Release 5 SESAR Solution ID #37

"Extended flight plan"

Contextual note – SESAR Solution description form for deployment planning

Purpose:

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

Improvements in Air Traffic Management (ATM)

The "Extended flight plan" (EFPL) represents an extension to the ICAO 2012 flight plan. It provides the 4D trajectory as calculated by the flight planning system to generate the operational flight plan; it also provides performance data describing the climbing and descending capabilities specific to the flight. In detail, the EFPL includes further information relevant to each point of the aircraft's trajectory, for example speed and aircraft mass, as well as other performance data such as planned climb and descent profiles. **This allows both Air Traffic Control and the Network Manager to improve their prediction of the trajectory**. This is especially relevant in complex airspace, because it allows better flow management, and also improves the performance of the conflict detection and resolution tools used by controllers. **Moreover**, thanks to the EFPL, **ATM and Flight crew can get the same profile information from the Flight Operations Centre (FOC)**.

As already said, this SESAR Solution is supported by the introduction of two new key sets of data, in addition to the ICAO 2012 FPL data. :

- **4D Trajectory (filed trajectory)**: as calculated by the FOC flight planning system in support to the generation of the operational flight plan. The 4D trajectory information is not limited to 4D points, it contains additional elements for each point of the trajectory such speeds, and aircraft mass;
- **(optionally) Flight specific Climb and Descent Data**: flight specific performance data. This represents the initial unconstrained climb profile of the aircraft specific to the flight's take-off gross mass, respectively the final and unconstrained descend profile of the aircraft specific to the flight's expected landing mass.

This SESAR Solution does not introduce new operating methods: operational procedures related to the filing of a flight plan are not changed by the introduction of EFPL. The current procedures will continue to be applicable.

However, due to the additional data that is included in an EFPL, the flight plan transmission format and means have been reconsidered. The length of an EFPL message may be

significantly greater compared to current flight plan messages in either ICAO or ADEXP format. As a result, the AFTN and SITA networks that are currently used for the transmission of flight plan messages may not be able handle such longer messages. To accommodate the new information and make its transmission possible, new solutions have been proposed:

- XML format through B2B connection - EFPL messages may be transmitted using SWIM web services available via the new B2B interface with the NM. This means that the transmission of extended flight plans and associated messages would be done using Internet based technologies for the data communication and a corresponding new data exchange format such as XML, instead of the current AFTN and SITA networks and text flight plan messages in ICAO format.
- ADEXP format through AFTN and SITA - Considering that some Airspace Users might not be able to support B2B, another mean to transmit extended flight plan and associated messages should be made available for them. Furthermore, in case of an outage of the B2B web services, there will be a need to have a fall-back solution available so that Airspace Users can continue to transmit extended flight plan messages to IFPS. It has been therefore proposed to support the submission of extended flight plan messages as well in ADEXP format through the AFTN and SITA networks. The AFTN and SITA networks may need to further evolve in order to support extended flight plan messages that could potentially be even longer than the current flight plan messages in ADEXP format.

The process to modify (delay, change, and cancel) an EFPL is based on the equivalent ICAO process, to which, in terms of content, 4D trajectory of the flight and Flight Performance Data are added.

Operational Improvement Steps (OIs) & Enablers

OI Steps:

- **AUO-0203-A** (Partially covered): EFPL in NM processes.

  Short description: Initial implementation of the Shared Business Trajectory in advanced Step 1 through the standardisation of flight intent capture in medium term planning phase and the exchange of 4D Trajectory information (including flight performance data) in short-term planning.

  OI addressed features: Extended Flight Plan used in Flight Planning (VP-311, VP-616, VP-713); Extended Flight Plan used in DCB (VP-311, VP-713)

  Required Enablers:

  - **AOC-ATM-20**: Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services.
  - **NIMS-21a**: Initial Flight Planning management enhanced to support 4D for Step 1.
  - **SWIM-APS-03a**: Provision of ATFCM Information Services for Step 1.

- **SWIM-APS-04a**: Consumption of ATFCM Information Services for Step 1.

Optional Enablers:

- **NIMS-40:** Use of FO trajectory and constraints in NM systems
- **SWIM-GOV-05a:** Regulatory provisions for SWIM roles and responsibilities
- **SWIM-INFR-05a:** General SWIM Services infrastructure Support and Connectivity
- **SWIM-NET-01a:** SWIM Network Point of Presence
- **SWIM-SUPT-01a**: SWIM Supporting Registry Provisions
- **SWIM-SUPT-03a**: SWIM Supporting Security Provisions
- **SWIM-SUPT-05a**: SWIM Supporting IP Network Bridging Provisions
- **METEO-06b:** Generate and provide MET information relevant fro Network related operations, Step 1

Applicable Integrated Roadmap Dataset is **DS14,** as described within the latest version of VALR on EFPL.

However, based on ATM Master Plan Dataset, the evolution of OI Step AUO-0203-A (and related Enablers) from DS14 to DS15 is shown in the following table:

	DS14	**DS15**	**DS16**
OI Step	AUO-0203-A	AUO-0203-A	AUO-0203
Enablers	AOC-ATM-20 NIMS-21a SWIM-APS-03a SWIM-APS-04a NIMS-40 SWIM-GOV-05a SWIM-INFR-05a SWIM-NET-01a SWIM-SUPT-01a SWIM-SUPT-03a SWIM-SUPT-05a METEO-06b	AOC-ATM-20 NIMS-21a SWIM-APS-03a SWIM-APS-04a NIMS-40 SWIM-GOV-05a SWIM-INFR-05a SWIM-NET-01a SWIM-SUPT-01a SWIM-SUPT-03a SWIM-SUPT-05a METEO-06b	AOC-ATM-20 NIMS-21a SWIM-APS-03a SWIM-APS-04a NIMS-40 SWIM-GOV-05a SWIM-INFR-05a SWIM-NET-01a SWIM-SUPT-01a SWIM-SUPT-03a SWIM-SUPT-05a METEO-06b

Background and validation process

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The SESAR Solution has been validated through a series of activities including Fast Time Simulations, Gaming Exercises, and Shadow Mode. These validation activities aimed at exploring the feasibility of the EFPL (Extended Flight Plan) data exchange between airspace users and the Network Manager. Several aspects were focussed on in these exercises:

- Flight planning processes: to assess the impact of the EFPL format on the NM flight plan acceptance rates, to assess the impact of the EFPL on the dispatchers workload, to investigate technical differences between the flight planning and NM systems, and to assess the feasibility to use the FIXM format for the exchange of EFPL data
- DCB traffic predictability: to assess how the implementation of EFPL would improve DCB predictability.

A high level summary of the different validations is presented hereafter:

- Gaming:

  Sessions on test traffic where Flight Planning Systems were used at CFSP premises. The objective was mainly to assess the impact on the work of FOC staff and IFPS operators and validate further Human performance aspects. This session involved 13 flight dispatchers from 11 different airlines representing different type of airspace user business models (mainline airlines, charter airlines, cargo airlines, regional airlines, and low cost airlines)

- Shadow mode + Fast-Time Simulation (FTS):

  Sessions at AUs premises for quantitative analysis mainly on real traffic with two main objectives: evaluate the impact of the current EFPL implementation on flight plan filing/validation process in operational conditions and validate that the current EFPL improves or at least does not degrade DCB traffic prediction. These sessions involved 11 airlines, representing different business models (mainline airlines, charter airlines, cargo airlines, regional airlines, and low cost airlines). For this trial the flight planning systems used operationally by the participating airlines were enabled to provide the EFPL to the Network Manager Validation Platform (NMVP) in addition to the ICAO 2012 flight Plan that is filed to the NM OPS system. During this trial about 15,000 EFPLs were provided to the NMVP that were based on operational flights.

  This Shadow Mode Session was followed by several Replay Sessions which took shadow recorded data as a basis to build different solution scenarios.

Results and performance achievements

Implementing EFPL concept provides benefits in different areas:

- **Safety**:
  - Increased safety in ATSU due to better traffic predictability;

  - Increased safety due to reduction of cases when an FPL is accepted by NM while the AU planned trajectory is infringing ATM constraints
- **Traffic predictability/Capacity**:
  - Slight Improvement of network capacity due to better traffic predictability;
- **Cost efficiency**:
  - Reduced workload for NM operators due to flight data misinterpretation that need manual correction;
  - Fewer occurrences of Flight Plan rejections requiring FPL refilling;
- **Flight efficiency (Fuel)**
  - Some use-cases identified allowing AUs to plan more optimised 2D routes/3D profiles;

The following general conclusions could be derived from the results of the exercises.

Operational and technical feasibility of the use of the extended flight plan has been proven both at the level of flight planning and flow management.

- Main critical safety requirements have been validated. In particular the exercise has demonstrated that the EFPL does not create risks in some safety critical processes like flight plan distribution to ANSPs and identification of potential overloads in DCB. Some specific issues in some geographical areas need further analysis and resolution but these can be addressed during implementation on a case by case basis.
- Some immediate benefits have been demonstrated both at the level of flight planning and flow management in terms of increased transparency and trajectory alignment, less FPL rejections or increased traffic predictability in some specific areas.
- In terms of Key Performances Areas, quantified benefits are only available for the KPA cost-effectiveness linked to the reduction of occurrences of flight plan rejections and manual corrections by IFPS operators. For the other KPAs, the benefits quantitatively measured are limited at this stage. However, it is highlighted by all stakeholders that the exercise has not addressed some promising use-cases allowing improving flight efficiency. In particular, the EFPL provides Airspace Users with fine-tuned means to plan trajectories avoiding flight planning constraints or ATFCM regulations leading to more optimised filed 2D routes and/or vertical profiles.
- The technical feasibility of EFPL dedicated services has been proven. Dedicated services using the current NM B2B interface were prototyped and successfully used in the context of shadow mode sessions by on AUs on-site legacy flight planning systems.
- Standardisation needs have been covered and the migration to FIXM - the format for the future ICAO FPL - has been tested successfully.

Recommendations and Additional activities

From the results of the validation exercises, several recommendations can be extracted. Even if the concept is already at a very high maturity level a number of items are recommended to be further addressed in future activities. The two following types of recommendation have been derived:

- Recommendations concerning the first implementation step planned at short term;
- Recommendations regarding longer-term steps of implementation.

Regarding the first implementation step, the recommendations are:

- To perform pre- operational live trials (V4) with candidate airlines in order to:
    - Minimise the risk of new flight plan rejections during the initial learning phase;
    - Further validate some aspects of the EFPL benefit mechanisms, and in particular the possibility for AUs to optimise todays filed 2D routes and 3D profiles and improve flight efficiency;
    - Identify the best options in terms of EFPL data to be used by the NM systems in order to optimise traffic predictability improvements;
    - Assess in coordination with concerned ASNPs the impact of EFPLs on flight plan distribution and traffic predictability in some specific areas.
- To further specify and implement NM HMI improvements in order to support IFPS operators in the management of Extended Flight Plans.

These activities have been planned within the SESAR Programme Deployment phase (PCP).

Regarding further steps of the EFPL implementation, the recommendation is to plan additional Validations in order to:

- Assess the feasibility and benefits for AUs to integrate ATC constraints (Profile Tuning Restrictions) in their planned trajectory included in the EFPL;
- Clarify the requirements in terms of more structured error messages provided by NM to the AUs in the reply for an invalid EFPL (e.g. NM could make available profile tuning restrictions (PTR) that are used by the IFPS for flight planning systems to be taken into account for the flight 4D trajectory);
- Validate EFPL distribution services and the use of EFPL data in ATC systems and processes.
- Investigate the use of the Extended Flight Plan for the management of ATFCM regulations and the determination of TTOs/TTAs.

These activities have been planned within the SESAR2020 IR Programme.

Actors impacted by the SESAR Solution

The following actors are impacted by the Solution:

- Network Manager (NM)
- Airspace Users: FOC (Flight Operation Centre)
- ANSPs

Impact on Aircraft System

This solution has no impact on Aircraft System.

Impact on Ground Systems

The CFSP (Flight Planning Systems), by:

- the provision of extended flight plan data, and
- the development of systems evolutions required and support to prototypes utilization

will define the 4DT format used to exchange 4DT data, create a basis for making the airspace less complex and constrained by publishing more precise trajectory data, and will be in a position to demonstrate ROI of associated systems evolutions to customers.

The NM system by:

- the development of systems evolutions required and support to prototypes utilization will support cost reduction associated to improved FPL filing efficiency, and workload reduction.

ATC systems will be able to make use of Extended Flight Plan data, and will support the Workload reduction as well as Local DCB process.

Regulatory Framework Considerations

This solution is directly linked to the ATM Functionality "Network Collaborative Management" (sub-functionality "Automated Support for Traffic Complexity Assessment"), that is one of the six ATM Functionalities identified in the Implementing Regulation (EU) No 716/2014 on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan.

Standardization Framework Considerations

A further step into the direction of commissioning the EFPL is related to a global standardization. This will be achieved by the use of FIXM data model as vehicle for the exchange of the EFPL related information.

Considerations of Regulatory Oversight and Certification Activities

N/A

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Solution Data pack

The data pack for this Solution includes the following documents:

- OSED - 07.06.02-D56 "Step 1 Business Trajectory final OSED 2016", Edition 00.05.01 (03/10/2016). This document describes the operational concept, its expected benefits, the operating methods, the Roles and Responsibilities and the operational requirements of the solution.
- OSED – 11.01.02-D08 "Final FOC Step 1 and Step 2, as available, OSED", Edition 02.00.00 (08/11/2016). This document describes the operational concept, its expected benefits, the operating methods, the Roles and Responsibilities and the operational requirements of the solution.
- SPR - 07.06.02-D57 "Step 1 Business Trajectory final SPR", Edition 00.03.01 (03/10/2016). This document describes the Safety and Performance Requirements in relation with the Solution.
- INTEROP – 11.01.02-D08 "Final FOC Step 1 and Step 2, as available, INTEROP", Edition 01.00.00 (16/09/2016). This document describes interoperability requirements that ensure the on-going collaboration between the FOC and the capability configurations of all other ATM.
- VALR - 07.06.02-D55 "Step 1 Business Trajectory Validation report for EFPL", Edition 00.01.01 (06/10/2016). This document describes the validation activities carried out for the Extended Flight Plan (EFPL) for SESAR Step 1.
- VALR – 11.01.05-D31 "Contribution to EXE-07.06.02-VP-713 – EFPL Step 1 V3 Validation Report", Edition 00.01.00 (21/07/2016). This document describes the Lufthansa Systems contribution to the validation report for the validation exercise EXE-07.06.02-VP-713 from an AUs and FOC perspective.
- Technical Specifications - 07.06.02-D92 "Step 1 EFPL in NM Systems Technical Specification", Edition 00.01.01 (01/10/2016). This document contains the Technical Specifications describing the Extended Flight Plan (EFPL) system and the interface to exchange such information with FOC
- Technical Specifications – 11.01.03-2ca-D24 "Technical Specification Step 1 and Step 2 for FOC System", Edition 02.00.00 (11/10/2016). This document contains the Technical Specifications applicable to adapt the FOC systems to manage the EFPL related information.
- ISRM: 08.03.10-D65 00.01.01 including the ISRM v2.0, the ISRM Service Portfolio and the SDDs of the EFPL related services (ExtendedFlightPlanSubmission – FlightPlanDataDistribution).
- TS: 14.01.04-D44-004 00.01.00. This document specifies the SWIM Yellow Profile including the requirements applicable to interface with the SWIM-TI.

- 08.01.01-D48 SWIM Compliance Report for R5 V&V Exercise VP-713, Edition 00.01.00 (16/08/2016).

In addition to the above mentioned documents, the SWIM reference documents are included in the data packs of the SESAR Solutions SWIM Yellow Profile and SWIM Framework.

Intellectual Property Rights (foreground)

The foreground is owned by the SJU.