Release 4 SESAR Solution #56
Enhanced ATFM Slot Swapping

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.

Improvement in Air Traffic Management (ATM)

In today operations, "ATFM slot swapping" allows Airspace Users (AU) to request to the Network Manager (NM) a rearrangement of their own flights subject to a regulation[1] in order to better suit their needs.

However the current process has got some limitations and the AU requests for rearrangement to NM are not always satisfied.

This SESAR solution improves the process of Air Traffic Flow Management (ATFM) slot swapping currently used by Airspace Users (AU) to prioritize their flights during pre-tactical part of operations

The Enhanced Slot swapping increases flexibility for Airspace Users and provides a wider range of possibilities, by facilitating the identification of possible swaps for a subject regulated flight and by reducing the rate of rejection of swap request by refining current processes.

The solution is supported by the provision of a new web based tool ("eSS" Tool, enhanced Slot Swapping) which provides a Slot-swapping interface between Aircraft Operators and the NM Operating Centre, allowing:

- Identification of viable swaps;
- Multi-swap: capability to swap the same flight up to three times instead of a single swap today. This feature allows the improvement of a flight by swapping it up to three consecutive times, therefore distributing the delay among three other flights. This may be particularly useful in case of long delays or instability of the regulation (e.g. weather deterioration);
- Slot substitution on Cancellation: capability to substitute the ATFM slot of a cancelled flight for another flight.

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[1]Flights subject to a regulation refers here to i.e. flights which and have been given a calculated take off time (CTOT) by the Network Manager Operating Centre (NMOC) resulting from an En-Route or Arrival constraint.

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ATFM slot swapping is one process of the User-Driven Prioritization Process (UDPP) which contributes to resolve a Capacity Constrained situation, either at Airport or in Airspace in a fair manner among Airspace Users.

Operational Improvement Steps (OIs) & Enablers

AUO-0101-A: "ATFM Slot Swapping for Step 1" (DS14):

The swapping of regulated flights on departure, on arrival, and en-route, that is already possible for the flights of the same Airspace User (AU) sharing the same Most Penalising Regulation (MPR), will be extended to all regulated flights without any constraints due to AU (or MPR if possible). Changing of flight priority between two flights where at least one flight is not regulated will also be possible. The AUs requests for these changes in flight priority will be introduced at the initiative of the AUs themselves, possibly with the support of the relevant actor at the airport or of the Network Management function. The Network Management function will supervise the swapping or changing of flight priority requests.

Enablers:

- NIMS-39a "Enhancement of ETFMS"
- NIMS-39b "Enhancement of FOC HMI"

Background and validation process

The solution has been validated through a series of validation exercises:
- A model-based V2 simulation that investigated the network effects as a result of slot swapping over a period of 88 days;
- A Human-In-The Loop (HITL) V2 trial that estimated the cost savings per year for Airspace Users in Europe using ATFM Slot Swapping;
- The final V3 live trial where 13 Aircraft Operators took part with NM to the ATFM Slot Swapping trial and performed slot swapping using either the eSS Tool or the current process, allowing thus comparison of the results in both cases.

Results and performance achievements

Flexibility:

The live trial demonstrated that the Enhanced Slot swapping features bring more flexibility to AUs by facilitating the identification of possible swaps for a subject regulated flight and by reducing the rate of rejection of swap requests. Over a 7 week time period in winter 2014-2015:

- 199 swaps requests were made using Enhanced Slot Swapping Tool with 5 %

rejection;
- 83 swaps requests were made without the Tool, with 22% rejection.

An Airspace User could swap with any other in the UDPP trial – providing both had given their permission to swap. This is not operationally different from today. The Enhanced Slot Swapping Tool makes it very easy to identify suitable candidate flights to swap with, and it may encourage inter-airline swaps in the future. During the trial, 6 swaps were performed between different Airspace Users.

Network effects:
- The potential for beneficial swapping by AUs is not in the thousands per day in the ECAC area, but likely to be closer to 100-200 for most days;
- Slot swapping is a means to reduce impact of delays on their operations for AUs (drivers can be reduction of passengers costs, of passengers transits missed, of reactionary delay, i.e. delay caused by late arrival of aircraft or crew from previous journeys);
- The additional features were acceptable for the Network Management Operating Centre (NMOC) in terms of workload (no perceived change in the response time to requests).

Cost Savings:

- Airspace Users indicated that the average cost saved per swap was 4600-4900 euros, but costs saved per flight varied from less than 1000 euros to more than 10000 euros
- Assuming a certain value on the number of swaps, amount of costs saved can be predicted, but it is not clear how many swaps could be expected in the coming years. Using this cost model, the estimated cost savings for 1548 swaps (basic scenario for2013) are 7,6 M€.

Recommendations and Additional activities

No further validation activities are required, the Solution is ready for deployment, and the supporting UDPP Slot Swap Identification Tool is currently in a prolonged transitory "test-bed" state while it is integrated in the official NM release. The earliest operational deployment could be October 2016 in Network Manager (NM) Release 20.5.

Further improvements to the eSS Tool are identified:

- Integrate a "one-click" request function to facilitate the SWAP proposal to NMOC;
- Include Departure and Arrival Airports (ADEP, ADES) of the candidate flight;
- Add swap counter for each flight to help NM operators;
- Provide ability to search flights occurring near a specified CTOT;
- Provide access to log files or recent usage history for AUs.

The following features need additional R&D:

- Pre-allocated Slot Swapping: swapping a regulated flight in the "slot-allocated" status with a flight still in pre-allocated status (already V2 validated, it is subject to further NM releases)
- Most Penalising Delay: integrate the CDM delay in the slot swapping process to allow an AU to swap two departure flights going in different directions, provided that for both of them the airport delay can be considered as the most penalising one : planned in the frame of SESAR 2020

Actors impacted by the SESAR Solution

The actors involved in the Enhanced Slot Swapping are:
- NM Operations Centre (NMOC): major role in the development and implementation.
- Airline Operators (AOs): monitoring and assessment of the level of deterioration of their flights operations and triggering the ATFM Slot Swapping process.
- Airport CDM: Informed of changes resulting from ATFM Slot Swapping.

Impact on Aircraft Systems

No impact

Impact on Ground Systems

The UDPP eSS Tool architecture needs to be implemented. Several logical architectures are possible:
a) NM ETFMS modifications, NOP B2B services to propose slot swaps and FOC HMI.
b) NM ETFMS modifications, NOP B2B services to propose slot swaps, FOC & NOP Portal HMIs.
c) NM ETFMS modifications, NOP B2B services to propose Flights and Regulations, and FOC HMI to propose possible slot swap solutions.
d) NM ETFMS modifications and NOP B2B services to offer Flights and Regulations, and FOC HMI and NOP Portal HMI to propose possible slot swap solutions.

The eSS prototype took the approach described on bullet a). The final option that will be deployed has yet to be confirmed.

Regulatory Framework Considerations

There is no specific topic in the field of the Regulation Framework to be considered in deployment, beyond the applicable existing one.

Standardization Frameworks Considerations

There is no specific topic in the field of the Standardization Framework to be considered in deployment, beyond the applicable existing one.

Considerations of Regulatory Oversight and Certification Activities

There is no specific topic in the field of the Regulatory Oversight and Certification Activities to be considered in deployment, beyond the applicable existing ones.

Solution Data pack

The Data pack for this Solution includes the following documents:

- Regulatory overview;
- OSED: 07.06.02-D66 Edition 00.02.01 13/11/2015;
- SPR: 07.06.02-D68 Edition 00.01.01 13/11/2015;
- TS: 07.06.02-D63 Edition 00.02.00, 11/12/2015; and
- VALR: 07.06.02-D67 Edition 00.01.01 13/11/2015.

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