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PJ10-W2 PROSA

PJ10-W2 PROSA

This Contextual Note is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874464 under European Union's Horizon 2020 research and innovation programme.

Abstract

The objective of the SESAR Solution PJ.10-W2-Solution 93 is to explore the different possible cases of delegation of provision of ATM Services amongst ATSUs based on traffic / organisation needs (either static on fix-time transfer schedule (Day/Night) or dynamic, e.g. when the traffic density is below/over certain level) or on contingency needs.

This solution focuses on the "U" architecture relying on a delegation between 2 ATSUs, each one with its own system, and using exchange capabilities between the 2 systems for transferring relevant data to the ATSU receiving the delegation.

Without clear definitions and standards for how different ADSPs should communicate with each other, it was difficult to make progress in developing and implementing a functional system in the Sol93C and it is essential to prioritise the development of clear definitions and standards for inter-ADSP communication in future efforts to improve the U architecture. Therefore, the Sol93C does not reach TRL4.

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1 Purpose

This Contextual Note provides to any interested reader (external and internal to the SESAR programme) an introduction to the Technological SESAR Solution 93C, in terms of scope, main Technical definition to the Virtual Centre improvements defined as “U” Architecture.

This Contextual Note shows the results for technological Solution 93C, PJ.10-W2, and for hosting PJ.32-03 contribution to Virtual Centre service improvements and the “U” architecture.

This Contextual Note defines the architecture of each PJ.10-W2-93 technological solution, as well as the common interface requirements for the ATM Data Service Provider (ADSP) and the Virtual Centre ATSUs (VC ATSUs) necessary to support the various possible cases of delegation and contingency of ATM services between ATSUs.

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2 Improvements in Air Traffic Management (ATM)

2.1 Challenges and Scope

The delegation of ATM services provision concept applies when one ATSU delegates a portion of its airspace, or the entire airspace, to another ATSU based on a particular condition. The Solution 93 investigates Use Cases for the Delegation of ATM and Contingency in conjunction with the Virtual Centre Technology where the ATM Data Service Provider (ADSP) is geographically separated from the Virtual Centre ATSU providing ATS to a region of airspace.

These technological solutions have been created in the project for structuring the development of different technical architecture options in support to the main ATM solution, thus allowing different levels of maturity to be reached for the proposed technical architectures.

In this option, positions in one ATSU can connect to a different ADSP managing the sectors they need to control:

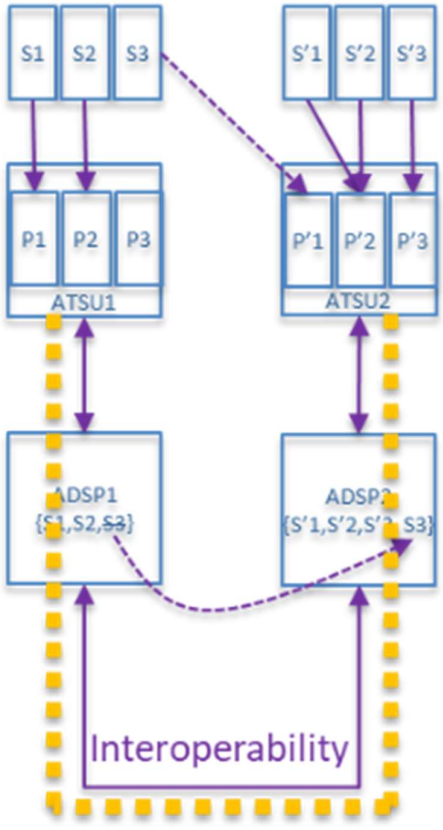

Figure 1: U Architecture in a Virtual Centre Environment

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2.1.1 Introduction

The Delegation of ATM services provision may be achieved by transferring an ATSU AoR, or a piece of AoR, to another ATSU. In this set-up, the receiving ATSU provides both the CWPs and an extension of its AoR in the system, while at the same time the AoR of the delegating ATSU is reduced accordingly. This principle is based on the capability of the systems to exchange the required information at the right time in order to provide the relevant information to the CWPs taking the delegation(s). This delegation configuration set-up is referenced as the “U” architecture. This architecture can be applied to any combination of Virtual Centres and/or non-Virtual Centres.

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3 Operational Improvement Steps (OIs) & Enablers

Solution PJ.10-W2-93C Delegation of ATM services provision with a "U" architecture

The delegation of ATM services provision, as described by the OI *"SDM-0217_Delegation of ATM Services provision between ATSUs"*, may be achieved with different system architectures. This solution focuses on the "U" architecture relying on a delegation between 2 ATSUs, each with its own system, and using exchange capabilities between the 2 systems for transferring relevant data to the ATSU receiving the delegation. Each system may be a legacy one or be provided by an ADSP (i.e. "I" architecture). In this architecture, the respective AoRs are reshaped according to the delegation.

POI-0077 U-Architecture supporting Infrastructure for delegation of ATM services provision amongst ATSUs

A delegation of ATM services provision may be achieved by transferring an ATSU AoR, or a piece of AoR, to another ATSU. In this set-up, the receiving ATSU provides both the CWPs and an extension of its AoR in the system, while at the same time the AoR of the delegating ATSU is reduced accordingly. This principle is based on the capability of the systems to exchange the required information at the right time in order to provide the relevant information to the CWPs taking the delegation(s). This delegation configuration set-up is referenced as the 'U' architecture.

This architecture can be applied to any combination of Virtual Centres and/or non-Virtual Centres. Therefore, the use or not of the VC Enablers is not directly relevant for this architecture.

'U' architecture is also well fitted for supporting ATSU contingency scenarios.

This POI is valid for En-Route and TMA phases of flight but has only been validated for En-Route.

The table below provides a summary of the current Enabler allocations per Technological Solution Architecture (Y, D and U) and the validation coverage at the end of the projects achieved at TRL4 and TRL6.

Enabler	Service	Sol93A POI-0075 "Y"	Sol93B POI-0076 "D"	Sol93C POI-0077 "U"	Initial Maturity	Target Maturity
SVC-008	Provision and Consumption of Flight Data Distribution Service in the context of Virtual Centres.	Optional	Optional	n/a	TRL6	TRL6
SVC-009	Provision and Consumption of Flight Data Management Service in the context of Virtual Centres	Optional	Optional	n/a	TRL6	TRL6
SVC-010	Provision and Consumption of Coordination And Transfer Management Service in the context of Virtual Centres	Optional	Optional	n/a	TRL6	TRL6
SVC-013	Provision and Consumption of Airspace Status Distribution Service	Optional	Optional	n/a	TRL6	TRL6
SVC-014	Provision and Consumption of Arrival Sequence Distribution Service	Optional	Optional	n/a	TRL4	TRL4

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SVC-015	Provision and Consumption of Arrival Sequence Management Service	Optional	Optional	n/a	TRL4	TRL4
SVC-016	Provision and Consumption of Correlation Distribution Service	Optional	Optional	n/a	TRL6	TRL6
SVC-017	Provision and Consumption of Correlation Management Service	Optional	Optional	n/a	TRL6	TRL6
SVC-018	Provision and Consumption of Medium Term Conflict Detection Distribution Service	Optional	Optional	n/a	TRL4	TRL4
SVC-019	Provision and Consumption of Medium Term Conflict Management Service	Optional	Optional	n/a	TRL4	TRL4
SVC-020	Provision and Consumption of Monitoring Aids Distribution Service	Optional	Optional	n/a	TRL4	**TRL6**
SVC-021	Provision and Consumption of Operational Configuration Distribution Service	Optional	Optional	n/a	TRL4	**TRL6**
SVC-049	Operational Configuration Distribution of Working Position Preview Mode, and Neighbouring ATSU Sector configuration for ATM Service Delegation	Optional	Optional	n/a	new	**TRL6**
SVC-022	Provision and Consumption of Operational Configuration Management Service	Optional	Optional	n/a	TRL4	**TRL6**
SVC-050	Operational Configuration Management of Working Position Preview Mode, and Neighbouring ATSU Sectors for ATM Service Delegation	Optional	Optional	n/a	new	**TRL6**
SVC-023	Provision and Consumption of Safety Net (SNET) Alert Distribution Service	Optional	Optional	n/a	TRL4	TRL4
SVC-024	Provision and Consumption of SSR Code Distribution Service	Optional	Optional	n/a	TRL4	TRL4
SVC-025	Provision and Consumption of SSR Code Management Service	Optional	Optional	n/a	TRL4	TRL4
SVC-026	Provision and Consumption of Support Functions Distribution Service	Optional	Optional	n/a	TRL4	TRL4
SVC-027	Provision and Consumption of Support Functions Management Service	Optional	Optional	n/a	TRL4	TRL4
SVC-028	Provision and Consumption of Surveillance Data Distribution Service	Optional	Optional	n/a	TRL4	TRL4
SVC-029	Provision and Consumption of Technical Supervision Distribution Service	Optional	Optional	n/a	TRL4	**TRL6**
SVC-031	Provision and Consumption of Time-based Separation Distribution Service	Optional	Optional	n/a	TRL4	TRL4
SVC-032	Provision and Consumption of Time-based Separation Management Service	Optional	Optional	n/a	TRL4	TRL4
SVC-033	Provision and Consumption of Voice Comm Information Distribution Service	Optional	Optional	n/a	TRL6	TRL6
SVC-034	Provision and Consumption of Voice Comm Management Service	Optional	Optional	n/a	TRL6	TRL6

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ER APP ATC 184	ATM Data Service Provider for ATC services in a Virtual Centre context	Required	Required	n/a	TRL6	TRL6
ER APP ATC 185	ATM Data Service Provider for Voice services in a Virtual Centre context	Required	Required	n/a	TRL6	TRL6
ER APP ATC 186	Virtual Centre ATSU	Required	Required	n/a	TRL6	TRL6
ER APP ATC 193	Management in the VC ATSU of a CWP preview mode during delegation of ATS Provision between ATUs	Required	Required	Optional	new	**TRL6**
ER APP ATC 194	Management in the ADSP of a CWP preview mode during delegation of ATS Provision between ATUs	Required	Required	Optional	new	**TRL6**
ER APP ATC 195	Management in the VC ATSU of Delegation of ATS Provision between ATSUs with Static AoRs for Y-Architecture	Required	n/a	n/a	new	**TRL6**
ER APP ATC 196	Management in the VC ATSU of Delegation of ATS provision between ATSUs with Dynamic AoRs for U-Architecture	n/a	n/a	Required	new	**TRL4**
ER APP ATC 197	Management in the ADSP of Delegation of ATS provision between ATSUs with Dynamic AoRs for U-Architecture	n/a	n/a	Required	new	**TRL4**
ER APP ATC 215	Management in the VC ATSU of Delegation of ATS Provision between ATUs with Static AoRs in a D-Architecture	n/a	Required	n/a	new	**TRL4**
ER APP ATC 216	Management in the ADSP of Delegation of ATS provision between ATUs with Static AoRs in a Y-Architecture	Required	n/a	n/a	new	**TRL6**
ER APP ATC 217	Management in the ADSP of Delegation of ATS provision between ATUs with Static AoRs in a D-Architecture	n/a	Required	n/a	new	**TRL4**
ER APP ATC 218	Management in the VC ATSU of Delegation of ATS provision between ATUs with Dynamic AoRs in a Y-Architecture	Optional	n/a	n/a	new	**TRL6**
ER APP ATC 209	Management in the ADSP of Delegation of ATS provision between ATUs with Dynamic AoRs in a Y-Architecture	Optional	n/a	n/a	new	**TRL6**
STD-097	EUROCAE ER for Taxonomy of Services between ATSU & ADSP(s), and between ADSP &ADSP	Optional	Optional	n/a	TRL4	TRL4

Table 1: Recap of SESAR Technological Solutions PJ.10-W2-93 related POIs, Enablers and maturities

With reference to Table 1, many services are identified as optional. Particularly, due to the lack of the Standard for the Service exchange protocol, it is not possible to define a proper interface between 2 ADSPs with a limited number of Optional Services. In fact, they should be needed in case of Management in the VC ATSU and ADSP of a CWP preview mode during delegation of ATS Provision between ATSUs.

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Below is reported the table on PJ10.W2-93C /POI-0077 “U” Architecture with the Functional Blocks/Roles &Enablers

SESAR Solution ID and Title	Functional Blocks/Role impacted by the SESAR Solution (from EATMA)	Enabler ID (from EATMA)	Enabler Title (from EATMA)	Initial Maturity	Target Maturity	Enabler Compulsory
PJ.10-W2-93C	OPSUP HMI, CHMI	ER APP ATC 193	Management in the VC ATSU of a CWP preview mode during delegation of ATS Provision between ATUs	new	TRL6	Optional
PJ.10-W2-93C	OPSUP, TP&M	ER APP ATC 194	Management in the ADSP of a CWP preview mode during delegation of ATS Provision between ATUs	new	TRL6	Optional
PJ.10-W2-93C	CHMI, OPSUP HMI, SUPP HMI	ER APP ATC 196	Management in the VC ATSU of Delegation of ATS provision between ATUs with Dynamic AoRs	new	TRL4	Required
PJ.10-W2-93C	AGDL, CTM, FPLD, G/G Voice, GGCD, OPSUP, SUPP	ER APP ATC 197	Management in the ADSP of Delegation of ATS provision between ATUs with Dynamic AoRs	new	TRL4	Required

Table 2: Solution Related Functional Blocks/Roles &Enablers

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4 Background and validation process

The PJ10.W2-93C is Solution targets a TRL4 maturity level.

A proper analysis was performed to be compliant with OSED Use Cases to process the Operational Requirements.

In a U architecture, delegation of Airspace between two ATSU has an impact on adjacent ATSUs. Studies did not manage so far to find a way managing properly this impact.

The VC solution & design PJ10.W2-93C was assessed through different objectives:

- Its capability to support the delegation process of ATM services between two ATSUs with their own ADSP, and the ADSP connected together.
- The number and maturity of existing or newly developed services between ADSP and ATSUs
- The interoperability aspects
- The performance of the global VC platform with regard to the operational acceptance of the overall delegation process

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5 Results and performance achievements

This Architecture was validated only in EXE3.

The analysis of the results obtained through the questionnaires and de-briefing sessions have been thoroughly analysed by human factors experts with operational background, allowing the extraction of relevant conclusions and recommendations in the Validation Report.

From technical point of view, the validation platforms were well prepared and showed a certain stability during the final runs although these distributed platforms had a high complexity since components of different vendors had to be integrated. And this is particularly true for the VC platforms for the U architecture, the technical platform was mature enough for the delegation of ATM services to be consider the entire architecture for the use cases of the rationalization of the infrastructure with more ADSP.

However, some limitations are also considered from Technical Perspectives:

- Technical limitations:
  - As reported, the Preview mode was well implemented in all the ATC and Voice ADSPs, as well as in the CWPs under EXE3. However, the lack of interoperability between ADSPs (CCS and iTEC) was the cause of the low maturity of the U architecture platform.
  - In most of the VC validation platforms, some Network issues have led to interrupt, restart or postpone the runs
  - Although the U architecture failed to validate the delegation concept, it is still considered useful in future implementations of European Virtual Centres. However, significant effort is needed to develop standards and protocols for the interoperability between European ADSPs, which may be difficult to achieve without the involvement of suppliers in the European ATM Market.
  - The implementation of the Preview mode was successful in all the ATC and Voice ADSPs, as well as in the CWPs under EXE3. However, due to the lack of interoperability between the ADSPs (specifically CCS and iTEC), the U architecture platform was deemed to have low maturity
  - The lack of the progress for the U Architecture attributed to not defining the proper services for inter-ADSP communication. Without clear definitions and standards for how different ADSPs should communicate with each other, it may be difficult to make progress in developing and implementing a functional system. It is essential to prioritise the development of clear definitions and standards for inter-ADSP communication in future efforts to improve the U architecture.

The synchronization work between two different ADSPs has been initiated, but the lack of essential data has hindered the progress, resulting in an insufficiently mature solution.

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6 Recommendations and Additional activities

The confidence of the results for the using of “U” architecture of the EXE 3 was just acceptable. Following the results obtained in EXE3 validation, the ADSPs have successfully shared data between them allowing the increase or reduction of their AoRs during a delegation. However, the procedure and the mitigations applied to carry out the exchange of information is not considered successful in the context of an ATS Delegation.

The architecture under evaluation involved changes and adaptation of a great volume.

SESAR 3 Island Solution B aims to complete validation of cross border delegation under a “U” architecture to cover the functional and non-functional System Requirements. Based on the outcome obtained in the Solution 93- C, U Architectures on EXE 3, this solution will assess the Technical Systems description and the definition of the Services that need to validated in European geographical environment.

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7 Actors impacted by the SESAR Solution

The following stakeholders are impacted by PJ10.W2- Solution 93C in the Validation process:

- Air Navigation Service Providers (ANSPs);
- Air Data Service Provider (ADSP);
- Network Manager;
- Ground systems manufacturers;
- Airspace Users;
- Civil-Military coordination;
- Standardization Group EUROCAE WG-122;
- Regulatory for certification aspects.

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8 Impact on Aircraft System

None impact on Aircraft system.

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9 Impact on Ground Systems

Some conclusions on the technical feasibility are reported in a general manner regarding several implementation to improve the Delegation process.

In addition, the impact only for the ADSPs are reported in the different Contextual note Sol A, SOL B and Sol C according to different Architectures per validation exercises.

The impacted ground functionalities are reported below:

- **Preview mode**
  The preview mode is the main "technical enabler" of the overall delegation of ATS between ATSUs. It was successfully implemented in most exercises and the process resulted acceptable both at the CWPs and ADSPs levels.

- **Supervision & Monitoring**
  Monitoring tools were developed for each involved ATC ADSPs or involved ATSUs. If the supervision and monitoring of the systems is mainly performed by the various ATSEPs, this was done in close collaboration with the local SUPs and the decisions taken during the delegation process (e.g., switch of CWP modes) are performed together.

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10 Regulatory Framework Considerations

The National Supervisory Authorities (NSAs) of both the delegating and receiving ATSUs must work closely for following development (and the list is not exhaustive):

- EASA involvement for licencing and Certification aspects;
- Based on the Virtual Centre concept on “U” Architecture, it is recommended the review of ATCO and ATSEP licensing schemes by providing them with new Certification means
- Review of eventual SLAs- Service Level Agreements put in place between the involved ATSUs
- Supervision of the implemented changes at each ATSU for the need for example of Cross-border delegation and this shall include those related to IOP- Interoperability

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11 Standardization Framework Considerations

The solution PJ10.93 is a follow up of the SESAR Wave 1 PJ16.03 which has brought a first list of services between ADSPs and ATSUs. The maturity of the services varies from TRL4 to TRL6 and our solution has increased the maturity of some services from TRL4 to TRL6 while new services (mainly those supporting the delegation process) have been created and validated at TRL6

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12 Solution Data pack

D3.5 - PJ.10-W2-93C: solution pack TRL4 (31st March 2023) including:

- D3.2.030 - PJ.10-W2-93-V3 Final SPR-INTEROP/OSED
- D3.2.180 - PJ.10-W2-93-V3 Final CBA
- D3.2.060 - PJ.10-W2-93-V3 Final TS/IRS
- D3.2.150 - PJ.10-W2-93-V3 Final VALR

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