



# Step 1 UDPP Technical Specification for ESS prototype

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## **Abstract**

Airspace Users will use the slot swapping process that is enhanced by adding multi-ATFM slot swapping, and the possibility to swap a pre-allocated ATFM slot with an issued ATFM slot of regulated flights. The aim of UDPP Step 1 process is to develop an enhanced user driven ATFM slot-swapping to provide wider range of possibilities and increased flexibility in prioritisation.

The goal of this prototyping development is to evaluate possible benefits of the UDPP Extended Slot Swapping process.

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## Executive summary

This Technical Specifications (TS) document describes the behaviour of the UDPP enhanced Slot Swapping System for the Airspace Users in order to prioritise their flights.

The operational requirements are formulated in Step 1 V3 UDPP Final OSED [5], and the safety and performance requirements in Step 1 V3 UDPP Safety and Performance Requirements [10].

The enhanced Slot Swapping (eSS) process aims to give the AUs the opportunity to prioritise their flights, which in return enables

- the reduction of the inefficiencies caused by delays under capacity constrained situations
- the reduction of the cancellation induced costs

The slot swapping process is enhanced by adding multi-ATFM slot swapping, and the possibility to swap a pre-allocated ATFM slot with an issued ATFM slot of regulated flights.

The scope of this Technical Specifications is a subset of the Enhanced Slot Swapping concept, which shall be validated during exercise VP-712. A prototype has been developed, implementing these Technical Specifications to support the exercise.

The validation objectives of the VP-712 as described in UDPP Step 1 validation plan, see reference [7], related to the eSS are the following:

1. OBJ-07.06.04-VALP-S1V2.0003: To establish the effect the feature has on cost-effectiveness for different profiles of airspace user.
2. OBJ-07.06.04-VALP-S1V2.0006: To establish the effect the feature has on improving flexibility for different airspace user types.
3. OBJ-07.06.04-VALP-S1V2.0008: To determine if up to three swaps per flight is sufficient for operational needs.
4. OBJ-07.06.04-VALP-S1V2.0010: To establish how far in advance pre-allocated flights should be able to be eligible for swaps.
5. OBJ-07.06.04-VALP-S1V3.0001: To confirm that the feature known as Pre-Allocated Slot Swap is operationally feasible
6. OBJ-07.06.04-VALP-S1V3.0002: To confirm that the feature known as Multi-Swap of ATFM Slots is operationally feasible
7. OBJ-07.06.04-VALP-S1V3.0003: To confirm that the feature known as ATFM Slot Reservation on Cancellation is operationally feasible
8. OBJ-07.06.04-VALP-S1V3.0008: For ATFM-related concept features: to assess the consistency between the role of the human and human capabilities and limitations. (HP argument 1).
9. OBJ-07.06.04-VALP-S1V3.0009: For ATFM-related concept features: to provide evidence that technical systems support the human actors in performing their tasks (HP argument 2).
10. OBJ-07.06.04-VALP-S1V3.0011: For ATFM-related concept features: to demonstrate that human performance related transition factors such as training, staffing, competence and selection are considered (HP argument 4).
11. OBJ-07.06.04-VALP-S1V3.0012: For departure-related concept features: to assess the consistency between the role of the human and human capabilities and limitations. (HP argument 1).

The VP-712 validation exercise consists of two parts: Human In The Loop (HITL) and Live Trial. These technical specifications cover both parts and indicate the applicability of the requirements for each part. When not indicated, a requirement applies to both parts of the validation exercise.

The enhanced UDPP slot swapping prototype is a web based application used by the Airspace Users, that uses the NM data and NM B2B services to obtain the flight list, flight details, regulations, regulation details and implements the eSS business rules and algorithms to propose slot swapping

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opportunities to the airspaces users, which then can be submitted as slot swap eHelpdesk request to NM.



# 1 Introduction

## 1.1 Purpose of the Document

Today the Airspace Users can submit slot swap requests via NOP eHelpdesk to NM. These technical specifications describe the extensions needed to build an NM system that supports the UDPP enhanced Slot Swapping concept.

These extensions are identifying slot swap candidates, solutions and request submission; by using the NM flight and regulation data, implementing enhanced slot swapping business rules, and preparing a slot swap request for the Airspace User to submit to NM.

## 1.2 Intended Readership

The intended readership of this document is:

- SESAR P07.06.02 Project Team:
  - To describe the specifications needed for the impacted systems.
  - To be able to make an effort estimate and adjust the P07.06.02 planning.
  - To ensure that the systems and prototype implementation will fit the needs of the OSED and the Validation exercise.
- SESAR 07.06.01 Project Team:
  - To be aware of and collect NOP requirements.
- EUROCONTROL NMD Team:
  - To have a good understanding of the needs of this particular SESAR project and to ensure that the implementation in NM systems is meeting the needs of the SESAR project.
  - To ensure that the implementation in NM systems, the objectives of the Validation exercise VP-712 can be met.

## 1.3 Inputs from Other Projects

This document is relying on inputs coming from the Step 1 V3 UDPP Final OSED [5] and Step 1 V3 UDPP Safety and Performance Requirements [10]. It is translating these inputs to Technical Specifications.

For the validation exercise VP-712, the eSS prototype is developed by EUROCONTROL.

The prototype is using NM B2B web services which are enhanced by Regulations and Regulation Details web services in NM 18.5 release via the FB619 project of NM. NM has described the requirements for their software modifications in a Business Service Requirements (BSR) document, see reference [8].

## 1.4 Structure of the Document

This document has the following structure:

Chapter 1: Purpose and scope; Requirements Structure; Glossary

Chapter 2: General Functional Block Description

Chapter 3: Functional Block Functional and non-Functional Requirements

Chapter 4: Assumptions

Chapter 5: Referenced Documents

## 1.5 Requirements Definitions – General Guidance

The following requirements numbering structure has been followed:

**Standard:** REQ-07.06.02-TS-*abcd.efgh*

- **abc** is the number of the Deliverable in 3 digits (002, 003, 004...) where the requirement was created for the first time. For example, In case a requirement is for the first time specified in an initial requirements document and later re-used in a final version, it keeps the deliverable number of the first document to avoid duplication of the requirement.
- **d** a Requirement Category (1, 2, 3, 4 .. , 9):
  - 1 for functional/capability requirement,
  - 2 for adaptability requirements,
  - 3 for performance requirements,
  - 4 for safety & security requirements,
  - 5 for maintainability requirements,
  - 6 for reliability requirements,
  - 7 for component internal data requirements,
  - 8 for design and construction requirements and
  - 9 for component interface requirements).
- **e** a Requirement Subcategory (0, 1, 2, ..)
- **fgh** a Requirement Number. Often this will be a simple sequence number.

## 1.6 Functional Block Purpose

Reference is P07.02 D42 Step 1 Network Sub-systems Technical Architecture, see [6].

The Functional Block is: **FB-2.05 Demand & Capacity Balancing**.

This FB groups all functions related to Demand and capacity balancing in short-term planning phases. It covers the regional and local levels, a DCB measure or a regulation being decided at local levels and its impact being analysed at Regional level.

The FB supports its actors as they seek to deploy their resources in the most efficient manner in order to operate within context of safety and business performance regulation. Locally, for ANSPs, as the time of operation approaches, the DCB FB has a direct impact on controller workload and hence the elements of the FB are safety related.

The FB supports SESAR performance targets in the areas of:

- Capacity
- Cost-Effectiveness
- Efficiency
- Flexibility
- Predictability
- Environmental Sustainability
- Safety

The “Demand and capacity balancing” FB groups only the functions in the short term planning phase, the time horizon varies from few hours (generally 2 hours) until just before the time of operation. The short term changes considered by the FB include trajectory update, capacity change due to sector configuration modification, meteorological hazards and airspace management decisions. The need is for timely and accurate information updates, which includes the use of surveillance information.

## 1.7 Functional Block Overview

The scope of this Technical Specifications is related to the short-term planning phase: the enhanced Slot Swapping between Airspace Users and NM, via a web application by using NM B2B Flow Management web services. These web services, allow identifying slot swap candidate solutions by calculating the delays after a possible slot swap. The proposed swap can then be submitted to NM.

## 1.8 Glossary of Terms

**Slot Swap Subject Flight:** The flight for which slot swap solutions are looked for, is called 'subject flight' further on.

**Slot Swap Candidate Flight:** The flight which can be swapped with the slot swap subject flight is called 'candidate flight' further on.

**Slot Swap Solution:** The list of possible candidate flights that can be swapped with the slot swap subject flight is called 'solution' further on.

**Slot Swapping:** Locating candidate flights for slot swapping by identifying flights that

- a) share the same Most Penalizing Regulation (MPR)
- b) arrive in the regulation at the "appropriate" time, so that
- c) swapping the regulation entry times (i.e. the slots) results in "valid" new CTOTs

The definitions of "appropriate" and "valid" are the subjects of these technical specifications, therefore elaborated further in the requirements sections.

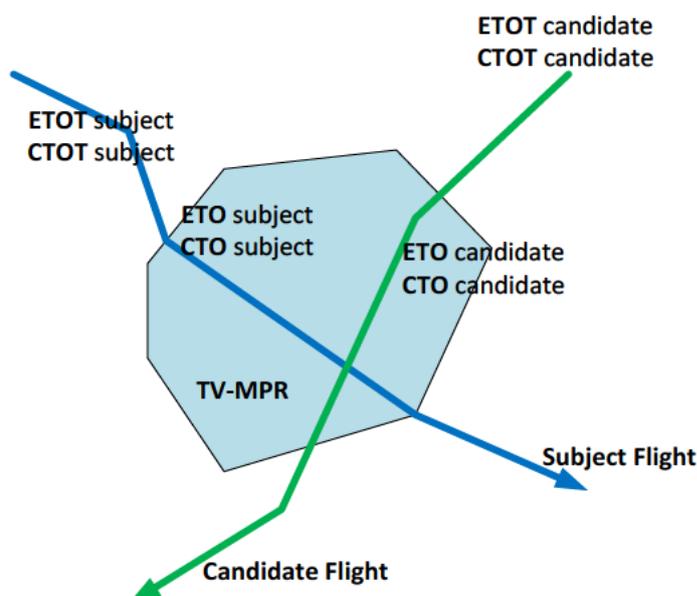


Figure 1: Subject and Candidate Flights

### One Request Multi Slot Swapping:

One Request Multi Slot Swapping is finding several slot swap solutions in which the subject flight always remains the same, "jumping" step by step through the regulation slots, towards its' target.

The following example shows a subject flight A, that is first swapped with candidate flight E, and then swapped again with candidate flight J.

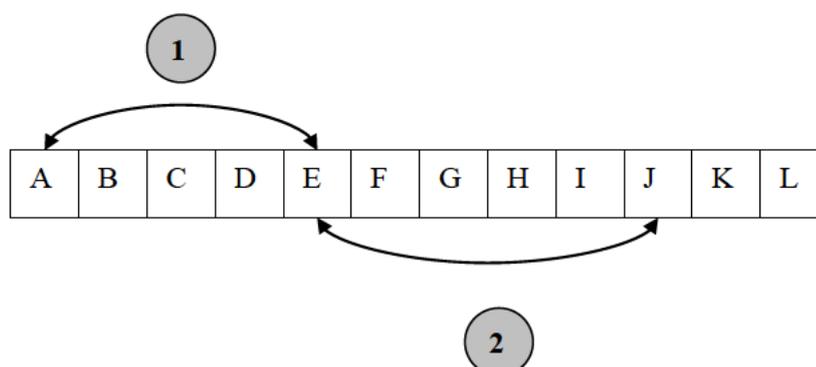


Figure 2: One Request Multi Slot Swap Solutions

**Suspended Flight:** In NM ETFMS, the original CTOT of a flight is cancelled, a flight suspension message is sent, and NM waits for a response from AU. For the detailed description and possible reasons, please refer to the EUROCONTROL ATFCM User’s Manual ref. [9]).

**NM ETFMS Features:** For the further definition of all ETFMS functions please refer to the EUROCONTROL ATFCM User’s Manual ref. [9]).

## 1.9 Acronyms and Terminology

Term	Definition
ADD	Architecture Definition Document
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
B2B	Business to Business
CDM Airport	Collaborative Decision-Making Airport
CTO	Computed Time Over (NM – ETFMS CASA)
CTOT	Calculated Take-Off Time
DOD	Detailed Operational Description
DPI	Departure Planning Information
eSS	Enhanced Slot Swapping
E-ATMS	European Air Traffic Management System
ETFMS	Enhanced Tactical Flow Management System
ETO	Estimated Time Over (a significant point)
ETOT	Estimated Take-Off Time
FOC	Flight Operations Control
FTFM	Filed Tactical Flight Model (NM)
RTFM	Regulated Tactical Flight Model (NM – by ATFM measures)
HITL	Human In The Loop
HMI	Human Machine Interface
IRS	Interface Requirements Specification
INTEROP	Interoperability Requirements
NM	Network Manager

Founding members



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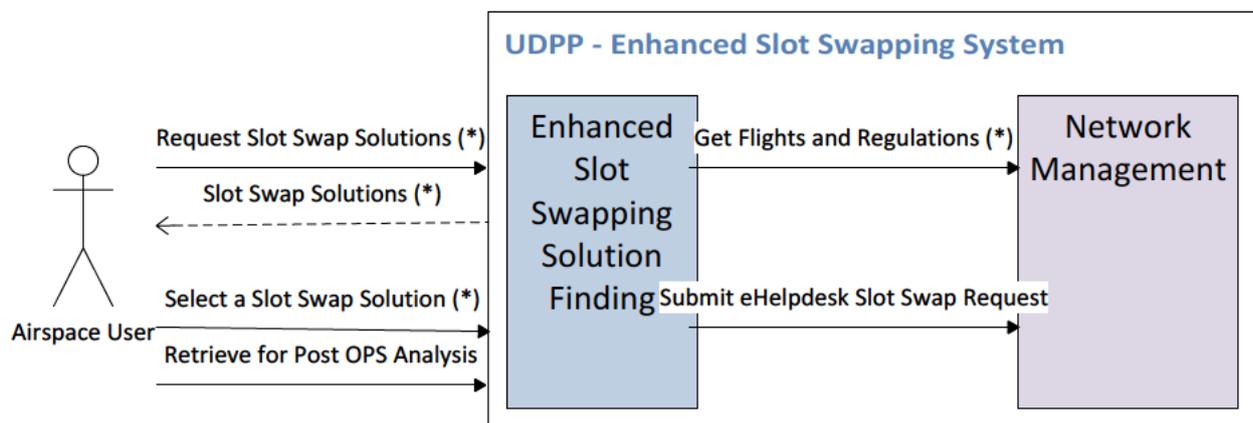
Term	Definition
<b>NMOC</b>	Network Manager Operations Centre
<b>NOP</b>	Network Operations Plan
<b>MPR</b>	Most Penalising Regulation
<b>OBT</b>	Off Block Time
<b>OSED</b>	Operational Service and Environment Definition
<b>RVR</b>	Runway Visual Range
<b>SESAR</b>	Single European Sky ATM Research Programme
<b>SJU</b>	SESAR Joint Undertaking (Agency of the European Commission)
<b>SJU Work Programme</b>	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
<b>SESAR Programme</b>	The programme which defines the Research and Development activities and Projects for the SJU.
<b>SPR</b>	Safety and Performance Requirements
<b>STW</b>	Slot Tolerance Window
<b>TAD</b>	Technical Architecture Description
<b>TDPI</b>	Target Departure Planning Information
<b>TS</b>	Technical Specification
<b>TIS</b>	Time to Insert in Sequence
<b>TRS</b>	Time to Remove from Sequence
<b>TTOT</b>	Target Take-Off Time
<b>UDPP</b>	User Driven Prioritisation Process

## 2 General Functional Block Description

### 2.1 Context

The context of this Technical Specification document is related to the Enhanced Slot Swapping System which helps the Airspace Users to find slot swap solutions prior to requesting a slot swap to NMOC.

This is part of functional block **FB-2.05 Demand & Capacity Balancing**.



**Figure 3: Logical System Architecture Overview**

(\*) The features that are part of the prototype developed for VP-712. The Submit eHelpdesk Slot Swap Request is implemented by outputting what would be submitted to eHelpdesk.

The eSS system requirements are linked to two enablers:

1. NIMS-39a ETFMS Enhancements: ETFMS modifications and/or NOP B2B services
2. NIMS-39b FOC HMI Enhancements: FOC HMI and/or NOP HMI

The eSS logical system architecture can be implemented via one of the following possibilities:

1. NM ETFMS modifications, and NOP B2B services to offer possible slot swap solutions, and FOC HMI
2. NM ETFMS modifications, and NOP B2B services to offer possible slot swap solutions, and FOC HMI, and NOP HMI
3. NM ETFMS modifications, and NOP B2B services to offer Flights and Regulations, and FOC HMI to offer possible slot swap solutions
4. NM ETFMS modifications, and NOP B2B services to offer Flights and Regulations, and FOC HMI and NOP HMI to offer possible slot swap solutions

**The prototype developed for the VP-712 validation exercise took the approach of the solution 3.**

The system requirements in these technical specifications shall be read and used with these possibilities in mind. The industrialisation step needs to start with a decision which chooses one of the possibilities above before using these requirements for implementation.

## 2.2 Functional Block Modes and States

The “Demand and Capacity Balancing” functional block groups only the functions in the short term planning phase, the time horizon varies from few hours (generally 2 hours) until just before the time of operation. These Technical Specifications are referring to this phase.

## 2.3 Major Functional Block Capabilities

The requirements are grouped in 7 categories in [5]:

- ATFM Slot Substitution on Cancellation
- Multi-Swap of ATFM Slot Swap
- Pre-allocated Slot Swap
- Most Penalising Delay
- Departure Reference-Time Reordering
- First Priority for Departure
- Upwards Cascade on Departure Cancellation

The scope of the VP-712 validation exercise and these technical specifications are:

- **HITL Part:** ATFM Slot-Substitution on Cancellation, Multi-Swap of ATFM Slot Swap, Pre-allocated Slot Swap
- **Live Trial Part:** ATFM Slot-Substitution on Cancellation, Multi-Swap of ATFM Slot Swap
- The eHelpdesk requests are recorded but not sent to NM.

## 2.4 User Characteristics

Following actors are identified in [5].

1. Airspace User (AU): Monitors his flight operations, assesses the level of deterioration, and triggers the UDPP process via the eSS
2. Network Manager (NM): Provides the flight and regulation information and assesses the slot swap request
3. Airport, ANSP, and FMP: informed if they are impacted

## 2.5 Operational Scenarios

The operational scenarios are described in Chapter 5 of [5].

## 2.6 Functional

### 2.6.1 Functional Decomposition

All functions of these Technical Specifications belong to the same functional block **FB-2.05 Demand & Capacity Balancing**.

There are several functions identified in the P07.02 D42 Step 1 Network Sub-systems Technical Architecture, see reference [6]).

These technical specifications cover the “Flight priority & departure slot swapping management: slot improvement, extension of tolerance window, slot swapping, prioritisation in case of diversion” with the exception of “tolerance window extension”, and “prioritisation in case of diversion”.

## 2.6.2 Functional Analysis

These technical specifications implement the following use cases as described in [5]:

1. ATFM Slot Substitution on Cancellation
2. Multi-swap of ATFM Slot Swap
3. Pre-allocated Slot Swap

## 2.7 Service View

There is no Service identified in the WP8 for UDPP.

## 3 Functional block Functional and non-Functional Requirements

### 3.1 Capabilities

#### 3.1.1 General Requirements

Identifier	REQ-07.06.02-TS-0631.1101
Requirement	The eSS system shall allow any AU to access the flight list and related information of any other AU.

Identifier	REQ-07.06.02-TS-0631.1102
Requirement	The eSS system shall allow any AU to submit a slot swap request.

Identifier	REQ-07.06.02-TS-0631.1103
Requirement	<p>The eSS system shall allow the AU to set the following preferences:</p> <ul style="list-style-type: none"> <li>- The possibility to include a flight without commercial agreement in the solution,</li> <li>- The maximum number of minutes for the new CTOT to be earlier than the ETOT, 'earliest departure'</li> <li>- The 'look ahead time' for which the eSS system shall look for solutions,</li> <li>- The minimum number of minutes that the swap provides as gain,</li> <li>- The number of minutes that the AU wants to be informed in advance to investigate the swap solutions for a flight, 'investigate by delay'</li> <li>- The possibility to allow a delay swap for a flight that is in REAdy status,</li> <li>- The possibility to see if a slot swapped flight enters new regulations,</li> <li>- The possibility to allow the solutions to include pre-sequenced flights, 'pre-sequenced flight swap is allowed',</li> <li>- The possibility to choose to ensure slot swap solutions have a greater chance of surviving TTOT instability because of DPI revision, 'apply TTOT instability protection',</li> <li>- The NM 'eHelpdesk processing time' to be used for calculations to take slot swap decisions</li> </ul>

Identifier	REQ-07.06.02-TS-0631.1104
Requirement	<p>The eSS system shall allow the AU to define a priority for a flight as one of the following:</p> <ul style="list-style-type: none"> <li>- 'none'</li> <li>- 'high priority'</li> <li>- 'low priority'</li> </ul>

Identifier	REQ-07.06.02-TS-0631.1105
Requirement	<p>The eSS system shall determine the flight state as one of the following:</p> <ul style="list-style-type: none"> <li>- 'at the departure airport': if it is not ACTivated or TERMINATED</li> <li>- 'departure sequence frozen': if an A-DPI or a TDPI_s message has been received, and the AU has chosen to allow pre-allocated slot flight to be included</li> <li>- 'ready to depart': if the REA status is set</li> <li>- 'slot issued': if it has a CTOT and the EOBT is within 2 hours of current-time (now)</li> </ul>

Identifier	REQ-07.06.02-TS-0631.1106
Requirement	The eSS system shall calculate a flight's 'best taxi time' as the first defined value in the following order: <ul style="list-style-type: none"> <li>- REA message specified lineup-time,</li> <li>- DPI message specified taxi time,</li> <li>- Airport default taxi time</li> </ul>

Identifier	REQ-07.06.02-TS-0671.1107
Requirement	The eSS system shall calculate a flight's 'remove from sequence decision time' as: (if the flight is in 'ready to depart' status then CTOT - ('best taxi time') else CTOT - ('best taxi time') - TRS ) - ('eHelpdesk processing time')

Identifier	REQ-07.06.02-TS-0631.1108
Requirement	The eSS system shall calculate a flight's 'insert in sequence decision time' (new CTOT) as: (if the flight is in 'ready to depart' status then (new CTOT) - ('best taxi time') else (new CTOT) - ('best taxi time') - TRS ) - ('eHelpdesk processing time')

Identifier	REQ-07.06.02-TS-0631.1109
Requirement	The eSS system shall determine that the flight is 'too late to remove from sequence' if 'remove from sequence decision time' is earlier or equal to current time.

Identifier	REQ-07.06.02-TS-0631.1110
Requirement	The eSS system shall calculate the 'best CDM TTOT' by taking the first defined value in the following order: <ul style="list-style-type: none"> <li>- ATC TTOT</li> <li>- Sequenced TTOT</li> <li>- Slot not before TTOT</li> <li>- Aircraft Operator TTOT</li> </ul>

Identifier	REQ-07.06.02-TS-0631.1111
Requirement	The eSS system shall determine that a flight is in 'TTOT CTOT convergence phase' when all the following conditions are met: <ul style="list-style-type: none"> <li>- The flight's CDM status is TARGETED,</li> <li>- The flight's REA status is set by NM ETFMS</li> <li>- The flight's CDM no slot before is set</li> </ul>

Identifier	REQ-07.06.02-TS-0631.1112
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Requirement	The eSS system shall calculate the 'enforced RVR minima' as follows: If a flight has a most penalising regulation then the regulation's 'sub-period RVR minima' value at the time of the entry to the regulation else undefined.
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Identifier	REQ-07.06.02-TS-0631.1113
Requirement	The eSS system shall determine if the two given flights have compatible RVR minima, when for both flights, 'enforced RVR minima' is not defined or the flight's RVR is less than the 'enforced RVR minima'.

Identifier	REQ-07.06.02-TS-0631.1114
Requirement	The eSS system shall determine that two flights are 'commercially swappable' if: - Both flights have the same aircraft operator (or operating aircraft operator), or - There is a commercial agreement between the aircraft operators.

Identifier	REQ-07.06.02-TS-0631.1115
Requirement	The eSS system shall determine that a flight is in overload when the regulated time over (RTO) the most penalising regulation is equal to the regulation's end time.

Identifier	REQ-07.06.02-TS-0631.1116
Requirement	The eSS system shall calculate a flight's 'TTOT instability protection buffer' as: if all the following conditions are met: - The AU has chosen to 'apply TTOT instability protection', - The flight is departing from a CDM airport applying TTOT CTOT convergence process, - The flight is in 'TTOT CTOT convergence phase' then the 'TTOT instability protection buffer' is 5 minutes else the 'TTOT instability protection buffer' is 0 minutes

Identifier	REQ-07.06.02-TS-0631.1117
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Requirement	<p>The eSS system shall calculate the 'no slot swap before time' (earliest new CTOT) as:</p> <ul style="list-style-type: none"> <li>- If the flight is departing from a non-CDM airport, the maximum of the two following time values: <ul style="list-style-type: none"> <li>a. Now + maximum of (TIS, TRS) + ('best taxi time') + ('eHelpdesk processing time')</li> <li>b. ETOT - ('earliest departure')</li> </ul> </li> <li>- If the flight is in ready status, and departing from a non-CDM airport, then Now + ('best taxi time') + ('eHelpdesk processing time')</li> <li>- If the flight is departing from a CDM airport, then the maximum of two following time values: <ul style="list-style-type: none"> <li>a. Now + max (TIS, TRS) + ('best taxi time') + ('eHelpdesk processing time')</li> <li>b. The first defined value in the descending order of <ol style="list-style-type: none"> <li>1. ('best CDM TTOT') + ('TTOT instability protection buffer')</li> <li>2. ETOT - ('earliest departure')</li> </ol> </li> </ul> </li> <li>- If the flight is in ready status and departing from a CDM airport, then the maximum of two following time values: <ul style="list-style-type: none"> <li>a. Now + ('best taxi time') + ('eHelpdesk processing time')</li> <li>b. The first defined value in the descending order of <ol style="list-style-type: none"> <li>1. ('best CDM TTOT') + ('TTOT instability protection buffer')</li> <li>2. ETOT - ('earliest departure')</li> </ol> </li> </ul> </li> </ul>
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Identifier	REQ-07.06.02-TS-0631.1120
Requirement	<p>The eSS system shall determine that the flight is a subject flight when all the following conditions are met:</p> <ul style="list-style-type: none"> <li>- The flight is not suspended,</li> <li>- The flight has a most penalising regulation (MPR),</li> <li>- The flight's MPR is not a cherry picking regulation,</li> <li>- The flight is in 'slot issued' state,</li> <li>- The flight is 'at the departure airport',</li> <li>- The flight is not 'too late to remove from sequence',</li> <li>- The flight's departure sequence is not frozen,</li> <li>- The flight is not in overload</li> </ul>

Identifier	REQ-07.06.02-TS-0631.1121
Requirement	The eSS system shall calculate 'delay swapped' as (CTO of the subject flight - CTO of the candidate flight)

Identifier	REQ-07.06.02-TS-0631.1122
Requirement	The eSS system shall calculate the new CTOT of the subject flight as (CTO of the subject flight - 'delay swapped')

Identifier	REQ-07.06.02-TS-0631.1123
Requirement	The eSS system shall calculate the 'look ahead time window' as (now) and (now + 'look ahead time').

Identifier	REQ-07.06.02-TS-0631.1124
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Requirement	The eSS system shall take the flights that have an issued CTOT which is within the 'look ahead time window' when looking for slot swap solutions.
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Identifier	REQ-07.06.02-TS-0631.1126
Requirement	The eSS system shall calculate the 'investigate by time' as the minimum of the following values minus 'investigate by delay': - 'remove from sequence decision time', - 'insert in sequence decision time'

Identifier	REQ-07.06.02-TS-0631.1127
Requirement	The eSS system shall highlight the 'investigate by time' value to the AU, if ('investigate by time' + 10) is later or equal to current clock time.

Identifier	REQ-07.06.02-TS-0631.1128
Requirement	The eSS system shall automatically refresh the Flight List and Solutions information in the HMI at least every 1 minute.

Identifier	REQ-07.06.02-TS-0631.1129
Requirement	The eSS system shall allow the AU to request the slot swap solutions for one or more airlines by using the three letter ICAO code of the airline.

Identifier	REQ-07.06.02-TS-0631.1130
Requirement	The eSS system shall allow the AU to choose one of the features: slot swap for improvement, or slot swap for delay, or slot swap for cancel; upon selecting a flight from the flight list.

Identifier	REQ-07.06.02-TS-0631.1131
Requirement	The eSS system shall allow the AU to access the rejected candidate flights and the reason for a subject flight.

Identifier	REQ-07.06.02-TS-0631.1134
Requirement	The eSS system shall allow the AU to submit the NM eHelpdesk request automatically from the HMI upon selection of a slot swap solution.

Identifier	REQ-07.06.02-TS-0631.1135
Requirement	The NM ETFMS system shall not freeze the CTO of the slot swapped flights.

Identifier	REQ-07.06.02-TS-0631.1136
Requirement	The eSS system shall allow the AU to access to all slot swap requests made to the NM at least 18 months in the past.

Identifier	REQ-07.06.02-TS-0631.1137
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Requirement	The NM ETFMS system shall provide all the network information (e.g. regulation and regulation details, cherry picking regulations, hotspots) to the eSS system.
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Identifier	REQ-07.06.02-TS-0631.1138
Requirement	The NM ETFMS system shall provide all the flight and flight details (e.g. CTO, TTO, ATFM slot issued) information to the eSS system.

### 3.1.2 Multi Slot Swap Requirements

Identifier	REQ-07.06.02-TS-0631.1132
Requirement	The eSS system shall use the 'maximum number of slot swaps per flight' system parameter to limit the maximum number of times that a flight can be swapped.

Identifier	REQ-07.06.02-TS-0631.1133
Requirement	The eSS system shall allow NM to set the 'maximum number of slot swaps per flight'.

### 3.1.3 Slot Swap for Improvement and Delay Requirements

#### 3.1.3.1 General Requirements

Identifier	REQ-07.06.02-TS-0631.1201
Requirement	The eSS system shall calculate the new CTOT of the candidate flight for improvement or delay as (CTO of the candidate flight + 'delay swapped')

Identifier	REQ-07.06.02-TS-0631.1202
Requirement	The eSS system shall calculate the 'swap decide by time' for improvement and delay as the minimum of the following values: - subject flight's 'remove from sequence decision time' - candidate flight's 'remove from sequence decision time' - subject flight's 'insert in sequence decision time' - candidate flight's 'insert in sequence decision time'

Identifier	REQ-07.06.02-TS-0631.1203
Requirement	The eSS system shall highlight to the AU the 'swap decide by time' that the NM eHelpdesk request needs to be submitted to NM.

#### 3.1.3.2 Slot Swap for Improvement Requirements

Identifier	REQ-07.06.02-TS-0631.1301
Requirement	The eSS system shall calculate the subject flight's 'minimum delay after improvement' as ('no slot swap before time') - (ETOT of the subject flight).

Identifier	REQ-07.06.02-TS-0631.1302
Requirement	The eSS system shall determine that a flight is a possible candidate for improvement if the CTO is later or equal to the (ETO of the subject flight + 'minimum delay after improvement') and before the CTO of the subject flight.

Identifier	REQ-07.06.02-TS-0631.1303
Requirement	<p>The eSS system shall determine that a possible candidate flight is a candidate flight for improvement if all of the following conditions are met:</p> <ul style="list-style-type: none"> <li>- The subject and the possible candidate flights share the same Most Penalising Regulation,</li> <li>- The AU has chosen to have the flights without a commercial agreement, or the subject and the possible candidate flights are 'commercially swappable', in a slot swap solution</li> <li>- The AU has chosen to have the 'slot pre-allocated' flights and at most one flight has a pre-allocated slot, or both flights have slots issued, in a slot swap solution</li> <li>- The possible candidate flight is 'at the departure airport',</li> <li>- The possible candidate flight is not 'too late to remove from sequence',</li> <li>- The possible candidate flight's departure sequence is not frozen</li> <li>- If the AU has set the preference to not to allow ready to depart flights to be swapped, then the possible candidate flight is not in 'ready to depart' status,</li> <li>- The possible candidate flight is not in overload,</li> <li>- Both flights have a compatible RVR minima,</li> <li>- The 'delay swapped' is greater than the required minimum swap gain time,</li> <li>- The possible candidate flight does not have a swap preference 'high priority',</li> <li>- The new CTOT for the possible candidate is later than 'no slot swap before time'</li> </ul>

Identifier	REQ-07.06.02-TS-0631.1304
Requirement	The eSS system shall determine that the possible candidate flight is a rejected candidate flight if it does not meet the requirement <REQ-07.06.02-TS-0631.1303>.

### 3.1.3.3 Slot Swap for Delay Requirements

Identifier	REQ-07.06.02-TS-0631.1401
Requirement	The eSS system shall allow the AU to define the 'minimum extra delay' and 'maximum extra delay' that will be added to the subject flight.

Identifier	REQ-07.06.02-TS-0631.1402
Requirement	The eSS system shall calculate the 'minimum delay after delay' for a subject flight as the maximum value of ('minimum extra delay', 'no slot swap before time' - CTOT)

Identifier	REQ-07.06.02-TS-0631.1403
Requirement	The eSS system shall determine that a flight is a possible candidate if CTO of the flight is later or equal to (ETO + 'minimum delay after delay') and before (CTO + 'maximum extra delay')

Identifier	REQ-07.06.02-TS-0631.1404
Requirement	The eSS system shall determine that a possible candidate flight is a candidate flight for delay if all of the following conditions are met: <ul style="list-style-type: none"> <li>- The subject flight and the possible candidate flight share the same Most Penalising Regulation,</li> <li>- The AU has chosen to have the flights without a commercial agreement, or the subject and the possible candidate flights are 'commercially swappable',</li> <li>- The AU has chosen to have 'slot pre-allocated' flights and at most one flight has a pre-allocated slot, or both flights have slots issued</li> <li>- The possible candidate flight is 'at the departure airport',</li> <li>- The possible candidate flight is not 'too late to remove from sequence',</li> <li>- The possible candidate flight's departure sequence is not frozen,</li> <li>- The possible candidate flight is not in overload,</li> <li>- Both flights have a compatible RVR minima,</li> <li>- The 'delay swapped' is greater than the required minimum swap gain time,</li> <li>- The new CTOT for the possible candidate is later than 'no slot swap before time'</li> </ul>

Identifier	REQ-07.06.02-TS-0631.1405
Requirement	The eSS system shall determine that the possible candidate flight is a rejected candidate flight if it does not meet the requirement <REQ-07.06.02-TS-0631.1404>.

### 3.1.3.4 Slot Swap for Cancel Requirements

Identifier	REQ-07.06.02-TS-0631.1501
Requirement	The eSS system shall determine the 'swap decide by time' as the minimum of one of the values below: <ul style="list-style-type: none"> <li>- subject flight's 'remove from sequence decision time'</li> <li>- candidate flight's 'remove from sequence decision time'</li> <li>- candidate flight's 'insert in sequence time'</li> </ul>

Identifier	REQ-07.06.02-TS-0631.1502
Requirement	The eSS system shall allow the AU to define the 'maximum extra cancel delay'.

Identifier	REQ-07.06.02-TS-0631.1503
Requirement	The eSS system shall determine that a flight is a possible candidate for cancel if the flight's CTO is later or equal to (the CTO of the subject flight) and before (CTO of the subject flight + 'maximum extra cancel delay')

Identifier	REQ-07.06.02-TS-0631.1504
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Requirement	The eSS system shall determine that a possible candidate flight is a candidate flight for improvement if all of the following conditions are met: <ul style="list-style-type: none"> <li>- The subject and the possible candidate flights share the same Most Penalising Regulation,</li> <li>- The AU has chosen to have the flights without a commercial agreement, or the subject and the possible candidate flights are 'commercially swappable', in a slot swap solution</li> <li>- The AU has chosen to have 'slot pre-allocated' flights and at most one flight has a pre-allocated slot, or both flights have slots issued, in a slot swap solution</li> <li>- The possible candidate flight is 'at the departure airport',</li> <li>- The possible candidate flight is not 'too late to remove from sequence',</li> <li>- The possible candidate flight's departure sequence is not frozen,</li> <li>- The possible candidate flight is not in overload,</li> <li>- The subject flight's 'enforced RVR minima' is not defined or candidate flight's RVR is less than or equal to subject flight's 'enforced RVR minima',</li> <li>- The 'delay swapped' is greater than the required minimum swap gain time,</li> <li>- The new CTOT for the possible candidate is later than or equal to 'no slot swap before time'</li> </ul>
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Identifier	REQ-07.06.02-TS-0631.1505
Requirement	The eSS system shall determine that the possible candidate flight is a rejected candidate flight if it does not meet the requirement <REQ-07.06.02-TS-0631.1504>.
	<REQ-07.06.02-TS-0631.1504>

Identifier	REQ-07.06.02-TS-0631.1509
Requirement	The NM ETFMS system shall allow the NM to 'Substitute' a slot.

Identifier	REQ-07.06.02-TS-0631.1510
Requirement	The NM ETFMS system Network Impact Display (NID) shall enable the NM to obtain the network impact of the candidate flight only.

Identifier	REQ-07.06.02-TS-0631.1511
Requirement	The NM ETFMS system shall trigger the NID of the candidate flight only when the 'Substitute' function is selected.

Identifier	REQ-07.06.02-TS-0631.1508
Requirement	The NM ETFMS system shall suspend the candidate flight and replace the subject flight's slot with the candidate flight's slot, in one transaction.

### 3.1.4 Pre-Allocated Slot Swap Requirements

The Pre-Allocated Slot Swap requirements were implemented in the prototype and used during the HITL part of the VP-712 validation exercise but not part of the Live Trial. They are captured in this section for the sake of completeness, and remain 'in progress'..

Identifier	REQ-07.06.02-TS-0631.1901
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Requirement	The eSS system shall allow the AU to define if the system shall propose solutions for 'slot pre-allocated' flights, 'allow pre-allocated slot swap', in addition to the requirement <REQ-07.06.02-TS-0631.1103>
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Identifier	REQ-07.06.02-TS-0631.1902
Requirement	The eSS system shall determine the flight state as 'slot pre-allocated', if the flight has a CTOT and the EOBT is greater than 2 hours of current-time (now)

Identifier	REQ-07.06.02-TS-0631.1903
Requirement	The eSS system shall determine that the flight is a subject flight when all the following conditions in requirement <REQ-07.06.02-TS-0631.1120> are met, and the flight is either slot-issued state or in slot pre-allocated state.

Identifier	REQ-07.06.02-TS-0631.1913
Requirement	The eSS system shall ensure that either the subject or the candidate flight is in 'slot issued' state and the other in 'pre-allocated slot' state.

Identifier	REQ-07.06.02-TS-0631.1914
Requirement	The eSS system shall ensure that both subject and candidate flights are not in 'pre-allocated slot' state.

### 3.1.5 One Request Multi Slot Swap Requirements

The One Request Multi-Slot Swap requirements were implemented in the prototype and used during the HITL part of the VP-712 validation exercise but not part of the Live Trial. They are captured in this section for the sake of completeness.

Identifier	REQ-07.06.02-TS-0631.1915
Requirement	The eSS system shall allow the AU to define if the system shall propose one request multi swap, 'activate one request multi swap', in addition to the requirement <REQ-07.06.02-TS-0631.1103>

Identifier	REQ-07.06.02-TS-0631.1904
Requirement	The eSS system 'slot swap for improvement' and 'slot swap for delay features' shall look for several slot swap solutions for a subject flight, if the 'activate one-request multi swap' preference is set.

Identifier	REQ-07.06.02-TS-0631.1905
Requirement	The eSS system shall determine the 'swap decide by time' by taking the minimum value of 'swap decide by time' of all slot swap solutions in the one request multi swap.

Identifier	REQ-07.06.02-TS-0631.1906
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Requirement	The eSS system shall keep the subject flight the same in each slot swap solution within the one request multi swap.
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Identifier	REQ-07.06.02-TS-0631.1907
Requirement	The eSS system shall ensure that a candidate flight appears only once in the one request multi swap.

Identifier	REQ-07.06.02-TS-0631.1908
Requirement	The eSS system shall include a slot swap solution in a one request multi swap if the subject flight's new CTOT is earlier than the previous slot swap solution.

Identifier	REQ-07.06.02-TS-0631.1909
Requirement	The eSS system shall calculate the total 'delay swapped' as sum of the 'delay swapped' value of all slot swap solutions in the one request multi swap.

Identifier	REQ-07.06.02-TS-0631.1910
Requirement	The eSS system shall propose a slot swap solution in a one request multi swap for delay, when the total 'delay swapped' is within the 'minimum extra delay' and 'maximum extra delay'.

Identifier	REQ-07.06.02-TS-0631.1911
Requirement	The eSS system shall include a swap solution in a one request multi swap when all of the following conditions are met: - 'delay swapped' is later or equal to 'minimum swap gain time' and earlier than 'maximum extra delay' for multi swap, - the subject flight's new CTOT is later than the previous slot swap solution

Identifier	REQ-07.06.02-TS-0631.1912
Requirement	The NM eHelpdesk system shall process all slot swaps present in one request multi-swap as one eHelpdesk request.

## 3.2 Adaptability

N/A

## 3.3 Performance Characteristics

Identifier	REQ-07.06.02-TS-0631.3601
Requirement	The eSS system Slot Swap request response time shall not exceed the NM eHelpdesk target response time

Identifier	REQ-07.06.02-TS-0631.3602
Requirement	The eSS system Slot Swap solution query response time shall not exceed 3 seconds for a single airline for a look ahead time window of 2 hours.

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### 3.4 Safety & Security

Identifier	REQ-07.06.02-TS-0631.4602
Requirement	The eSS features shall inherit from the security, authorisation and authentication requirements from the current NM eHelpdesk features.

### 3.5 Maintainability

Identifier	REQ-07.06.02-TS-0631.5603
Requirement	A weekly maintenance window of maximum 1 hour shall be foreseen during which the eSS features is not possible.

Identifier	REQ-07.06.02-TS-0631.5604
Requirement	A planned downtime of NM systems shall be announced in a deployment plan that is available 3 months prior to the planned intervention.

### 3.6 Reliability

Identifier	REQ-07.06.02-TS-0631.6605
Requirement	The eSS features shall be available for 7 days a week, 24 hours a day. In case of a eSS system failure, the system shall be available back within 1 hour.

### 3.7 Functional Block Internal Data Requirements

N/A

### 3.8 Design and Construction Constraints

N/A

### 3.9 Functional Block Interface Requirements

Identifier	REQ-07.06.02-TS-0631.9701
Requirement	The eSS system shall implement such that the default time durations are in minutes.

### 3.10 Deleted Requirements

The requirements that are in this section were identified based on the earlier versions of the OSED and deleted during the development of the prototype and the initial parts of the VP-712 exercise execution.

Identifier	REQ-07.06.02-TS-0631.1139
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Requirement	The NM eHelpdesk system shall publish the 'eHelpdesk processing time'.
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Identifier	REQ-07.06.02-TS-0631.1118
Requirement	The NM ETFMS system shall provide the CTO of a flight as the flight's arrival time in the Traffic Volume of the Most Penalising Regulation to the eSS system.

Identifier	REQ-07.06.02-TS-0631.1119
Requirement	The NM ETFMS system shall provide the ETO of a flight as the estimated time over as defined in the FTFM to the eSS system.

Identifier	REQ-07.06.02-TS-0631.1506
Requirement	The eSS system shall allow NM to set the 'maximum number of minutes for slot reservation'.

Identifier	REQ-07.06.02-TS-0631.1507
Requirement	The NM ETFMS system shall reserve the slot of the candidate flight upon cancellation for 'maximum number of minutes for slot reservation'.



## 4 Assumptions

N.A.



## 5 References

- [1] Template Toolbox 03.01.01
- [2] Requirements and V&V Guidelines 03.00.00
- [3] SESAR Toolbox User Manual 03.01.01
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<https://extranet.eurocontrol.int/http://atmlexicon.eurocontrol.int/en/index.php/SESAR>
- [5] Step 1 V3 UDPP Final OSED, SESAR deliverable D66, Edition 00.02.01, 13/11/2015.
- [6] SESAR P07.02 D42 Step 1 Network Sub-systems Technical Architecture, Edition 00.02.00, 15/05/2014
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- [9] EUROCONTROL Air Traffic Flow & Capacity Management Operations – ATFCM User Manual, Edition 18.1.1.
- [10] Step 1 V3 UDPP Safety and Performance Requirements, SESAR deliverable D68, Edition 00.01.01, 13/11/2015.

### 5.1 Use of copyright / patent material /classified material

#### 5.1.1 Classified Material

N/A.

**-END OF DOCUMENT-**

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