S01V3 Final INTEROP

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Abstract

This document collects Final INTEROP requirements according to the results obtained in the validation exercise EXE-06.08.04-VP-453 and associated to the operational services of the Coupled AMAN/DMAN function as described in the P06.08.04.D17 – S01V3 Final OSED v00.01.00 [11] and with the safety and performance requirements described in P06.08.04 D18 – S01V3 Final SPR v00.01.00 [12].

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Rational for rejection
None.

Document History

Edition	Date	Status	Author	Justification
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00.00.02	17/03/2015	Draft		Updated figures in section 2 according to new IER requirements
00.00.03	19/03/2015	Draft		Updated with ENAV and DSNA input
00.00.04	16/04/2015	Draft		Traceability to S1V3 OSED and SPR added for internal and external review
00.01.00	04/05/2015	Final		Updated Draft integrating internal and external review comments and ready for approval
00.01.01	22/07/2015	Final		Updated according to SJU comments

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This deliverable consists of SJU foreground.

Table of Contents

List of figures

Executive summary

This INTEROP document provides P06.08.04 S1V3 Final INTEROP interoperability requirements for Step 1 Coupled AMAN/DMAN concept.

The following operational improvement steps (as described in DS13) are addressed by this INTEROP:

- **Solution #53 'Pre-Departure Sequencing supported by Route Planning'**

  TS-0202 - Pre-Departure Sequencing supported by Route Planning

- **Solution #54 'Flow based Integration of Arrival and Departure Management'**

  TS-0308 - Flow based Integration of Arrival and Departure Management

In Step 1 a master/slave configuration has been identified as coupling solution, where AMAN acts as master leading to an optimization of traffic flows (coupled pre-departure sequencing and arrival metering) rather than to provide a detailed integrated arrival/departure sequence (i.e. flow based integration). The complete integration will be addressed in Step 2.

The integration between departure management and surface management is considered as well since it is seen as a pre-requisite for achieving an efficient coupled AMAN/DMAN.

It should be noted that this document is the update of 06.08.04.D80 S01V2 Preliminary INTEROP according to the results obtained in EXE-06.08.04-VP-453, which has been collected in its VALR [10] and coordinated with 06.08.04.D17 – S01V3 Final OSED [11] and 06.08.04.D18 – S01V3 Final SPR [12].

1 Introduction

1.1 Purpose of the document

The purpose of an INTEROP document is to provide interoperability requirements for air traffic management services (ATS). The INTEROP is used to define the minimum technical and functional requirements that provide the basis for ensuring compatibility among identified elements of the CNS/ATM system using a specific technology imposed as a design constraint (therefore captured as a requirement). These elements comprise the distributed CNS services and ATS applications in the aircraft system, the CNS service providers' system and the ATS provider system.

As the aim of this document is to focus on the interactions of the AMAN and the DMAN function with their surrounding identified elements of the CNS/ATM system (ATCO, Routing and Planning Function, Airspace User), identifying both the interactions between AMAN and DMAN to work in a coupled way and their interaction with the rest of actors involved.

In the figure below the location of the OSED and INTEROP is depicted within the hierarchy of SESAR concept documents, together with the SESAR Work Package or Project responsible for their maintenance.

The present INTEROP document collects and incorporates the results obtained in EXE-06.08.04-VP-453 which closes Phase 1 of the project (Step 1 V3 Coupling Arrival and Departure Management) [10].
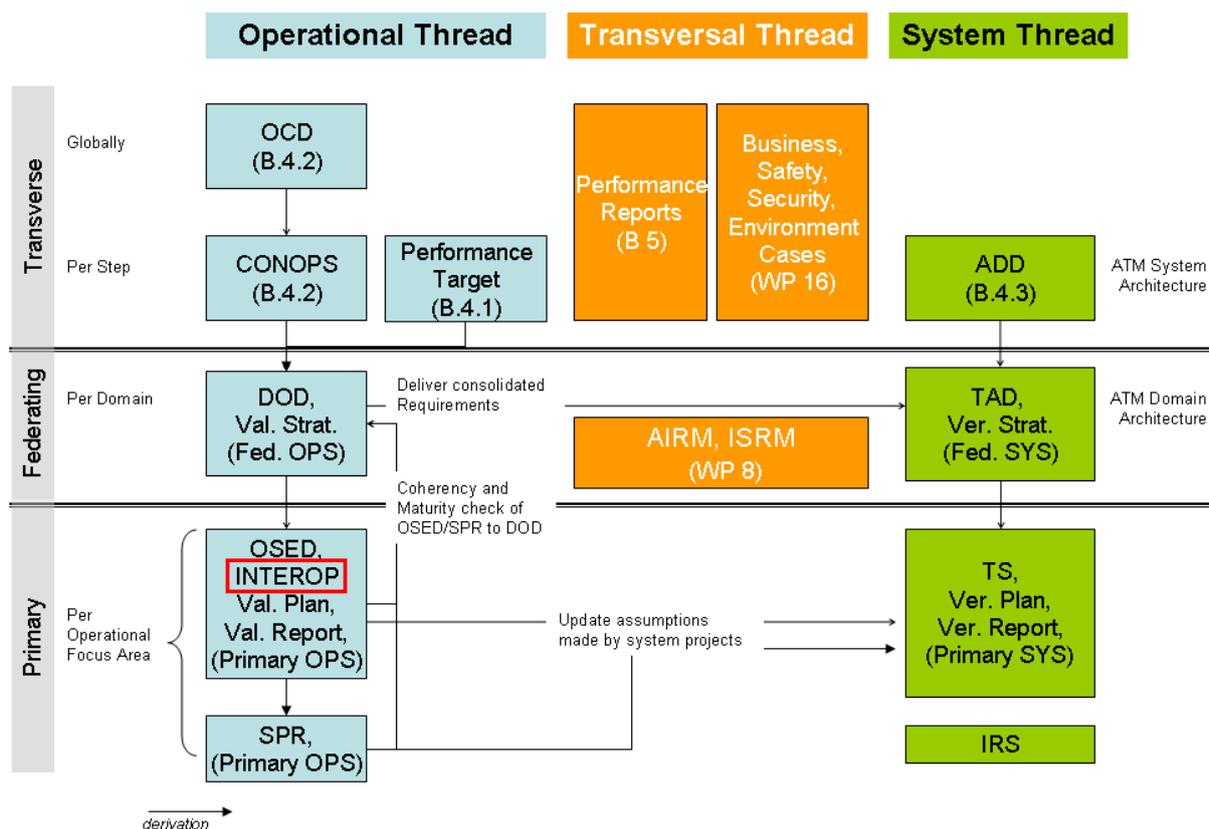

Figure 1: Flow of documentation overview [PMP]

The scope of the document is to ensure and demonstrate that the systems supporting the concept developed in 06.08.04 can meet the relevant interoperability requirements for the operational services described in the Final OSED [11], following the approach described in Figure 1 above.

The interoperability requirements collected in the present document are related to the main services expected to be provided by the Coupled AMAN/DMAN function for STEP 1 of the project:

- RunwayMixSequence service
- CalculatedPreDepartureSequenceDelivery service

This Final INTEROP contributes to the Operational Focus Area OFA04.01.01 "Integrated AMAN/DMAN" as part of the Operational Sub Package "SPC04.01 Traffic Synchronisation" of the Operational Package "PAC04 End to End Traffic Synchronisation". The hierarchy of the main operational deliverables within SESAR and their relation with the present INTEROP is presented in Figure 2 below.
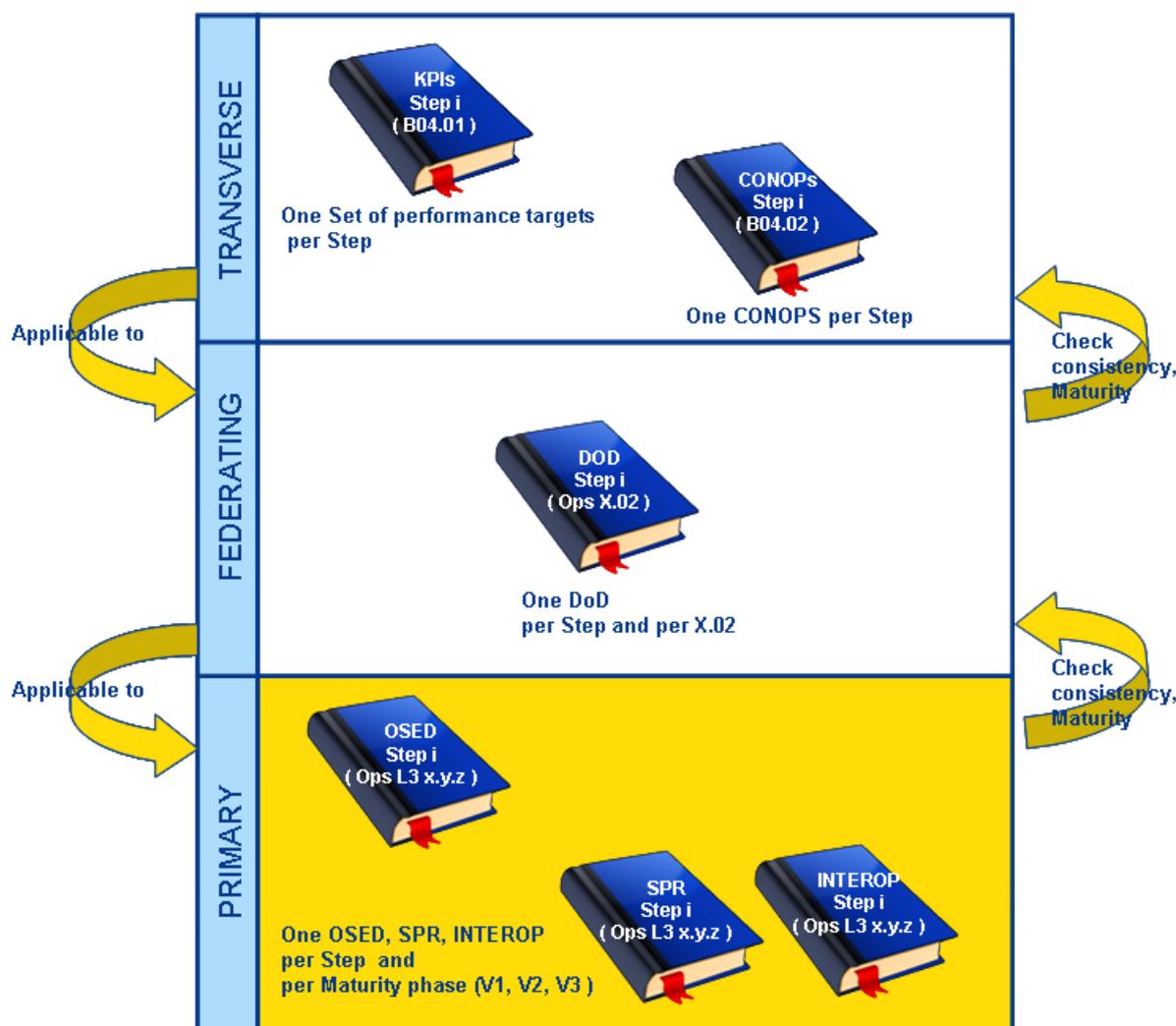

Figure 2: INTEROP document with regards to other SESAR deliverables

1.2 Intended readership

Following projects could be interested in this Final INTEROP document:

- P06.08.04 (Coupled Arrival and Departure Management) for continuing to work with the Coupled AMAN/DMAN concept development

- P06.07.02 (A-SMGCS Routing and planning) and P06.07.03 (A-SMGCS Guidance) as a full integration between departure management and Routing and Planning service is expected to optimize the departing traffic flow;

- P12.04.04 (Integration of Departure Management and Surface Management), as the interoperability requirements related to the integration between departure and surface management have to be considered for future prototypes development;

- P10.09.01 (Integration of Queue Management) to provide the reference set of AMAN/DMAN interoperability requirements describing a basis for further operational improvements;

- P10.04.04 (Time Based Separation) as TBS was used in one scenario in coupled AMAN/DMAN.

- 06.02 for coordination and consolidation of operational concept definition and validation work.

- WP08 for consolidation.

- WPB, transverse and federating projects for architecture and performance modelling;

- And, more generally, the SESAR JU community.

1.3 Inputs from other projects

All the inputs to the current document come from other 06.08.04 Deliverables.

1.4 Glossary of terms

Term	Definition	Source
AFI – Arrival Free Interval	*An AFI describes the standard amount of nautical miles (NM) to be maintained between two consecutive arrivals in order to process one or more departures in between. Internal to the system, those Nautical Miles shall have to be converted into times to be used by DMAN.AFI*	*Internal 6.8.4*
Arrival Manager (AMAN)	*AMAN is a planning system to improve arrival flows at one or more airports by calculating the optimised approach / landing sequence and Target Landing Times (TLDT) and where needed times for specific fixes for each flight, taking multiple constraints and preferences into account.*	*ATM-Lexicon*
A-SMGCS (Advanced – Surface Movement Guidance and Control System)	*A system providing routing, guidance and surveillance for the control of aircraft and vehicles in order to maintain the declared surface movement rate under all weather conditions within the aerodrome visibility operational level (AVOL) while maintaining the required level of safety.*	*ATM-Lexicon*
Departure Manager (DMAN)	*DMAN is a planning system to improve departure flows at one or more airports by calculating the Target Take Off Time (TTOT) and Target Start Up Approval Time (TSAT) for each flight, taking multiple constraints and preferences into account.*	*ATM-Lexicon*
EOBT	*The estimated time at which the aircraft will commence movement associated with departure.*	*ATM-Lexicon*
EXOP	*The estimated Outbound Taxi (EXOP) is the Expected Taxi Period from Off-Block to Runway Holding Point (with no buffer or delay)*	*To be added to ATM-Lexicon*
EXOT	*The Estimated taxi Out Time (EXOT) is the estimated taxi time between off-block and take-off. This estimate includes*	*ATM-Lexicon*

Term	Definition	Source
	any delay buffer time at the holding point or remote de-icing prior to take off.	
Push-Back	*Movement of an aircraft on the ground consisting of leaving the parking area in reverse motion as far as alignment on the taxiway.*	*To be added to ATM-Lexicon*
Sequence Pattern	*The order in which aircraft are planned to use the RWY (either take-off or landing) describes the RWY sequence.* *Only looking at the departing aircraft describes the DEP sequence and only looking at the arriving aircraft describes the ARR sequence.*	*Internal 6.8.4*
TOBT	*The time that an aircraft operator / handling agent estimates that an aircraft will be ready, all doors closed, boarding bridge removed, push back vehicle present, ready to start up / push back immediately upon reception of clearance from the TWR.*	*ATM-Lexicon*
TSAT	*The time provided by ATC taking into account TOBT, CTOT and/or the traffic situation that an aircraft can expect start-up / push-back approval* *Note: The actual start up approval (ASAT) can be given in advance of TSAT*	*ATM-Lexicon*
TTOT	*An ATM computed take off time. It is not a constraint but a progressively refined planning time that is used to: - refine the departure airport sequencing and optimization of RWY throughput - plan the take-off in order to achieve targets at the destination and during flight, whilst maintaining optimum flight efficiency.*	*ATM-Lexicon*

1.5 Acronyms and Terminology

Term	Definition
A-CDM	Airport Collaborative Decision Making
AFI	Arrival Free Interval
ANSP	Air Navigation Service Provider
AMAN	Arrival MANagement
AOC	Airline Operations Centre
APP	APProach
ARR	ARRival

Term	Definition
ASAT	Actual Start-up Approval Time
A-SMGCS	Advanced Surface Movement Guidance and Control System
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATS	Air Traffic Services
AU	Airspace User
CDM	Collaborative Decision Making
CFMU	Central Flow Management Unit
CNS	Communication, Navigation & Surveillance
CTOT	Calculated Take-Off Time
DEP	DEParture
DFS	Deutsche FlugSicherung
DMAN	Departure MANagement
DPI	Departure Planning Information
ELDT	Estimated Landing Time
EOBT	Estimated Off-Block Time
EXE	Exercise
EXOP	Estimated Taxi Out Time
EXOT	Estimated Taxi Out Period
FUM	Flight Update Message
HMI	Human Machine Interface
INTEROP	Interoperability Requirements
ICAO	International Civil Aviation Organization
IOP	InterOPerability
KPI	Key Performance Indicator
NM	Nautical Miles

Term	Definition
OFA	Operational Focus Areas
OSED	Operational Service and Environment Definition
REQ	REQuirement
RPF	Routing and Planning Function
RWY	RunWaY
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SPR	Safety and Performance Requirements
TAD	Technical Architecture Description
TLDT	Target LanDing Time
TOBT	Target Off-Block Time
TSAT	Target Start-up Approval Time
TTOT	Target Take-Off Time
V&V	Validation & Verification

2 System Description

In order to identify the different functions of the ATM system which support the Arrival/Departure Management Functions, a very high-level description of the process has been defined in Figure 3. The stakeholders of the ATM system that interact in a direct way with these functions are:

- From the Airspace User:

    o The Flight Operations Centre

    o The Ground Handling Agent

- From the Airport Airside Operations

    o The Apron Manager

- From the Network Manager Operations:

    o The European Network Manager

- From the Air Traffic Services Operations

    o The Executive Controller (approach)

    o The ACC/Approach Supervisor

    o The Tower Runway Controller

    o The Airport Tower Supervisor

    o The Tower Clearance Delivery Controller

    o The Routing and Planning Function

All these stakeholders involved (except the Routing and Planning function) are listed according to latest Step 1 ConOPS [8] Appendix C "Actors, Roles and Responsibilities".

Once the different elements have been identified, a time-evolution explanation of the different interactions will follow. This explanation has been organised in following steps:

- input data received by the Arrival Management Function (Figure 4),

- input data received by the Departure Management Function (Figure 5),

- data sent by the Arrival Management Function (Figure 6),

- data sent by the Departure Management Function (Figure 7)

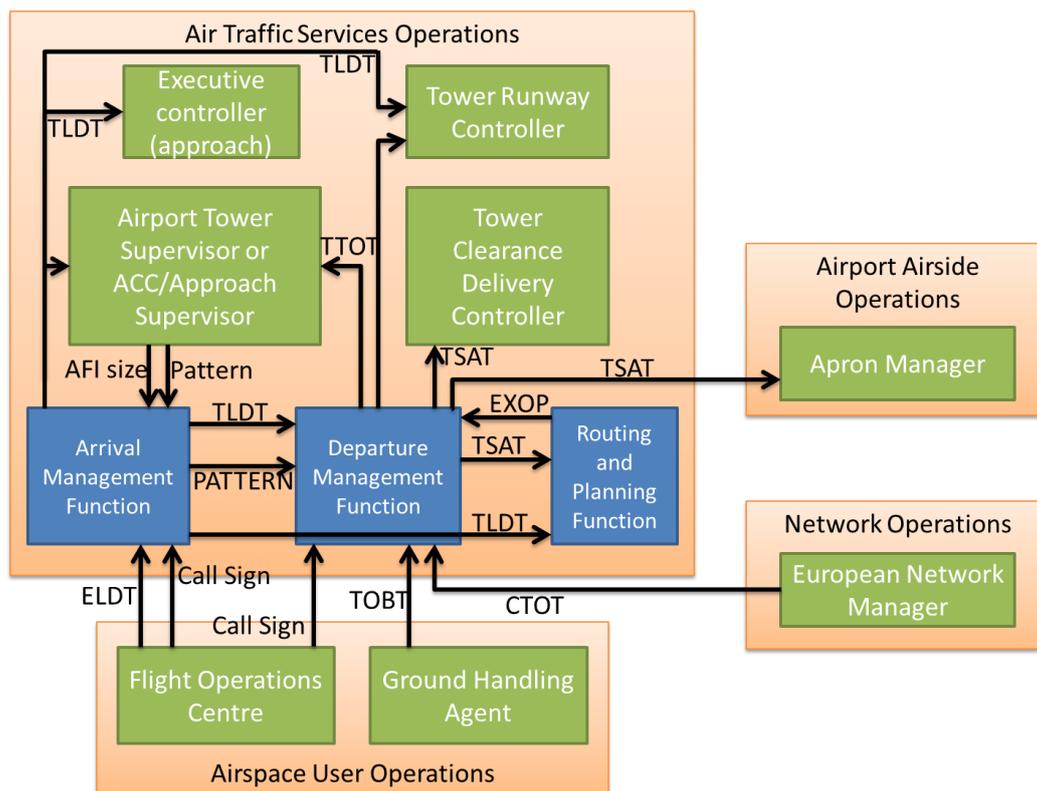All this information elements are coherent with D17 S1V3 Final OSED [11] and the D18 S1V3 Final SPR [12].

Figure 3: High level description of the Coupled AMAN/DMAN function interaction with its surrounding agents[1]

The process starts when the Arrival Management Function receives input data. The inputs include:

- The Sequence Pattern and the associated AFI-sizes, in NM, provided by Airport Tower Supervisor or by ACC/Approach Supervisor
- The ELDT and the Callsign provided by the Flight Operations Centre

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[1] This figure focuses on the essential information needed for the coupled AMAN/DMAN and does not include the not-validated information elements (IER-06.08.04-OSED-0103.0050, IER-06.08.04-OSED-0103.0060 and IER-06.08.04-OSED-0103.0070) needed for the optional AMAN calculated sequence pattern proposal to Airport Tower Supervisor and ACC/Approach Supervisor to optimise a set of KPIs (for more information, see OSED [11] section 3.5.1.3).
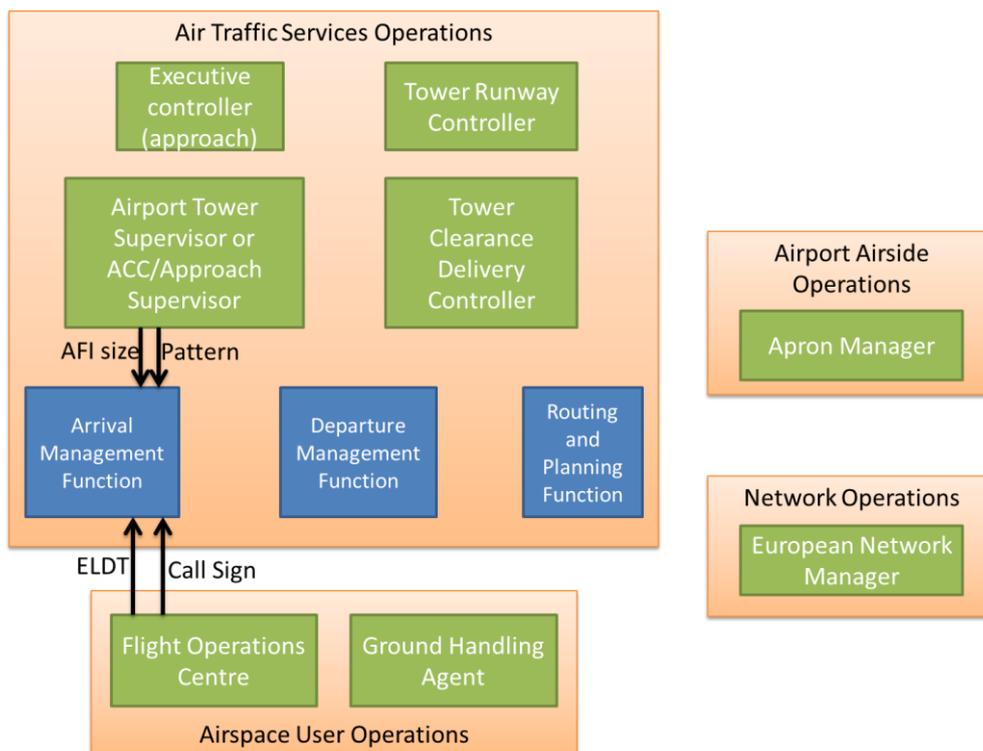
Figure 4: AMAN 'Receiving triggering inputs' high-level diagram of the Coupled AMAN/DMAN function

Once the Arrival Management Function has received the input data and performed its calculations, the Departure Management Function gets the following inputs:

- From the Arrival Management Function:
  - TLDT
  - Sequence Pattern
- From the Routing and planning Function:
  - EXOP
- From the Flight Operations centre:
  - Callsign
- From the Ground Handling Agent
  - TOBT
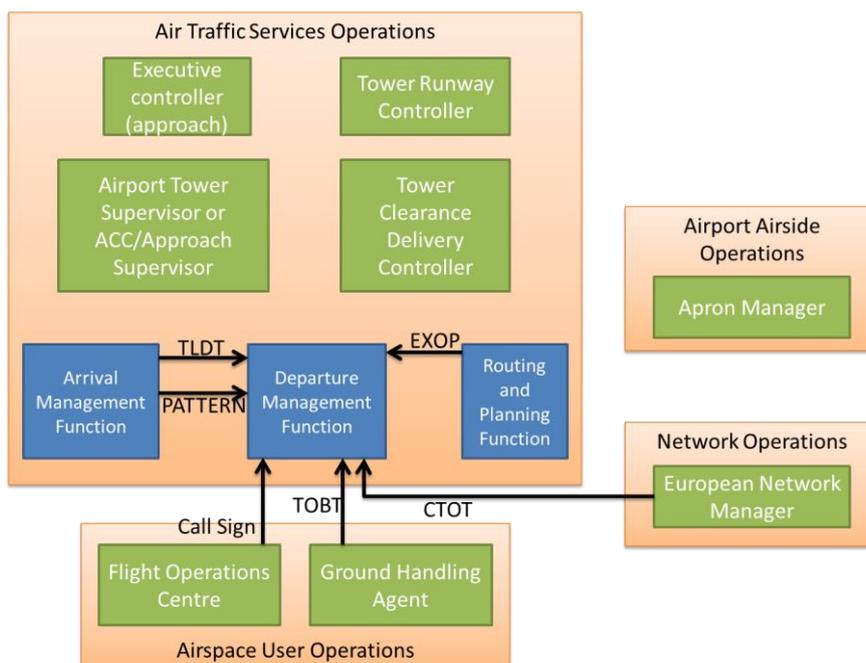- From the European Network Manager:
  - CTOT

Figure 5: Input data received by the Departure Management Function

Once the data has been collected by the different functions, the Arrival and Departure Management Function will calculate the TLDT arrival sequence, the TTOT departure sequence and the TSAT pre-departure sequence, all of them adapted to the chosen sequence pattern. Once this is performed, the Arrival Management Function shall send:

- TLDT to the Tower and Approach Supervisor in order to have visibility on the demand to estimate in a coordinated way the most appropriate sequence pattern

- TLDT to Approach executive controllers in order to provide the appropriate sequence and separation

- TLDT to Tower Runway Controller to provide the take-off clearance

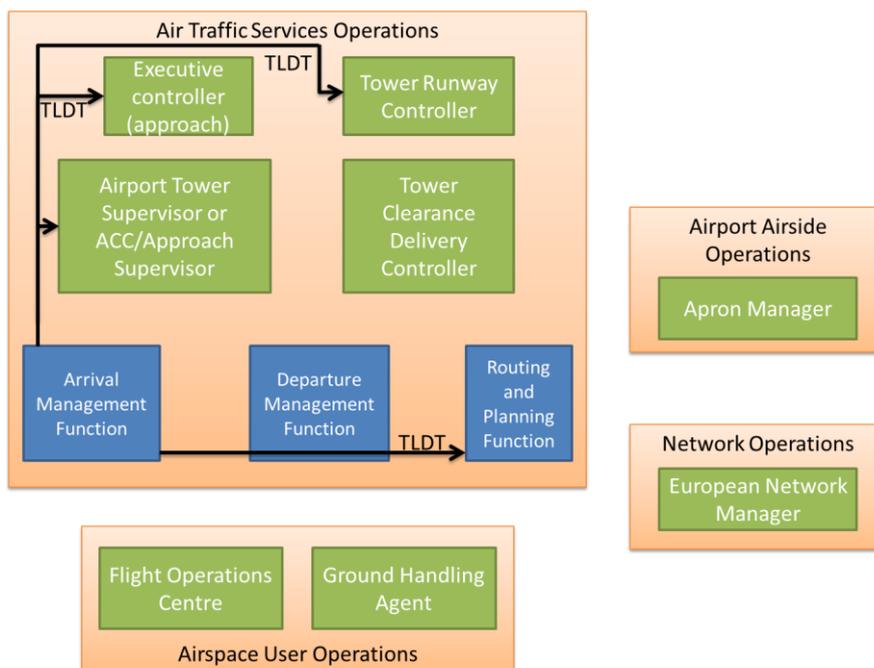- Furthermore, it sends TLDT to the RPF so that it can estimate taxi-in times (EXIT)

Figure 6: data sent by the Arrival Management Function

Regarding the Departure Management Function, this one sends:

- TTOT to the Tower Runway Controller in order to provide the take-off clearance

- TTOT to the Tower and Approach Supervisor in order to have visibility on the demand to estimate in a coordinated way the most appropriate sequence pattern

- TSAT to the Tower Clearance Delivery Controller in order to provide start-up clearance, and push-back clearance in airports in which this clearance is provided by the Tower Clearance delivery Controller.

- TSAT to the Airport Apron Manager in order to provide push-back clearance in airports in which this clearance is provided by the Apron Manager.

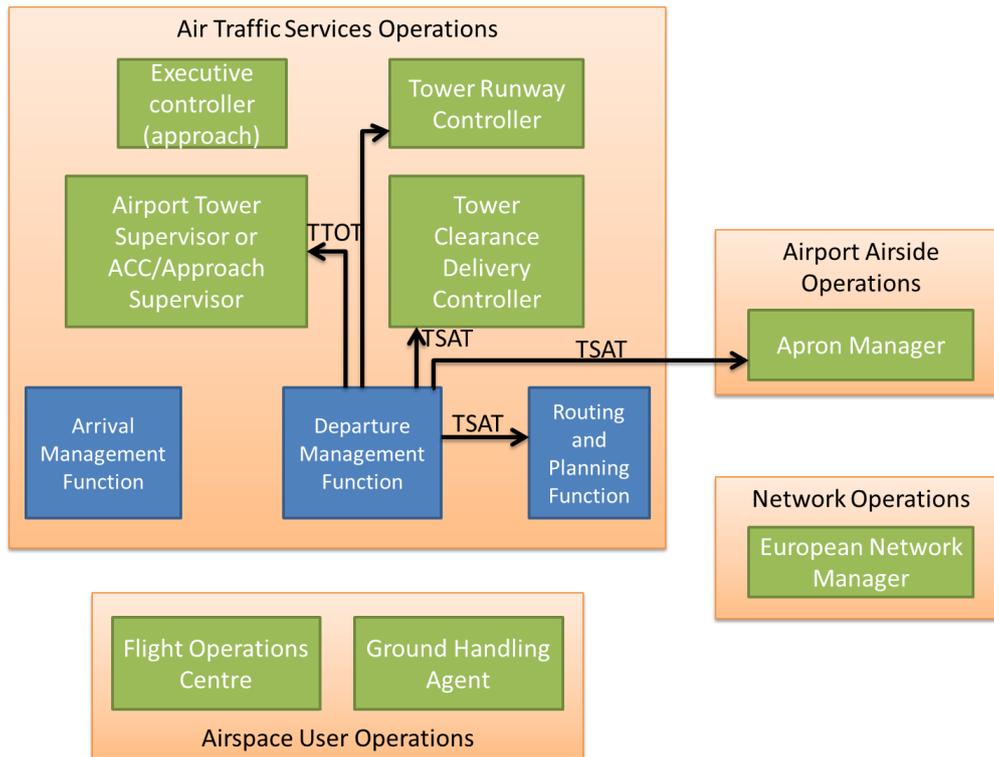- TSAT to the RPF so that it can estimate taxi-out times (EXOP)

Figure 7: DMAN calculated outputs high-level diagram of the Coupled AMAN/DMAN function

3 Interoperability Requirements

This section collects all the INTEROP requirements. The requirements identifiers are set accordingly to the rules defined in the Requirements and V&V Guidelines 03.00.00 [2].

The generic pattern applied is as follows:

<Object type>-<Project code>-<Document code>-<Reference number 1>.<Reference number 2>

Where:

- <Object type> is **REQ**

- <Project code> is **06.08.04**

- <Document code> is **INTEROP**

- <Reference number 1> reflects the following organization:
  - o 0131 – Inputs INTEROP requirements for solution 01 V3
  - o 0132 – Outputs INTEROP requirements for solution 01 V3
  - o 0133 – Exchanges between AMAN and DMAN

- <Reference number 2> is a sequence number (incremental by 10) for each series of requirements.

3.1 Requirements for ATS CNS/ATM Applications

Although the document refers to Coupled AMAN/DMAN function, along Step 1 there is no completely coupling function. AMAN and DMAN are independent tools which collaborate to elaborate an optimised runway sequence.

The interface between TBS-Tool and AMAN is covered by P6.8.1 and is not repeated in this document.

3.1.1 Inputs to the DMAN/SMAN function (Solution #53)

Identifier	REQ-06.08.04-INTEROP-0131.0010
Requirement	The Departure Management Function shall receive the EXOP value provided by the Routing and Planning service

Identifier	REQ-06.08.04-INTEROP-0131.0015
Requirement	The Arrival Management Function may receive the EXOP value provided by the Routing and Planning service

3.1.2 Inputs to the Coupled AMAN/DMAN function (Solution #54)

Identifier	REQ-06.08.04-INTEROP-0131.0020
Requirement	The Departure Management Function shall receive the TOBT value provided and continuously updated by the Airspace User through the A-CDM process

Identifier	REQ-06.08.04-INTEROP-0131.0025
Requirement	The Arrival Management Function may receive the TOBT value provided and continuously updated by the Airspace User through the A-CDM process

Identifier	~~REQ 06.08.04 INTEROP 0121.0030~~
Requirement	~~The DMAN shall receive the EOBT value provided by the Airline Operating Centre.~~

Identifier	REQ-06.08.04-INTEROP-0131.0040
Requirement	The Arrival Management Function shall receive the ELDT value provided by the Airspace User.

Identifier	REQ-06.08.04-INTEROP-0131.0050
Requirement	The Arrival Management Function shall be able to receive a specific sequence pattern as input either by the Airport Tower Supervisor or by the Approach Supervisor depending on local procedures.

Identifier	REQ-06.08.04-INTEROP-0131.0060
Requirement	The Arrival Management Function shall be able to receive AFIs as input (provided in distance or time) by the approach or tower supervisor ATCO (depending on local procedures).

Identifier	REQ-06.08.04-INTEROP-0131.0070
Requirement	The Arrival Management Function may be able to receive CTOTs as input by the Network Manager.

Identifier	REQ-06.08.04-INTEROP-0131.0080
Requirement	The Departure Management Function shall be able to receive CTOTs as input by the Network Manager

Identifier	REQ-06.08.04-INTEROP-0131.0090
Requirement	Both Arrival Management Function and Departure Management Function shall be able to receive the aircraft identifier (Call sign) as input by the Flight Operations Centre

3.1.3 Outputs from the Coupled AMAN/DMAN function

Identifier	REQ-06.08.04-INTEROP-0132.0010
Requirement	The Departure Management Function shall provide the surface routing and planning function (RPF) with the TSAT pre-departure sequence

Identifier	REQ-06.08.04-INTEROP-0132.0080
Requirement	The Arrival Management Function shall provide the surface routing and planning function (RPF) with the TLDT arrival sequence

~~Identifier~~	~~REQ 06.08.04 INTEROP 0122.0020~~
~~Requirement~~	~~The Departure Management Function shall provide the surface routing and planning function (RPF) with the TTOT departure sequence~~

Identifier	REQ-06.08.04-INTEROP-0132.0030
Requirement	The Departure Management Function shall provide the tower clearance delivery ATC and/or the Apron manager with the TSAT pre-departure sequence

Identifier	REQ-06.08.04-INTEROP-0132.0040
Requirement	The Departure Management Function shall provide the Approach Supervisor, the Airport Tower Supervisor and the Tower Runway Controller with the TTOT departure sequence

Identifier	REQ-06.08.04-INTEROP-0132.0050

Requirement	The Arrival Management Function and the Departure Management Function may provide the approach or tower supervisor ATCO with a proposal on an optimal sequence pattern (optional functionality)
Identifier	REQ-06.08.04-INTEROP-0132.0070
Requirement	The Arrival Management Function shall provide the approach ATCO, the Tower Runway Controller, the approach supervisor and the tower supervisor with the TLDT arrival sequence

3.1.4 Exchanges between AMAN and DMAN

Identifier	REQ-06.08.04-INTEROP-0133.0010
Requirement	The Arrival Management Function shall provide information related to the active pattern to Departure Management Function

Identifier	REQ-06.08.04-INTEROP-0133.0020
Requirement	The Arrival Management Function shall provide the TLDT (arrival sequence) for all arrivals to the Departure Management Function

3.2 Dynamic functions / operations

N/A

3.3 Unique characteristics

N/A

4 References

4.1 Applicable Documents

[1] Template Toolbox 03.00.00
https://extranet.sesarju.eu/Programme%20Library/SESAR%20Template%20Toolbox.dot

[2] Requirements and V&V Guidelines 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Requirements%20and%20VV%20Guidelines.doc

[3] Templates and Toolbox User Manual 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Templates%20and%20Toolbox%20User%20Manual.doc

[4] EUROCONTROL ATM Lexicon
https://extranet.eurocontrol.int/http://atmlexicon.eurocontrol.int/en/index.php/SESAR

4.2 Reference Documents

[5] ED-78A Guidelines for Approval of the provision and use of Air Traffic Services supported by Data Communications

[6] ICAO Document 9694

[7] WPB.01 Integrated Roadmap Latest version

[8] PB.04.02 SESAR Concept of Operations Step 1, Edition 02.00.00, dated 2013
https://extranet.sesarju.eu/WP_B/Project_B.04.02/Project%20Plan/ConOps/ConOps/SESAR%20ConOps%20Document%20Step%201%20v01%2000%2000.docx

[9] P06.08.04.D80 – S01V2 Preliminary INTEROP v00.01.00, 16/04/2013

[10] P06.08.04.D16 - S01V3 Validation Report P06.08.04-VP453 Coupled AMAN/DMAN/A-SMGCS v00.01.01 2nd of March 2015

[11] P06.08.04.D17 – S01V3 Final OSED v00.01.00

[12] P06.08.04.D18 - S01V3 Final SPR V00.01.00

[13] Airport CDM Implementation Manual, Amendment 4 March 2012 http://www.euro-cdm.org/

[14] P06.02, Step1 Airport DOD Update 2014, edition 00.01.00, dated 30th December 2014

[15] 12.01.07 TAD Step1-3rd Iteration- Airport Technical Architecture Description; edition 00.03.00; Dated December 2014.

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