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PJ07-W2-39

SESAR SOLUTION 39 - TS_IRS

This SESAR Solution PJ07-W2-39 TS-IRS document is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874465 under European Union's Horizon 2020 research and innovation programme.

Abstract

The present document describes the PJ07 solution 39 technical architecture, by reusing the existing capability configurations which are already in EATMA.

The scope of the Solution is to define and validate a collaborative framework for managing arrival delay within an ATFM regulation (considered the most important contributor to capacity performance issues).

The different options for the target architecture are only described but couldn't be modelled completely in the document due to delay taken in the elaboration of the operational process due to the COVID-19 crisis.

The "AU fleet prioritisation (and preferences)" solution's technical architecture identifies two capability configurations to modify when the Airport delegates the resolution of a Capacity Constrained Situation to the Airspace Users (AU):

- Civil AU Flight Operations Centre (FOC)
- Regional ATFCM

The solution modifies the 'Flight Management' functional block of the Civil AU Operations Centre by adding new functions that allocate flight priorities and assess the network impact; and then decide on flight block time's modifications to be submitted as requests to the Network.

The solution updates the functional block in the Regional ATFCM capability configuration: 'Demand and Capacity balancing'. This functional block now provides the functions to obtain a new sequence and analyse the network impact of the flight prioritisation as requested by the AU.

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1 Executive summary

This document focuses on the definition of a collaborative framework for managing arrival constraints for Local DCB issues in collaboration with Network Function, and with the participation of Airspace Users (AUs).

This collaborative framework will enable the integration and necessary coordination of 4D constraints (limited to arrivals management) from various stakeholders (Airports, ANSPs, AUs and NM); it will ensure continuous stability and performance of the Network and will give the opportunity to the Airspace Users to prioritise their most important flights (**UDPP** application), hence reducing the impact of ATM planning constraints to limit the induced disruption and excess cost on their operations.

In the definition of the operational framework, it is assumed that the UDPP process could be triggered to allow AUs to propose acceptable solutions for Local Demand Capacity Balancing issues through "What-If" scenario calculations using the information available to them. It is also assumed that the UDPP output will be used as an initial acceptable solution to the Local DCB processes.

The proposed solutions are expected to have a positive impact in the following areas:

- Increased flexibility by allowing the Airspace Users to recommend to the Network Management Function a preferred order for their flights in a measure;
- Increased punctuality of individual flights, especially the ones for which delays cause a large impact on the AU fleet, thanks to the collaborative framework for managing arrival constraints;
- Cost-efficiency of airspace users (reduced excess cost of the fleet operation due to the impact of delay).

This Technical Specification document describes the modifications to the existing systems needed to implement UDPP. It provides a first high-level analysis of the technical changes implied by UDPP at a V3 level. This analysis will be completed when integration of UDPP with local DCB takes place, by elaborating further implementation options and then defining the SWIM services.

This approach has allowed progressing on the feasibility of UDPP for Airspace Users and Airports APOC, and defining an integration option with DCB.

The AU fleet prioritisation (and preferences) solution's technical architecture modifies two capability configurations when the Airport delegates the resolution of Capacity Constrained Situation to the AU:

- Civil AU Operations Centre (FOC);
- Regional ATFCM.

The solution modifies the 'Flight Management' functional block of the Civil AU Operations Centre by adding new functions to:

- Allocate flight prioritisation;
- Assess the AU network impact of modified block times;
- Decide on modifying the flight block times.

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The solution updates the functional block in the Regional ATFCM capability configuration: 'Demand and Capacity balancing'. This functional block now provides the functions to:

- Obtain and store AU priorities and margins;
- Obtain new flight block times by using AU priorities and margins;
- Analyse the EATM network impact of the flight prioritisation as decided by the AU;
- Apply the result of the AU decision with new block times.

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2 Introduction

2.1 Purpose of the document

This document provides the technical architecture and specifications, covering technical (system and services) requirements related to SESAR Solution PJ07-W2-39.

The SESAR Solution Development Life Cycle aims to structure and perform the work at project level and progressively increase SESAR Solution maturity, with the final objective of delivering a SESAR Solution data pack for industrialisation and deployment. The TS/IRS represents one of the key parts of this SESAR Solution data pack.

2.2 Scope

This TS/IRS covers functional and non-functional requirements for the Airspace Users' Driven Prioritisation process (UDPP).

2.3 Intended readership

This document is aimed at the following stakeholders:

- the SESAR2020 PJ07, PJ09, PJ04, PJ25 members, including Airspace Users
- the SJU and EUROCONTROL; and
- the transversal PJ19 project.

2.4 Background

In SESAR 1 and S2020 Wave 1, different approaches, and Use Cases for the management of arrival constraints have been defined and validated using specific local tools:

SESAR 1 Solution #18 "CTOT and TTA" validated the concept of Target Time Management in the planning phase from a Network perspective for arrival traffic allowing provision for AU interactions. SESAR 1 Solutions #20 "Initial Collaborative Network Operations Plan (NOP)" and #21 "Airport operations plan (AOP) and its seamless integration with the network operations plan (NOP)", validated the process for local DCB actors to collaborate with the Network in the TTA allocation process.

Wave 1 PJ24 VLD (Very Large Demonstration) Exercises at Barcelona, Palma de Majorca and Heathrow Airports addressed the hotspot resolution (Local DCB issues) based on TTAs (Target Times of Arrival) proposed for arriving flights (in pre-flight phase) by local DCB tools and applying local business/operational rules. The TTs were defined at local (Airport) level and shared with the Network Manager via the AOP connected to the NOP. Some limited provision was defined for AU integration, but an active AU participation as described within UDPP concept was not integrated in the local processes.

Wave 1 PJ25 shadow mode Exercise at Zurich Airport addressed the hotspot resolution through the local (FMP and AU) management of arrival regulations, for building an optimised sequence based on airlines' priorities. A limited part of UDPP was integrated in the local process.

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These Exercises provided a very initial demonstration of how TTAs and AUs flights' prioritisation could be combined.

The collaborative framework builds on these past activities, and aims at:

- Reconciling and standardising local initiatives developed for managing arrival delay constraints;
- Providing AUs with a single harmonised entry point through NM to manage their priorities;
- Supporting further integration of Network/Airport processes;
- Addressing remaining issues and gaps identified by SESAR Wave 1 Projects.

2.5 Structure of the document

See Table of Contents.

2.6 Glossary of terms

Term	Definition	Source of the definition
Air Navigation Service Provider (ANSP)	Organisation responsible for the provision of traffic control and information services at airports and en-route. It includes control of air traffic at and around a controlled airport as well as local flow management.	PJ.07-W2-S39 OSED
Airport Collaborative Decision Making (A-CDM)	Operational concept, which starts with information sharing, taking capacity related decisions in a collaborative manner on the day of operations (D-0). It aims at improving the overall efficiency of airport operations by optimising the use of resources, and improving the predictability of events. It focuses especially on aircraft turnaround and pre-departure sequencing processes by using A-CDM milestones.	PJ.07-W2-S39 OSED
Airport Operations Centre (APOC)	A coordination arrangement at an airport, whereby operational stakeholders (actors) collaborate for the effective/efficient establishment and execution of an agreed operational plan, in a structured manner with agreed processes, either through physical or virtual interaction or a combination thereof.	PJ.07-W2-S39 OSED

	The APOC is the prime interface between the Airport and the Network Manager Operations Centre (NMOC) established in the States within, and adjacent to, the ECAC area.	
Arrival Optimisation period **UDPP flight Cut-off Time**	Arrival Optimisation period is the local Airport (the one creating the UDPP measure) arrival anticipation period, applicable on each flight of the UDPP measure used as part of the calculation of the UDPP flight cut-off time. The UDPP flight cut-off time specifies until when the AU can set priorities/Margins on their flight. Once the flight cut-off time has been reached, the last prioritisation submitted by the AU on this flight is taken as the "final UDPP prioritisation" to elaborate the UDPP solution. UDPP flight cut-off time = COBT – TRS@ADEP – TRS@ADES TRS@ADEP: Time To Remove a flight from Sequence on departure airport (already existing in NM) TRS@ADES: Time To Remove a flight from Sequence on arrival airport (doesn't currently exist in NM). The TRS@ADES represents the Arrival Optimisation Period. The Arrival Optimisation period is defined when the "UDPP Measure" is initiated.	PJ.07-W2-S39 OSED
Airspace User (AU)	Civilian airspace users include scheduled airlines, charter companies, cargo and air freight service providers, the business and leisure aviation sectors and all forms of non-military air travel.	PJ.07-W2-S39 OSED
Baseline delay, Baseline Time	Represents the allocated delay to each flight in a constrained situation before or without the incorporation of AU constraints into the CCS resolution. It is used as a baseline of the equity in the CCS resolution and can be used to benchmark the concept to identify the concept's benefits.	PJ.07-W2-S39 OSED

Capacity Constrained Situation (CCS)	A period of time in which the Capacity of an ATFM element (Airspace, Arrival Runway, Departure Runway …) has to be controlled in relation to the demand (reduction of capacity, overload situation …) . The Capacity Constrained Situation defines the capacity as a constraint to be respected and associated with a time window to apply it (or a group of time windows, in which case the capacity constraints define the sub-periods). Typically, the CCS includes also the recovery period where flights have delay to smooth the traffic during the transition from constrained to unconstrained state.	PJ.07-W2-S39 OSED
Delay-Cost Curve	The function expressing the relationship between delay incurred on a flight and the cost penalty for the AU this delay represents. The delay-cost curve is unique for each flight, and it can encompass many aspects of the AU operation. Crucially, the delay-cost curve of a specific flight may be built in such way that it incorporates the costs of subsequent rotations of the same aircraft.	PJ.07-W2-S39 OSED
Demand Capacity Balancing (DCB)	The process of comparing traffic demand and available capacity in a defined timeframe, determining bottlenecks and assessing mitigation measures in order to find the optimum result in terms of minimising delays and costs. Where used in this OSED to convey a role in the proposed process, the term 'DCB' is intended to be the aggregate group including Local DCB, Airport, and Network Manager.	PJ.07-W2-S39 OSED
Fleet Delay Reordering (FDR)	The UDPP feature by which the AU can rearrange its own allocated baseline time by giving priority values on flights.	PJ.07-W2-S39 OSED
Flow Management Position (FMP)	An operational position established in appropriate air traffic control units to monitor traffic load for defined sectors (at en-route or at airport level) to ensure that traffic is safely managed by Air Traffic Controllers. The established FMP can operate at a Regional, Sub-Regional or Local level and, when required,	PJ.07-W2-S39 OSED

	applies appropriate ATFCM measures in coordination with the NMOC.	
Knock-on delay or Reactionary delay	A side effect on subsequent flights due to delay given to an initial flight. The initial delays can be caused by various reasons, e.g. capacity constraints, ATC/Network constraints, airport constraints, but also airline constraints (crew, passengers …). The AU perspective on reactionary delay, in relation to the proposed concept, is to take into account all the AU fleet and aircraft rotations of the day to decrease the impact of the original delay. This is completely different from the Airport perspective where the typical approach to reactionary delay is to take into account only the impact on the local Airport platform.	PJ.07-W2-S39 OSED
Margin of Manoeuvre	For an AU, it is the maximum delay a flight can take before incurring significant cost (i.e. disruption on the delay-cost curve according to delay). It is anticipated that the "significant cost" can be defined differently by each AU, but for the purposes of this example, the cost represents a "step" that is due to factors such as crew or pilot time-out constraints, a large number of passengers who miss a connection, an airport curfew infringement etc. Each time one of the factors is met; another step in cost is incurred, which represents the end of another Margin of Manoeuvre for the AU. The Margins are typically expressed via "Time not After" and "Time not Before" parameters (see definitions below).	PJ.07-W2-S39 OSED
Network Manager Operations Centre (NMOC)	The Network Manager Operations Centre delivers core operational services across several domains: Flow and Capacity Management ATM Access Gateway and Flight Planning Operations Information Management Domain Crisis and Contingency Management Post-operations analysis and reporting	PJ.07-W2-S39 OSED
Network Operations Plan (NOP)	A rolling operational plan set up, maintained and shared by the Network Manager, containing expected and current traffic information, available	PJ.07-W2-S39 OSED

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	sector capacities provided by the ANSPs and expected or actual delay information.	
Prioritisation	Actions made by the AUs (using the UDPP features SFP, FDR, Slot Swap, Margins) according to the importance of their flights impacted by a UDPP measure, based on their business needs (N.B. Slot Swap is not part of this document because it is already implemented).	PJ.07-W2-S39 OSED
Protection/Protect a flight	UDPP Protection is part of the UDPP prioritisation. It is the highest priority given to a flight pushing its operation as close as possible to the planned (scheduled) off block time or to the margin (time not after) if specified. To do this, UDPP applies the SFP algorithm for this flight.	PJ.07-W2-S39 OSED
Scenario	An operational situation in which Use Cases are executed.	PJ.07-W2-S39 OSED
Selective Flight Protection (SFP)	The UDPP feature by which an AU can obtain the minimum delay for a flight (Priority P) in exchange for more delay of another earlier own flight, even if the total delay for the given AU is increased.	PJ.07-W2-S39 OSED
Suspension	ATFM suspension (FLS) is an ETFMS message sent, suspending a flight, which thereafter should not get take-off clearance. NB an ATFM Suspended flight is not visible in the NOP.	PJ.07-W2-S39 OSED
Time not After (TNA), Time not Before (TNB)	These are the time components of the Margin of Manoeuvre. The components allow the definition of a closed (TNA and TNB together) or open-ended (TNA or TNB only) time window to be allocated by an AU to its own flight, as a constraint. This expression of AU constraint can be used to rearrange the AU sequence and/or to define a CCS resolution.	PJ.07-W2-S39 OSED
Time to Remove from Sequence (TRS)	Time needed to remove a flight from departure sequence. Its purpose is to prevent last minute modifications of the CTOT. These values are kept updated by the relevant FMPs and TWRs. They may be adjusted at any time depending on the local aerodrome traffic situation and may vary during the day. The TRS prevents a change to a later CTOT, or the allocation of a CTOT, when the flight is already in the departure sequence.	PJ.07-W2-S39 OSED
UDPP Suspended flight	UDPP Suspension is part of the UDPP prioritisation. It is the lowest priority given to a flight pushing its	PJ.07-W2-S39 OSED

	operation to the end of the CCS managed by UDPP (the UDPP measure). NB UDPP suspended flight is not an ATFM suspension, i.e. an FLS message.	
UDPP inputs	UDPP inputs is a collective term for Protection, Margins of Manoeuvre and UDPP Priority values (see definitions above and below) that an AU may set for their flights in the UDPP measure.	PJ.07-W2-S39 OSED
UDPP max schedule anticipation	This CCS airport parameter (common to all AUs) gives the maximum early arrival delay buffer allowed by the airport to manage flights. (e.g. 5mn = 5minutes before reference flight arrival time is allowed). It's also used by the UDPP service to optimise the Arrival sequence maximising the arrival throughput.	PJ.07-W2-S39 OSED
UDPP measure **UDPP NCP measure**	ATFCM measures that allows the AU participation through the articulation of AU constraints for the purpose of CCS resolution. Two principal types of UDPP measure are anticipated in the concept: - "UDPP measure" based on ATFM regulation; - "UDPP NCP measure" based on Network Cherry-Pick measure. Each type of UDPP measure has its own specificities that are largely inherent from the original measure that is currently used in operations.	PJ.07-W2-S39 OSED
UDPP Priority value	A value given by the Airspace user on a flight (or a specified default value) used by the UDPP function to reorder the flights in the UDPP measure. Values can be: ***P*** for Protect, ***S*** for UDPP suspend, ***B*** for "keep baseline", or a number from 1 (highest priority) to 999 (lowest priority). See UDPP feature definitions in Appendix A2.	PJ.07-W2-S39 OSED

Table 1: Glossary of terms

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2.8 Acronyms and Terminology

Acronym	Definition
4D	Four Dimensional
ACP	Airport Cherry-Pick
AFUA	Advanced Flexible Use of Airspace
AMAN	Arrival Manager
ANSP	Air Navigation Service Provider
AOC	Airline Operations Centre
AOP	Airport Operational Plan
API	Arrival Planning Information (message)
APOC	Airport Operations Centre
APT	Airport
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
AU	Airspace User
BDT	Business Development Trajectory
CASA	Computer-Assisted Slot Allocation (Network Manager slot allocation for regulations)
CCS	Capacity Constrained Situation
CDM	Collaborative Decision Making
CFMU	Central Flow Management Unit
CI	Confidence Index
CNS	Communication Navigation and Surveillance
CONOPS	Concept of Operations
CR	Change Request
CTOT	Calculated Take-Off Time
D0	Day ‘zero’, Day of Operation
D-1	Day ‘zero minus one’, Day before Operation
DCB	Demand Capacity Balancing

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dDCB	Dynamic Demand Capacity Balancing
DFlex	Departure Flexibility
DMAN	Departure Manager
DOD	Detailed Operational Description
DPI	Departure Planning Information (message)
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
EIBT	Estimated In Block Time
EOBT	Estimated Off Block Time
E-OCVM	European Operational Concept Validation Methodology
EXE	Exercise
F2F	Face-to-Face
FAB	Functional Airspace Block
FCL	Flexible Credits for Low Volume Users in Constraints (LVUCs)
FDA	Fleet Delay Apportionment
FDR	Fleet Delay Reordering
FIBT	Forecasted In Block Time
FIXM	Flight Information Exchange Model
FMP	Flow Management Position
FMS	Flight Management System
FOBT	Forecasted Off Block Time
FOC	Flight Operations Centre
FSFS / FPFS	First Scheduled First Served / First Planned First Served
HPAR	Human Performance Assessment Report
HSPT	Hot Spot
IBT	In-Block Time
ID	Identifier
INTEROP	Interoperability Requirements
IRS	Interface Requirements Specification
KPA	Key Performance Area
KPI	Key Performance Indicator
MCP	Mandatory Cherry-Pick
MPC	Most Penalising Constraint

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NIMS	Prefix of Enablers linked to operational improvement defined in the European ATM master plan.
MTT	Minimum Turnaround Time
NCP	Network Cherry-Pick
NM	Network Manager
NMF	Network Manager Function
NOP	Network Operational Plan
OBJ	Objective
OBT	Off-Block Time
OCD	Operational Concept Description
OI	Operational Improvement
OPAR	Operational Performance Assessment Report
OSED	Operational Service and Environment Definition
PAR	Performance Assessment Report
PDS	Pre-Departure Sequence
PIRM	Programme Information Reference Model
QoS	Quality of Service
RBT	Reference Business Trajectory
RMAN	Runways Manager (first Airport process to organise departure)
RTS	Real-Time Simulation
SAC	Safety Criteria
SAR	Safety Assessment Report
SBT	Shared Business Trajectory
SecAR	Security Assessment Report
SESAR	Single European Sky ATM Research Programme
SFP	Selective Flight Protection
SIBT	Scheduled In Block Time (initial Airline schedule)
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SOBT	Scheduled Off Block Time (initial Airline schedule)
SPR	Safety and Performance Requirements
STAM	Short-Term ATFCM Measures
SWIM	System Wide Information Model
TAD	Technical Architecture Description

TMA	Terminal Manoeuvring Area
TRS	Time to Remove from Sequence.
TS	Technical Specification
TSAT	Target Start-Up Approval Time
TT	Target Time
TTA	Target Time of Arrival
TTOT	Target Take-Off Time
TW	Target Window
UC	Use Case
UDPP	User Driven Prioritisation Process
UIBT	User In Block Time (prioritisation given by User)
UOBT	User Off Block Time (prioritisation given by User)
VALP	Validation Plan
VALR	Validation Report
VALS	Validation Strategy
V-FOC	Virtual Flight Operation Centre (FOC)
VP	Verification Plan
VR	Verification Report
VS	Verification Strategy

Table 2: Acronyms and terminology

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3 SESAR Solution Impacts on Architecture

3.1 Target Solution Architecture

3.1.1 SESAR Solution(s) Overview

PJ.07-W2-39: Collaborative framework for managing arrival delay within an ATFM regulation

SESAR is developing and validating a collaborative framework that will enable the integration and coordination of 4D constraints from various stakeholders including Airports, Air Navigation Service Providers, Airspace Users (AUs) and the Network Manager. This Solution extends the AUs' ability to influence the sequence of arrivals whilst the flights are in pre-departure phase. The Solution introduces a framework for single point of entry for the AUs to provide UDPP prioritisation in a harmonised format, with the aim to allow the Network Manager and other ATM stakeholders to utilise the AU prioritisation for the resolution of capacity-constrained situations within the context of an arrival regulation. Such approach is primarily expected to result in reducing the costs of AUs' operations, either through their direct use of UDPP mechanisms integrated in NM systems and thus reducing the cost of delay, or through informing ATM stakeholders about the AU needs. The framework thereby provides opportunities adapted to different situations and types of AUs, and in parallel it ensures continued stability and performance of the Network. The following OI is documented in the TS/IRS:

- **AUO-0110: Collaborative framework for managing arrival constraints at Local DCB level**

  In case of arrival Network constraints in the planning phase, a set of collaborative DCB resolution procedures and decision support tools will be required, to ensure reconciliation of local DCB measures with Airport CDM and Network Management process. These procedures may include the allocation of CASA regulations or means of directly managing arrival flights combined with the User Driven Prioritization Process (UDPP) into the overall reconciliation process, also in case of multiple constraints. Expected benefits would include coherency between the different processes, enhanced predictability from common usage of most up-to-date flight data by all users, and reduced impact of delays on Airspace Users operations.

  Rationale:

  Need for new collaborative operational procedures between ANSP, AU, Airport, and Network to manage local DCB issues at arrival (in pre-flight phase), minimizing the risk of imposing multiple penalties to Airspace Users or increased workload for FMPs.

  Better management of disruptions by increasing flexibility (integration of AU priorities via UDPP, and speeding up of the recovery to normal operations).

  More automated tools and reduction of the 'human-in-loop' for the collaborative processes are also expected to evaluate the proposed UDPP solution, and its impact on the overall operational performance (AUs, Airports and Network effect).

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OI Step	OI description	Open Change Requests (CRs) at time of Publication
AUO-0110	Collaborative framework for managing arrival constraints at Local DCB level	None.
AUO-0109	Collaborative framework for managing arrival constraints at Airport	CR-07068, unlink this OI step from the Solution; change the title and description of the Solution
EN code	EN description	Open CRs
AOC-ATM-18	FOC adaptation to support UDPP	None
NIMS-44	Evolution of NIMS to support management of UDPP, inclusion of user preferences and priority as part of SBT	None
NIMS-46	Integrated local DCB working position	None
NIMS-46b	Interface to the integrated local DCB working position	None
NIMS_48	Integrated Network Working Position (iNWP)	CR-07051, unlink enabler from AUO-0110. CR-07261, keep this enabler for future even though it will not have a Solution.

Table 3: SESAR Solution PJ.07-W2-39 OIs and Enablers

3.1.1.1 Deviations with respect to the SESAR Solution(s) definition

Enabler	Opt/Req	Deviation
AOC-ATM-18_FOC adaptation to support UDPP	Required	None
NIMS-44_Evolution of NIMS to support management of UDPP, inclusion of user preferences and priority as part of SBT	Required	Use
NIMS-46_Integrated local DCB working position	Required	None
NIMS-46B_Interface to Integrated local DCB working position	Required	None

Table 4: Deviations from SESAR definition.

3.1.1.2 Relevant Use Cases

Operational Use Case	Description
[NOV-5] Collaborative Arrival Management (Planning phase) - UC1 (NOV: network operations view)	The UC1 is founded on the use of ATFM regulation for the initial solution of the DCB issue on arrivals: The initial delay given to flights within the measure are calculated by the FPFS algorithm of CASA. As a result, one of the key features of this UC is the guarantee of equity in the initial solution that would be ensured through CASA algorithm and the UDPP algorithms. Additionally, this kind of UDPP measure, starting by smoothing the traffic done by the FPFS CASA function, is typically used for more severe and/or longer duration DCB issues, which in turn

	typically means a larger number of flights affected by the measure. Consequently, this kind of UDPP measure and the associated ATFM slot list is the most efficient environment suitable for the integration of UDPP mechanisms into the global arrival process.
System Process	**Description**
[NSV-4] Collaborative Arrival Management (Planning phase) - UC1 (NSV: network systems view)	The UC1 incorporates three actors: the local ATFCM function as the originator of the measure (ATFM regulation), the regional ATFCM function, which processes the AU priorities in relation to the ATFM regulation in question, and the AU who is the originator of the priorities.

Table 5: Relevant use cases.

3.1.1.3 Applicable standards and regulations

None.

3.1.2 Capability Configurations required for the SESAR Solution

Collaborative Arrival Management (Planning phase)				
Capability Configuration	**Op Env**	**Capability**	**Node**	**Stakeholder**
Civil AU Operations Centre (PJ.07-W2-39)	Airport; En-Route; NET-Network; Terminal Airspace;	Flight Prioritisation; Trajectory Management;		Civil Flight Operations Centre;
Communication Infrastructure	Airport; En-Route; NET-Network; Network; Terminal Airspace;	Communication; Messaging;		Civil CNS Service Provider; Military CNS Service Provider
Local ATFCM (PJ.07-W2-39)	En route; Terminal airspace	ATFM	Air Traffic Flow and Capacity Management;	Civil ATS Approach Service Provider; Civil ATS En-Route Service Provider;
Regional ATFCM (PJ.07-W2-39)	Network;	Air Traffic Flow Management; Collaborative Network Management;		Network Manager;

		Demand and Capacity Balancing; Flight Prioritisation;		

Table 6: List of Capability Configuration required for the SESAR Solution

3.2 Changes imposed by the SESAR Solution on the baseline Architecture

Enabler	Element type	Element name	Impact
NIMS-44 (CR)	Evolution of NIMS to support management of UDPP, inclusion of user preferences and priority as part of SBT		
	Function	Calculate New Delay and Network Impact	Update
	Function	Calculate UDPP Flight and Cut-Off Time	Introduce
	Function	Update Flight Priorities and Margins in AU Flight Prioritisation Warehouse	Introduce
	Function	Update Slot Allocation in NOP	Update
AOC-ATM-18 (CR)	FOC adaptation to support UDPP		
	Function	Assess Business Impact	Introduce
	Function	Assess Prioritisation Impact	Introduce
	Function	Assess UDPP Eligibility	Introduce
	Function	Define Prioritisation	Introduce
	Function	Send Submit Prioritisation	Introduce
	Function	Send What-If Prioritisation	Introduce
NIMS-46b (create CR)	Interface to the integrated local DCB working position		
	Function	Create UDPP Measure with Regulation	Update
	Function	Optimise Flight(s) via eHelpDesk	Update
	Function	Perform Impact Assessment of DCB Solution	Update

Table 7: Changes imposed on the baseline architecture.

4 Technical Specifications

4.1 Functional architecture overview

The use case is a UDPP measure to replace ATFCM regulation measure. Due to the nature and scope of the Solution, the applicability of the UC presented here (and thus of the generic process) is limited to CCS on arrivals i.e. non-nominal situations. The UC below is envisaged to be usable for a wide range of DCB issues leading to capacity-constrained situations on arrivals. Any DCB issue can be described through a set of parameters such as length of notice ahead of the DCB issue when the DCB issue is identified; severity of the DBC issue; duration of the DCB issue; nature or source of the DCB issue; and DCB issue dynamicity and predictability. These parameters will be used as variables when the UC is used as basis for validation scenarios.

Role	Functional Block	Function
[NSV-4] Collaborative Arrival Management (Planning phase) - UC1		
	Flight Management (PJ.07-W2-39)	Assess Business Impact; Assess Prioritisation Impact; Assess UDPP Eligibility; Define Prioritisation; Send Submit Prioritisation; Send What-If Prioritisation;
	Demand and Capacity Balancing (Local) (PJ.07-W2-39)	Create UDPP Measure with Regulation; Optimise Flight(s) via eHelpDesk if necessary; Perform Impact Assessment of DCB Solution;
	Demand and Capacity Balancing (Regional) (PJ.07-W2-39)	Calculate New Delay and Network Impact; Calculate UDPP Flight and Cut-Off Time; Update Flight Priorities and Margins in AU Flight Prioritisation Warehouse; Update Slot Allocation in NOP;

Table 8: Functional architecture overview.

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4.1.1 Resource Connectivity View

The figure presents the resource use with required connections (NSV-4) view for UC1.

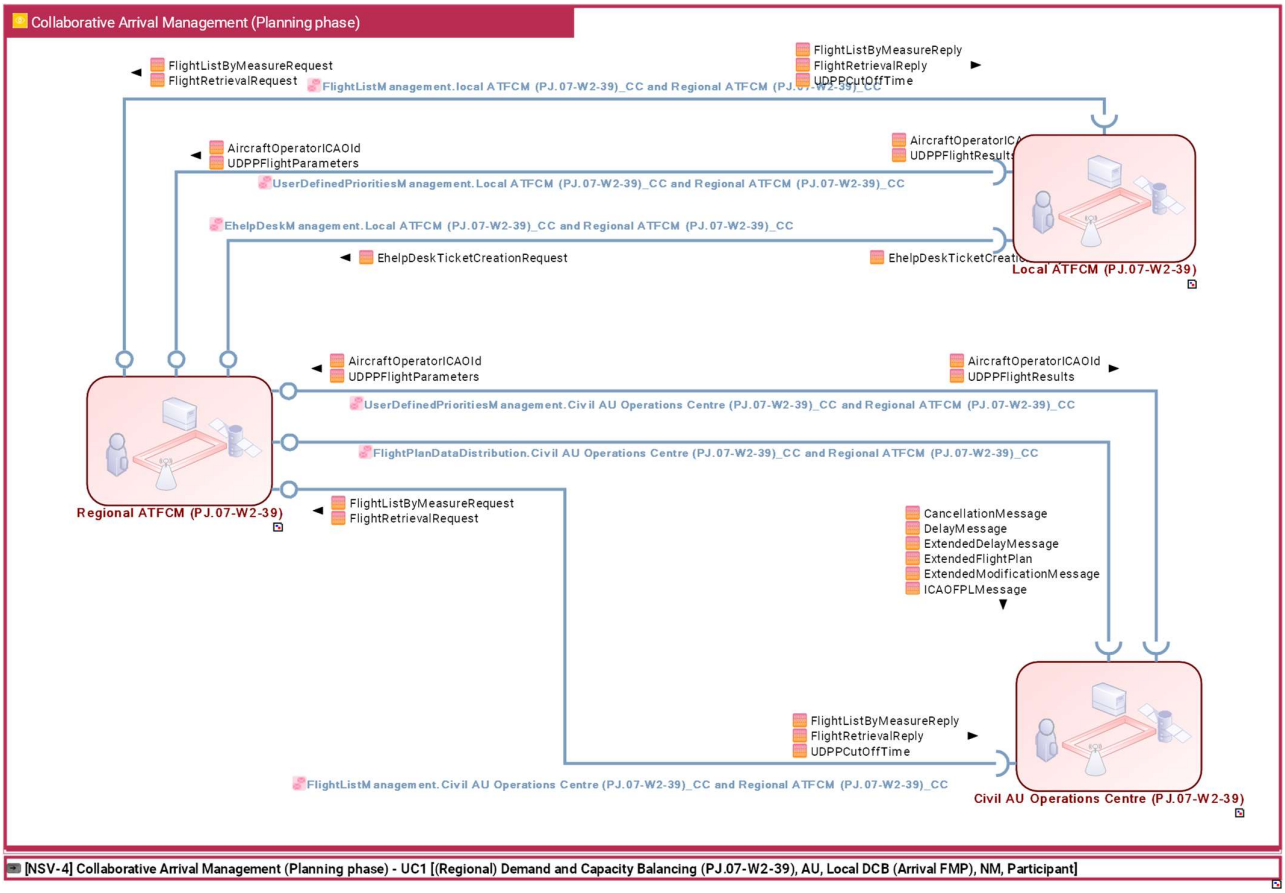

Figure 1: Resource connectivity review.

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4.1.2 Resource Infrastructure View

The figure presents the resource infrastructure view (NSV-4) view for UC1.

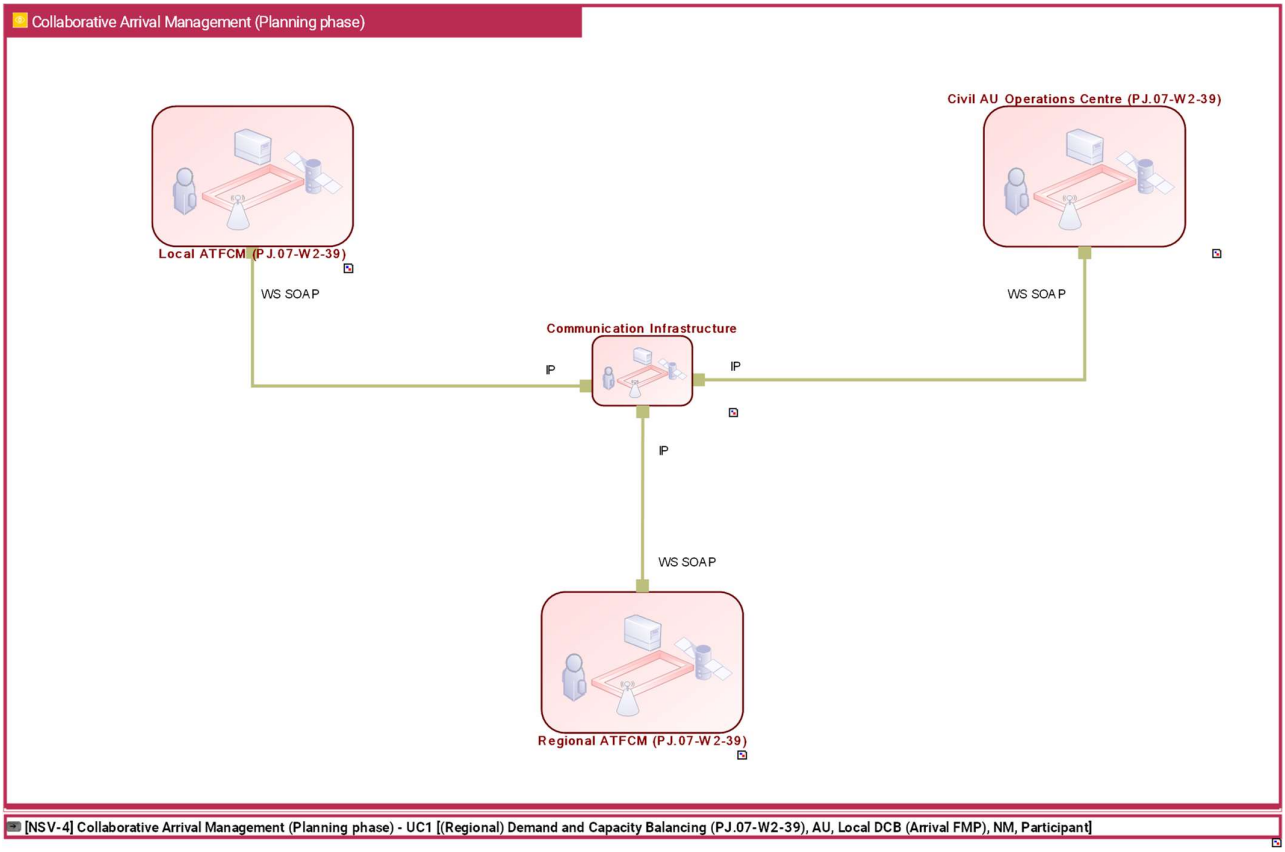

Figure 2: Resource infrastructure review.

4.1.3 Resource Orchestration View

4.1.3.1 [NSV-4] Collaborative Arrival Management (Planning phase) - UC1

The UC1 is founded on the use of ATFM regulation for the initial solution of the DCB issue on arrivals: The initial delay given to flights within the measure are calculated by the FPFS algorithm of CASA.

As a result, one of the key features of this UC is the guarantee of equity in the initial solution that would be ensured through CASA algorithm and the UDPP algorithms.

Additionally, this kind of UDPP measure, starting by smoothing the traffic done by the FPFS CASA function, is typically used for more severe and/or longer duration DCB issues, which in turn typically means a larger number of flights affected by the measure. Consequently, this kind of UDPP measure and the associated ATFM slot list is the most efficient environment suitable for the integration of UDPP mechanisms into the global arrival process.

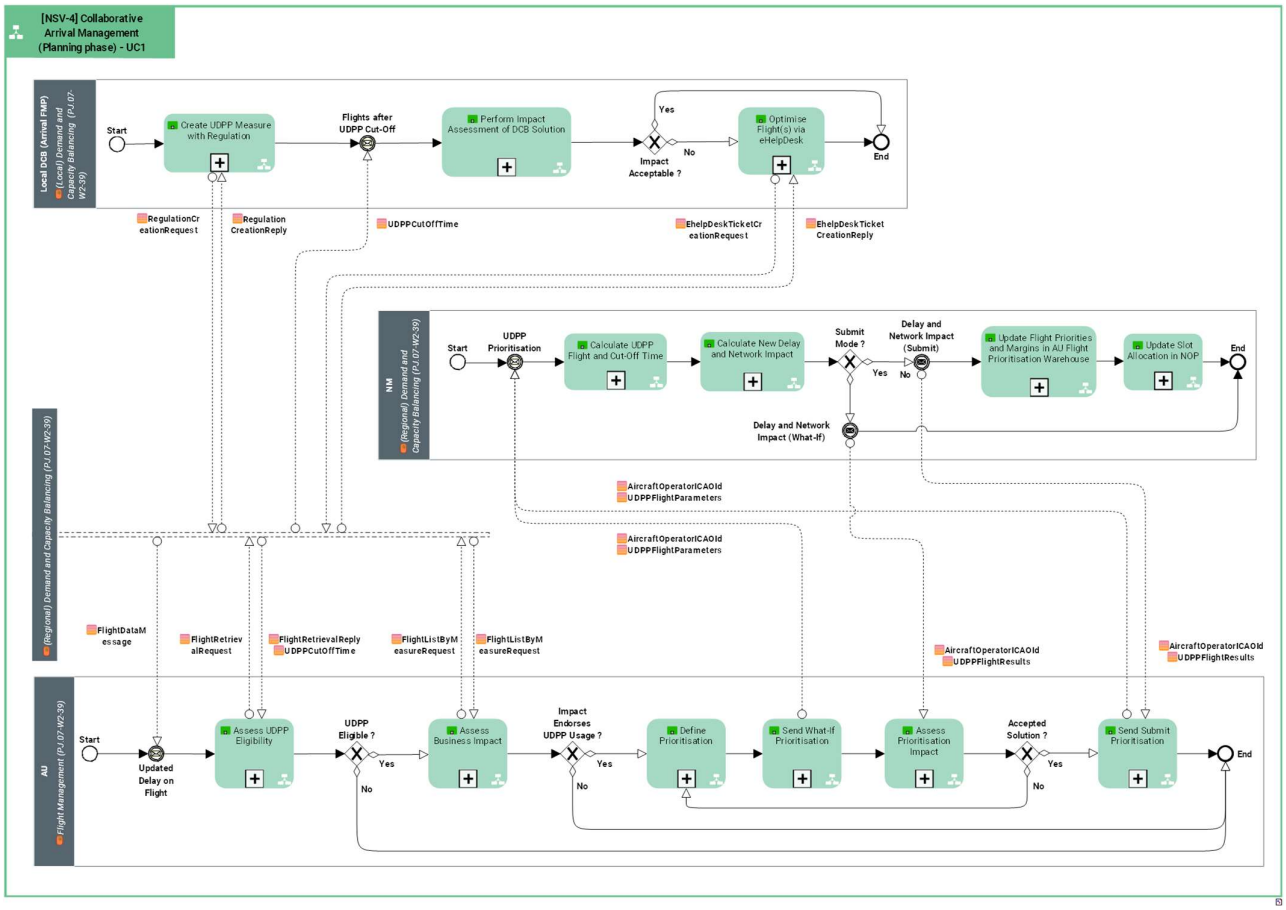

Figure 3: Collaborative arrival management in the planning phase (UC1).

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Role	Functional Block	Function
	Flight Management (PJ.07-W2-39)	Assess Business Impact; Assess Prioritisation Impact; Assess UDPP Eligibility; Define Prioritisation; Send Submit Prioritisation; Send What-If Prioritisation;
	(Local) Demand and Capacity Balancing (PJ.07-W2-39)	Create UDPP Measure with Regulation; Optimise Flight(s) via eHelpDesk; Perform Impact Assessment of DCB Solution;
	(Regional) Demand and Capacity Balancing (PJ.07-W2-39)	Calculate New Delay and Network Impact; Calculate UDPP Flight and Cut-Off Time; Update Flight Priorities and Margins in AU Flight Prioritisation Warehouse; Update Slot Allocation in NOP;

Table 9: Functional blocks and their respective functions.

Function	Description
Assess Business Impact	The AU can assess if the flights concerning a UDPP measure have to be prioritized to decrease the impact of the delay on its fleet.
Assess Prioritisation Impact	AU can assess the impact of new times given by the UDPP functions on its fleet.
Assess UDPP Eligibility	The AU can check if UDPP measures are affecting its flights.
Calculate New Delay and Network Impact	Convert AUs prioritisation to new times according to all AUs prioritisation values and equity rules using reference times and baseline times. This activity implements the UDPP algorithms. Runs a network assessment and update the time on flight if necessary.
Calculate UDPP Flight and Cut-Off Time	This UDPP central function calculates the baseline time, UDPP cut-off time on flights according to the current status of each flight within the UDPP measure.

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Create UDPP Measure with Regulation	If necessary, the local DCB actor, though a NM Function, can initiate UDPP measures to manage the arrival traffic, enabling AUs to mitigate the delay on their flights. The Initial delays, allocated to AUs' flights, are based on ATFCM regulation to allow an equitable solution for AUs.
Define Prioritisation	AU can set prioritisation on flights concerned by a UDPP measure.
Optimise Flight(s) via eHelpDesk	Local DCB can optimize the UDPP measure after flight's UDPP cut-off time through the NMOC eHelpDesk if needed.
Perform Impact Assessment of DCB Solution	Local DCB (as Airport representative and Network representative) can assesses the UDPP arrival times, given by the Submission of the new prioritisation from AUs, by using the NOP and the AOP. If Airport DCB what-if functions exist, they can support the flight optimisation through TTA after flights' UDPP cut-off times.
Send Submit Prioritisation	When AU determines acceptable prioritisation, it can formally submit it to the Network. New times on flights are implemented and be visible through the NOP.
Send What-If Prioritisation	AU can run What-if to evaluate the result of a prioritisation on its flights.
Update Flight Priorities and Margins in AU Flight Prioritisation Warehouse	Priorities and Margins from AUs have to be stored to update the UDPP measure when the measure parameters or the flights within the measure changed/updated.
Update Slot Allocation in NOP	Update the Slot of each flights affected by the new prioritisation, if modified.

Table 10: Description of functions (UC1).

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4.1.4 Resource Composition

4.1.4.1 (Local) ATFCM (PJ.07-W2-39)

Supports the local Air Traffic Flow and Capacity Management functions.

4.1.4.1.1 Composition

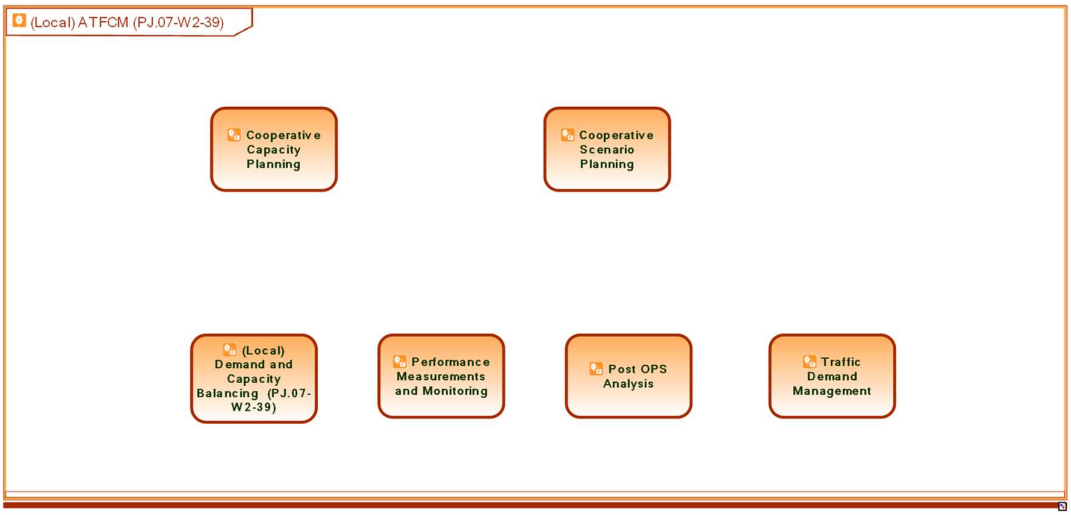

Figure 4: Local ATFCM resource composition. Please click here to see and interact with this diagram.

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4.1.4.2 System Interfaces Diagram

The diagram below is an artifact assembly diagram for the Solution.

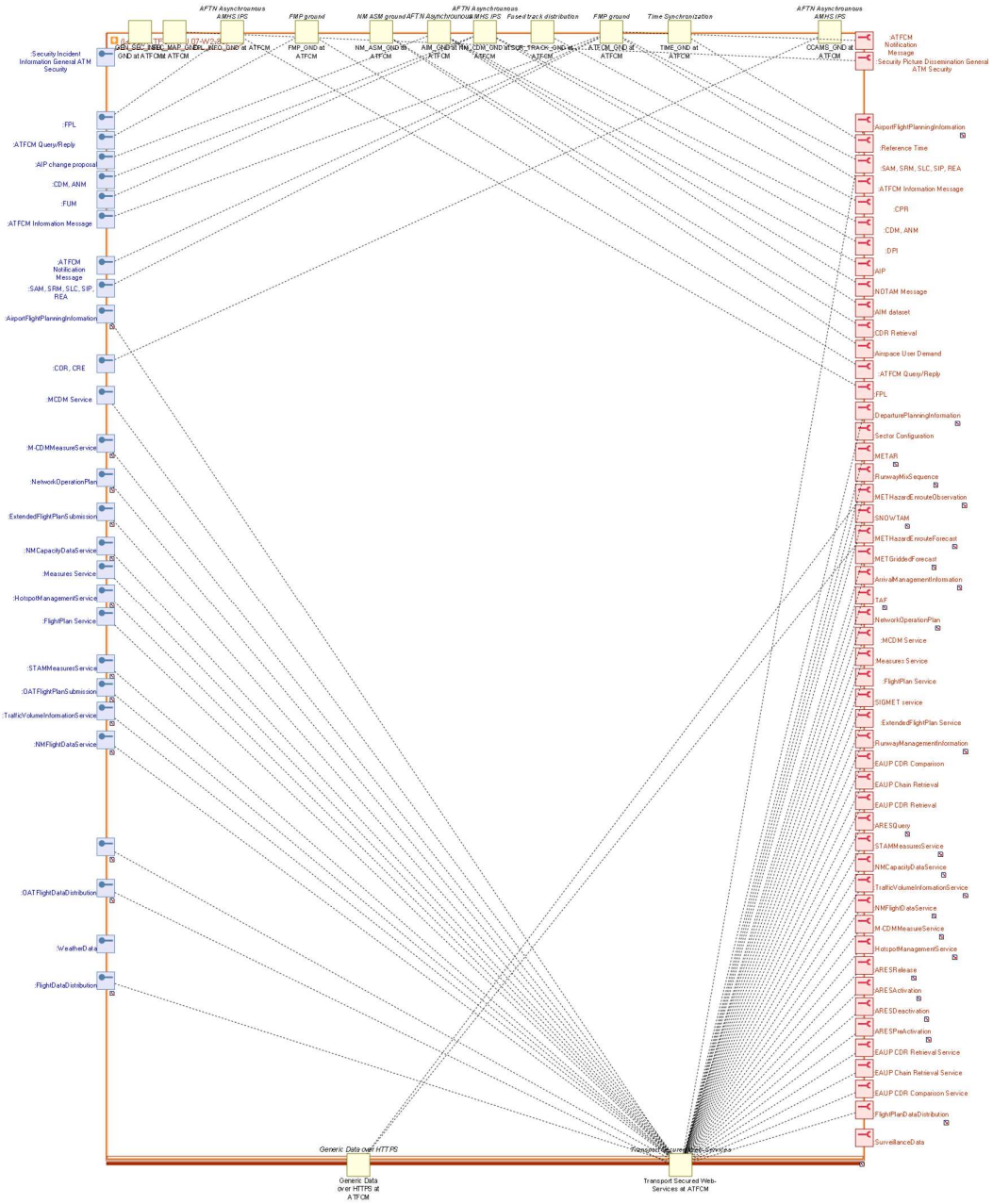

Figure 5: Artifact assembly diagram. Please click here to see and interact with this diagram.

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4.1.4.3 (Regional) ATFCM (PJ.07-W2-39)

Supports the regional Air Traffic Flow and Capacity Management functions.

4.1.4.3.1 Composition

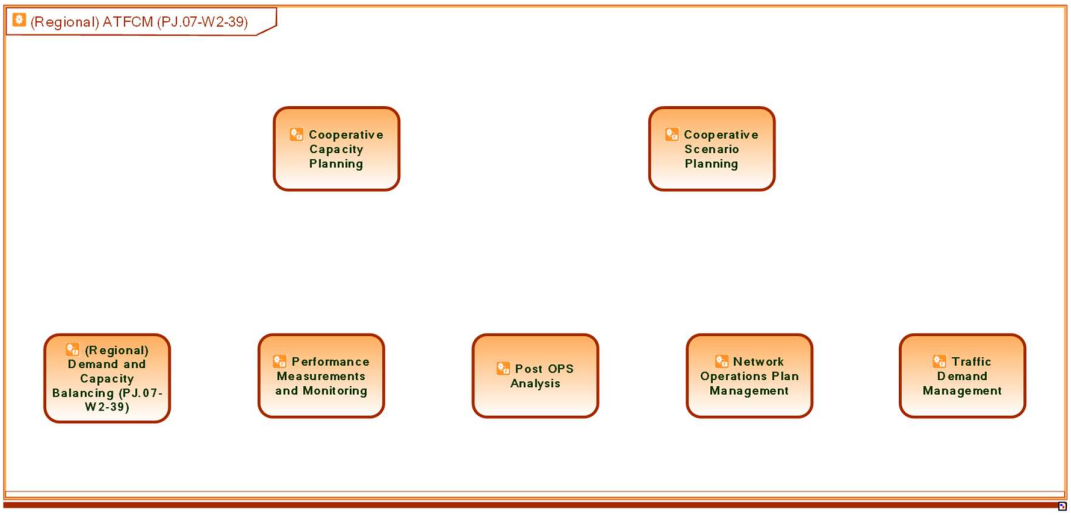

Figure 6: Regional ATFCM resource composition. Please click here to see and interact with this diagram.

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4.1.4.4 System Interfaces Diagram

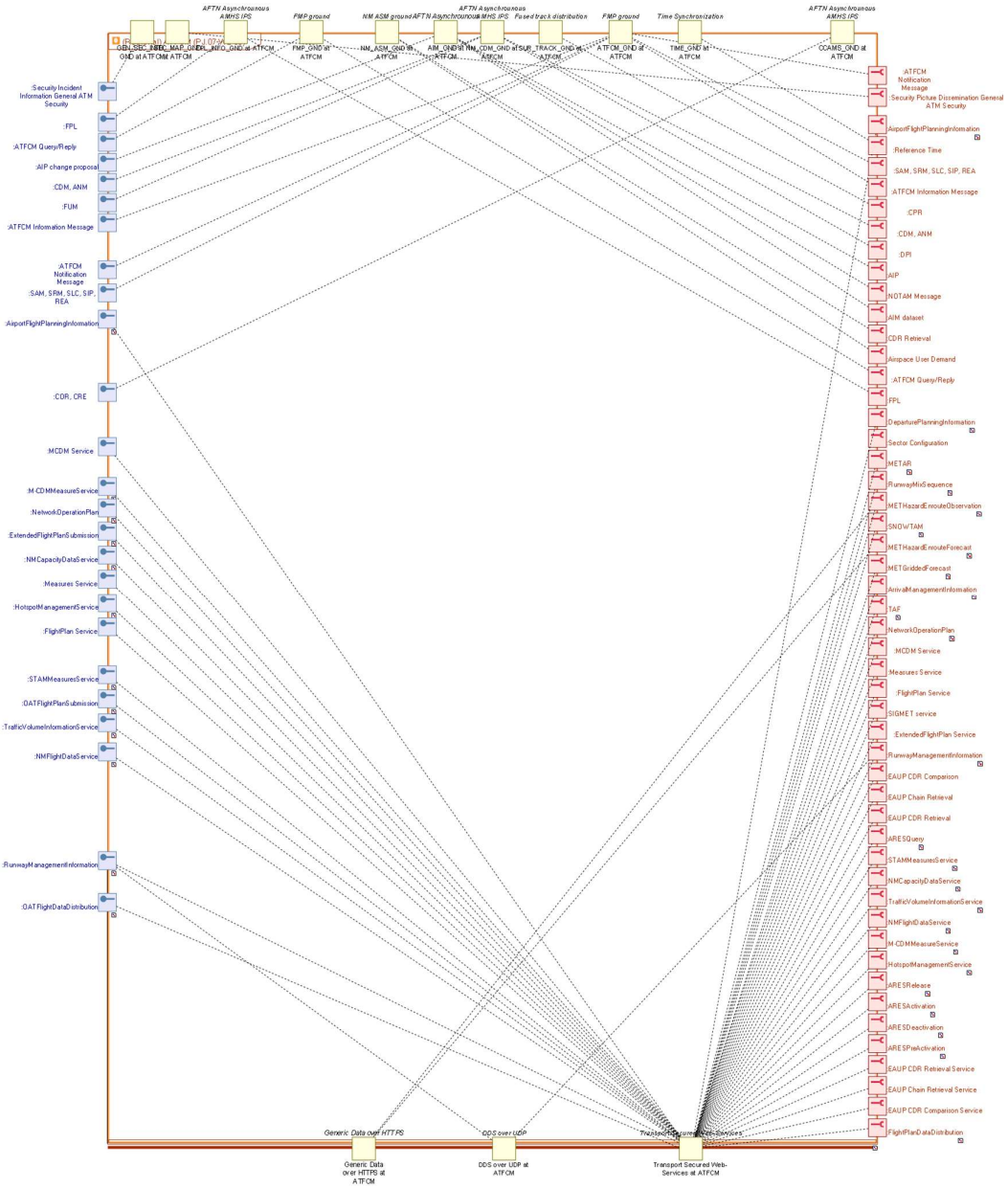

Figure 7: System interfaces diagram. Please click here to see and interact with this diagram.

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4.1.4.5 Civil AU Flight Operations Centre (FOC) (PJ.07-W2-39)

Supports Airspace Users performing manned or unmanned flight operations of civil aircraft (as defined by ICAO).
The FOC Technical System represents the 'Flight Operations' domain as part of the whole operations of the Airspace User. The domain 'Flight Operations' covers all activities that deal with the flights operated by the Airspace Users. These activities refer to the medium- and short-term planning and the execution phases of the flights.

4.1.4.5.1 Composition

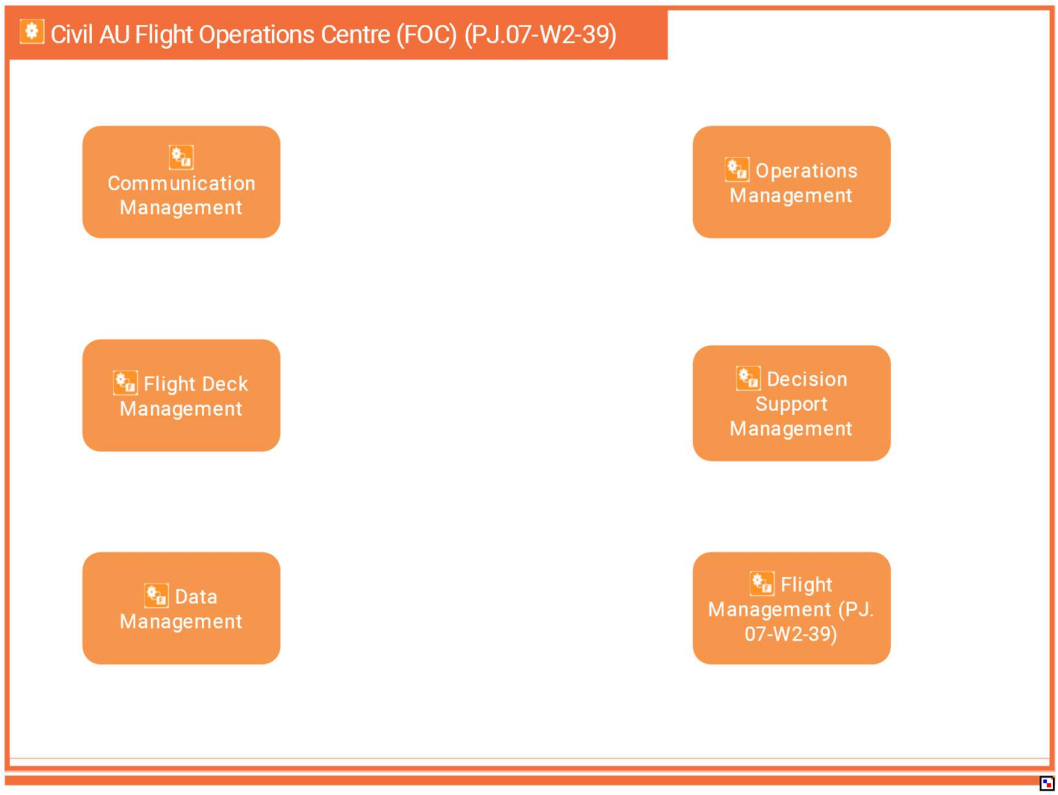

Figure 8: Civil AU flight operations centre (FOC). Please click here to see and interact with this diagram.

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4.1.4.5.3 System Interfaces Diagram

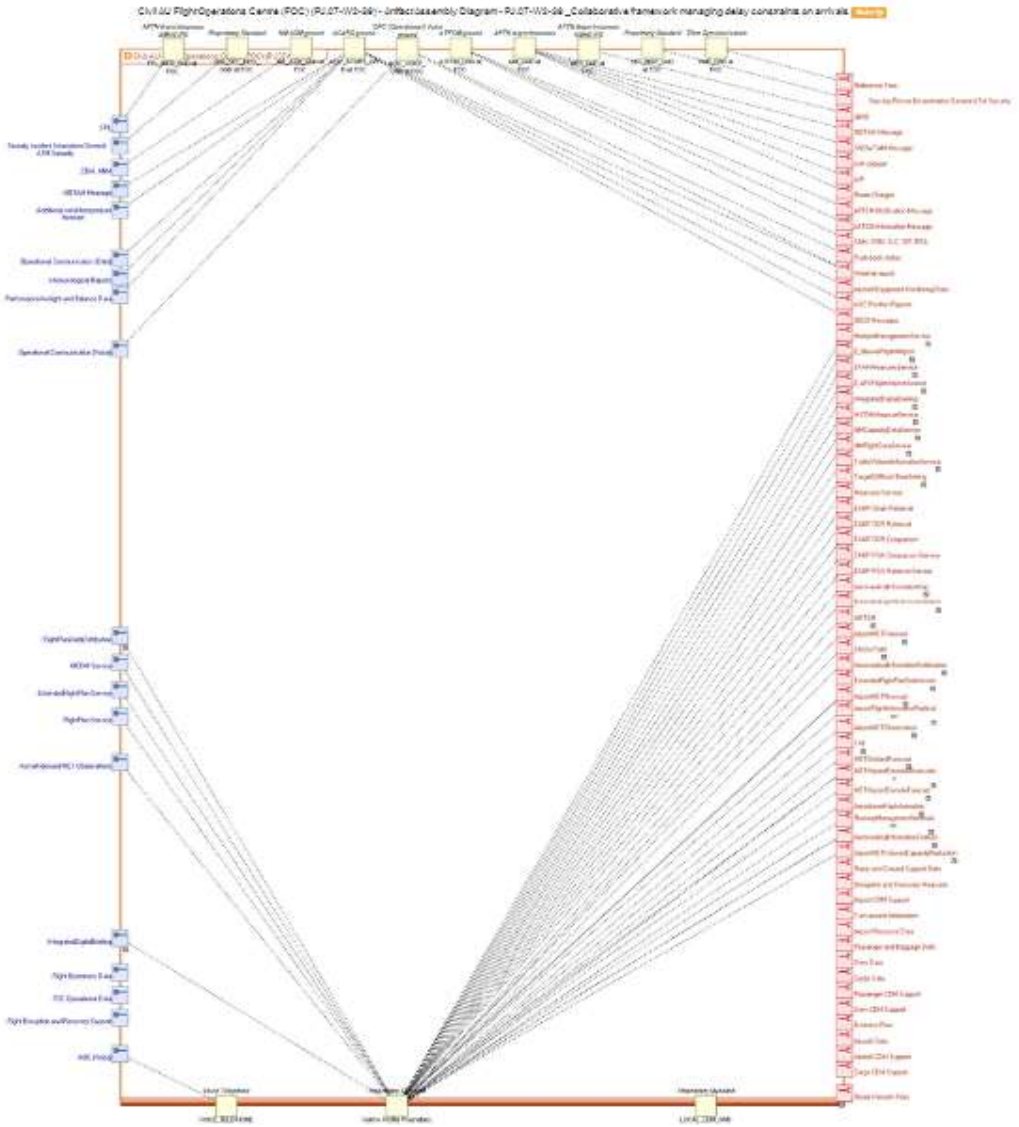

Figure 9: System interfaces diagram. Please click here to see and interact with this diagram.

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4.1.5 Service view

4.1.5.1 Service description

Service	Service description
EhelpDeskManagement	EhelpDeskManagement service allows to submit an Ehelpdesk request via B2B for NMOC to review and accept/reject for a.o. slot swaps, slot improvements, slot extensions, regulation exclusion, force flight …
FlightListManagement	FlighListManagement service allows to retrieve flight lists by certain criteria (AO, Airport, Traffic Volume, Measure ...) and with certain fields to be specified in the request.
FlightPlanDataDistribution	The FlightPlanDataDistribution Service supports the service provider (Network Manager) to: - send a copy of a valid Extended Flight Plan (EFPL) message, Extended Modification (ECHG) message, Extended Delay (EDLA) message to the service consumers concerned by the flight that want to receive extended flight plan messages; - send to all of other service consumers concerned by the flight only a copy of the ICAO Flight Plan included in the EFPL message or a copy of a 'simple' modification (CHG) message or a copy of a 'simple' delay (DLA) message; - notify to the service consumers the cancellation of a specified flight plan; - send a specific Flight Plan (in Extended or ICAO format) following a specific request from a service consumer.
UserDefinedPrioritiesManagement	UserDefinedPrioritiesManagement service allows to send and retrieve airspace user UDPP priorities on flights to NM to be taken into account depending on the type of regulation (flow, cherry picked ...).

Table 11: Service description (UC1).

4.1.5.2 Service Provisioning

Interaction	Consumer CC	Consumer System	Provider CC	Provider System
FlightListManagement.local ATFCM (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC	Local ATFCM (PJ.07-W2-39)		Regional ATFCM (PJ.07-W2-39)	(Regional) ATFCM;
EhelpDeskManagement.Local ATFCM (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC	Local ATFCM (PJ.07-W2-39)	(local) ATFCM;	Regional ATFCM (PJ.07-W2-39)	(Regional) ATFCM;

Interaction	Consumer CC	Consumer System	Provider CC	Provider System
UserDefinedPrioritiesManagement.Local ATFCM (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC	Local ATFCM (PJ.07-W2-39)	(local) ATFCM;	Regional ATFCM (PJ.07-W2-39)	(Regional) ATFCM;
FlightListManagement.Civil AU Operations Centre (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC	Civil AU Operations Centre (PJ.07-W2-39)		Regional ATFCM (PJ.07-W2-39)	(Regional) ATFCM;
UserDefinedPrioritiesManagement.Civil AU Operations Centre (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC	Civil AU Operations Centre (PJ.07-W2-39)	Civil AU Flight Operations Centre (FOC);	Regional ATFCM (PJ.07-W2-39)	(Regional) ATFCM;
FlightPlanDataDistribution.Civil AU Operations Centre (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC	Regional ATFCM (PJ.07-W2-39)	(Regional) ATFCM;	Civil AU Operations Centre (PJ.07-W2-39)	Civil AU Flight Operations Centre (FOC);

Table 12: Service provisioning (UC1).

4.1.5.3 Service Realization

4.1.5.3.1 Interaction EhelpDeskManagement.Local ATFCM (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC

System Port: WS SOAP at Regional ATFCM (PJ.07-W2-39)_CC

Protocol Stack	Protocol
WS SOAP	
	SOAP 1.1 or 1.2
	HTTP 1.1
	TLS 1.2

System Port: IP_GND at Communication Infrastructure_CC

Protocol Stack	Protocol

IP	

System Port: WS SOAP at APP ACC (PJ.07-W2-39)_CC

Protocol Stack	Protocol
WS SOAP	
	SOAP 1.1 or 1.2
	HTTP 1.1
	TLS 1.2

4.1.5.3.2 Interaction FlightListManagement.Civil AU Operations Centre (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC

System Port: WS SOAP at Civil AU Operations Centre (PJ.07-W2-39)_CC

Protocol Stack	Protocol
WS SOAP	
	SOAP 1.1 or 1.2
	HTTP 1.1
	TLS 1.2

System Port: IP_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
IP	

System Port: WS SOAP at Regional ATFCM (PJ.07-W2-39)_CC

Protocol Stack	Protocol
WS SOAP	
	SOAP 1.1 or 1.2
	HTTP 1.1
	TLS 1.2

System Port: IP_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
IP	

4.1.5.3.3 Interaction FlightPlanDataDistribution.Civil AU Operations Centre (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC

System Port: WS SOAP at Civil AU Operations Centre (PJ.07-W2-39)_CC

Protocol Stack	Protocol
WS SOAP	
	SOAP 1.1 or 1.2
	HTTP 1.1
	TLS 1.2

System Port: IP_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
IP	

System Port: WS SOAP at Regional ATFCM (PJ.07-W2-39)_CC

Protocol Stack	Protocol
WS SOAP	
	SOAP 1.1 or 1.2
	HTTP 1.1
	TLS 1.2

System Port: IP_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
IP	

Service Interface Definition
FlightPlanDataConsumer

Service Interface Definition
FlightPlanDataPublisher

Service Interface Definition
FlightPlanProvider

Standard	MEP, Security Configuration, Interface Bindings
FlightPlanProviderInterface.YP.WS SOAP	MEPs Supported: SRR PSPUSH PSPULL Security Configuration: Interface Binding Traceability: REQ-14.01.04-TS-0901.0790 REQ-14.01.04-TS-0901.0795 REQ-14.01.04-TS-0901.0304 REQ-14.01.04-TS-0901.0305 REQ-14.01.04-TS-0901.0325

4.1.5.3.4 Interaction UserDefinedPrioritiesManagement.Civil AU Operations Centre (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC

System Port: WS SOAP at Civil AU Operations Centre (PJ.07-W2-39)_CC

Protocol Stack	Protocol
WS SOAP	
	SOAP 1.1 or 1.2
	HTTP 1.1
	TLS 1.2

System Port: IP_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
IP	

System Port: WS SOAP at Regional ATFCM (PJ.07-W2-39)_CC

Protocol Stack	Protocol
WS SOAP	
	SOAP 1.1 or 1.2
	HTTP 1.1
	TLS 1.2

System Port: IP_GND at Communication Infrastructure_CC

Protocol Stack	Protocol

IP	

4.1.5.3.5 Interaction UserDefinedPrioritiesManagement.Local ATFCM (PJ.07-W2-39)_CC and Regional ATFCM (PJ.07-W2-39)_CC

System Port: WS SOAP at Regional ATFCM (PJ.07-W2-39)_CC

Protocol Stack	Protocol
WS SOAP	
	SOAP 1.1 or 1.2
	HTTP 1.1
	TLS 1.2

System Port: IP_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
IP	

4.2 Functional and non-Functional Requirements

4.2.1 Regional ATFCM Requirements

4.2.1.1 Functional Requirements

[REQ]

Identifier	REQ-S39-TS-NMOP.0001
Title	UDPP functions are available
Requirement	The Regional ATFCM system shall provide the UDPP centralized functions to consider AU prioritisations in the slot allocation process
Status	<Validated>
Rationale	The UDPP functions allow AUs to manage their fleet in a UDPP measure and influence the CASA slot allocation process.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39

<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-NMOP.0001
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Update Flight Priorities and Margins in AU Flight Prioritisation Warehouse Update Slot Allocation in NOP

[REQ]

Identifier	REQ-S39-TS-NMOP.0002
Title	Provide and maintain up-to-date traffic status and constraints
Requirement	The Regional ATFCM system shall provide and maintain up-to-date traffic status and constraints.
Status	<Validated>
Rationale	The Regional ATFCM system shall provide and maintain all data related to traffic status, constraints, and prioritisations, and make them available in timely manner (provision).
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-NMOP.0002 REQ-S39-OPS-NMOP.0003 REQ-S39-OPS-NMUD.0005
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Update Flight Priorities and Margins in AU Flight Prioritisation Warehouse

[REQ]

Identifier	REQ-S39-TS-NMOP.0004
Title	AU prioritisation creation and update
Requirement	The Regional ATFCM system shall centrally enable the AU to privately create, read, update and delete prioritisation information.
Status	<Validated>
Rationale	The Regional ATFCM system shall provide a communication link to the AU to enable the creation, and also privately read update and delete its prioritisation information, in a central prioritisation repository (warehouse).
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-NMOP.0004 REQ-S39-OPS-NMOP.0005 REQ-S39-OPS-NMUD.0010
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Update Flight Priorities and Margins in AU Flight Prioritisation Warehouse

[REQ]

Identifier	REQ-S39-TS-NMOP.0005
Title	AU prioritisation default values
Requirement	The system shall automate the suggestion of Flight Priority and Flight Margin, providing sensible values by default.
Status	<Validated>
Rationale	During the scenarios, it was seen that having the user manually update each flight was time prohibitive.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-NMOP.0004 REQ-S39-OPS-NMOP.0005 REQ-S39-OPS-NMUD.0010
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Update Flight Priorities and Margins in AU Flight Prioritisation Warehouse

[REQ]

Identifier	REQ-S39-TS-NMUD.0001
Title	Prioritisation management function (create, read, update) available to AU
Requirement	The Regional ATFCM system shall centrally enable the AU to privately create, read and update prioritisation information.

Status	<Validated>
Rationale	The Regional ATFCM system shall support the provision by AU of prioritisation information, in a central prioritisation repository (warehouse).
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-NMUD.0001 REQ-S39-OPS-NMUD.0008
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Update Flight Priorities and Margins in AU Flight Prioritisation Warehouse

[REQ]

Identifier	REQ-S39-TS-NMUD.0002
Title	Prioritisation functions implement UDPP algorithm (including equity)
Requirement	The Regional ATFCM system shall implement the UDPP algorithm for its prioritisation functions (including the respect of the equity principle)
Status	<Validated>
Rationale	The Regional ATFCM system shall implement the UDPP algorithm centrally and use it for its prioritisation and slot allocation decisions and, by consequence, respect the equity principle. The impact of such prioritisation in terms of delay shall be visible in the NOP.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-NMUD.0002 REQ-S39-OPS-NMUD.0005 REQ-S39-OPS-NMUD.0009 REQ-S39-OPS-NMUD.0011
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Calculate UDPP Flight and Cut-Off Time

[REQ]

Identifier	REQ-S39-TS-NMUD.0003
Title	Maintain and respect UDPP decision times
Requirement	The Regional ATFCM system shall maintain for each flight the UDPP cut-off time and prohibit any changes in priority past this time.
Status	<Validated>
Rationale	The Regional ATFCM system shall implement the UDPP cut-off time for each flight impacted by UDPP measure and prohibit prioritisation changes past this time.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-NMUD.0003
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Calculate UDPP Flight and Cut-Off Time

[REQ]

Identifier	REQ-S39-TS-NMUD.0006
Title	Maintain and update slot allocation based on prioritisation and network evolution
Requirement	The Regional ATFCM system shall update the slot allocation when the network evolves or at certain key milestones like SIT1 based on the latest flight prioritisations.
Status	<Validated>
Rationale	At SIT1, or when the network evolves after SIT1, the slot is allocated/updated. This shall always consider the latest flight prioritisation.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-NMUD.0006
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Update Slot Allocation in NOP

[REQ]

Identifier	REQ-S39-TS-NMUD.0007
Title	Provide What-If functions to AUs
Requirement	The Regional ATFCM system shall provide one-off What-If prioritisation functions to the AU
Status	<Validated>
Rationale	The AU shall be able to get an idea of the impact of a set of flight prioritisation on the slot allocation without this prioritisation to become persistent.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-NMUD.0007
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Calculate New Delay and Network Impact

4.2.1.2 Non-Functional Requirements

[REQ]

Identifier	REQ-S39-TS-NONF.0001
Title	What-if response time
Requirement	The UDPP functions shall provide the response to **What If** within a limited time (10 sec)
Status	<Validated>
Rationale	AU must be able to evaluate the impact on their flee via what-if function in due time
Category	<Non-Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-07-W2-39-SPRINTEROP-HUMP.P01
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Provide What-If functions to AUs (REQ-S39-TS-NMUD.0007)

[REQ]

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Identifier	REQ-S39-TS-NONF.0002
Title	Submit response time
Requirement	The UDPP functions shall provide the response to **Submit** within limited time (10 sec)
Status	<Validated>
Rationale	AU must be able to evaluate the impact on their flee via Submit function in due time
Category	<Non-Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-07-W2-39-SPRINTEROP-HUMP.P02
< ALLOCATED_TO >	<Enabler>	NIMS-44
<ALLOCATED_TO>	<Function>	Prioritisation management function (create, read, update) available to AU (REQ-S39-TS-NMUD.0001)

4.2.2 APP/ACC Requirements

4.2.2.1 Functional Requirements

[REQ]

Identifier	REQ-S39-TS-LDCB.0001
Title	Ability to monitor demand and capacity on traffic volumes
Requirement	Local DCB tool can monitor the load and capacity of traffic volumes (En-route, Departure Airport, Arrival Airport)
Status	<Validated>
Rationale	This function is for detecting and monitoring DCB issues and support the management of UDPP measure.
Category	<functional >

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39

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<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-LDCB.0001 REQ-S39-OPS-LDCB.0007 REQ-S39-OPS-LDCB.0008
< ALLOCATED_TO >	<Enabler>	NIMS-46B
<ALLOCATED_TO>	<Function>	Perform Impact Assessment of DCB Solution

[REQ]

Identifier	REQ-S39-TS-LDCB.0002
Title	Ability to manage UDPP measure
Requirement	Local DCB tool shall be able to manage a UDPP measure function (creation, read, update, delete)
Status	<Validated>
Rationale	This function is for managing the UDPP measure
Category	<functional >

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-LDCB.0002 REQ-S39-OPS-LDCB.0003 REQ-S39-OPS-LDCB.0004
< ALLOCATED_TO >	<Enabler>	NIMS-46B
<ALLOCATED_TO>	<Function>	Create UDPP Measure with Regulation

[REQ]

Identifier	REQ-S39-TS-LDCB.0003
Title	Optimisation of flights in a UDPP regulation using the eHelpDesk
Requirement	Local DCB tool shall be able to optimise flights in a UDPP regulation by means of eHelpDesk
Status	<Validated>
Rationale	This function is for using eHelpDesk to adjust and optimize the final arrival sequence.

Category	<functional >

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-LDCB.0009
< ALLOCATED_TO >	<Enabler>	NIMS-46B
<ALLOCATED_TO>	<Function>	Optimise Flight(s) via eHelpDesk if necessary

4.2.3 Civil AU Operations Centre Requirements

4.2.3.1 Functional Requirements

[REQ]

Identifier	REQ-S39-TS-OAUF.0001
Title	Provide AU flight details and regulation impact information
Requirement	The Regional ATFCM system shall provide the AU's flight details and regulation impact information
Status	<Validated>
Rationale	The AU needs to know if its flight is impacted by a UDPP regulation and which of its flights are impacted by the same regulation
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-OAUF.0001 REQ-S39-OPS-OAUF.0002 REQ-S39-OPS-OAUF.0003
< ALLOCATED_TO >	<Enabler>	AOC-ATM-18
<ALLOCATED_TO>	<Function>	Assess Business Impact Assess Prioritisation Impact Assess UDPP Eligibility

[REQ]

Identifier	REQ-S39-TS-OAUF.0004

Title	Provide AU the ability to manage its flight prioritisation information
Requirement	The Regional ATFCM system shall provide to the AU the ability to create, read, update and delete the prioritisation information on its flights.
Status	<Validated>
Rationale	The AU needs to be able to create, read, update and delete the prioritisation of its flights.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-OAUF.0004 REQ-S39-OPS-OAUF.0006 REQ-S39-OPS-OAUF.0007
< ALLOCATED_TO >	<Enabler>	AOC-ATM-18
<ALLOCATED_TO>	<Function>	Define Prioritisation Send Submit Prioritisation

[REQ]

Identifier	REQ-S39-TS-OAUF.0005
Title	Provide AU the ability to What-If the impact of its flight prioritisation information
Requirement	The Regional ATFCM system shall provide to the AU the ability to What-If the impact in terms of delay of a set of prioritisation parameters on its flights.
Status	<Validated>
Rationale	The AU needs to be able to evaluate the potential impact of prioritising with a certain set of parameters its flights
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-S39-OPS-OAUF.0005
< ALLOCATED_TO >	<Enabler>	AOC-ATM-18
<ALLOCATED_TO>	<Function>	Define Prioritisation Send What-If Prioritisation

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4.2.3.2 Non-Functional requirements

[REQ]

Identifier	REQ-S39-TS-NONF.0003
Title	AU FOC system responsiveness
Requirement	The AU FOC system integrating the automated assistance for UDPP functionalities shall provide a flight priority combination on a selected objective metric (e.g. Flight Value, Passenger Value) within limited time (20 seconds)
Status	<Validated>
Rationale	AU has to be able to come up with a suggested priority combination within a reasonable timespan
Category	<Non-Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.07-39
<SATISFIES>	<ATMS Requirement>	REQ-07-W2-39-SPRINTEROP-OAUF.004
< ALLOCATED_TO >	<Enabler>	AOC-ATM-18
<ALLOCATED_TO>	<Function>	Provide AU the ability to What-If the impact of its flight prioritisation information (REQ-S39-TS-OAUF.0005)

5 Recommendation for Implementation

5.1 FOC system

5.1.1 Technical requirements

5.1.1.1 MFLOW-CSPEC-2758 F833

The system shall display an Airline Flight List, a list of flights for which a single airline major has responsibility across all airports relevant to the ATFM boundary with the following default data:

Element	Type	Description
Info (Optional)	Icon	Link to additional flight details
Status (Optional)	String	Flight status
ACID	String	Aircraft ID
ADEP	String	Departure airport
ADES	String	Destination airport
AC Type	String	Aircraft type
Most Penalising	String	Name of most Penalizing Regulation
UDPP	Boolean	Boolean (Yes/No) indicating whether a flight is part of a UDPP regulation
ATFM Delay	Number	Amount of delay from most penalising regulation
UDPP Time Remaining	Number	Minutes remaining until UDPP action is no longer allowed
COBT	Time	Controlled Off Block Time
CTOT	Time	Calculated Take-off Time
CLDT (TTA) (Optional)	Time	Controlled Landing Time
CIBT	Time	Controlled In Block Time

5.1.1.2 MFLOW-CSPEC-2759 F848

The system shall highlight flights in the Airline Flight List meeting the following configurable conditions to assist with identifying flights that have a high business impact:

Element	Type	Configuration Options	Default
UDPP	Boolean	Yes or No	Yes
ATFM Delay	Value (minutes)	min: 0	10

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		max: 1440	
UDPP Timeout	Value (minutes)	min: 0 max: 1440	30
Option to include one or any combination of the above in highlighting criteria	Boolean for each option above	One, two or all	All included

5.1.1.3 MFLOW-CSPEC-2521 F763

The system shall display EUROCONTROL data for the following ATFM Measures:

1. ATFM Regulation for Demand Capacity Balancing (DCB) measures with arrival airports as the Reference Location

5.1.1.4 MFLOW-CSPEC-2520 F761

The system shall display UDPP regulations based on the starting character ("U") of the regulation name with the following default data for each regulation:

Element	Type	Definition
Regulation ID	String	Regulation ID
With Effect From (WEF) - Until (UNT)	Time	Regulation start and end times
Number Flights UDPP	Integer	Number of Airspace User's (AU's) flights that have not yet reached their respective UDPP cut-off times
Number Flights All	Integer	Total number of AU's flights within the given regulation
Delay Flights UDPP	Number	Sum of delay of AU's flights that have not reached their respective UDPP cut-off times
Delay Flights All	Number	Sum of delay of Au's totality of flights within the given regulation
Interaction flag	String	Regulation interaction flag. Gives the AU the reminder on the last action on the given UDPP regulation N - Not actioned yet W - What-if performed S - UDPP inputs submitted
Changed	Boolean	"Change since last action" flag. Should denote/highlight any changes in operation since the last W or S action. Should be based on operational data (e.g., change in Baseline vs. UDPP delay) + colour (green/amber/red) based on AU Business from AU prototype or any other criteria/business logic

5.1.1.5 MFLOW-CSPEC-2528 F795

The system shall display the following general data for each UDPP flight in a UDPP Editing View:

Element	Type	Definition
Info column	Icon	Link to additional flight details
Status	String	Flight status
ACID	String	Aircraft ID
AC Type	String	Aircraft type
ADEP	String	Departure airport
Flight Value (Flight Val*) (Optional)	Number	1-10 value; default value = 5
UDPP Cut-Off	Number	Defines end of UDPP eligibility period of a flight
Baseline TOT	Time	Baseline Take-off Time
CLDT (TTA)	Time	Controlled Landing Time (Time to Arrive)
+/-	Number	Scenario UDPP Delay – Baseline UDPP Delay

*Note: The Flight Val is a placeholder for calculating flight value based on other internal airline factors not part of Solution 39. This value can be used in internal algorithms to help find the optimal flights to include in What-If or submitted scenarios.

5.1.1.6 MFLOW-CSPEC-2762 F835

The system shall display the following UDPP Flight Parameters for each UDPP flight as defined in UDPPFlightParameters in a UDPP Editing View:

Element	Type	Definition
IFPLId	String	The IFPS id of the UDPP flight
udppFlightType	String	See F774
timeNotAfter (contextual)	Time	If the CTOT of the flight output by CASA is higher than this value, then CASA will automatically try to swap this flight with another flight from the list (provided it is not protected) to keep all flights before timeNotAfter whenever possible. *Mandatory when udppFlightType = Protect or Margin, shall be null otherwise.*
timeNotBefore (contextual)	Time	When processing a P-flight, the UDPP algorithms will first try to find an available slot between the minimum CTOT and timeNotAfter. If no slot available, the UDPP algorithms will try a holes recovery (possibly improving flights not part of the

		UDPP request) then search again for a slot. The timeNotBefore parameter controls the holes recovery (it will stop as soon as a slot is made available after timeNotBefore). *Optional when udppFlightType = Protect, shall be null otherwise.* *Note: ELTOT is the current Harmony equivalent*
priorityValue (contextual)	Integer	The priority of the flight, 1 = highest priority, then the higher the number the lower the priority. *Mandatory when udppFlightType = Margin or Normal, shall be null otherwise.* *Constraint: when applicable, priorityValue shall be >= 1.*

5.1.1.7 MFLOW-CSPEC-2526 F774

The system shall allow the user to edit UDPP Flight Type on each restricted UDPP flight with the following possible values for UDPPFlightType:

1. Protect (P) - denotes a P-flight. Priority/protection editing is defined further in F773.
2. Margin (M) - denotes a Margin-flight (flight that has Time Not Before and Time Not After values). Margin editing is defined further in F775.
3. DefaultBaseline: denotes a dB-flight
4. Normal: denotes a N-flight

5.1.1.8 MFLOW-CSPEC-2525 F773

The system shall allow the user to edit Fleet Delay Reordering (FDR)/Flight Priority, the priorityValue parameter of UDPPFlightParameters for each restricted UDPP flight with priority assigned by default or on a flight-by-flight basis:

1 (highest priority) to 1000 (lowest priority)

Note: FDR gives airlines ability to choose which flights are assigned to which slot assuming there are several internal airline factors that influence the flight's value. Values of note are: 1 = Protection flight, 500 = Default priority.

5.1.1.9 MFLOW-CSPEC-2527 F775

The system shall allow the user to edit margins on each restricted UDPP flight as part of the UDPPFlightType:

1. Time not Before: specifies a time by which the flight is requested not to be earlier than the value indicated.
2. Time not After: specifies a time by which the flight is requested not to be later than the value indicated.

Note: Gives airlines ability to request a time not before / time not after

5.1.1.10 MFLOW-CSPEC-2530 F797

The system shall store the following UDPP times specific to a flight:

1. Baseline Time - CASA FPFS baseline time
2. UDPP cut-off time - defines end of UDPP eligibility period of a flight: defined as current time less a constant
3. UDPP time - CTOT associated to the UDPP calculated time - calculated time even if not in Submit mode

5.1.1.11 MFLOW-CSPEC-2529 F796

The system shall group the following data to define a What-If scenario:

Scenario Component	Data Element
Identifying Data	ACID Baseline TOT Baseline ATFM Delay (CTOT - STOT)
What-If Data Per Flight	Flight Priority UDPP Flight Type UDPP Time UDPP Delay Delay difference between UDPP Delay and Baseline Delay Time not before Time not after Slot list position Flight value

Note:

Baseline Time is the original non-UDPP slot time (CASA FPFS baseline time)

UDPP Time: UDPP solution CTOT/CTO time returned by the UDPP service

5.1.1.12 MFLOW-CSPEC-2531 F798

The system shall display up to three what-if processing results compared to the baseline including the metrics:

1. What-If Timestamp - Each scenario is identified by a What-If submission timestamp
2. Delay difference – difference between original ATFM delays and UDPP ATFM delays across all flights in the scenario
3. Value difference* - difference between original flight values and across all flights in the scenario
4. No. of priority changes - count of the number of flight priorities that are different
5. No. of ordering changes - count of the number of flights slot list position that is different

*Note: The value difference is a placeholder for calculating flight value based on other internal airline factors not part of Solution 39

5.1.1.13 MFLOW-CSPEC-2740 F841

The system shall display the comparison of the submitted UDPP scenario with the original baseline including the metrics:

1. Total Delay
2. Total Value

5.1.2 NM B2B Interface Requirements

Note: This section's requirements are most likely too low a level of detail for the TS/IRS. These requirements give an approximate idea how the FOC system will collect data from the NM B2B system.

5.1.2.1 MFLOW-CSPEC-2761 F840

The system shall request queryFlightsByMeasure from the NM B2B FlightService for the response fields defined in F756 with the following query parameters:

Element	Needed	Suggested Value	Definition	Default if not specified
MeasureId	Mandatory		Measure id (usually pulled from RegulationList request)	
FlightListByMeasureMode	Mandatory	CONCERNED_BY_MEASURE	Indicates if the reply must contain the flights that are concerned by the given measure or the flights that the measure has impacted (measure activated). For a regulation the concerned flights are those flights that use a regulation slot. However not all of them have an actual delay/have received a slot allocation message (typically exempted flights do not get regulated in a normal regulation (non-exceptional-conditions regulation). For a regulation, the flights that the measure has impacted (measure activated), are a subset of those flights: only those flights that did get a delay (can be 0 minutes) and have/will receive a SAM (Slot Allocation Message).	

5.1.2.2 MFLOW-CSPEC-2760 F834

The system shall request queryFlightsByAircraftOperator from the NM B2B FlightService for the response fields defined in F756 with the following query parameters:

Element	Needed	Suggested Value	Definition	Default if not specified
CountsCalculationType	Optional		Indicates what is the calculation type of the count (entry or occupancy). By default, calculationType is ENTRY.	ENTRY

Note: We assume that the airline for which the FOC system is approved to act on behalf of is configured by the installed EUROCONTROL certificate.

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5.1.2.3 MFLOW-CSPEC-2513 F788

The system shall request RegulationListRequest from the NM B2B FlowService for the response fields defined in F786 and F787 with the following parameters:

Element	Needed	Suggested Value	Definition	Default if not specified
requestedRegulationFields	Mandatory	As defined in F786 and F787	The reply returns only the requested regulation fields in this set, and only if the values of these requested fields are available at NM. Note that the regulation id is always returned. Constraint: Size must be comprised between 0 and 24.	
DateTimeMinutePeriod	Mandatory	0000 prior to effective time start to 0000 following effective time end	To and from datetimes down to the minute	
DataSet	Mandatory	OPERATIONAL		
RegulationState	Optional	APPLIED APPLYING CANCELLING	Selects the regulations with a state that matches an entry in this set. By default, regulations are selected regardless to their state. Constraint: Size must be comprised between 1 and 5.	

5.1.2.4 MFLOW-CSPEC-2515 F757

The system shall subscribe to the following pub-sub NM RegulationMessage queues:

Element	Needed	Suggested Value	Definition	Default if not specified
RegulationMessageFilter				
RegulationPayloadConfiguration		Fields from F787		

Note: For the first connection, the system will need to register for a new connection (create connection). For subsequent connections, the connection will be paused/resumed.

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5.1.2.5 MFLOW-CSPEC-2516 F790

The system shall subscribe to the following pub-sub NM FlightDataMessage queues:

Element	Needed	Suggested Value	Definition	Default if not specified
FlightDataMessageFilter		Aerodromes of Arrival		
FlightDataPayloadConfiguration		As defined in F756		

Note: For the first connection, the system will need to register for a new connection (create connection). For subsequent connections, the connection will be paused/resumed.

5.1.2.6 MFLOW-CSPEC-2562 F803

The system shall submit the following SubmitUDPPRequest What-If parameters from the SubmitUDPP service:

Element (type)	Needed	Suggested Value	Definition	Default if Not Specified
dataset (Dataset)	Mandatory		Dataset on which the UDPP parameters need to be applied	
aircraftOperator (AircraftOperatorICAOId)	Mandatory		Aircraft operator requesting the UDPP measure. The flights referenced by other attributes below must all be operated by this aircraft operator.	
isWhatIf (Boolean)	Mandatory	True	Indicates if the measure should be applied immediately (isWhatIf = False) or if this is just a trial (isWhatIf = True)	
udppFlights (UDPPFlightParameters)	Optional		The list of flights concerned by the UDPP measure. A flight from the same aircraft operator but not included in this list will keep the previous parameters and	

			behave like any other flight (but will keep its previous priority if defined)	

5.1.2.7 MFLOW-CSPEC-2522 F771

The system shall submit the following SubmitUDPPRequest applied parameters from the SubmitUDPP service:

Element (type)	Needed	Suggested Value	Definition	Default if Not Specified
dataset (Dataset)	Mandatory		Dataset on which the UDPP parameters need to be applied	
aircraftOperator (AircraftOperatorICAOId)	Mandatory		Aircraft operator requesting the UDPP measure. The flights referenced by other attributes below must all be operated by this aircraft operator.	
isWhatIf (Boolean)	Mandatory	False	Indicates if the measure should be applied immediately (isWhatIf = False) or if this is just a trial (isWhatIf = True)	
udppFlights (UDPPFlightParameters)	Optional		The list of flights concerned by the UDPP measure. A flight from the same aircraft operator but not included in this list will keep the previous parameters and behave like any other flight (but will keep its previous priority if defined)	

5.1.2.8 MFLOW-CSPEC-2524 F793

The system shall receive the following SubmitUDPPReply parameters from the SubmitUDPP service:

Element (type)	Needed	Suggested Value	Definition	Default if Not Specified
aircraftOperator (AircraftOperatorICAOId)	Mandatory		Aircraft operator requesting the UDPP measure. The flights referenced by other attributes below must all be operated by this aircraft operator.	
isWhatIf (Boolean)	Mandatory		Indicates if the measure should be applied immediately (isWhatIf = False) or if this is just a trial (isWhatIf = True)	
udppFlights (UDPPFlightResults)	Optional		The list of flights concerned by the UDPP measure, along with the resulting CTOT, suspension status and list of regulations.	

5.1.2.9 MFLOW-CSPEC-2775 F855

The system shall submit the following atfcmSituation request parameters from the NM B2B FlowService:

Element (type)	Needed	Suggested Value	Definition	Default if not specified
Dataset	Mandatory	dayOPERATIONAL	Dataset from which the ATFCM situation must be retrieved: i. dayFORECAST ii. dayOPERATIONAL iii. daySIMULATION	
day (DateYearMonthDay)	Mandatory		Day for which the ATFCM situation is requested	

5.1.2.10 MFLOW-CSPEC-2774 F854

The system shall receive the following ATFCMSituation response parameters from the NM B2B FlowService:

Element (type)	Needed	Suggested Value	Definition	Default if not specified
lastUpdated (DateTimeSecond)	Mandatory		Indicates when the ATFCM situation was last updated	
counts (ATFCMSituationCounts)	?		ATFCM situation counts	Need to confirm if needed
delays	Not needed		ATFCM situation delays. Provides additional roll-up info for ATFCM Measures	Not needed - information is
regulations: regulationId period trafficVolumeId regulationState regulationReason delay nrImpactedFlights protectedAerodrome	Mandatory		ATFCM situation regulations - main need is: regulationId delay nrImpactedFlights	

5.2 FMP system

5.2.1 Overview

For a first stage UDPP implementation, no changes are expected to the FMP local system.

At later stages, the idea would be to reinforce the digital communication between the NM and the FMP via B2B services in replacement of the most common use of phone to put in place a regulation (for a Flow Measure or Network Cherry Pick).

5.2.2 B2B interfaces used

In this solution, NM B2B Flow services are not modified. In consequence, the following operational B2B services are used with “normal” parameters:

- RegulationProposalList
- RegulationProposalFiling
- RegulationProposalUpdate
- RegulationProposalRevocation

During the exercises of this solution and as long as the FMP local system is connected to NMVP, it is also possible to use the following NM B2B Flow services (as these services are “trial only” and are involved in a simplified process but are not foreseen to be used in Operation):

- RegulationCreation
- RegulationUpdate
- RegulationCancellation

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5.3 NM system

5.3.1 Definitions

5.3.1.1 P/M/dB/N/B-flights

Please refer to the UDPP document for the definition of P-flights, M-flights, dB-flights, N-flights and B-flights.

5.3.1.2 UDPP flights

A "UDPP flight" is a flight that is contained in the list of flights provided by a UDPP request (via the SubmitUDPP service). It is either a P-flight, M-flight, dB-flight or N-flight.

Remark: B-flights as described in the UDPP document are **not** considered as impacted by the UDPP request (like flights from any other company) and therefore are not UDPP flights. Note that the SubmitUDPP service does not allow the sending of B-flights. One could think that after having set a flight to an N-flight (for instance), it could be interesting to set it back to a B-flight. But this would create some issues regarding equity between companies. E.g., an airline could set a flight as N-flight with high priority, resulting in the improvement of the CTOT of this flight. If, later, this flight would be set back to B-flight, it would keep its "baseline" CTOT (i.e., the improved CTOT after it has been set as a high-priority N-flight) but at the same time, it would "lose" its high priority in benefit of other flights from the UDPP measure, which could be improved as well (which is unfair towards other airlines). This is a restriction of the current implementation because in UDPP concept: baseline is always time without prioritisation on local constraint, moving priority around from an AU perspective (including B-flight) does impact others AUs (except for P-flight) on local constraints and side effects on the network are managed after the local reordering.

5.3.2 Logical view

This section gives an overview of the UDPP processes: purpose, input data (informal), principles and a high-level description of the processing by ETFMS.

5.3.2.1 Scope

The prototype will implement the processing of P-flights, M-flights, dB-flights and N-flights, respecting the main rules described in the UDPP document.

Please note that the algorithms will not be implemented exactly as described in the UDPP document. The UDPP algorithms generally consider the UDPP flights as concerned by only one regulation (the same for all UDPP flights of the request) and disregard the impact of the UDPP request on the other active regulations that the flights might be crossing. The algorithms of the prototype should, on the contrary, consider the impact on the whole network and must avoid creating overloads in the other regulations. For this purpose, they will generally rely on the usual CASA mechanisms (e.g., use the Search_Delay procedure that implements the Most Penalising principle, considers the auto/manual links between regulations, etc…).

The scope also includes the what-if functionality, with some limitations: no slots will be blocked (booked) after a UDPP input is submitted in the what-if context. So, a what-if is just a trial; there is no guarantee that a subsequent UDPP request with the same parameters will get the same results, as the network situation is constantly changing.

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5.3.2.2 Immediate vs Permanent application of a UDPP request

When processing a UDPP request, the prototype will take immediate actions and permanent actions.

Immediate actions: Immediately after reception of the UDPP request, the prototype will attempt to reallocate the flights to satisfy the constraints of P-Flights and M-flights (Time_Not_After) and the new orders for dB-flights and N-flights.

Permanent actions: Once the immediate actions have been taken, the prototype will have to swap the STOs of the N-flights, so that the reordering remains stable. As time goes by, some slots might be freed giving some opportunities of the already allocated flights. If we would not swap the STOs, some flights could be improved not respecting the priorities given by the UDPP request but based on the original priorities. The reordering of the N-flights will be effective until new priorities are given by a new UDPP request.

5.3.2.3 Algorithms

The algorithms will be implemented to satisfy as closely as possible the requirements from the UDPP document but shall be adapted to fulfil the NM commitments towards flow management and safety. To realize this, the chosen solution will be based on the already existing CASA procedure Search_Delay. This procedure already considers the impact of slot allocation on the network by obeying rules such as Most Penalising Principle, auto-link or manual links between regulations, suspension (XCD), etc…

The algorithms are described more in details in section 4.

They need an enhancement of the Search_Delay procedure, also described in detail in section 4.

5.3.2.4 What-If

In what-if mode, the same algorithms should be applied as in the normal context, but it should be applied on a copy of the CASA data structures that will be discarded after reply to the UDPP request. No slots will be blocked (booked).

There are two different approaches to implement the what-if functionality:

Incrementally save each flight just before this flight gets modified by the algorithms, in a “partial” database. At the end of the what-if procedure, restore the original flights from this “partial” database, and restore the linked slots in the regulation database.

- Pros: consumes less memory, and maybe less CPU (but could cost more CPU if a lot of flights are impacted in a knock-down effect).
- Cons: more complex, increased risk of bugs (forgetting to restore something).

Make a complete copy of the flight and regulation (slot list) data structures and apply the algorithms on this copy. At the end of the what-if process, discard (free) this copy.

- Pros: simpler and reduced risk of bugs (operations on the what-if data structure cannot corrupt the operational data structure).
- Cons: more memory consumed.

As the amount of memory used by CASA is relatively low, option b) seems to be the best approach. So, option b) will be implemented, but the memory consumption shall be looked at during testing to validate this approach.

5.3.3 Functional requirements

5.3.3.1 Check the aircraft operator

The system **shall** ignore (remove from the UDPP list of flights) all flights that do not belong to the aircraft operator submitting the request. Note that the operating aircraft operator, if different from the aircraft operator, is not considered in this requirement.

5.3.3.2 Check for pre-allocated / slot issued / suspension flags

The system **shall** ignore (remove from the UDPP list of flights) all flights that are in pre-allocated stage, except in the what-if context. The reason is that the CTOT of these flights is not stable yet, so trying to protect or keep the baseline time of a pre-allocated flight makes little sense and is hardly feasible in a constantly evolving environment. However, it still makes sense in the what-if context as the what-if is a "one-shot" operation, it can be useful for the client to identify potential issues and solutions for the near future.

The system **shall** ignore (remove from the UDPP list of flights) all flights that are in suspended state.

5.3.3.3 Check the cut-off time

The system **shall** ignore all UDPP flights that are after the cut-off time, i.e., when the clock is after OBT – TRS of departure – TRS of arrival.

The purpose of "TRS of arrival" is to leave some time for arrival management to establish the arrival sequence (via API). Normally, it should be airport dependant, but this data is not available yet in ENV, so the system **shall** assume a default TRS of 30 minutes for all arrival airports (system parameter).

5.3.3.4 Unlink the UDPP flights

After the check described above, the system **shall** unlink (i.e., remove the association between a flight and its allocated slots in the crossed regulations) all flights concerned by the UDPP request.

The result of the Unlink procedure is that the associated slots are considered as available until it is linked again to a flight. However, the Unlink procedure doesn't change the CTOT / CTOs in regulations.

5.3.3.5 Reverse Search_Delay (procedure)

The procedure Search_Delay **shall** be enhanced to enable the possibility to search a CTOT backwards, from a Time_Not_After time value backwards to a minimum take-off time (Time_Not_Before or usual Min_CTOT). This will be needed for the management of P and M-flights.

In backwards search mode, in particular:

a) The suspending slots are skipped.

b) The Search_Delay procedure **shall** search a slot in every regulation crossed, backwards.

c) If no slot can be found in at least one regulation between Min_CTOT (or Time_Not_Before) and Time_Not_After, the procedure **shall** return none. It means that no solution has been found for this flight.

d) Otherwise (a slot has been found in all regulations), the Most Penalising Rule applies as usual: the biggest delay (i.e. CTOT closest to Time_Not_After) is kept.

e) Auto-link **shall** be applied as usual. Manual links **shall** be followed backwards.

5.3.3.6 Search_Delay returning a slot already taken by a higher priority flight

When specified, the Search_Delay procedure **shall** consider as "potentially available" a slot already taken by a P or M-flight that is part of the UDPP measure, if this flight has a higher priority:

a) Any P-flight has higher priority than any M-flight.

b) A P-flight has higher priority than any other P-flight with a later Time_Not_After.

c) For M-flights, the priority numbers are used.

"Potentially available" means that the Search_Delay **shall** stop as soon as it encounters such a slot during the search and returns this slot. It doesn't mean that the slot will be taken by the lower priority flight: see procedure Move_Flight_Earlier.

5.3.3.7 Procedure Move_Flight_Earlier

This procedure is described by the following pseudo-code:

```
function move_flight_earlier (being_pushed : Boolean) return slot:
  loop
    slot := Reverse Search_Delay from Time_Not_After backwards to min
CTOT. It may return a slot taken by a higher priority flight.
    if slot /= none
      if slot is available
        take slot and exit loop;
      else (slot taken by a higher priority UDPP flight)
        pushed_ft_slot  :=  move_flight_earlier  (higher_prio_flight,
Time_Not_After => current CTOT – 1s, being_pushed => True)
        if pushed_ft_slot /= none
          take slot and exit loop;
        end if;
        Time_Not_After := CTOT slot – 1s;
      end if;
    elsif P_flight and holes recovery not done yet and not being_pushed
      do_holes_recovery (see remarks below)
    else
      exit loop;
    end if;
  end loop;
  return slot;
end move_flight_earlier;
```

Remarks about holes recovery:

a) Holes Recovery is a procedure done on a per-regulation basis. The order in which the holes recoveries are done is arbitrary.

b) Start time: Usually, in CASA, when the holes recovery is invoked, it starts from the first slot that has been freed after being allocated to a flight, which might not be the first available slot. The same mechanism can be applied here, considering the slots that have been potentially freed by the unlink procedure called at the start of the UDPP processing.

c) End time: The holes recovery shall end as soon as a slot has been freed after Time_Not_Before (F) (translated into an entry time into the regulation for which the holes recovery is performed).

5.3.3.8 Procedure Manage_Flight_Common

This procedure is described by the following pseudo-code:

```
loop
  slot := forward_delay_search; This may return the slot of a higher
priority flight.
  if slot taken by higher prio P or M-flight
    pushed_ft_slot := move_flight_earlier (higher_prio_flight);
    if pushed_ft_slot /= none
      take slot and return;
    else
      new_min_CTOT := CTOT slot + 1s
    end if;
  else (e.g., slot available, or suspension)
    take slot and return;
  end if;
end loop;
```

5.3.3.9 Manage P-flights

After unlinking of all the UDPP flights, the system **shall** process the P-flights first.

Each P-flight **shall** be processed one by one, by increasing Time_Not_After (P-flights with earliest Time_Not_After are processed first).

For each P-flight F:

a) The system **shall** call move_flight_earlier (F, being_pushed => False).

b) If the returned slot /= none, STOP.

c) Else, the system **shall** call Manage_Flight_Common (F).

5.3.3.10 Manage M-flights

The system **shall** manage the M-flights just after the P-flights.

The M-flights will be managed in the same way as P-flights but there are two differences:

a) They are processed by increasing priority number (instead of increasing Time_Not_After).

b) The step about holes recovery **shall** be skipped.

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5.3.3.11 Manage dB-flights

The system **shall** manage the dB-flights just after the M-flights.

Each dB-flight **shall** be processed one by one, by increasing CTOT (dB-flights with earliest CTOT are processed first).

For each dB-flight F, the system **shall** call Manage_Flight_Common (F) with minimum take-off time = current CTOT (the delay search starts from current CTOT).

5.3.3.12 Manage N-flights

The system **shall** manage the N-flights just after the dB-flights.

Each N-flight **shall** be processed one by one, by increasing priority number (N-flights with smallest priority numbers are processed first).

For each N-flight F, the system **shall** call Manage_Flight_Common (F) with the usual minimum take-off time.

5.3.4 B2B Interface changes

The data types and request/replies are to be implemented in Flight Services.

The submitUDPP and queryUDPP services are to be implemented as FlightManagement services.

Role: Airspace User

5.3.4.1 RevisionTimes (changed data type)

A new attribute shall be added to this data type, after the timeToRemoveFromSequence:

DateTimeMinute udppCutOffTime *(Optional)*

The latest time at which the CTOT of a flight can be changed by a UDPP measure. This deadline gives some margin to arrival management (if any) to establish/correct the arrival sequence via the Take-Off API service.

5.3.4.2 udppFlightType (new enumeration)

Possible values:

a) **Protect**: denotes a P-flight.

b) **Margin**: denotes an M-flight.

c) **Default_Baseline**: denotes a dB-flight.

d) **Normal**: denotes an N-flight.

5.3.4.3 UDPPFlightParameters (new data type) <abstract>

A flight identification along with the UDPP parameters for this flight.

Attributes:

IFPLId ifplId *(Mandatory)*

The IFPS id of the UDPP flight.

5.3.4.4 UDPPFlightParametersProtect (new data type)

Inherits UDPPFlightParameters

Attributes:

DateTimeMinute timeNotAfter *(Mandatory)*

If the CTOT of the flight output by CASA is higher than this value, then CASA will automatically try to swap this flight with another flight from the list (provided it is not protected) to keep all flights before timeNotAfter whenever possible.

Mandatory when udppFlightType = Protect or Margin, shall be null otherwise.

DateTimeMinute timeNotBefore *(Optional)*

When processing a P-flight, the UDPP algorithms will first try to find an available slot between the minimum CTOT and timeNotAfter. If no slot available, the UDPP algorithms will try a holes recovery (possibly improving flights not part of the UDPP request) then search again a slot. The timeNotBefore parameter controls the holes recovery (it will stop as soon as a slot is made available after timeNotBefore).

Optional when udppFlightType = Protect, shall be null otherwise.

5.3.4.5 UDPPFlightParametersMargin (new data type)

Inherits UDPPFlightParameters

Attributes:

DateTimeMinute timeNotAfter *(Mandatory)*

If the CTOT of the flight output by CASA is higher than this value, then CASA will automatically try to swap this flight with another flight from the list (provided it is not protected) in order to keep all flights before timeNotAfter whenever possible.

Mandatory when udppFlightType = Protect or Margin, shall be null otherwise.

int priorityValue *(Mandatory)*

The priority of the flight, 1 = highest priority, then the higher the number the lower the priority.

Mandatory when udppFlightType = Margin or Normal, shall be null otherwise.

Constraint: when applicable, priorityValue shall be >= 1.

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5.3.4.6 UDPPFlightParametersDefaultBaseline (new data type)

Inherits UDPPFlightParameters

5.3.4.7 UDPPFlightParametersNormal (new data type)

Inherits UDPPFlightParameters

Attributes:

int priorityValue *(Mandatory)*

The priority of the flight, 1 = highest priority, then the higher the number the lower the priority.

Mandatory when udppFlightType = Margin or Normal, shall be null otherwise.

Constraint: when applicable, priorityValue shall be >= 1.

5.3.4.8 UDPPFlightResults (new data type)

Attributes:

UDPPFlightParameters udppFlightParams *(Mandatory)*

Contains the flight identification and the UDPP parameters of a flight part of a UDPP measure.

DateTimeMinute newCTOT *(Optional)*

The new CTOT of the flight as a result of the UDPP measure.

RegulationId mostPenalisingRegulation *(Optional)*

The most penalising regulation as a result of the UDPP measure.

SuspensionStatus newSuspensionStatus *(Mandatory)*

The new suspension status of the flight as a result of the UDPP measure.

FlightRegulationLocation [] regulations *(Optional)*

List of regulations impacting the flight after application of the UDPP measure.

5.3.4.9 SubmitUDPP (new service)

5.3.4.9.1 SOAP

The associated SOAP operation is:

SubmitUDPPReply SubmitUDPP (SubmitUDPPRequest request)

5.3.4.9.2 SubmitUDPPRequest

Request to submit a set of UDPP parameters for a set of flights.

Inherits from: Request

Attributes:

Dataset dataset *(Mandatory)*

Dataset on which the UDPP parameters need to be applied.

AircraftOperatorICAOId aircraftOperator *(Mandatory)*

Aircraft operator requesting the UDPP measure. The flights referenced by other attributes below must all be operated by this aircraft operator.

Boolean isWhatIf *(Mandatory)*

Indicates if the measure should be applied immediately (isWhatIf = False) or if this is just a trial (isWhatIf = True).

UDPPFlightParameters [ ] udppFlights *(Mandatory)*

The list of flights concerned by the UDPP measure. A flight from the same aircraft operator but not included in this list will keep the previous parameters and behave like any other flight (but it will keep its previous priority if defined).

5.3.4.9.3 SubmitUDPPReply

Reply to eurocontrol.cfmu.cua.b2b.flight.SubmitUDPPRequest

Inherits from: Reply

Attributes:

SubmitUDPPReplyData data *(Optional)*

The reply data for eurocontrol.cfmu.cua.b2b.flight.SubmitUDPPReply.

5.3.4.9.4 SubmitUDPPReplyData

The reply data of eurocontrol.cfmu.cua.b2b.flight.SubmitUDPPReply

Attributes:

AircraftOperatorICAOId aircraftOperator *(Mandatory)*

Aircraft operator requesting the UDPP measure.

Boolean isWhatIf *(Mandatory)*

Indicates if the measure has been applied immediately (isWhatIf = False) or if this is just a trial (isWhatIf = True).

UDPPFlightResults [ ] udppFlights *(Optional)*

The list of flights concerned by the UDPP measure, along with the resulting CTOT, suspension status and list of regulations.

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5.3.4.10 QueryUDPP (new service)

5.3.4.10.1 SOAP

The associated SOAP operation is:

QueryUDPPReply QueryUDPP (QueryUDPPRequest request)

5.3.4.10.2 QueryUDPPRequest

Request the list of flights concerned by a UDPP measure with associated information.

Inherits from: Request

Attributes:

Dataset dataset *(Mandatory)*

Dataset from which the UDPP flights need to be retrieved.

AircraftOperatorICAOId aircraftOperator *(Mandatory)*

Aircraft operator having requested the UDPP measure.

5.3.4.10.3 QueryUDPPReply

Reply to eurocontrol.cfmu.cua.b2b.flight.QueryUDPPRequest

Inherits from: Reply

Attributes:

QueryUDPPReplyData data *(Optional)*

The reply data for eurocontrol.cfmu.cua.b2b.flight.SubmitUDPPReply.

5.3.4.10.4 QueryUDPPReplyData

The reply data of eurocontrol.cfmu.cua.b2b.flight.QueryUDPPReply

Attributes:

AircraftOperatorICAOId aircraftOperator *(Mandatory)*

Aircraft operator having requested the UDPP measure.

UDPPFlightResults [ ] udppFlights *(Optional)*

The list of flights concerned by the UDPP measure, along with the resulting CTOT, suspension status and list of regulations.

6 Assumptions

None

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7 References and Applicable Documents

7.1 Applicable Documents

Content Integration

[1] B.04.01 D138 EATMA Guidance Material

- EATMA Community pages
- SESAR ATM Lexicon, https://ext.eurocontrol.int/lexicon/index.php/SESAR

Content Development

-

System and Service Development

- SESAR 2020 Requirements and Validation Guidelines

Performance Management

-

Validation

-

System Engineering

-

Safety

-

Human Performance

-

Environment Assessment

-

Security

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7.2 Reference Documents

- ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS

-END OF DOCUMENT-

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