Areas is among the ATM functionalities that will have to be implemented by a selected set of stakeholders. As per 1.3 in the Annex:

"ATS providers and the Network Manager shall ensure that ATS units providing ATC services within the terminal airspace of the airports referred to in point 1.2 and the associated en-route sectors operate Extended AMAN and PBN in high density TMAs as from 1 January 2024".

A.1 EU and EFTA Member States

Extended AMAN and PBN in high density TMAs and associated en-route sectors shall be operated at the following airports:

No.	Airport name	IATA Airport code	Country
1	London-Heathrow	LHR	United Kingdom
2	Paris-CDG	CDG	France
3	London-Gatwick	LGW	United Kingdom
4	Paris-Orly	ORY	France
5	London-Stansted	STN	United Kingdom
6	Milan-Malpensa	MXP	Italy
7	Frankfurt International	FRA	Germany
8	Madrid-Barajas	MAD	Spain
9	Amsterdam Schiphol	AMS	Netherlands
10	Munich Franz Josef Strauss	MUC	Germany
11	Rome-Fiumicino	FCO	Italy
12	Barcelona El Prat	BCN	Spain
13	Zurich Kloten (1)	ZRH	Switzerland
14	Düsseldorf International	DUS	Germany
15	Brussels National	BRU	Belgium
16	Oslo Gardermoen (2)	OSL	Norway
17	Stockholm-Arlanda	ARN	Sweden
18	Berlin Brandenburg airport	BER	Germany
19	Manchester Ringway	MAN	United Kingdom
20	Palma de Mallorca Son San Juan	PMI	Spain
21	Copenhagen Kastrup	CPH	Denmark
22	Vienna Schwechat	VIE	Austria
23	Dublin	DUB	Ireland
24	Nice Cote d'Azur	NCE	France

A.2 Other third countries

Extended AMAN and PBN in high density TMAs should be operated at the Istanbul Ataturk Airport:

No.	Airport name	IATA Airport code	Country
25	Istanbul Ataturk	IST	Turkey

Appendix B LSSIP 2016. Implementation view for ATC15.2

The most updated information regarding deployment status of SESAR1 Solutions as reported by Member States for Master Plan Level 3 is available via the European ATM Portal. It contains the latest edition of the LSSIP (2018) showing the overall progress reported by Member States. It is updated up to Dataset DS19.

B.1 ATC15.2 Arrival Management extended to en-route airspace

MS	Overall Progress	L1 Comments	L1 Implementation date	L1 % completed	IATA APT code
AT	Ongoing	Apart from the implementation of the basic AMAN tool, which has been put into operation in November 2018, the upgrade of the ATC System (TopSky/COOPANS) will coherently support the functionality of an Extended AMAN (AMA messages to be processed and likewise to be distributed, plus processing of those data, providing the most accurate trajectory prediction information available) Concluding, the Extended AMAN is considered as a collaborative project with all adjacent partners / ATC Units concerned, plus Network Manager. Timeframe to become fully operational with all eligible ATC Units is estimated till end 2023 at the latest.	31/12/2023	6%	VIE
BE	Not yet planned	Refer to ASP comments	-	0%	BRU
CH	Ongoing	An AMAN is implemented in Zurich. In the frame of the FABEC activities an XMAN project was launched in 2015. Initial step is to receive XMAN information (Munich) from DFS and integrate them in Zurich ACC for operational use by ACC ATCOs. Also with this step, XMAN information is sent to Munich, Langen & Reims for operational use by ACC ATCOs of these adjacent centres.	31/12/2023	49%	ZRH

DE	Completed	In line with the PCP Implementing Rule 716/2014 and the associated Deployment Programme, the planning horizons of the AMAN systems serving Frankfurt, Munich, Dusseldorf and Berlin airport will be extended up to 220NM into the area of responsibility of identified upstream control centres until the given PCP deadline (31.12.2023). Due to dependencies of neighbouring partners and their schedules, the connections to all upstream centres and vice versa still require time. However, the objective is considered as “Completed” because the DFS systems, procedures and agreements are ready and prepared for implementation.	12/10/2017	100%	FRA, MUC, DUS, BER
DK	Completed	Functionality technically implemented with OLDI. Only in use with Malmo ACC. For now it is not judge necessary to extent implementation to other ACCs due to the traffic demand at EKCH and we haven't received requests from neighbouring ACCs to receive AMA messages from other Airports. When future demand and request necessitate this the functionality will be extended to cover this as well	30/06/2018	100%	CPH
ES	Planned	ENAIRE has finished (31/10/2018) the deployment of objective ATC15.1 (Implement, in en-route sectors, information exchange mechanisms, tools and procedures in support of basic AMAN) for the availability of AMAN sequence in the en-route sectors. Once completed that objective, the systems will be upgraded to meet the requirements of ATC15.2	31/12/2023	0%	MAD, BCN, PMI
FR	Ongoing	The objective should be fully implemented by the end of 2023	31/12/2023	73%	CDG, ORY, NCE
IE	Not yet planned	New objective. While there is no specific plan commenced, the IAA has responsibility for delivery of traffic from the en-route airspace to state airports in Ireland: EIDW, EICK, EINN and Regional, non-state airports: EIDL, EISG, EIKN, EIKY and EIWF. This task is managed internally with the IAA ATM system for state airports and more manually for non-state airports. In line with the ATC 15.1 objective, it is the position of the IAA that there is no need for further development in this area, when the geographical location of IAA controlled en-route airspace and the interfaces with this airspace are considered. This objective will be re-visited for the LSSIP 2017 report.	-	0%	DUB

IT	Ongoing	ENAV is going to implement AMAN concept, investing in a solution able to offer the functionalities of the Basic AMAN combined with the feasibility to extend the operational horizon of the tool from the TMA to the En-route scenario, according to PCP EU Regulation 716/2014 timing and system requirements	31/12/2019	20%	MXP, FCO
NL	Not yet planned	In 2017 LVNL has developed an AMAN roadmap. Extended AMAN to en-route airspace is part of this roadmap. No activities are planned yet.	-	18%	AMS
NO	Ongoing	Extended AMAN is planned and functionality will be part of new ATM system. It will not be a part of the initial delivery, but the new ATM system will be designed to support implementation of extended AMAN.	31/12/2023	10%	OSL
SE	Ongoing	-	31/12/2019	26%	ARN
TR	Completed	Extended AMAN project for Istanbul TMA and related ACC sectors including Sofia ACC has been started.	31/12/2018	100%	IST
UK	Completed	NATS provides extended arrival management (XMAN) for Heathrow only at this time. We are currently working on bringing Gatwick XMAN on-line via a SESAR 2020 project as a trial.	30/04/2015	100%	LHR, LGW, STN, MAN

Appendix C Overview of OE and Sub-OEs from PJ20 WP2.2

In order to furnish the information required for Validation Target setting, PJ20 sWP2.2 provided a Sub-OEs base based primarily on airport movements.

The table below presents the updated Sub-OEs to consider in Validation Targets 2018 Edition:

OEs	Sub Operating Environments	Definition
Terminal	Terminal Very High Complexity	Very High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of equal or more than 10
	Terminal High Complexity	High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of between 6 and 10
	Terminal Medium Complexity	High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of between 2 and 6
	Terminal Low Complexity	Low complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of less than 2
En-route	En-route Very High Complexity	Very High complexity ACCs have a complexity score of equal to or greater than 10
	En-route High Complexity	High complexity ACCs have a complexity score of between 6 and 10
	En-route Medium Complexity	Medium complexity ACCs have a complexity score of between 2 and 6
	En-route Low Complexity	Low complexity ACCs have a complexity score of less than 2
Airport	Very Large Airport	Airports with more than 250k movements per year
	Large Airport	Airports with more or equal than 150k and less or equal than 250k movements per year
	Medium Airport	Airports with more or equal than 40k and less than 150k movements per year
	Small Airport	Airports with more or equal than 15k and less than 40k movements per year
	Other	Airports with less than 15k movements per year

Table 6: Overview of Operating Environments (OEs) and Sub-OEs


DFS Deutsche Flugsicherung
dgac
DSNA
EUROCONTROL
indra
NATS
THALES

-END OF DOCUMENT-