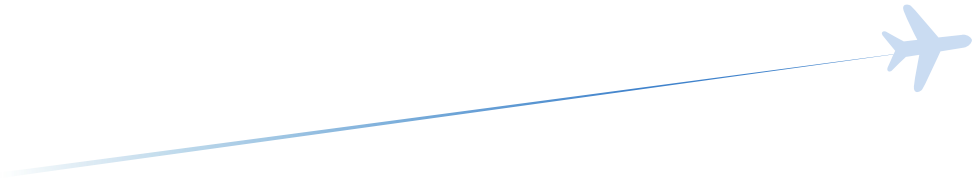

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Authoring & Approval

Authors of the document

Name/Beneficiary	Position/Title	Date
Svein G. Johnsen / SINTEF	TS task leader	08.11.2019
Jan-Olof Roof / LFV-COOPANS	Solution leader	19.07.2019
Dag Kjenstad / SINTEF	PJ02-08 Member	19.07.2019
Didier Chouvet / THALES AIR SYS	PJ02-08 Member	19.07.2019
Mohamed Ellejmi / EUROCONTROL	PJ02-08 Member	19.07.2019
Mateusz Sokolowski / PANSA	PJ02-08 Member	04.09.2019

Reviewers internal to the project

Name/Beneficiary	Position/Title	Date
CHALON MORGAN, Catherine / EUROCONTROL	PJ02-08 Member	06.09.2019
CHOUVET, Didier / THALES AIR SYS	PJ02-08 Member	06.09.2019
COSTA CONDE, Sarai / INDRA	PJ02-08 Member	06.09.2019
FUENTES DE FRUTOS, Pablo / INDRA	PJ02-08 Member	06.09.2019
MENDOZA, Montserrat / SKYGUIDE	V3 OSED Task Leader	06.09.2019
KJENSTAD, Dag / SINTEF	PJ02-08 Member	06.09.2019
KETTNER, Mattes / ZRH-SEAC2020	PJ02-08 Member	06.09.2019
MANGO, Gennaro / LEONARDO	PJ02-08 Member	06.09.2019
PERROTTA, Luigi / NAIS-ENAV	PJ02-08 Member	06.09.2019
ROOS, Jan-Olof / LFV-COOPANS	Solution Leader	06.09.2019
VELJANOVSKI, Nikola / LFV-COOPANS	PJ02-08 Member	06.09.2019

Approved for submission to the SJU By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date
CHOUVET, Didier / THALES AIR SYS	THALES AIR SYS PJ02.08 POC	11.09.2019
COSTA CONDE, Sarai / INDRA	INDRA PJ02.08 POC	11.09.2019
ELLEJMI, Mohamed / EUROCONTROL	EUROCONTROL PJ02.08 POC	11.09.2019

KETTNER, Mattes / SEAC	SEAC PJ02.08 POC	11.09.2019
KJENSTAD, Dag / SINTEF	SINTEF PJ02.08 POC	11.09.2019
MANGO, Gennaro / LEONARDO	LEONARDO PJ02.08 POC	11.09.2019
MENDOZA NAVAS, Montserrat / SKYGUIDE	SKYGUIDE PJ02.08 POC	11.09.2019
PERROTTA, Luigi / NAIS-ENAV	ENAV PJ02.08 POC	11.09.2019
ROOS, Jan-Olof / LFV-COOPANS	LFV-COOPANS PJ02.08 POC	11.09.2019
NIEWINSKI, Jaroslav / PANSA	PANSA PJ02.08 POC	11.09.2019
TREVE, Vincent / EUROCONTROL	EUROCONTROL PJ02.08 PROJECT MANAGER	11.09.2019

Rejected By - Representatives of beneficiaries involved in the project

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Copyright Statement

EARTH

TRAFFIC OPTIMISATION ON SINGLE AND MULTIPLE RUNWAY AIRPORTS

This Solution is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 731781 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document contains both the V3 System Architecture and System Requirements definition of the concepts that contribute to Traffic Optimisation on Single and Multiple Runway Airports:

- Optimised integration of arrival and departure traffic flows
- Optimised use of RWY capacity for multiple runway airports
- Enhanced Prediction of Runway Occupancy Time (ROT)

The final version of this document will be part of the PJ.02-08 V3 Data Pack due November 2019.

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1 Executive summary

This document contains both the V3 System Architecture and Systems Requirements definition of the concepts that contribute to traffic optimisation on single and multiple runway airports:

- Optimised integration of arrival and departure traffic flows
- Optimised use of RWY capacity for multiple runway airports
- Enhanced Prediction of Runway Occupancy Time (ROT)

This document has the objective to provide a stable reference for the implementation of the prototypes to be used in the SESAR 2020 PJ.02-08 V3 validation EXEs. The level of maturity of each requirement within this document is being assessed according to all the development and validation activities carried out along the lifecycle of this project and the SESAR2020 programme, resulting on different <status> for each technical requirement ("validated" or "in progress") depending on whether V3 maturity has been *verified* or not.

It should be noted that, sticking to the TS template and to SE-DMF, the technical requirements would be validated; however, what really occurs is that these *technical* requirements would be *verified*.

The aim for this V3 document is to cover the following Operational Improvements and Enablers:

- TS-0301. Integrated Arrival Departure Management for Full Traffic Optimisation on the Runway
    - AERODROME-ATC-33: Coupled sequencing tool enhanced to better handle arrivals and departures
    - AERODROME-ATC-58: Agile synchronisation of arrivals with departure information for the same airport
    - APP-ATC-164: APP ATC System adapted to support integrated arrival/departure sequence functionalities in ATCO's HMI

- TS-0313. Optimized Use of Runway Capacity for Multiple Runway Airports
    - APP-ATC-164: APP ATC System adapted to support integrated arrival/departure sequence functionalities in ATCO's HMI
    - AERODROME-ATC-74: Airport Demand and Capacity system enhanced for multiple runway airport

- AO-0337. Increased Runway Throughput based on local ROT characterization (ROCAT)
    - AERODOME-ATC-55: Aerodrome ATC System to support Optimised Runway Delivery on Final Approach based on Aircraft ROT categorisation
    - APP ATC 169: Approach ATC System to support Optimised Runway Delivery on Approach based on Aircraft ROT categorisation.

- AO-0338. Use of Enhanced Runway Occupancy Time (ROT) for medium airports
    - AERODROME-ATC-32: Runway condition awareness management system based on weather-based runway condition model
    - AERODROME-ATC-55a: Airport ATC analyser tool for optimising AROT

2 Introduction

2.1 Purpose of the document

The final objective of the implementation of the TS/IRS document is to complete the V3 SESAR Solution Data Pack in order to increase the SESAR Solution maturity level. The different deliverables as per as type of project are divided in three groups: ATM Solution Projects, Enabling Projects and VLD´s, being this TS document part of the ATM Solution Projects group.

This document provides the requirements specification, covering functional, non-functional and interface requirements related to SESAR 2020 Project 02 Solution 08 V3.

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 Technical specifications (TS/IRS) represent one of the key parts of this SESAR Solution data-pack.

The Technical Specifications address the “what” and not the “how”, therefore they do not aim at specifying the physical design of the functional block (which remains under each industry decision), but the functional description and the necessary logical interfaces with other functional blocks. The TS/IRS documents are intended to form the basis for the development of industry standards for the systems or sub-systems in standardisation development organisations, for example EUROCAE**.** The target architecture will be made up of a set of domain level “systems” that will be further broken down into functional blocks based on performance requirements. In this way, the En-Route/Approach ATC and the Aerodrome ATC systems could be decomposed into a number of ‘functional blocks’ defined at the level of performance requirements and logical interfaces (interface requirements) but without the need to go to the level of system or interface design.

The target architecture will be maintained in EATMA by PJ19 while the further breakdown will be done in the TS/IRS for each ATM ‘functional block’ supporting a given SESAR Solution.

This Technical Specification document includes all impacted Functional Blocks. The Technical Specification includes as well the interface(s) related requirements (IRS).

The requirements included in TS/IRS satisfy requirements captured at SESAR Solution 02-08 SPR-INTEROP/OSED for V3 – Part I [41] and are associated with Functional blocks and Enablers (ENs) available in EATMA applicable version.

TS/IRS should provide sufficient information so as to allow the functional block (or parts of it in which the project is working) to be designed and implemented either as separate functional block or as part of an integrated system, depending upon the design choice, for V&V activity within the programme and ultimately for industrialization, standardization and deployment.

2.2 Scope

This is the TS/IRS for Project 02 Solution 08 for V3/TRL6 phase, once verification activities and validation exercises have been performed and their validation results analysed and consolidated in the SESAR Solution 02.08 Validation Report (VALR) for V3 [42]:

- EXE.02-08.V3.001 – ENAV RTS (cancelled)
- EXE.02-08.V3.002 – LFV-COOPANS RTS
- EXE.02-08.V3.003 – SKYGUIDE RTS
- EXE.02-08.V3.004 – PANSA RTS
- EXE.02-08.V3.005 – EUROCONTROL RTS
- EXE.02-08.V3.006 – INDRA RTS
- EXE.02-08.V3.007 – ENAV FTS
- EXE.02-08.V3.008 – PANSA FTS

It covers the architecture and the functional, non-functional and interface requirements related to SESAR Project 02 Solution 08 and the following Operational Improvements and Enablers[1]:

OI Step code	OI Step title	Enabler	Required / Optional	V3 coverage
TS-0301	Integrated Arrival Departure Management for Full Traffic Optimisation on the Runway	AERODROME-ATC-33	Required	YES
		AERODROME-ATC-58	Required	YES
		APP-ATC-164	Required	YES
		AERODROME-ATC-09c, AERODROME-ATC-27, AERODROME-ATC-34	Optional	No
TS-0313	Optimized Use of Runway Capacity for Multiple Runway Airports	AERODROME-ATC-74	Required	YES
		APP-ATC-164	Required	YES
		AERODROME-ATC-29	Optional	NO
AO-0337	Increased Runway Throughput based on local ROT	AERODROME-ATC-55	Required	YES

[1] The contents of this TS/IRS document are aligned with both the Dataset 20 and EATMA V13.0.

	characterization (ROCAT)	APP ATC 169	Required	YES
AO-0338	Use of Enhanced Runway Occupancy Time (ROT) for medium airports	AERODROME-ATC-55a	Required	YES
		AERODROME-ATC-32	Optional	NO

Table 1: Solution #02-08 OIs and Enablers

The coverage of the remaining required OIs and EN will be analysed in the next maturity phase.

2.3 Intended readership

This document is intended for the following audience:

- SESAR 2020 Projects/Solutions:
  - PJ01-01 (Enhanced Arrivals and Departures): Extended arrival management with overlapping AMAN operations and interaction with DCB.
  - PJ01-02 (Enhanced Arrivals and Departures): Use of arrival and departure management information for traffic optimisation in the TMA.
  - PJ02-01, Optimised Runway Delivery on Final Approach, AO-328.
  - PJ02-03 develops the concept of Minimum Pair Separations Based on Required Surveillance Performance (RSP) in support of a reduction of the in-trail Minimum Radar Separation (MRS) from 2.5 NM to 2 NM on final approach.
  - PJ03a-01, since it provides the Routing function.
  - PJ.03b-06 which develops runway condition continuous monitoring and prediction tools.
  - PJ04 (Total Airport Management): Improved prediction and quality of estimated take-off and landing time for Airport DCB.
  - PJ09 (Advanced DCB): Improved prediction and quality of estimated take-off and landing time for Network management.
  - PJ16 (Controller Working Position / Human Machine Interface): HMI integration aspects.
  - PJ18 (4D Trajectory Management): Improved prediction and quality of estimated take-off times for trajectory management processes.
  - PJ20 (Master Plan Maintenance).
  - PJ22 Validation and Demonstration Engineering.
  - PJ19: Content Integration
  - PJ02-01 (Wake Turbulence Separation Minima): Use of the prediction algorithm of ROT for the separation delivery tool. A combined V3 validation will be performed.

Reduced separations used by WDS in arrivals and departures can modify the sequence provided by the Integrated Runway Sequence function,

- The validation exercises associated to this phase of the project.
- In general, the SESAR JU community.
  -

2.4 Background

The SESAR Solution 02-08 SPR-INTEROP/OSED for V3 part I [41] is identified as the main source for the operational requirements used in this TS.

The main technical Input for the first concept is the SESAR1 12.04.04.D38 - System Requirements Final S2V3 [39]. The RMAN system, which is part of the second concept, was covered in SESAR1 (in 12.02.01 D34 - P3_Final System Requirements [38]) and, therefore, this system's technical specifications will not be re-developed in this document.

2.5 Structure of the document

The structure of the document is composed of the following sections:

- **Section 1 – Executive summary**: It describes the scope and purpose of the Solution PJ.02-08.
- **Section 2 – Introduction**: It details the purpose and the scope of the document.
- **Section 3 – SESAR Solution Impacts on Architecture**: It describes the Functional Blocks included in the Solution as well as the Capability Configurations and the changes from the architecture in EATMA if needed.
- **Section 4 – Technical Specifications**: It describes the Functions needed to realise the Solution and provides a functional view of how the technical systems, functional blocks, system ports and roles participate in realising the operational needs. It contains the technical Requirements.
- **Section 5 – Implementation Options**: It describes the available options that can be chosen when implementing the solution using capability configurations and sub-operating environments.
- **Section 6 – Assumptions**: It covers any assumption made about impacts on the technical specifications described in Section 4.
- **Section 7 – References and Applicable Documents**: It references the documents mentioned throughout this document.

2.6 Glossary of terms

Term	Definition	Source of the definition
AROT	the time interval between the aircraft crossing the threshold and its tail vacating the runway.	EUROCONTROL Enhancing Airside Capacity, the Complete Guide [40].
TLDT	The Target Landing Time is the targeted time from the Arrival management	EUROCONTROL Airport CDM Implementation Manual

	process at the threshold, taking runway sequence and constraints into account. It is not a constraint, but a progressively refined planning time used to coordinate between arrival and departure management processes.	[40].
TSAT	The Target Start Up Approval Time is the time provided by ATC taking into account TOBT, CTOT and/or the traffic situation that an aircraft can expect to receive start-up / push back approval.	EUROCONTROL Airport CDM Implementation Manual.
TTOT	The Target Take-Off Time is the time taking into account the Target Start Up Approval Time (TSAT) plus the Estimated Taxi-Out Time (EXOT).	EUROCONTROL Airport CDM Implementation Manual.
ORD	Refers to the Optimised Runway Delivery concept which intends to provide additional tool support to show the Controller the required spacing on the approach to take into account the effect of compression primarily caused by aircraft decelerating to land.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [43]

Table 2: Glossary

2.7 Acronyms and Terminology

Term	Definition
A-CDM	Advanced Collaborative Decision Making
ADD	Architecture Description Document
ALDT	Actual Landing Time
AMAN	Arrival Manager / Arrival Management
AOP	Airport Operations Plan
ASAT	Actual Start-up Approval Time
ATM	Air Traffic Management
CC	Capability Configuration
CHMIM	Controller Human Machin Interaction Management

DCB	Demand & Capacity Balancing
DMAN	Departure Manager / Departure Management
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
ELDT	Estimated Landing Time
EOBT	Estimated Off-Block Time
ETOT	Estimated Take-Off Time
EXOP	Estimated Outbound Taxi
EXOT	Estimated Taxi Time (departing aircraft)
FB	Functional Block
FDP	Flight Data Processing
FLDT	Forecasted Landing Time
FP	Flight Plan
FTD	Final Target Distance
FTOT	Forecasted Take-Off Time
HMI	Human Machine Interface
IER	Information Exchange Requirement
INTEROP	Interoperability Requirements
IO	Implementation Option
IRS	Interface Requirements Specification
ISRM	Information Services Reference Model
ITD	Intermediate Target Distance
NAF	NATO Architecture Framework
NSOV	NATO Service Oriented View
NOV	NATO Operational View
NSV	NATO System View
OI	Operational Improvement

OSED	Operational Service and Environment Definition
RMAN	Runway Manager
ROT	Runway Occupancy Time
RSFM	Runway Sequence and Flow Management
RTUM	Runway and Taxiway Usage Management
RWY	Runway
SID	Standard Instrumental Departure
SDD	Service Description Document
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SPR	Safety and Performance Requirements
STAR	Standard Arrival
SWIM	System Wide Information Management
TLDT	Target Landing Time
TMA	Terminal Manoeuvring Area
TOBT	Target Off-Block Time
TRL	Technology Readiness Level
TS	Technical Specification
TTG	Time To Gain
TTL	Time To Lose
TTOT	Target Take-Off Time
TWR	Tower

Table 3: Acronyms and terminology

3 SESAR Solution Impacts on Architecture

3.1 Target Solution Architecture

3.1.1 SESAR Solution(s) Overview

As described in SESAR Solution 02-08 SPR-INTEROP/OSED for V3 – Part I [41], the solution 02-08 encompasses different concepts (and OIs) that aim to optimize RWY operations by providing dynamic assistance to APP controllers, tower controllers and supervisors:

- **Concept 1**: Optimised integration of arrival and departure traffic flows with the use of a trajectory based Integrated Runway Sequence (TS-0301). This concept applies namely to execution phase and addresses mainly TWR and TMA ATCOs.
- **Concept 2**: Optimised use of RWY capacity for multiple runway airports with the combined use of an Integrated Runway Sequence and RMAN (TS-0313). This concept applies namely to the planning phase, uses forecasted data of traffic demand, capacity constraints and target KPIs and addresses TWR Supervisor although considers input from execution phase.
- **Concept 3**: Increased Runway Throughput based on local ROT characterization (ROCAT) (AO-0337).
- **Concept 4:** Optimised use of RWY capacity for medium airports with the use of enhanced prediction of Runway Occupancy Time (ROT) (AO-0338).

3.1.1.1 SESAR Solution(s) overview for Concept 1 and Concept 2

In the following subsections, an overview of the SESAR solution for Concept 1 and Concept 2 is given.

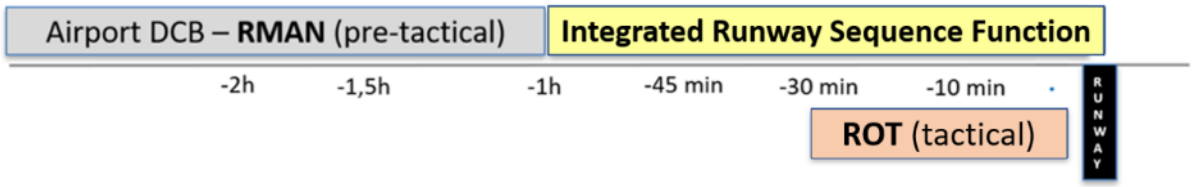

Figure 1: Time horizon application for PJ.02-08 solution concepts

The following image illustrates the relationship between Integrated Runway Sequence Function and RMAN.

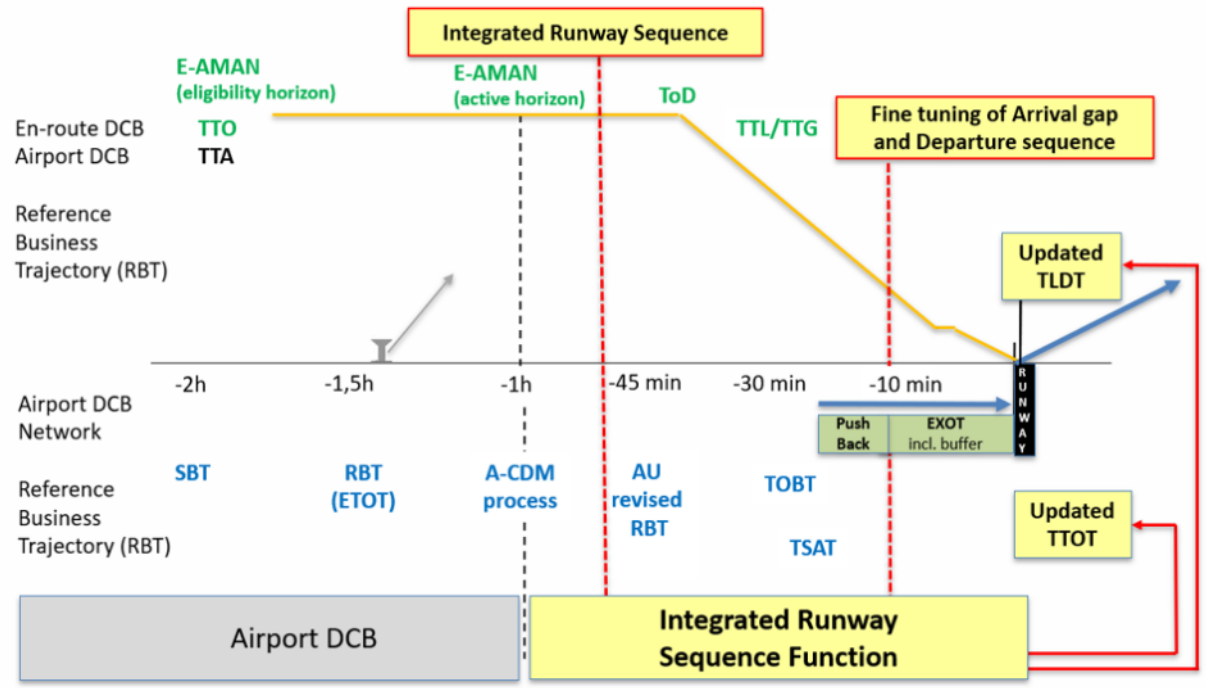

Figure 2: Integrated Runway Sequence Function and RMAN

Both concepts cover the optimised integration of arrival and departure traffic flows throughout the ***Runway Sequence and Flow Management*** **(RSFM)** functional block, which generates an optimized arrival/departure integrated sequence. This functional block can either build the integrated sequence on its own or complement the arrival sequence built by AMAN and/or the departure sequence built by DMAN (as explained in **Section 4.1** and **Section 5**).

Additionally, other functional blocks impacted by this SESAR Solution are:

- **Controller Human Machine Interaction Management (CHMIM) (Aerodrome ATC and ER APP)**: will display the integrated sequence and support the ATCOs inputs on the integrated sequence.
- **Runway and Taxiway Usage Management (RTUM)**: will provide inputs such as Airport Configuration, Runway Capacities and Adjusted Demand to the RSFM in order to improve the integrated sequence.

Although in next sections other FBs have been inserted into the model to make the architecture understandable, these FBs are considered as black boxes.

The mandatory ENs for V3/TRL6 maturity phase, shown hereunder in both figure and table, will be fully covered by implementing new functions belonging to these FBs.

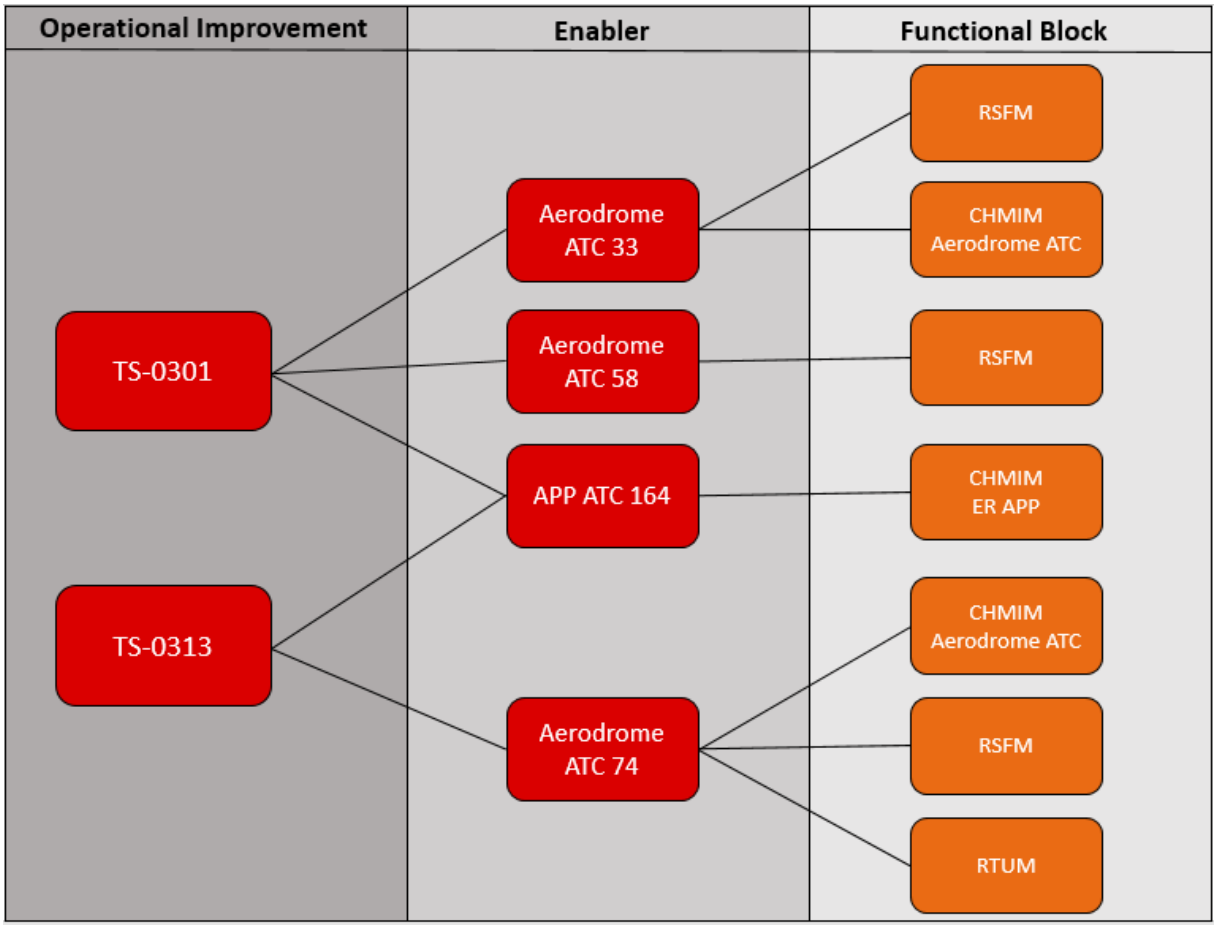

Figure 3: Solution Overview - Enablers and Functional Blocks trace for Concept 1 and Concept 2

Functional Blocks/Role impacted by the SESAR Solution (from EATMA)	Enabler ID (from EATMA)	Enabler Title (from EATMA)	Enabler coverage
Runway Sequence and Flow Management Controller Human Machine Interaction Management Aerodrome ATC	AERODROME-ATC-33	Coupled sequencing tool enhanced to better handle arrivals and departures.	**Full**
Runway Sequence and Flow Management	AERODROME-ATC-58	Agile synchronisation of arrivals with departure information for the same airport	**Full**
Controller Human Machine Interaction	APP ATC 164	System adapted to support integrated arrival/departure	**Full**

Management ER APP		sequence functionalities in ATCO's HMI	
Runway and Taxiway Usage Management	AERODROME-ATC-74	Airport Demand and Capacity system enhanced for multiple runway airport	**Full**
Runway Sequence and Flow Management			
Controller Human Machine Interaction Management Aerodrome ATC			

Table 4: PJ.02-08 Scope and related Functional Blocks & Enablers for Concept 1 and Concept 2

The roles directly impacted on this Solution are the Sequence Manager, the Approach Controller, the Tower Runway Controller and the Tower Supervisor.

- Sequence Manager: The ATC person/role responsible for overseeing the AMAN and DMAN operation in general.
- Approach Controller: his/her main task is to provide the separation according to the integrated arrival/departure sequence displayed in the CHMI.
- Tower Runway Controller: his/her main task is to provide the separation according to the integrated arrival/departure sequence displayed in the CHMI.
- Tower Supervisor: his/her main task is to decide the optimal runway configuration based on what is displayed in the CHMI.

Other impacted roles are the Ground Controller, the Clearance Delivery Controller, the Flight Crew and the ACC/Approach Supervisor.

3.1.1.1.1 Deviations with respect to the SESAR Solution(s) definition for Concept 1 and Concept 2

The solution enablers for the solution are those identified in EATMA Data Set 19.

3.1.1.1.2 Relevant Use Cases for Concept 1 and Concept 2

With the two following Technical Use Cases, all the relevant operational Use Cases are covered. It has to be noted that the relevant Technical Architecture Models (**Implementation Options**) developed are the ones corresponding to validation exercises, nevertheless, other implementation options should be considered, as stated in **Section 5**.

Integrated sequence by coupling AMAN and DMAN

The Runway Sequence Flow Management receives as input the flight plans information for arrival and departures as AMAN for arrivals and DMAN for departures:

- Estimated Times (ELDTs, ETOTs, EOBTs) and CTOTs
- Callsign, departure and arrival airport, SIDs and STARs
- Aircraft type and WKT category
- Actual Times (ASAT, ATOT, ALDT)

The Runway Sequence Flow Management receives as input the arrival sequence provided by AMAN and the departure sequence provided by DMAN

The AMAN arrival sequence (resp. DMAN departure sequence) is built taking into account the current airport/runway configuration and the current arrival/departure integrated sequence to manage room in the sequence for the departure (resp. arrival) traffic in case of mixed mode runway.

Based on the received information, RSFM calculates the arrival/departure integrated sequence over the runways, optimising the runway usage and provides target times (TLDTs, TTOTs and TSAT in pre-departure phase). The arrival/departure integrated sequence, built according to the AMAN sequence order for arrivals, can be optimised with balancing arrival and departure within the runways in case of parallel runways. The balancing between two runways can be automated (if the TWR Supervisor has activated this option). The RWY change associated to the balancing will be processed by AMAN for arrivals, DMAN for departures resulting in an update of the associated flight plan. Manual balancing between the runways can also be performed manually by AMAN for arrivals and DMAN for departures.

The arrival/departure integrated sequence is distributed to AMAN and DMAN and will then be available for display in the ad-hoc CHMIM. Furthermore, the sequencer[2] will be able to manually modify the arrival/departure integrated sequence by means of specific interactions. These modifications will be taken into account by AMAN for arrivals, DMAN for departures, the modified sequences will allow RSFM to update the arrival/departure integrated sequence, with as required updates of TTOTs, TLDTs and TSAT in pre-departure phase.

Integrated Sequence without AMAN and DMAN (and RMAN)

The Runway Sequence Flow Management receives as input the flight plans information:

- Estimated Times (ELDTs, ETOTs, EOBTs) and CTOTs
- Callsign, departure and arrival airport, SIDs and STARs
- Aircraft type and WKT category
- Actual Times (ASAT, ATOT, ALDT)

[2] It has to be noted that the Sequencer is considered as a logical Role that follows the EATMA Framework. The responsibilities associated to this Role could be carry out by controllers, supervisors, sequence managers… depending on the local implementation.

Based on the information received in this communication, the component calculates the arrival/departure sequence and provides target times (TLDTs, TTOTs and TSATs) over the runways.

The sequences will be displayed in the ad-hoc CHMIM. Furthermore, the sequencer will be able to manually modify the sequences by means of specific interactions. These modifications will be taken into account by the RSFM, which will recalculate de TTOTs, TSATs and TLDTs.

Additionally, for the second concept, the RSFM receives as inputs the outputs from the Airport DCB calculations:

- Optimal airport configuration
- Runway capacities (ratios)
- Adjusted demand (FLDTs, FTOTs and assigned runways)

These data will be displayed to the Tower Supervisor in the Operational Supervision. Furthermore, the supervisor will be able to manually modify them. These modifications will be taken into account by the RSFM, which will recalculate de TTOTs and TLDTs.

3.1.1.1.2.1 Trace Relevant UC for Concept 1 and Concept 2 and Technical Models

Table hereunder show the trace of the Technical Use cases for Concept 1 and Concept 2 developed in the validation against the Operational Use Cases from SESAR Solution 02-08 SPR-INTEROP/OSED for V3 – Part I [41].

Operational Use Case	Op. UC Description	Related Technical Model
[NOV-5][RWY-SEQ-01 Manage departure flight (using an integrated arrival/departure sequence)	This Use Case describes the management of a sequenced departure in nominal mode following the integrated arrival/departure sequence provided by the Integrated Runway Sequence Function. *Pre-conditions*: • Airport CDM process is in place and there is an agreed business trajectory; • Advanced HMI; • An integrated sequence is provided by the Integrated Runway Sequence Function; • The pilot calls within the TSAT window. *Assumptions*: • The Sequence Manager has verified that the Integrated Runway Sequence Function is configured according to the operational needs; • If TSAT is respected, TTOT is achieved (i.e. the taxi times are as expected).	***Integrated sequence by coupling AMAN and DMAN*** ***Integrated Sequence without AMAN and DMAN (and RMAN)***

Operational Use Case	Op. UC Description	Related Technical Model
[NOV-5][RWY-SEQ-02] Manage arrival flight (using an integrated arrival/departure sequence)	This Use Case describes the management of a sequenced arrival in nominal mode following the integrated arrival/departure sequence provided by the Integrated Runway Sequence Function. *Pre-conditions*: • Airport CDM process is in place and there is an agreed business trajectory; • Advanced HMI; • An integrated sequence is provided by the Integrated Runway Sequence Function; • Flight is within the AMAN horizon. *Assumptions*: • The Sequence Manager has verified that the Integrated Runway Sequence Function is configured according to the operational needs; • TLDT and linked TTL/TTG are provided by the Integrated Runway Sequence Function; • TTL can be absorbed within the unit; • Most of the TTL should be absorbed within ACC, as far as practicable.	***Integrated sequence by coupling AMAN and DMAN*** ***Integrated Sequence without AMAN and DMAN (and RMAN)***
[NOV-5][RWY-SEQ-03] Manage integrated arrival/departure sequence changes prior to TSAT	This Use Case describes the generic management of the integrated arrival/departure sequence when a departure flight cannot meet its TSAT. *Pre-conditions*: • Airport CDM process is in place and there is an agreed business trajectory; • An integrated sequence is provided by the Integrated Runway Sequence Function. *Assumptions*: • Close monitoring of the handling process must assure that in case of late boarding / loading the impact on TOBT is recognized in an early stage and when necessary an updated TOBT determined, the AOP updated and a new TSAT provided. In case of a new TSAT an updated pre-departure sequence and TTOT are determined, taking into account local constraints at the airport (on apron, taxiways and/or runways);	***Integrated sequence by coupling AMAN and DMAN*** ***Integrated Sequence without AMAN and DMAN (and RMAN)***

Operational Use Case	Op. UC Description	Related Technical Model
	• Arrival sequence is not impacted; • TWR Supervisor performs the tasks of Sequence Manager. This use case applies to different operational situations: • A departure flight is not ready for push-back at the TSAT: If for whatever reason (e.g. technical problem) the aircraft is foreseen not ready at TSAT, a new TOBT has to be announced and a new TSAT determined (based on available TTOT); • Aircraft is not foreseen ready at TOBT: when for whatever reason (e.g. de-icing on stand takes longer, missing passengers, late boarding of passengers and/or late loading of baggage and cargo) the aircraft is not ready at TOBT, a new TOBT and TSAT has to be determined. *In both cases*: [1] The Airspace User OPS Support updates the TOBT according to the A-CDM procedures; [2] The Integrated Runway Sequence function processes the new TOBT and re-sequences the flight by moving it into the sequence at the next appropriate departure slot and updates its TTOT and TSAT accordingly; [3] The TWR Runway Controller, TWR Ground Controller, TWR Clearance Delivery and TWR Supervisor receive the relevant information on the up-to-date integrated sequence (TSAT, TTOT, TLDT, sequence numbers); [4] The TWR Clearance Delivery follows the TSAT re-calculated by the Integrated Runway Sequence function based on the new TOBT; [5] The TWR Supervisor assesses the change in the sequence and makes manual adjustments if required (e.g. if spacing of arrivals need to be fit with the runway occupancy time of the departing flight).	
[NOV-5][RWY-SEQ-04] Manage integrated arrival/departure sequence changes prior to TTOT	This use case describes the management of the changes occurring in the integrated arrival/departure sequence prior to TTOT. The departure flight deviating from the integrated sequence plan cannot meet its TTOT either because of own reasons (e.g. slow taxi, call late in the TSAT window) or because of the context (e.g. taxi blocked by other traffic). *Pre-conditions*: • Airport CDM process is in place and there is an agreed business trajectory;	***Integrated sequence by coupling AMAN and DMAN*** ***Integrated Sequence without AMAN and***

Operational Use Case	Op. UC Description	Related Technical Model
	• Advanced HMI; • An integrated sequence is provided by the Integrated Runway Sequence Function; • The sequence manager has verified that the Integrated Runway Sequence Function is configured according to the operational needs; • Start-up has been performed within calculated TSAT. *Assumptions*: • Impacted flights are in contact with TWR Ground Control; • All manual actions (if any) are performed by TWR Ground Control; • Changes impact only TWR. This generic use cases covers the following operational situations: • **Sequence changes due to TSAT window:** departure flight AC-1 initially planned ahead of departure flight AC-2 calls within the TSAT window but too late with a potential impact on the sequence. Several strategies can apply in this case: **The possibility for Recovering the Plan** is given if: ○ AC-2 can be overtaken by AC-1, ▪ e.g. manual sequence change at taxiway intersection; ▪ different taxi speeds; ▪ using different runway intersections for take-off. **The possibility for Updating the Pla**n is given if: ○ AC-1 and AC-2 are the same vortex category and same SID (if SID is relevant for separation); ○ No runway waiting time is expected (few departure demand). **The need for Updating the Plan** is given if: ○ The plan can be improved (capacity prioritised over predictability) ; ○ The plan is not feasible any more: ▪ The actual time plus remaining taxi time is bigger than TTOT ; ▪ Sequence is changed compared to plan and there is no possibility for overtaking (ac on same taxiway and same intersection).	***DMAN (and RMAN)***

Operational Use Case	Op. UC Description	Related Technical Model
	• Integrated Runway Sequence Function with **aircraft not ready at TTOT**: The departing flight was ready at TSAT but is not ready at TTOT du to taxi delay. In both operational situations, 2 alternatives are possible: *Alternative 1: Automatic re-calculation of the sequence* [1] Tower Ground Controller monitors taxi and receives automatic update of TTOT based on the remaining taxi time and on local constraints at the airport (on apron, taxiways and/or runways); [2] Tower Ground Controller provides new TTOT to the Flight Crew; [3] Tower Ground Controller or Tower Runway Controller re-sequences the other departures if required based on the updated sequence. *Alternative 2: Manual update of the TTOT* [1] Tower Ground Controller manually re-sequences the flight and provides the Flight Crew with the new TTOT; [2] Tower Ground Controller or Tower Runway Controller manually adjust the sequence if required and provide new TTOT and sequence number to the Flight Crew of the impacted flights.	
[NOV-5][RWY-SEQ-05] Manage integrated arrival/departure sequence changes impacting sequence order	This use case describes how to manage the situation when the integrated arrival/departure sequence order cannot be followed due to last time events. For this use case, 2 options are possible: either the Integrated Runway Sequence Function re-calculates automatically the integrated sequence based on current traffic situation and local rules, or the controller updates the sequence manually to fit to the new plan. *Pre-conditions*: • Airport CDM process is in place and there is an agreed business trajectory; • An integrated sequence is provided by the Integrated Runway Sequence Function. *Assumptions*: • Flight deviating from plan is in contact with TWR Runway	***Integrated sequence by coupling AMAN and DMAN*** ***Integrated Sequence without AMAN and DMAN (and RMAN)***

Operational Use Case	Op. UC Description	Related Technical Model
	Control; • Manual updates of the sequence are done by TWR Runway Controller; • Changes in the sequence impact only TWR (impacted flights are normally in contact with Tower Runway Control, but can also be in contact with Tower Ground Control) and Approach; • The spacing problem is limited to a couple of arrivals approaching and can be managed in a tactical way. If the spacing problem is systematic for the whole sequence, refer to the use case of manual change of Integrated Runway Sequence Function configuration. This generic use case corresponds namely to the operational situation when spacing between arrivals is not of the planned size. In this situation, 2 alternatives are possible: *Alternative 1: An aircraft that requires less departure time (runway occupancy time) is available to safely use the actual arrival gap.* [1] The Tower Runway Controller manually places the waiting aircraft (available to safety use the gap between arrivals) at the head of the departure sequence (normally by making a manual swap of sequence order with the originally planned departure); [2] The Tower Runway Controller, using the Integrated Runway Sequence Function, re-sequences the departure that can't take the gap, moving it to the earliest place in the sequence and updates the rest of the sequence, adjusting the spacing to succeeding aircraft if necessary; [3] The Tower Runway Controller clears the waiting aircraft (available to safely use the actual gap) for take-off. *Alternative 2: The actual arrival gap cannot be used by any awaiting departure.* [1] The Tower Runway Controller checks to see if the departing aircraft can comply with its TTOT once it has been held to allow the second arrival to land. If there is enough margin between the TTOT and the updated new planned take-off time and that the runway approach area is clear prior to providing by R/T the line-up instruction to the aircraft, the flow continues as planned; [2] The Tower Runway Controller will monitor progress and after flight is airborne (ATOT set) the runway sequence will be automatically updated.	

Operational Use Case	Op. UC Description	Related Technical Model
	Alternative option is for the Tower Runway Controller to update the TTOT prior take-off and the Integrated Runway Sequence Function will update the sequence and TTOTs as necessary.	
[NOV-5][RWY-SEQ-06] Manage planned runway closure (using arrival/departure integrated sequence)	This Use Case describes the management of the situation when it is necessary to temporary close the runway (planned closure 60 min in advance — e.g. maintenance, runway inspection). *Pre-Conditions*: • Airport CDM process is in place and there is an agreed business trajectory; • Advanced HMI exists for TWR Supervisor to input runway closure; • An integrated sequence is provided by the Integrated Runway Sequence Function; • The Integrated Runway Sequence Function takes into account runway closure and holding clearance inputs to update the integrated sequence. *Assumptions:* Planned RWY closure is announced early in advance so that the closure will not affect arrival aircraft already in the TMA (landing before the closure period) or departure aircraft already taxiing. This is done after coordination between APP and TWR.	***Integrated sequence by coupling AMAN and DMAN*** ***Integrated Sequence without AMAN and DMAN (and RMAN)***
[NOV-5][RWY-SEQ-07] Manage unplanned Runway Closure (using arrival/departure integrated sequence)	This Use Case describes the management of the situation when it is necessary to instantly close the active runway (unplanned closure of runway, a shorter period of time, for inspection after bird strike or FOD). The use case focuses on the specificity of an unplanned runway closure compared to a planned runway closure, i.e. the management of departures already taxiing and the management of arrivals already in the TMA. *Pre-Conditions:* • Airport CDM process is in place and there is an agreed business trajectory; • Advanced HMI exists for TWR Supervisor to input runway closure; • Advanced HMI exists for APP and ACC controllers to input holding clearances;	***Integrated sequence by coupling AMAN and DMAN*** ***Integrated Sequence without AMAN and DMAN (and RMAN)***

Operational Use Case	Op. UC Description	Related Technical Model
	• An integrated sequence is provided by the Integrated Runway Sequence Function; • The Integrated Runway Sequence Function takes into account runway closure and holding clearance inputs to update the integrated sequence. *Assumptions* Planned RWY closure will affect arrival aircraft already in the TMA and departure aircraft already taxiing. Go arounds might be required if there are flights in short final. Arriving flights not yet in the TMA might be also impacted. The absorption of the supplementary unplanned delay will require holding. It is assumed that the impacted departures having started taxi are in contact with the TWR Ground Controller and that the impacted arrivals are in contact with Approach and En-Route Control. The impact on TWR Clearance Delivery and TWR Runway Control in the frame of the concept is the same as for a planned runway closure (refer to [NOV-5][RWY-SEQ-06] Manage Planned Runway Closure), therefore it is not described in this use case.	
[NOV-5][RWY-SEQ-08] Manage integrated arrival/departure sequence in case of Go-Around	This use case describes the management of the integrated arrival/departure sequence when a go-around needs to be initiated due to special occurrences (e.g. aircraft on runway, technical failure etc.). In this case, the aircraft conducting a go-around as well as the aircraft detained from take-off need to be re-sequenced. *Pre-Conditions:* • An integrated sequence is provided by the Integrated Runway Sequence function; • Flight performing a go-around is within the stable or frozen Integrated Runway Sequence function time horizon. *Assumptions*: • The flight performing a go-around is in contact with Tower Runway Controller.	***Integrated sequence by coupling AMAN and DMAN*** ***Integrated Sequence without AMAN and DMAN (and RMAN)***
[NOV-5][RWY-SEQ-09] Use an integrated arrival/departure sequence and decision support	This use cases describes how the Airport Tower Supervisor uses the available decision tools (i.e. RMAN if available) to manage the runway configuration and the runway capacities in a consistent way. *Pre-conditions:* • Advanced HMI;	***Integrated Sequence without AMAN and DMAN and RMAN***

Operational Use Case	Op. UC Description	Related Technical Model
tool to manage RWY configuration	• Flight Data information is available (demand); • Accurate meteorological information. *Assumptions*: • Airport CDM process applies; • The Airport Operation Center (APOC) is in place; • RMAN retrieves the information required for calculation (capacity constraints, demand, runway capacities, taxiway capacities, weather information); • RMAN computes, based on the inputs, both optimal runway configuration and the forecasted times per flight; • The Integrated Runway Sequence Function receives the runway in use, mode of operation and forecasted times from RMAN; • The Integrated Runway Sequence Function respects the RMAN configuration and distribution of demand.	
[NOV-5][RWY-SEQ-10] Manage an integrated arrival/departure sequence during balancing of the number of arrival/departure flights between two runways	This Use Case describes how to manage the integrated arrival/departure sequences while balancing the number of flights between two runways, applicable for airports with two runways in use. This Use Case also describes how to support balancing of flights between the two runways to enhance overall runway throughput. The balancing for a single flight will imply a change of runway in use (and SID/STAR) and an update of integrated arrival/departure sequences for both runways. *Pre-Conditions:* • Airport CDM process is in place and here is an agreed business trajectory; • Two runways are in use at the airport; • An integrated sequence for each runway is provided by the Integrated Runway Sequence Function; • Rules to define the criteria for traffic balancing between runways are pre-defined. *Assumptions:* • Automatic update of runway in use for an arrival or a departure flight is performed by the Integrated Runway Sequence function according to local rules (e.g. depending on runway configuration, flights planning to follow a certain SID / STAR can be eligible for balancing from one runway to another);	***Integrated sequence by coupling AMAN and DMAN***

Operational Use Case	Op. UC Description	Related Technical Model
	• Update of runway in use for a specific flight is performed in a timeframe according to local rules (e.g. normally before arrival TOD and/or a locally defined time before departure EOBT); • The integrated sequence will be updated for both runways. *Post-Conditions:* Balanced arrival or departure flights follow their lifecycle to a new runway and other flights are re-planned. • Integrated Runway Sequence Function performs automatic balancing for arrival and departure flights; • Planned number of flights for each runway are balanced with positive impact on overall runway throughput; • All flights are re-planned according to updated runway sequences on both runways.	

Table 5: Trace Relevant Operational UC and Technical Models for Concept 1 and Concept 2

3.1.1.2 Overview of the SESAR Solution(s) for Concept 3

In the following subsections, an overview of the SESAR solution for Concept 3 is given.

To increase the runway throughput, the concept 3 introduces the use of the ROT information into the ORD tool to improve and optimise the arrival separation.

The ORD tool is used to indicate to the controller the separation that shall be applied between two consecutive aircrafts, if the separation is constrained by the ROT of the leader aircraft, the Initial Target Distance (ITD)or Final Target Distance (FTD) are showing to the controller that separation.

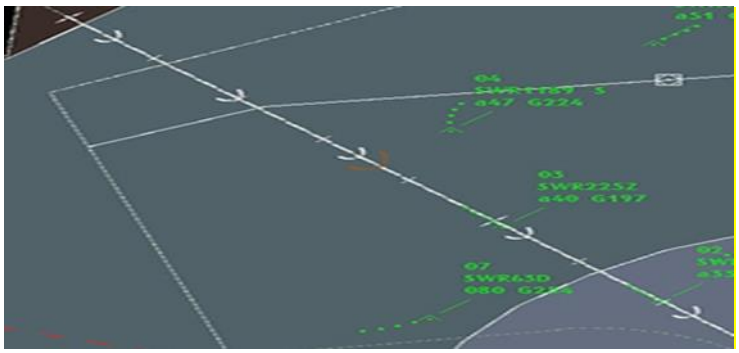

Figure 4: ORD tool for APP

To compute the separation, the ORD tool uses a local off line characterization of the average ROT per aircraft type and per runway direction (QFU).

The mandatory EN for V3/TRL6 maturity phase, shown hereunder in both figure and table, will be fully covered by implementing new functions belonging to these FBs.

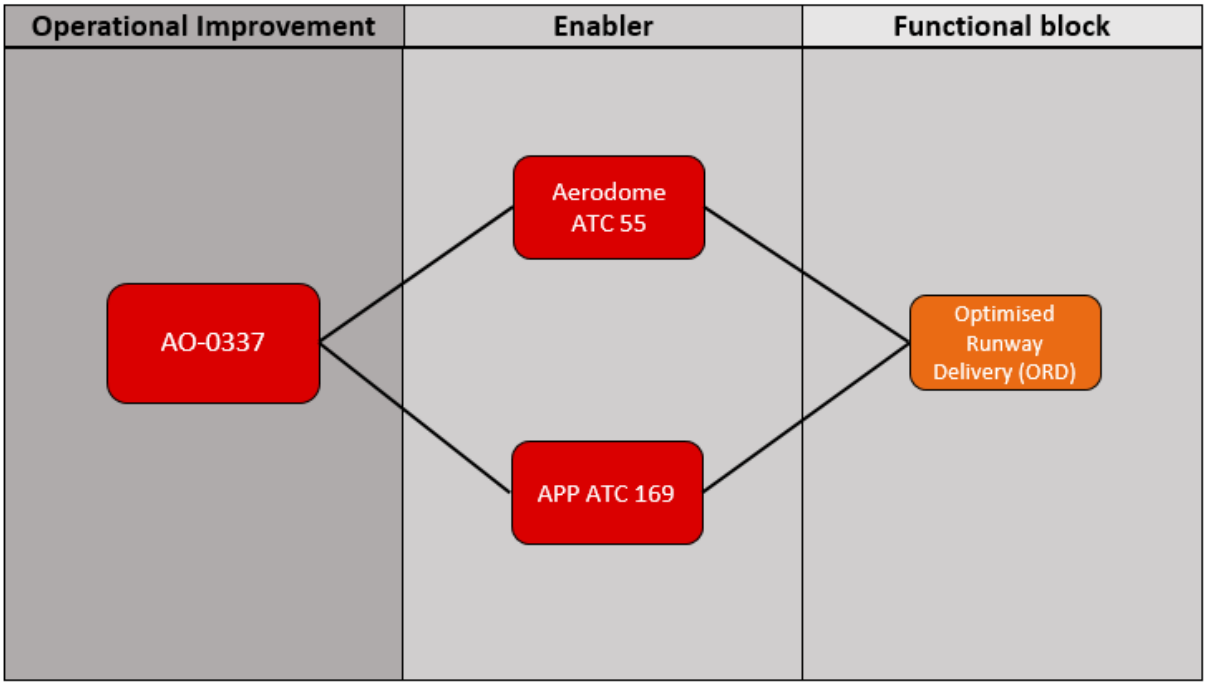

Figure 5 Solution Overview - Enablers and Functional Blocks trace for Concept 3

Functional Blocks/Role impacted by the SESAR Solution (from EATMA)	Enabler ID (from EATMA)	Enabler Title (from EATMA)	Enabler coverage
Optimised Runway Delivery (ORD)	AERODROME-ATC-55	Aerodrome ATC System to support Optimised Runway Delivery on Final Approach based on Aircraft ROT categorisation	**Full**
Optimised Runway Delivery (ORD)	APP ATC 169	Approach ATC System to support Optimised Runway Delivery on Approach based on Aircraft ROT categorisation	**Full**

Table 6: PJ.02-08 Scope and related Functional Blocks & Enablers for Concept 3

The roles directly impacted on this Solution are the Approach Controller and the Tower Runway Controller.

- Approach Controller: his/her main task is to provide the separation according to the integrated arrival/departure sequence displayed in the CHMI.
- Tower Runway Controller: his/her main task is to provide the separation according to the integrated arrival/departure sequence displayed in the CHMI.

3.1.1.2.1 Deviations with respect to the SESAR Solution(s) definition for Concept 3

The OI description has changed during the project, the solution enablers for the concept was modified as the following:

The Aerodrome ATC system is updated in order to achieve:

- local off line characterization of the average ROT per aircraft type and per runway direction (QFU) as well as its allocation to a sub ROT category;
- making the ROT category (resulting sub ROT category each approaching aircraft belongs to) available to the ATCO.

3.1.1.2.2 Relevant Use Cases for Concept 3

Table hereunder show the trace of the Technical Use case for Concept 3 developed in the validation against the Operational Use Cases from SESAR Solution 02-08 SPR-INTEROP/OSED for V3 – Part I [41].

Operational Use Case	Op. UC Description	Related Technical Model
[NOV-5][AROT-01] Increased RWY Throughput based on local ROT characterization (ROCAT)	This Use Case describes the exploitation of the Increased Runway Throughput based on local ROT characterization (ROCAT). This Use Case takes place during the phase of flight where the arrival aircraft is being metered through the TMA and towards the IAF. The Use Case ends upon arrival and the aircraft vacates the runway. *Pre-conditions:* The Minimum Radar Separation (MRS as defined in ICAO 4444 section 8.7.3) is reduced for low runway occupancy time medium aircraft. The analysis of historical ground radar data allows for characterization of ROT per aircraft type and per runway. Based on these results, the Medium aircraft can be grouped into 2 categories: - one for aircraft with short ROT,	***AROT***

	- one for aircraft with long ROT • A separation of either 2.0 NM (for aircraft presenting average ROT below 40s), 2.5 NM (for aircraft presenting average ROT below 50s) or 3.0 NM (for aircraft presenting average ROT above 50s) is associated to each ROT category. *Post-conditions:* • The arrival aircraft have landed and vacated the runway. *Actors:* • Approach Supervisor • Tower Supervisor • Initial Approach Control • Final Approach Control • Tower Runway Control • Flight Crew *Trigger:* • Coordination of an arrival aircraft into the assigned IAF between the TMA Sector Controller and the Intermediate Approach Controller.	

Table 7: Trace Relevant Operational UC and Technical Models for Concept 3

3.1.1.3 Overview of the SESAR Solution(s) for Concept 4

In the following subsections, an overview of the SESAR solution for Concept 4 is given.

Enhanced Prediction of ROT aims to bring an improvement in terms of Runway Capacity in regional aerodromes: the reduction of separation and/or designation of optimal exit taxiway has a direct impact on runway throughput (and also in the efficiency of runway usage) and therefore runway capacity.

Enhanced Prediction of ROT is an interesting solution to increase runway capacity, especially in contexts where no additional runway or change of airport layout could be made for environmental, economic reasons etc.

Another characteristic of the automated runway occupancy time prediction is that it considers the runway layout for the calculations. This allows for optimizing of the runway exit suggestion for Tower Runway Controller. The suggestion when communicated to the Flight Crew together with the provision of the landing clearance serves to reduce the runway occupancy when properly executed.

This concept aims to increase capacity of medium airports in peak hours by allowing easier operations in reduced separation minima on final approach. Additional effect of the proposed working method may be the simplification of ATCO decision process when handling traffic in diverse conditions.

This concept addresses mostly medium aircraft although ROT prediction development, testing and validation include realistic mix of light traffic that is present on medium airports. However, it was found that light traffic ROT is very variable and usually significantly smaller than for medium traffic which causes ROT prediction for this class not to contribute significantly to optimization of RWY use. On the other hand, heavy traffic is mostly absent from medium airports and once heavy flight is present wake separation minima negate any impact of ROT-based solution.

The mandatory EN for V3/TRL6 maturity phase, shown hereunder in both figure and table below, will be fully covered by implementing new functions belonging to these FBs.

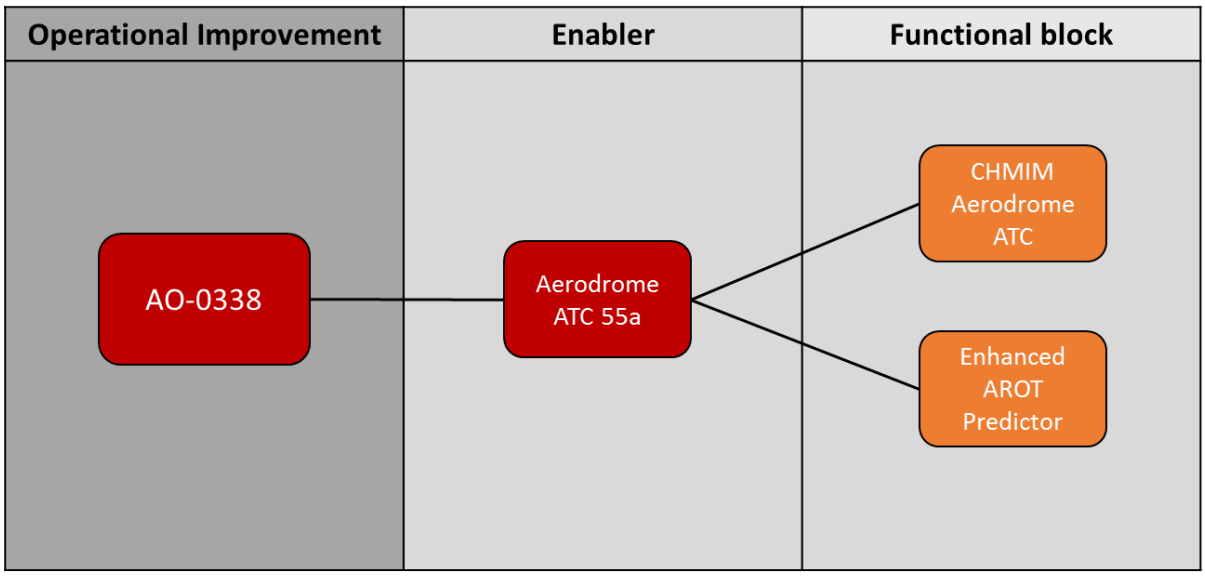

Figure 6: Solution Overview - Enablers and Functional Blocks trace for Concept 4

Functional Blocks/Role impacted by the SESAR Solution (from EATMA)	Enabler ID (from EATMA)	Enabler Title (from EATMA)	Enabler coverage
Controller Human Machine Interaction Management Aerodrome ATC Enhanced AROT Predictor	AERODROME-ATC-55a	Airport ATC analyser tool for optimising AROT	**Full**
Runway Surface Condition computing system	AERODROME-ATC-32	Runway condition awareness management system based on weather-based runway condition model	**Not addressed**

Table 8: PJ.02-08 Scope and related Functional Blocks & Enablers for Concept 4

The role directly impacted on this Solution is the Tower Runway Controller.

- Tower Runway Controller: his/her main task is to provide the Landing Clearance and Exit Prediction according to the ROT and Exit Prediction displayed in the Tower CWP.

3.1.1.4 Deviations with respect to the SESAR Solution(s) definition for Concept 4

OI Step Code	OI Step title	Deviation
AO-0338	Use of Enhanced Runway Occupancy Time (ROT) for medium airports	New OI Step. CR 03275 creates AO-0338 to complement former AUO-0704. New Enabler. CR 03473 creates AERODROME-ATC-55a.

Table 9: SESAR Solution PJ02-08 deviations for Concept 4

3.1.1.5 Relevant Use Cases for Concept 4

Table hereunder show the trace of the Technical Use case for Concept 4 developed in the validation against the Operational Use Cases from SESAR Solution 02-08 SPR-INTEROP/OSED for V3 – Part I [41].

Operational Use Case	Op. UC Description	Related Technical Model
[NOV-5] [AROT-02] AROT used in Tower Controller HMI	This Use Case describes the exploitation of Enhanced AROT Prediction via the Tower Controller HMI only. This method of AROT information exploitation is intended for medium and smaller airports where implementation of full Approach – Tower toolset might not be viable. This use case is intended for both mixed and segregated modes on a single or multiple runways. *Pre-conditions:* • A pre-defined mixed mode or segregated mode sequence is in place for the runway(s) *Assumptions:* • Enhanced AROT Prediction is online for arriving aircraft • Leader Aircraft is an arrival • Flight Crews try to follow Tower Controller exit designations *Post-conditions:* • Leader aircraft vacated the runway • Follower aircraft is cleared for landing or departure *Actors:* • Final Approach Control • Tower Runway Control • Flight Crew Leading Aircraft • Flight Crew Following Aircraft	***Optimised use of RWY capacity for regional aerodromes with the use of enhanced prediction of ROT***

Table 10: Trace Relevant Operational UC and Technical Models for Concept 4

3.1.1.6 Applicable standards and regulations

N/A

3.1.2 Capability Configurations required for the SESAR Solution

The table hereunder shows the relevant Capability Configurations of the Solution and their relation to the Sub-Operating Environments, Capabilities, Nodes and Stakeholders

Capability Configurations (CCs) (from EATMA)	Sub-Operating Environment(s) where the CCs operate	Capabilities (from EATMA)	Nodes (from EATMA)	Stakeholders (from EATMA)
APP ACC (Step 2)	TMA High Complexity	Sequencing and Merging	En-Route / Approach ATS Airspace Management Airspace Organisation Air Traffic Flow and Capacity Management	Air Navigation Service Provider
		AROT	Approach ATS	
TWR (Step 2)	High Utilisation Complex layout High Utilisation Simple layout	Demand and Capacity Balancing (airport) Sequencing and Merging	Aerodrome ATS Network Operations	Air Navigation Service Provider

Table 11: 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	Change
AERODROME-ATC-33 (Coupled sequencing tool enhanced to better handle arrivals and departures)	FB	Runway Sequence and Flow Management (PJ.02-08)	Updated Runway Sequence and Flow Management FB definition: *The Runway Sequence and Flow Management functional block generates an optimized arrival/departure integrated sequence.* *For this purpose, this functional block can either build the integrated sequence on its own or complement the arrival sequence built by AMAN and/or the departure sequence built by DMAN.*
		Controller Human Machine Interaction Management Aerodrome ATC (PJ.02-08)	The CHMIM and the CWP should be updated to display the integrated arrival/departure sequence and related information and to permit the user to interact with it.
AERODROME-ATC-58 (Agile synchronisation of arrivals with departure information for the same airport)	FB	Runway Sequence and Flow Management (PJ.02-08)	Updated Runway Sequence and Flow Management FB definition: *The Runway Sequence and Flow Management functional block generates an optimized arrival/departure integrated sequence.* *For this purpose, this functional block can either build the integrated sequence on its own or complement the arrival sequence built by AMAN and/or the departure sequence built by DMAN.*
APP-ACC-164 (APP ATC System adapted to support integrated arrival/departure sequence functionalities in ATCO's HMI)	FB	Controller Human Machine Interaction Management ER/APP (PJ.02-08)	The CHMIM and the CWP should be updated to display the integrated arrival/departure sequence and related information and to permit the user to interact with it.

Enabler	Element Type	Element Name	Change
AERODROME-ATC-74 (Airport Demand and Capacity system enhanced for multiple runway airport)	FB	Controller Human Machine Interaction Management Aerodrome ATC (PJ.02-08)	The CHMIM and the CWP should be updated to display the integrated arrival/departure sequence and related information and to permit the user to interact with it.
	FB	Runway Sequence and Flow Management (PJ.02-08)	RSFM must be updated to receive data from the Runway and Taxiway Usage Management FB.
AERODROME-ATC-55 (Aerodrome ATC System to support Optimised Runway Delivery on Final Approach based on Aircraft ROT categorisation)	FB	Controller Human Machine Interaction Management ER/APP (PJ.02-08)	The CHMIM and the CWP should be updated to display the Initial Target Distance (ITD).
	FB	Controller Human Machine Interaction Management Aerodrome ATC (PJ.02-08)	The CHMIM and the CWP should be updated to display the Final Target Distance (FTD).
AERODROME-ATC-55a (Airport ATC analyser tool for optimising AROT)	FB	Controller Human Machine Interaction Management Aerodrome ATC (PJ.02-08)	The CHMIM and the CWP should be updated to display the ROT and Exit Prediction.
	FB	Enhanced AROT Predictor (PJ.02-08)	The Enhanced AROT Predictor should compute the ROT and Exit Prediction.
APP ATC 169 (Approach ATC System to support Optimised Runway Delivery on Approach based on Aircraft ROT categorisation)	FB	Optimised Runway Delivery (ORD)	A new function is identify in order to “Compute APP ITD/FTD based on ROT” for the benefit of the Approach Executive controller.

Table 12: List of changes due to the SESAR Solution

4 Technical Specifications

4.1 Technical Specifications for the Solution for Concept 1 and Concept 2.

This section describes the new system method to achieve the Traffic Optimisation on Single and Multiple Runway Airport OIs and ENs.

Integrated Arrival and Departure Sequencing Tool

The main goal for the Integrated Runway Sequence Function (*Runway Sequence and Flow Management* Functional Block) is to establish an integrated arrival and departure sequence by providing accurate Target Take-Off Times (TTOTs) and Target Landing Times (TLDTs), including *dynamic balancing of arrivals and departures* while optimising the runway throughput.

The integrated sequence issued by the Integrated Runway Sequence Function is calculated according to a look-ahead **Time Horizon** which value will range from firstly a time before arrival flights top of descent (i.e. 60 minutes before entry to runway) and updated in the tactical phase until a certain *Stable Sequence Time Horizon*. At that time, TTOTs and TLDTs will be fine-tuned according to flight progress until a *Frozen Sequence Time Horizon*, from which TTOT/TLDT will be frozen.

The Figure below gives a view of time horizons for arrivals from the right to middle (runway) and of departures from the left to middle (runway) including a highlight of the main working area for setting of the combined sequence.

- The *Look Ahead Time Horizon* is the time at which flights become eligible for the integrated sequence
- The *Stable Sequence Time Horizon* is the time horizon within which no automatic swapping of flights in the sequence will occur, but landing and departure time will still be updated.
- The *Frozen Sequence Time Horizon* is the time horizon within which no automatic swapping of flights in the sequence and no update of landing /departure time will occur.

The values of these time horizons are determined by the local implementation and they are not necessarily the same for arrivals and departures.

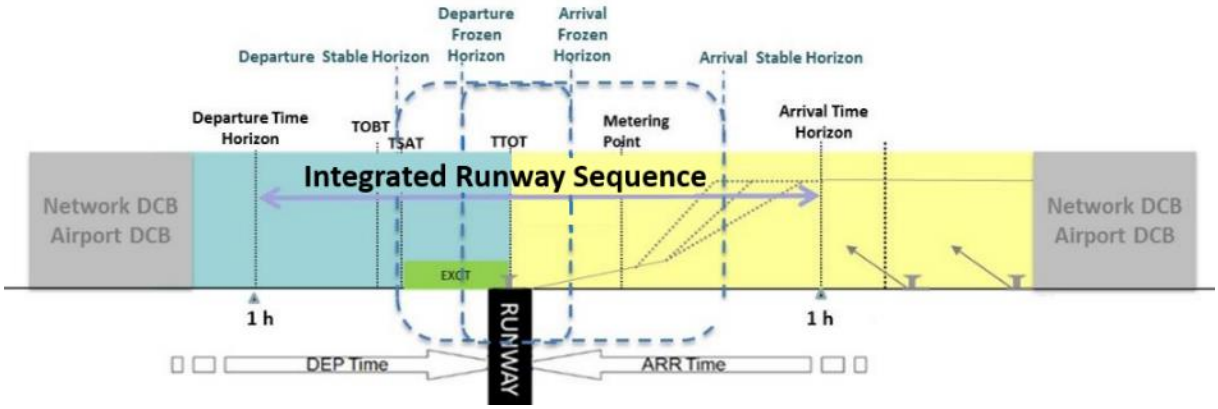

Figure 7: Time horizons for the new concept

The Integrated Runway Sequence Function receives:

- The Flight data for arrivals including estimated and actual times involved in the arrival process;
- The Flight data for departures including estimated and actual times involved in the departure process;
- Trajectory data updates (i.e. ETO, ATO);
- When integrated with Runway DCB (RMAN): Airport Configuration, runway capacities and adjusted demand.

The following tasks would be performed by the Integrated Runway Sequence Function:

- Calculation of an integrated arrival/departure sequence based on a dynamic balancing of arrival and departures, by using the estimated times at the runway;
- Calculation of an integrated arrival/departure sequence taking into account the Forecasted Times and relevant data from the RMAN (if available);
- Perform balancing of the arrival/departure flights between two runways in case this gives a positive impact on overall runway throughput;
- Assign TLDTs and TTOTs to arrivals and departures based on the best runway sequence which optimise the runway throughput;
- Update applicable parts of the sequence based on new information on arrival and departure flight progress;
- Provide a buffer of departing flights (predefined number) at the Runway hold to consider variability and delays depending on specific situation.

The integrated sequence optimisation of TTOT and TLDT is firstly calculated by the Integrated Runway Sequence Function in the look ahead Time Horizon balancing arrivals and departures according to demand, needs and configured parameters in order to achieve the best trade-off between efficiency, predictability and optimised throughput.

Target landing times (TLDT) will be set by the Integrated Runway Sequence Function to calculate constrains at Metering Fixes (MF). If TTL/TTG or CTA procedures are in place to implement the arrival sequence, the TLDTs from the Integrated Runway Sequence Function could be converted into Time to Lose (TTL), Time to Gain (TTG) or Controlled Time of Arrival *(CTA)* and made available for ATCOs.

4.1.1 Functional architecture overview

This section describes the Functions needed to perform the Solution concepts and provides a functional view of how the technical systems, functional block(s), system ports and roles achieve the operational needs.

As described in **Section 3.1.1**, the optimised integration of arrival and departure traffic flows is accomplished throughout the *Runway Sequence and Flow Management* (RSFM) functional block.

The main objective of the RSFM is to act as a queue management tool that provides the users with an integrated sequence of arrival and departure flights, generating a smooth flow of arrival and departure traffic at an aerodrome. All the sequences are calculated based on different criteria of the controllers' expectations (i.e. trying to reduce the total delay of the flights), taking into account the capacity constraints and keeping the safe separations defined between flights. The integrated sequence issued by the RSFM is calculated according to a look-ahead Time Horizon whose value will range from firstly a time before arrival flights top of descent (i.e. generally 40 minutes before entry to runway).

The RSFM functional block has been re-defined for SESAR2020 in order to be able to provide an optimised arrival/departure sequence with or without an Arrival Management and/or a Departure Management FB(s). Consequently, there could be four possible architecture cases, containing the following main FBs:

- *Runway Sequence and Flow Management*
- *Runway Sequence and Flow Management*, *Arrival Management* and *Departure Management*
- *Runway Sequence and Flow Management* and *Departure Management*
- *Runway Sequence and Flow Management* and *Arrival Management*

Furthermore, it needs to be possible to flexibly allocate the RSFM Functional Block to TWR (Step 2) and APP ACC (Step 2) Capability Configurations to express all the possible deployment decisions. Hence, this document, although it focuses on the TWR (Step 2) option, considers the two options.

The main objective of interlinking the Runway and Taxiway Usage Management (only for the second concept – TS-0313) function and RSFM function is the improvement in the generation of the arrival/departure sequence through determining within the planning phase the optimal runway configuration and the adjusted demand.

To summarize, these are the possible architecture implementation options:

		IMPLEMENTATION OPTION															
		IO1	IO1b	IO2	IO2b	IO3	IO3b	IO4	IO4b	IO5	IO5b	IO6	IO6b	IO7	IO7b	IO8	IO8b
RSFM	Within TWR (Step 2) CC	X	X	X	X	X	X	X	X								
	Within APP ACC (Step 2) CC									X	X	X	X	X	X	X	X
AMAN		X	X	X	X					X	X	X	X				
DMAN		X	X			X	X			X	X			X	X		
RTUM (Only for Concept 2)[3]			X		X		X		x		X		X		X		X

Table 13: Possible Architecture Implementation Options

Along this section, only the implementation options IO1 and IO4b, corresponding to the ones used in the validation exercises, will be deeply presented. Other architecture cases are defined in **section 5 Implementation Options**.

[3] Options for Concept 2 (TS-0313), that add the RTUM functionalities, are named as IOXb. X=1,2,…,8

This functional breakdown is consistent with the architecture modelled in MEGA and the latest applicable version of EATMA.

It should be noted that only those Functions related to Functional Blocks impacted by PJ.02-08 (see **section 3.1.1**) were modelled and created. The rest of the Functional Blocks were inserted into the model to make it understandable; nevertheless, these FBs are considered as black boxes and the functions modelled within them are Functions with the same name as the FBs.

Capability Configuration	Technical System	Functional Block	Function
ER ACC & APP ACC (Step 2)	En-Route / Approach ATC	Legacy G/G Datalink Communication	-
		Flight Planning- Life cycle Management - Data Distribution	-
		Arrival Management	-
		CHMIM ER APP	Display Arrival/Departure Integrated Sequence
APP ACC (Step 2) & TWR (Step 2)	Sequence Management	**Runway Sequence and Flow Management (RSFM)**	Calculate Arrival/Departure Sequence
			Distribute Arrival/Departure Sequence
TWR (Step 2)	Aerodrome ATC	Aerodrome Flight Data Processing	-
		G/G Communication Aerodrome ATC	-
		Departure Management	-
		CHMIM Aerodrome ATC	Display Arrival/Departure Integrated Sequence

Table 14: Functional Architecture Overview IO1

Capability Configuration	Technical System	Functional Block	Function
ER ACC &APP ACC (Step 2)	En-Route / Approach ATC	Legacy G/G Datalink Communication	-
		Flight Planning- Life cycle Management - Data Distribution	-
		CHMIM ER APP	Display Arrival/Departure Integrated Sequence
APP ACC (Step 2) & TWR (Step 2)	Sequence Management	**Runway Sequence and Flow Management (RSFM)**	Calculate Arrival/Departure Sequence
			Refine Integrated Arrival/Departure Sequence
			Distribute Arrival/Departure Sequence
TWR (Step 2)	Aerodrome ATC	Aerodrome Flight Data Processing	-
		G/G Communication Aerodrome ATC	-
		Aerodrome Weather Information Management	-
		Runway and Taxiway Usage Management	-
		Operational Supervision	-
		CHMIM Aerodrome ATC	Display Arrival/Departure Integrated Sequence

Table 15: Functional Architecture Overview IO4b

Capability Configuration	Role	Function	Related to FB

Capability Configuration	Role	Function	Related to FB
APP ACC (Step 2)	Sequence Manager	Assess Sequence	CHMIM ER/APP
	ATC Sector Executive Controller	Monitor and Separate	CHMIM ER/APP
	ACC/Approach Supervisor	-[4]	Operational Supervision ER/APP ATC
TWR (Step 2)	Sequence Manager	Assess Sequence	CHMIM Aerodrome ATC
	TWR Runway Controller	Monitor and Separate	CHMIM Aerodrome ATC
	Ground Controller	-	CHMIM Aerodrome ATC
	Clearance Delivery Controller	-	CHMIM Aerodrome ATC
	TWR Supervisor	Assess Airport Configuration	Operational Supervision
		Decide on Airport Configuration	

Table 16: Roles Involved

4.1.1.1 Resource Connectivity Model

The following diagrams represent the high-level interactions of the two CCs involved for the main architectures developed. Depending on the allocation of the Sequence Management System and on the existence of an AMAN and/or a DMAN, the relevant resource interactions may change.

- Implementation Option 1: Sequence Management System within TWR (Step 2) CC. Existing AMAN and DMAN:

[4] Means that these Roles were not taken into account when model ling as they had a minor impact in the solution than the ones modelled. Nevertheless, they should be considered as impacted Roles .

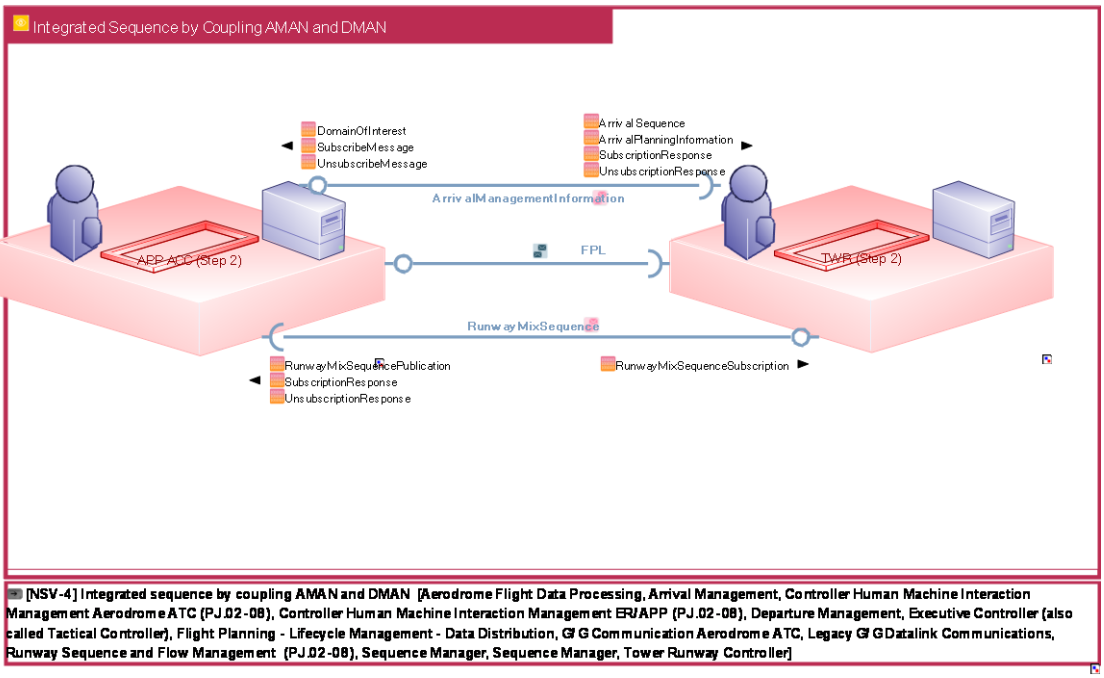

Figure 8: NSV-1 IO1

- Implementation Option 4b: Sequence Management System within TWR (Step 2) CC. No AMAN and DMAN:

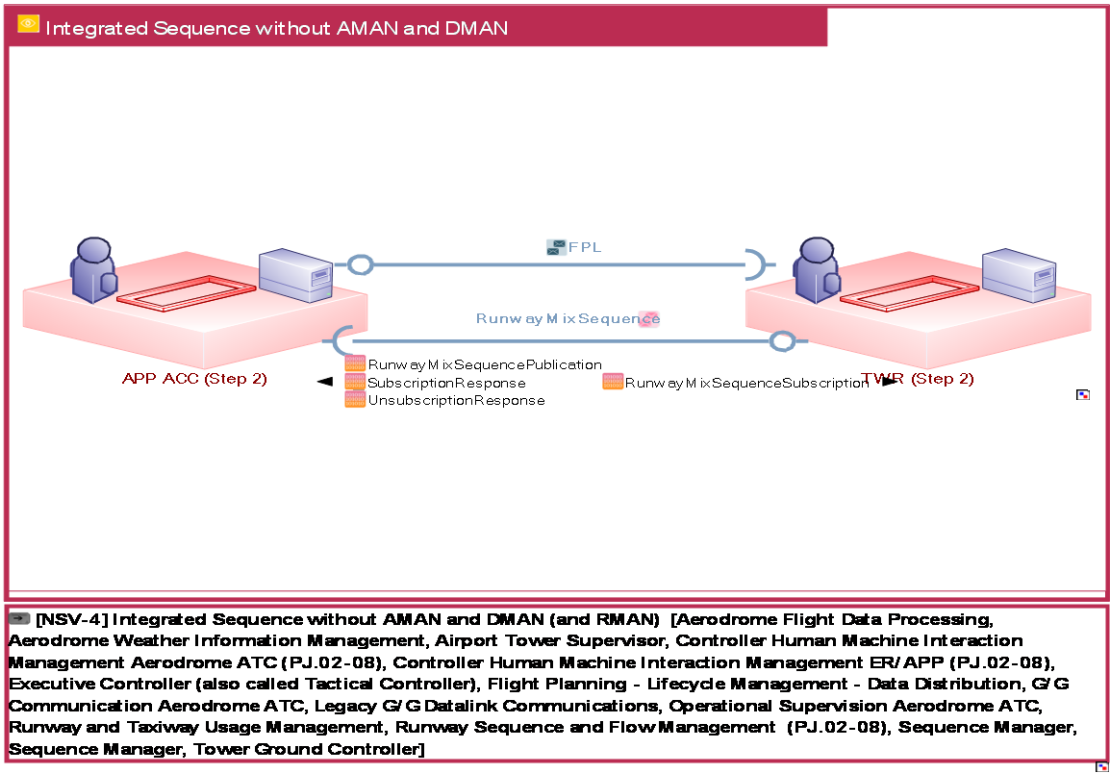

Figure 9: NSV-1 IO4b

4.1.1.2 Resource Orchestration view

The diagrams within this section represent the interactions of the main FBs involved. It must be highlighted that, where data flows are identified between functional blocks, their purpose is to clarify the scope of the functional blocks, their inter-relationships and to provide a verification level of the requirements. However, these do not currently indicate the standardisation of internal exchanges, as only external exchanges at the domain systems level are currently viewed as needing to be commonly defined.

It should be noticed that not all the Roles involved in the concept were modelled in order not to overload the figures. Nevertheless, secondary Roles for the solution like Ground Controller, Clearance Delivery Controller and Flight Crew have a minor impact on the solution (see SESAR Solution 02-08 SPR-INTEROP/OSED for V3 – Part I [41])

Hereunder, the main architectures and the corresponding descriptions (also available in MEGA with a better resolution):

IO1- Arrival/Departure Sequence reutilizing AMAN and DMAN

The Runway Sequence Flow Management receives as input the flight plans information for arrival and departures as AMAN for arrivals and DMAN for departures:

- Estimated Times (ELDTs, ETOTs, EOBTs) and CTOTs
- Callsign, departure and arrival airport, SIDs and STARs
- Aircraft type and WKT category
- Actual Times (ASAT, ATOT, ALDT)

The Runway Sequence Flow Management receives as input the arrival sequence provided by AMAN and the departure sequence provided by DMAN

The AMAN arrival sequence (resp. DMAN departure sequence) is built taking into account the current airport/runway configuration and the current arrival/departure integrated sequence to manage room in the sequence for the departure (resp. arrival) traffic in case of mixed mode runway.

Based on the received information, RSFM calculates the arrival/departure integrated sequence over the runways, optimising the runway usage and provides target times (TLDTs, TTOTs and TSAT in pre-departure phase). The arrival/departure integrated sequence, built according to the AMAN sequence order for arrivals, can be optimised with balancing arrival and departure within the runways in case of parallel runways. The balancing between two runways can be automated (if the TWR Supervisor has activated this option). The RWY change associated to the balancing will be processed by AMAN for arrivals, DMAN for departures resulting in an update of the associated flight plan. Manual balancing between the runways can also be performed manually by AMAN for arrivals and DMAN for departures.

The arrival/departure integrated sequence is distributed to AMAN and DMAN and then be available for display in the ad-hoc CHMIM. Furthermore, the controller will be able to manually modify the arrival/departure integrated sequence by means of specific interactions. These modifications will be taken into account by AMAN for arrivals, DMAN for departures, the modified sequences will allow

RSFM to update the arrival/departure integrated sequence, with as required updates of TTOTs, TLDTs and TSAT in pre-departure phase.

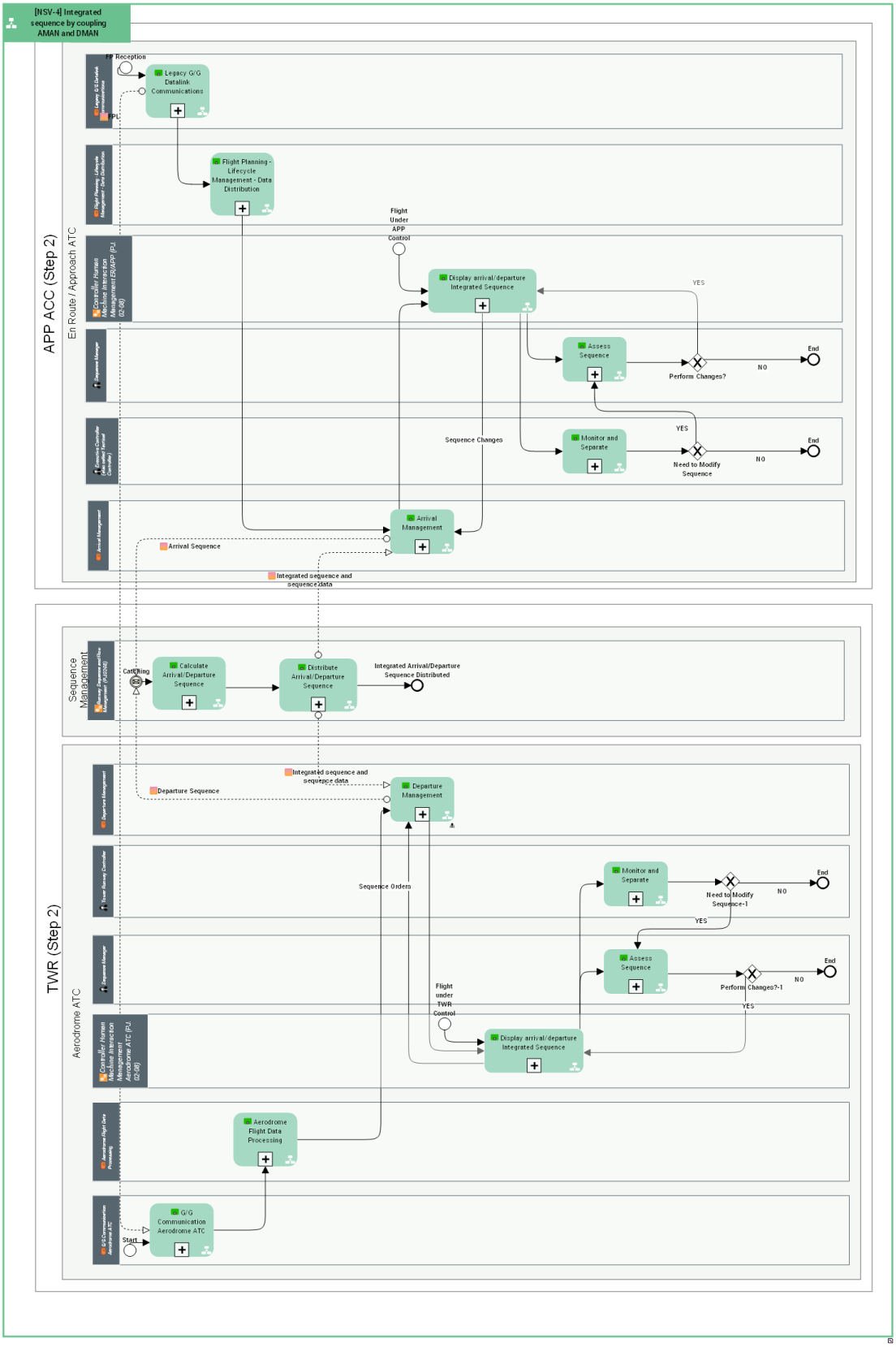

Figure 10: NSV-4 IO1 (AMAN, DMAN and RSFM)

IO4b - Arrival/Departure Sequence with Airport DCB and without AMAN and DMAN

The Runway Sequence Flow Management receives as input the flight plans information:

- Estimated Times (ELDTs, ETOTs, EOBTs) and CTOTs
- Callsign, departure and arrival airport, SIDs and STARs
- Aircraft type and WT category
- Actual Times (ASAT, ATOT, ALDT)

Based on the information received in this communication, the component calculates the arrival/departure sequence and provides target times (TLDTs, TTOTs and TSATs) over the runways.

The sequences will be displayed in the CHMIM. Furthermore, the controller will be able to manually modify the sequences by means of specific interactions. These modifications will be taken into account by the RSFM, which will recalculate de TTOTs, TSATs and TLDTs.

Additionally, in this concept, the RSFM will receive as input the outputs from the Airport DCB:

- Optimal airport configuration
- Runway capacities (ratios)
- Adjusted demand (FLDTs, FTOTs and assigned runways)

These data will be displayed to the Tower Supervisor in the Operational Supervision. Moreover, the supervisor will be able to manually modify them. These modifications will be taken into account by the RSFM, which will recalculate de TTOTs and TLDTs.

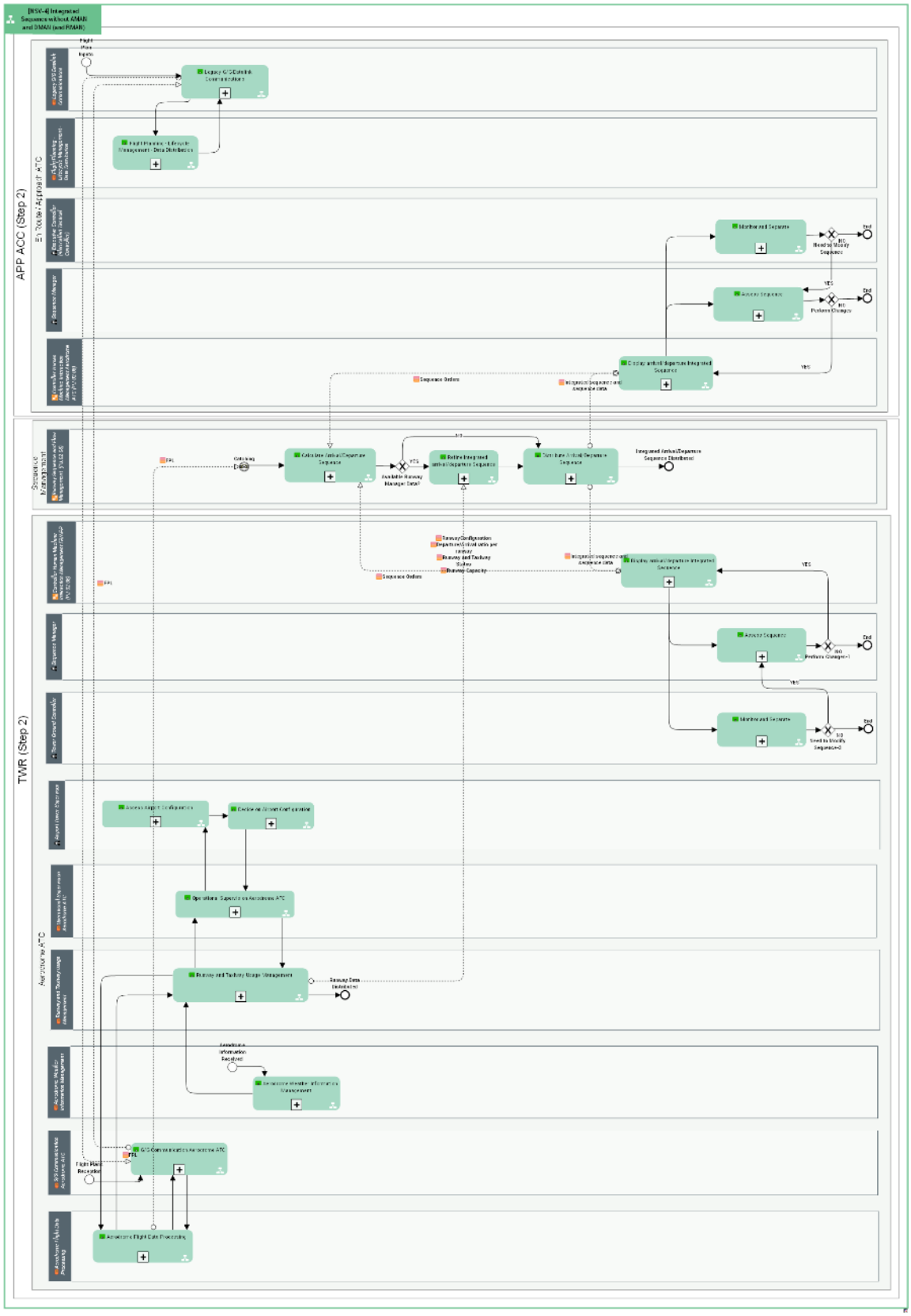

Figure 11: NSV-4 IO4b (RSFM + RTUM)

In order to clarify the main flows and to better understand the models, the next table has been developed, considering our four main options:

- IO1) AMAN, DMAN, RSFM
- IO4) RSFM
- IO1b) AMAN, DMAN, RSFM, RTUM
- IO4b) RSFM, RTUM

This table is only used as a guideline, it must be highlighted that, where dataflows are identified between functional blocks, their purpose is to clarify the scope of the functional blocks. However, these do not currently indicate the standardisation of internal exchanges.

Source : Domain / Functional block	Flow	Destination : Domain / Functional block	Options
Aerodrome ATC : Runway and Taxiway Usage Management	Airport Configuration Runway Capacities Adjusted Demand (FLDT, FTOT, assigned Runway)	Sequence Management: Runway Sequence and Flow Management Aerodrome ATC: Operational Supervision	IO1b, IO4b
Aerodrome ATC : Runway and Taxiway Usage Management		En-Route Approach ATC: AMAN	IO1b
Aerodrome ATC : Runway and Taxiway Usage Management	KPIs	Aerodrome ATC : Operational Supervision	IO1b, IO4b
Aerodrome ATC : Departure Management	Departure Sequence Data	Sequence Management: Runway Sequence and Flow Management	IO1, IO1b
Aerodrome ATC : Departure Management	Integrated Arrival/Departure Sequence	Aerodrome ATC : CHMIM	IO1, IO1b
En-Route / Approach ATC : Arrival Management	Arrival Management Information	Sequence Management: Runway Sequence and Flow Management	IO1, IO1b
En-Route / Approach ATC : Arrival Management	Integrated Arrival/Departure	En-Route / Approach ATC : CHMIM	IO1, IO1b

	Sequence		
Sequence Management: Runway Sequence and Flow Management	Integrated Arrival/Departure Sequence	En-Route / Approach ATC: Arrival Management	IO1,IO1b
Sequence Management: Runway Sequence and Flow Management	Integrated Arrival/Departure Sequence	Aerodrome ATC: Departure Management	IO1,IO1b
Sequence Management: Runway Sequence and Flow Management	Integrated Arrival/Departure Sequence	Aerodrome ATC: CHMIM	IO4, IO4b
		En-Route / Approach ATC: CHMIM	IO4, IO4b
Aerodrome ATC : CHMIM	Sequence order	Aerodrome ATC: Departure Management	IO1, IO1b
		Sequence Management: Runway Sequence and Flow Management	IO4, IO4b
En-Route / Approach ATC : CHMIM	Sequence Order	En-Route / Approach ATC: Arrival Management	IO1, IO1b
		Sequence Management: Runway Sequence and Flow Management	IO4, IO4b

Table 17: Flows between FBs

4.1.1.3 Infrastructure connectivity model

This Supporting Infrastructure is the set of:

- Capability Configurations:
  - APP ACC (Step 2)
  - TWR (Step 2)
  - Communication Infrastructure
- Technical Systems within the CCs:
  - En-Route/Approach ATC
  - Sequence Management
  - Aerodrome ATC

- System Ports:
    - Transport Secured Web-Services at APP ACC (Step2)
    - Transport Secured Web-Services at TWR (Step 2)
    - FPL_INFO_GND at APP ACC (Step2)
    - FPL_INFO_GND at TWR (Step 2)
    - MHS_GND at Communication Infrastructure

Infrastructure elements show the physical realisation of Resource Interactions and Services.

- Implementation Option 1: With AMAN and DMAN

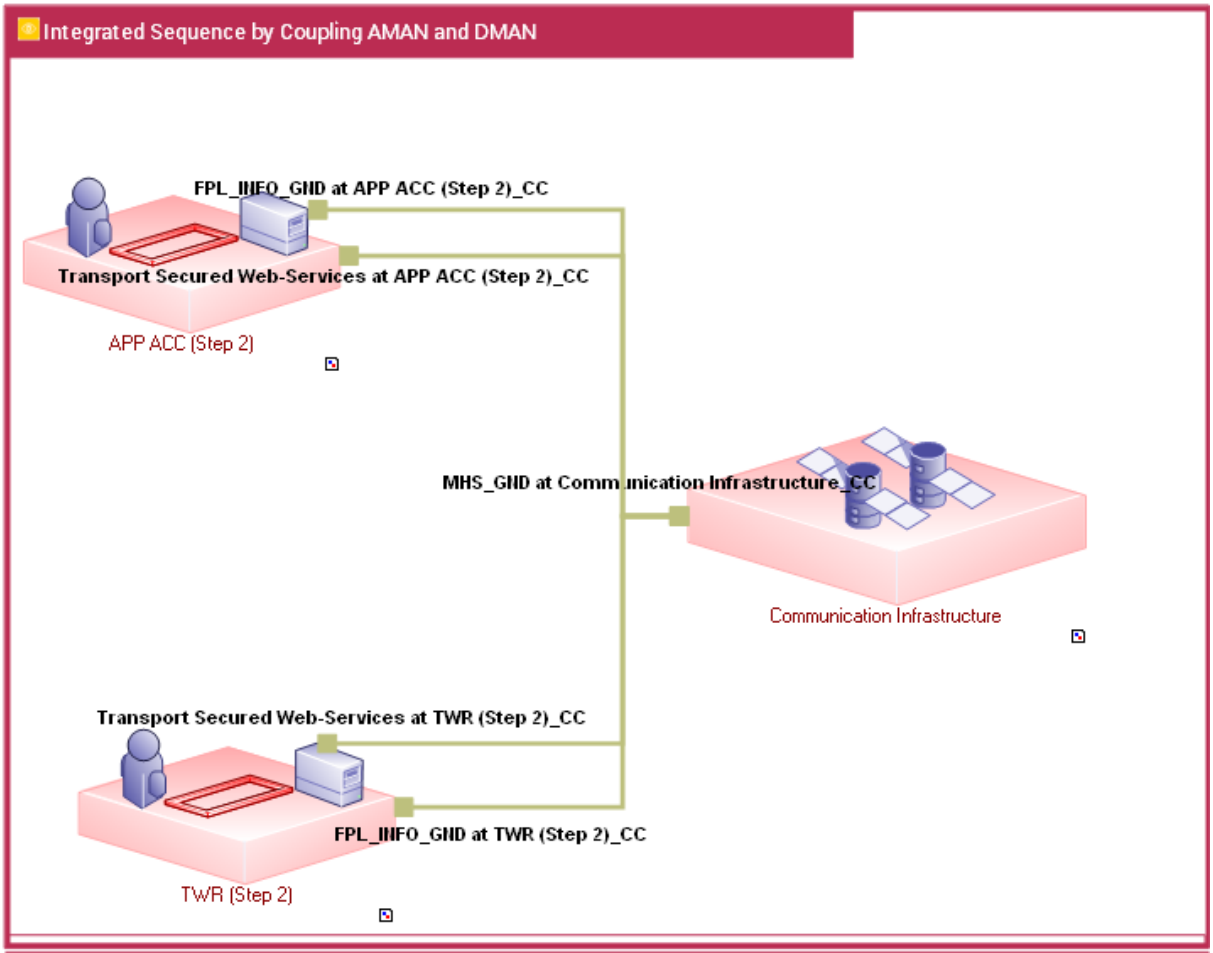

Figure 12: NSV-2 IO1 (AMAN, DMAN, RSFM)

- Implementation Option 4b: Without AMAN and DMAN

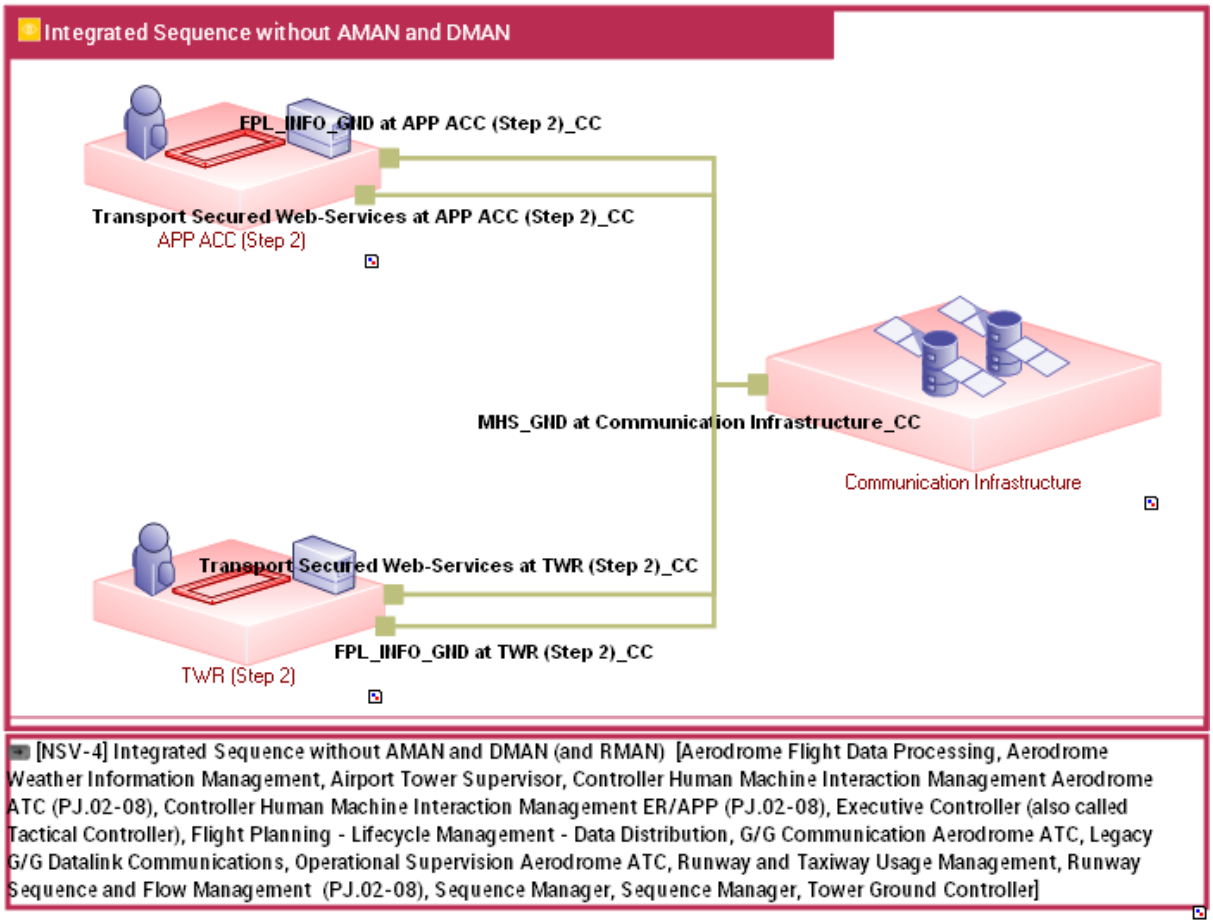

Figure 13: NSV-2 IO4b (RSFM + RTUM)

4.1.1.4 Service view

4.1.1.4.1 Service description

Although these services were created in SESAR1 for other purposes, they were assessed and considered as valid for PJ.02-08 solution. It should be noted that Services are not within the scope of this Solution, thus they are not being validated per se.

ArrivalManagementInformation:

Arrival Managers produce Arrival Information for Flights and Arrival Sequences to be used either by ATCOs displaying the need for delay absorption measures, or by IT systems to base further processing on this Information.

Arrival Management Information in an extended horizon context needs to be provided to upstream ATSUs, airports and satellite regional airports.

The service in addition offers arrival planning information (information related to the airborne trajectory segment of inbound flights). The payloads are strongly influenced by the notion of AOP-NOP integration. Specifically, some of the information obtained from Local ATC / AMAN is supposedly orchestrated by the AOP for provisioning to the NOP. Therefore, this service also covers

implicitly the requirements of the NOP for Arrival Planning Information as far as the primary source of this information is ATC.

RunwayMixSequence:

The runway mix sequence service is in charge of published the runway mix sequence generated by the tower to the previously subscribed nodes in order to have a unique sequence shared for arrivals and departures. There is also an operation for unsubscribing, with the same payload as the subscribe operation.

4.1.1.4.2 Service Provisioning

Interaction	Consumer CC	Consumer System	Provider CC	Provider System
RunwayMixSequence	APP ACC (Step 2)	Sequence Management; En-Route / Approach ATC;	TWR (Step 2)	Sequence Management; Aerodrome ATC;
FPL	APP ACC (Step 2)	Sequence Management; En-Route / Approach ATC;	TWR (Step 2)	Sequence Management; Aerodrome ATC;

Table 18: Service-Provisioning Matrix (IO4)

Interaction	Consumer CC	Consumer System	Provider CC	Provider System
RunwayMixSequence	APP ACC (Step 2)	Sequence Management; En-Route / Approach ATC;	TWR (Step 2)	Sequence Management; Aerodrome ATC;
FPL	APP ACC (Step 2)	Sequence Management; En-Route / Approach ATC;	TWR (Step 2)	Sequence Management; Aerodrome ATC;
ArrivalManagementInformation	TWR (Step 2)	Sequence Management; Aerodrome ATC;	APP ACC (Step 2)	En-Route / Approach ATC;

Table 19: Service-Provisioning Matrix (IO1)

4.1.1.4.3 Service Realization

This section describes the technology use to realise the Services.

- System Ports:
  - Transport Secured Web-Services at APP ACC (Step2)

- Transport Secured Web-Services at TWR (Step 2)
- FPL_INFO_GND at APP ACC (Step2)
- FPL_INFO_GND at TWR (Step 2)
- MHS_GND at Communication Infrastructure

4.1.2 Functional and non-Functional Requirements for the Solution for Concept 1 and Concept 2

The following section compiles Technical Requirements for Concept 1 and Concept 2 defined in Solution 02-08 for V3 maturity.

These Requirements have been transferred into the SE-DMF tool (https://portal.se-dmf.eu/rm/web). Links with Operational Requirements and EATMA elements have been performed.

For the Runway Manager system RMAN, the technical requirements were specified and validated in SESAR1, as provided in SESAR1 12.02.01.D34 - P3_Final System Requirements, Edition 00.02.00, 12/04/2016 [38].

4.1.2.1 The criteria used for requirement specification

The requirements REQ-XXb.YY-TS-UU01.0123 are built in compliance with the following criteria as described in the SESAR 2020 Requirements and Validation Guidelines [25]:

- **Identifier field**: Unambiguous identifier including <Object type>-<Solution code>-<Document code>-<Reference code>.<Reference number> where
  - <Object type> is REQ - Requirement
  - <Solution code> XXb.YY for the project code and then the last two digits for the solution identifier (i.e. 02.08)
  - <Document code> is TS – Technical Specification
  - <Reference code> is an implementation option of up to five alphanumeric characters (i.e. FUN01, FUN02, SAF, SEC…)
    - Functional requirements (numbered as):
      - For RSFM in any architectural option (numbered as FUN00)
      - For RSFM without AMAN and DMAN (numbered as FUN01);
      - For RSFM with AMAN and DMAN (numbered as FUN02):
      - For concept 3 (numbered as FUN03)
      - For concept 4 (numbered as FUN04)
  - <Reference number> is a sequence of four digits. For this solution, organized as follows (ABCD):
    - A: for different subcategories
      - If no subcategory available, A=0
      - If subcategory available, A=1,2,3,…,n
        - For functional requirements, subcategories are organized as follows:
          - RSFM inputs (numbered as FUNYY.1BCD)

- RSFM Outputs (numbered as FUNYY.2BCD)
- Controller HMI (numbered as FUNYY.3BCD)
- Sequence Calculation (numbered as FUNYY.4BCD)

- BC: Number of Requirement within that category (i.e. FUNYY.A01D)
- D: if the requirement is modified after a review, this number increases from 0 to n.

- **Title field**: Free text providing general description.
- **Requirement**: Description of the requirement developed from the relevant needs.
- **Status field**: Requirement lifecycle status that may be:
  - <In Progress> if the requirement is not confirmed as validated;
  - <Deleted> is used to indicate that the requirement is not considered valid anymore
  - <Validated> if the verification of the technical requirement is completed in the frame of the SESAR R&D activities (until V3) and the requirement is mature enough to be directly transferred to Industrialisation (V4). It should be noted that sticking to the TS template, the technical requirements would be validated; however, what really occurs from the technical side is that these requirements would be *verified*.
- **Rational Field**: Free text providing additional information to the requirement (if necessary) and describing (if applicable) the changes with respect to previous versions. The explanation may include references to other studies.
- **Category field**: Requirement category may be:
  - <Functional>
  - <Interface>
  - <Safety>
  - <Security>

4.1.2.2 System Interface and Functional requirements for Concept 1 and Concept 2

4.1.2.2.1 Sequence Management System

4.1.2.2.1.1 Inputs

[REQ]

Identifier	REQ-02.08-TS-FUN01.1010
Title	Aircraft identifier
Requirement	The Sequence Management System shall receive the aircraft identifier (Call Sign) from the flight plan.
Status	<Validated>
Rationale	The system requires specific data (aircraft identifier) to perform its calculations

Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1020
Title	Departure identifier
Requirement	The Sequence Management System shall receive the identifier of the departure aerodrome from the flight plan.
Status	<Validated>
Rationale	The system requires specific data (departure aerodrome) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001

<SATISFIES>	< ATMS Requirement>	FRD Requirement Identifier
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1030
Title	Destination Aerodrome
Requirement	The Sequence Management System shall receive the identifier of the destination aerodrome from the flight plan.
Status	<Validated>
Rationale	The system requires specific data (destination aerodrome) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence

<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1040
Title	Aircraft Type
Requirement	The Sequence Management System shall receive the Aircraft Type from the flight plan.
Status	<Validated>
Rationale	The system requires specific data (aircraft type) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1050
Title	SID exit point
Requirement	The Sequence Management System shall receive the route (SID exit point) from the flight plan.
Status	<Validated>
Rationale	The system requires specific data (SID) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1060
Title	CTOT reception
Requirement	The Sequence Management System shall receive the CTOT value provided by the flight plan.
Status	<Validated>
Rationale	The system requires specific data (CTOT) to perform its calculations

Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1070
Title	ATOT reception
Requirement	The Sequence Management System shall receive the ATOT value from the Aerodrome ATC System.
Status	<Validated>
Rationale	The system requires specific data (ATOT) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001

<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1080
Title	TOBT reception
Requirement	The Sequence Management System shall receive the TOBT value from the Aerodrome ATC System.
Status	<Validated>
Rationale	The system requires specific data (TOBT) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A

<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1090
Title	EOBT reception
Requirement	The Sequence Management System shall receive the EOBT value from the Aerodrome ATC System
Status	<Validated>
Rationale	The system requires specific data (EOBT) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1100

Title	EXOP reception
Requirement	The Sequence Management System should receive the EXOP value from the Aerodrome ATC System.
Status	<Validated>
Rationale	The Sequence Management System needs to update the sequence based on accurate estimated taxi times
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1110
Title	ASAT Reception
Requirement	The Sequence Management System shall receive the ASAT from the Aerodrome ATC System.
Status	<Validated>
Rationale	The system requires specific data (ASAT) to perform its calculations

Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1120
Title	ALDT Reception
Requirement	The Sequence Management System shall receive the ALDT value from the Aerodrome ATC System.
Status	<Validated>
Rationale	The system requires specific data (ALDT) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001

<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1130
Title	ELDT reception
Requirement	The Sequence Management System shall receive the ELDT value from the flight plan.
Status	<Validated>
Rationale	The system requires specific data (ELDT) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A

<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1140
Title	EXOT reception
Requirement	The Sequence Management System should receive the EXOT value from the Aerodrome ATC System.
Status	<Validated>
Rationale	The system requires specific data (EXOT) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	< ATMS Requirement>	FRD Requirement Identifier
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.1150
Title	Runway information reception
Requirement	The Sequence Management System shall receive from the Runway and Taxiway Usage Management sub-system, if available: • Runway Configuration and mode of operation, • Runway capacity • Flight allocation • Forecasted times (FLDT/FTOT)
Status	<Validated>
Rationale	If RMAN is available, the system requires specific data to perform its calculations.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0006
<SATISFIES>	<Enabler>	Aerodome-ATC-74
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Functional block>	Runway and Taxiway Usage Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Function>	Refine Integrated arrival/departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1160
Title	Flight progress report
Requirement	The Sequence Management System shall receive real time flight progress reports from Aerodrome ATC System for departures and from En-Route/Approach ATC system for arrivals
Status	<Validated>
Rationale	In order to provide an accurate sequence the system requires the reception of real time information from flights that are under its time horizon
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.1180
Title	Runway information reception
Requirement	The Sequence Management System shall receive the Arrival/Departure ratio from Aerodrome ATC System
Status	<Validated>

Rationale	The Arrival/Departure ratio per runway is necessary information for Sequence Management System
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.1190
Title	STAR input
Requirement	The Sequence Management System shall receive the STAR from the flight plan.
Status	<Validated>
Rationale	The system requires specific data (STAR) to perform its calculations
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN02.1200
Title	Arrival sequence input
Requirement	The Sequence Management System may receive the arrival sequence and arrival flight progress information from the AMAN
Status	<Validated>
Rationale	Depending on architectural deployment option the integrated sequence is built form the arrival sequence.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A

<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN02.1210
Title	Departure sequence input
Requirement	The Sequence Management System may receive the departure sequence and departure flight progress information from the DMAN
Status	<Validated>
Rationale	Depending on architectural deployment option the integrated sequence is built form the departure sequence.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.1220
Title	Alternative SID input
Requirement	The Sequence Management System shall receive the SID for the alternative runway in order to perform balancing between two runways.
Status	<Validated>
Rationale	The SID for the alternative runway is needed order to perform balancing between the runways. The alternative SID may be a global configuration and possibly overridden for specific flights.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0018
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.1230
Title	Alternative STAR input
Requirement	The Sequence Management System shall receive the STAR for the alternative runway in order to perform balancing between two runways.
Status	<Validated>
Rationale	The STAR for the alternative runway is needed order to perform balancing between the runways. The alternative STAR may be a global configuration and possibly overridden for specific flights.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0018
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	Aerodome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

4.1.2.2.1.2 Outputs

[REQ]

Identifier	REQ-02.08-TS-FUN00.2010

Title	Distribute computed data
Requirement	The Sequence Management System shall output computed data to stakeholders, in particular: • TLDT • TTOT • TSAT
Status	<Validated>
Rationale	Target times generated by the system according to the inputs received
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0005
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0002
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0003
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0010
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	APP ATC 164
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	CHMIM ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Distribute arrival/departure integrated sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A

<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.2020
Title	Output an integrated runway sequence
Requirement	The Sequence Management System shall output an integrated runway sequence to stakeholders
Status	<Validated>
Rationale	The integrated sequence calculated according to the inputs received is to be provided.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0016
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0004
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0002
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0003
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	APP ATC 164
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	CHMIM ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Distribute arrival/departure integrated sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A

<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.2030
Title	Time advisories
Requirement	The Sequence Management System may output time advisories (i.e. time to lose or gain) to stakeholders
Status	<Validated>
Rationale	In order to adhere to the target times calculated, the system can generate time advisories such as Time to Lose (TTL) or Time to Gain (TTG)
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0001
<SATISFIES>	< ATMS Requirement>	FRD Requirement Identifier
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	APP ATC 164
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	CHMIM ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Distribute arrival/departure integrated sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A

<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.2040
Title	Tactical advisories
Requirement	The Sequence Management System may output tactical advisories (i.e. speed, HDG or DCT) to stakeholders
Status	<Validated>
Rationale	In order to adhere to the target times calculated, the system can generate tactical advisories to be applied to the flight
Category	<Interface>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0006
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0001
<SATISFIES>	< ATMS Requirement>	N/A
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	APP ATC 164
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	CHMIM ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Distribute arrival/departure integrated sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A

<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN02.2050
Title	RWY change associated to the balancing
Requirement	The Sequence Management System shall output the RWY change associated to the balancing to stakeholders.
Status	<Validated>
Rationale	The RWY change associated to the balancing will be processed by AMAN for arrivals, DMAN for departures resulting in an update of the associated flight plan.
Category	<Interface>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0018
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<SATISFIES>	<Enabler>	APP ATC 164
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	CHMIM ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	TWR Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Distribute arrival/departure integrated Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A

<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

4.1.2.2.2 Controller HMI

[REQ]

Identifier	REQ-02.08-TS-FUN00.3010
Title	Configurable sequence information
Requirement	The Controller HMI shall display configurable sequence information provided by Sequence Management System
Status	<Validated>
Rationale	The information must the appropriate for each stakeholder in order to support his/her job and to avoid display overload.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF1.0001
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	APP ATC 164
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction Management Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Display arrival/departure Integrated Sequence
<ALLOCATED_TO>	<Service>	N/A

<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.3020
Title	Time horizon of the time line
Requirement	The Controller HMI shall display configurable Time horizon of the time line
Status	<Validated>
Rationale	The information must the appropriate for each stakeholder in order to support his/her job and to avoid display overload.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF1.0001
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	APP ATC 164
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction Management Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Display arrival/departure Integrated Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A

<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.3030
Title	Advisories (time to loose/gain, tactical);
Requirement	The Controller HMI may display configurable Advisories (time to loose/gain, tactical)
Status	<Validated>
Rationale	Controller should follow integrated sequence as closely as possible
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0005
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	APP ATC 164
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction Management Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Display arrival/departure Integrated Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.3040
Title	Display of Airport Priorities and constraints
Requirement	The Controller HMI shall display configurable Airport Priorities and constraints provided by the Runway and Taxiway Usage Management sub-system.
Status	<Validated>
Rationale	The information must the appropriate for each stakeholder in order to support his/her job and to avoid display overload.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0008
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF1.0002
<SATISFIES>	<Enabler>	Aerodrome-ATC-74
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction Management Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction ER/APP
<ALLOCATED_TO>	<Functional block>	Runway and Taxiway Usage Management
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Display arrival/departure Integrated Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.3050
Title	Runway closure displayed on HMI
Requirement	The Controller HMI shall display the integrated sequence display including indication of any runway closure
Status	<Validated>
Rationale	The capability to display critical safety information under abnormal conditions, such as a runway closure
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0008
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF1.0001
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	APP ATC 164
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction Management Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Display arrival/departure Integrated Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.3080

Title	HMI Display
Requirement	The HMI shall display TLDT, TTOT and TSAT
Status	<Validated>
Rationale	For the Controller to follow target times as closely as possible.
Category	<Interface>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0002
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0003
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0004
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0010
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF1.0001
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	APP ATC 164
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction Management
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Role>	Approach Executive Controller
<ALLOCATED_TO>	<Function>	Display arrival/departure Integrated Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.3090
Title	Activation/deactivation of option for automatic balancing

	between two runways
Requirement	The HMI for the Airport Tower Supervisor shall allow the option to activate or deactivate automatic balancing between two runways.
Status	<Validated>
Rationale	In specific situations the Airport Tower Supervisor may want to turn off this function in order to achieve improved stability of the runway sequences.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0019
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI1.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-33
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Role>	TWR Runway Controller
<ALLOCATED_TO>	<Function>	Display arrival/departure Integrated Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

4.1.2.2.3 Sequence Calculation

[REQ]

Identifier	REQ-02.08-TS-FUN00.4010
Title	Sequence Management System computation.
Requirement	The Sequence Management System shall compute an integrated sequence for Runways.

Status	<Validated>
Rationale	It could also consider dependencies between Runways (crossing RWYs, convergent RWYs, dependent RWYs with crossing SIDs or missed approach paths).
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0002
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0005
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0005
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0007
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.4020
Title	Total delay reduction
Requirement	The Sequence Management System shall provide an integrated sequence trying to reduce the total delay of the flights
Status	<Validated>
Rationale	The calculated times try to meet the flight slot in order to avoid traffic congestion. The way to reduce total delay needs to be

	detailed at operational level
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0006
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0016
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0005
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.4030
Title	Eligibility horizon
Requirement	The Sequence Management System shall consider a flight as eligible upon a reception of data for that flight if it satisfies the configurable eligibility horizons.
Status	<Validated>
Rationale	The Sequence Management System behaviour will depend on the time horizon
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0010
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0001
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.4040
Title	Stability horizon.
Requirement	The Sequence Management System shall consider a flight as stabilised in the sequence if it is eligible and satisfies the configurable stability horizon.
Status	<Validated>
Rationale	The System will compute a flight as sequenced if the flight is in the time horizon defined.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0010
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0002
<SATISFIES>	<Enabler>	Aerodrome-ATC-33

<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.4050
Title	Frozen horizon
Requirement	The Sequence Management System shall consider a flight as frozen if it is sequenced and satisfies the configurable frozen time horizon
Status	<Validated>
Rationale	The System will compute a flight as frozen if the flight is in the time horizon defined as frozen
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0003
<SATISFIES>	< ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0007
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence

<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.4060
Title	Go-around re-planning
Requirement	The Sequence Management System shall recalculate the sequence after a go-around
Status	<Validated>
Rationale	In case of a decision of not continuing with the approach or landing concerning a certain flight, the system will update the sequence taking into account this new situation
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0013
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.4070
Title	Manual input re-planning
Requirement	The Sequence Management System shall re-compute the sequence based on manual update
Status	<Validated>
Rationale	Manual inputs made by the ATCO will trigger an update and the consequent sequence recalculation
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0015
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0012
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.4080
Title	Time horizon configuration
Requirement	The Sequence Management System shall use various time horizon constraints off-line configurable according to local preferences
Status	<Validated>

Rationale	ATCO will be able to configure time horizon for the computation of the sequence. This will be done based on local preferences.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0002
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0003
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN01.4090
Title	Sequence Management What if
Requirement	The Sequence Management System shall propose and assess the effects of proposed sequence changes without disrupting the sequences in effect (what-if capability).
Status	<Validated>
Rationale	What-if capabilities will be available to assess the impact in operation of potential sequence changes. This assessment shall not affect the currently intent sequences.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0004
<SATISFIES>	<Enabler>	Enabler code
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN02.4100
Title	Integrated sequence re-computation on manual inputs
Requirement	The Sequence Management System shall re-compute the integrated sequence according to the updates of the arrival or departure sequence based on manual controller inputs
Status	<Validated>
Rationale	Depending on architectural deployment option the integrated sequence is built form the arrival sequence and/or the departure sequence. When controller manual input is taken into account either by AMAN or DMAN, the updated arrival (resp departure) sequence is recomputed and taken into by RSFM in the update of the integrated sequence. This also encompasses the handling of go-around.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0015
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.4110
Title	Controller Actions on HMI
Requirement	The Controller HMI shall allow the controller to manually adjust the integrated sequence and to introduce manual constraints by means of specific interactions.
Status	<Validated>
Rationale	Adjustment of the sequence and different constraints can be introduced by the controllers in order to adapt it to real traffic situation
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0002
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0003

<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0014
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0008
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0009
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0011
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI2.0001
<SATISFIES>	<Enabler>	APP ATC 164
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Controller Human Machine Interaction Management
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.4120
Title	Live input monitoring
Requirement	The integrated sequence shall be updated as soon as new arrival or departure information becomes available
Status	<Validated>
Rationale	The system will take into account new inputs affecting the integrated sequence as soon as they are available
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08

<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0004
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure Sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.4130
Title	Sequence Management System automatic balancing between two runways.
Requirement	The Sequence Management System shall perform automatic traffic balancing between two runways according to pre-defined eligibility criteria and in a timeframe according to local rules, whenever the Airport Tower Supervisor has activated this function.
Status	<Validated>
Rationale	Automatic traffic balancing between two runways will improve the flow, e.g., when the demand on one runway is above the maximum runway capacity. Examples of pre-defined eligibility criteria may be: depending on runway configuration, flights planning to follow a certain SID / STAR can be eligible for balancing from one runway to another) Update of runway in use for a specific flight is performed in a timeframe according to local rules (e.g. normally before arrival TOD and/or a locally defined time before departure EOBT)
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0018
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0019
<SATISFIES>	<Enabler>	Aerodrome ATC-33
<SATISFIES>	<Enabler>	Aerodrome ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN00.4140
Title	Activate/deactivate automatic balancing between two runways
Requirement	The Sequence Management System shall activate or deactivate the function for automatic balancing between two runways based on input from the Airport Tower Supervisor.
Status	<Validated>
Rationale	In specific situations the Airport Tower Supervisor may want to turn off this function in order to achieve improved stability of the runway sequences.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ02-08

<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN1.0019
<SATISFIES>	<Enabler>	Aerodrome ATC-33
<SATISFIES>	<Enabler>	Aerodrome ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Calculate Arrival/Departure sequence
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

4.1.2.3 Requirements for Safety and Security for Concept 1 and Concept 2

[REQ]

Identifier	REQ-02.08-TS-SAF00.0010
Title	Connection with the supervision function
Requirement	The Sequence Management System status shall be continuously monitored.
Status	<Validated>
Rationale	Continuous monitoring of the Sequence Management System status allows detecting possible failures
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF1.0003
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management

<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	CHMIM ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SAF00.0020
Title	Alert notification
Requirement	A failure of the Sequence Management System shall be properly notified on the controller and supervisor HMI
Status	<Validated>
Rationale	The alert of the failure on the controller and supervisor HMI will be useful in order to apply the backup procedures
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF1.0003
<SATISFIES>	< ATMS Requirement>	FRD Requirement Identifier
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	CHMIM ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager

<ALLOCATED_TO>	<Function>	Function Identifier
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SAF00.0030
Title	Backup procedures
Requirement	The Sequence Management System shall allow reverting to backup procedures that mitigate the failures in the system.
Status	<Validated>
Rationale	In case of a failure in the Sequence Management System, backup procedures will be available to the ATCO so as to mitigate the situation and prevent further negative impacts on the operation
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF1.0004
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	CHMIM ER/APP
<ALLOCATED_TO>	<Role>	Sequence Manager
<ALLOCATED_TO>	<Function>	Function Identifier
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A

<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SAF00.0040
Title	Frozen horizon sequence update
Requirement	The Sequence Management System shall not automatically update the sequence within the frozen horizon
Status	<Validated>
Rationale	Controller situational awareness can be compromised if the Sequence Management System makes changes to the sequence
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0007
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Function Identifier
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SAF00.0050
Title	Sequence Stability
Requirement	The Sequence Management System shall provide an adequate

	level of stability
Status	<Validated>
Rationale	Controller situational awareness can be compromised if Sequence Management System continuously updates the integrated sequence in an unrealistic manner
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0008
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Function Identifier
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SAF00.0060
Title	Sequence manual updates priority
Requirement	The Sequence Management System shall ensure that manual changes introduced in the sequence are maintained along further sequence updates and have priority on automatic updates.
Status	<Validated>
Rationale	To ensure the trust of the controller in the system
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-PRF1.0008
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Function Identifier
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SEC1.0001
Title	Network components segregated
Requirement	The Sequence Management System shall make transmissions segregating the components that operate at network level
Status	<Validated>
Rationale	Segregated components will make transmissions more secure as well as protect the Integrated Runway Sequence Function Network reducing the likelihood of specific attacks
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	N/A
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58

<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SEC1.0002
Title	Backup saving
Requirement	The Sequence Management System shall perform backup regularly so as to guarantee the possibility of restoring corrupted or lost data
Status	<Validated>
Rationale	A regularly backup will mitigate effectiveness of specific attacks reducing the amount of lost data. In addition, the use of backup procedures will allow to restore the Integrated Runway Sequence function very quickly making it more resilient
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	N/A
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SEC1.0003
Title	Anti-Malware
Requirement	The Sequence Management System shall use Anti-Malware software to avoid malicious software installation and to manage any of its operations
Status	<Validated>
Rationale	Specific anti-malware software will reduce the likelihood of malicious software operations impacting the Integrated Runway Sequence Function
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	N/A
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Flow Management
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SEC1.0004
Title	Data protection
Requirement	The Sequence Management System shall protect stored data and any data exchanged through communication channels that could compromise confidentiality and integrity
Status	<Validated>
Rationale	Implementation of specific control on the Integrated Runway Sequence Function will prevent hackers from clearly understanding and modifying in a consistent and detrimental way confidential data
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	N/A
<SATISFIES>	<Enabler>	Aerodrome-ATC-33
<SATISFIES>	<Enabler>	Aerodrome-ATC-58
<ALLOCATED_TO>	<Functional block>	Runway Sequence and Management Function
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

4.2 Technical Specification for the Solution for Concept 3

This section describes the new system method to achieve Optimized runway capacity at medium/high density airports by means of an enhanced prediction of Runway Occupancy Time (ROT) OIs and ENs.

4.2.1 Functional architecture overview

This section describes the Functions needed to perform the Solution concepts and provides a functional view of how the technical systems, functional block(s), system ports and roles achieve the operational needs.

Functions required to perform needed Operational Activities can be allocated to Resources of a different type: Human Role, Infrastructure System or Functional Block

Role	Functional Block	Function
[NSV-4] AROT		
	Controller Human Machine Interaction Management Aerodrome ATC (PJ.02-08)	Display Infringement Alert; Display TDI;
	Controller Human Machine Interaction Management ER/APP (PJ.02-08)	Arrange ORD Sequence; Display Infringement Alert; Display TDI;
Executive Controller (also called Tactical Controller) (PJ.02-08)		Change ORD Sequence; Identify pairing between ITD/FTD and aircraft; Sequencing and vectoring; Transfer flight; Change ORD Sequence; Identify pairing between ITD/FTD and aircraft; Sequencing and vectoring; Transfer flight;
	Optimised Runway Delivery (ORD)	Determine Spacing infringement; Compute ITD/FTD; Determine Spacing infringement;
	Optimised Runway Delivery (ORD)	Compute ITD/FTD;
Tower Runway Controller (PJ.02-08)		Assess Situation; identify TDI for follower; Instruct Go-around; Monitor aircraft on runway; Provide Landing clearance;

Table 20: Overview of functions and their allocation to resources

4.2.1.1 Resource Connectivity Model

The following diagram represent the high-level interactions of the CCs involved for the main architecture developed for ROT.

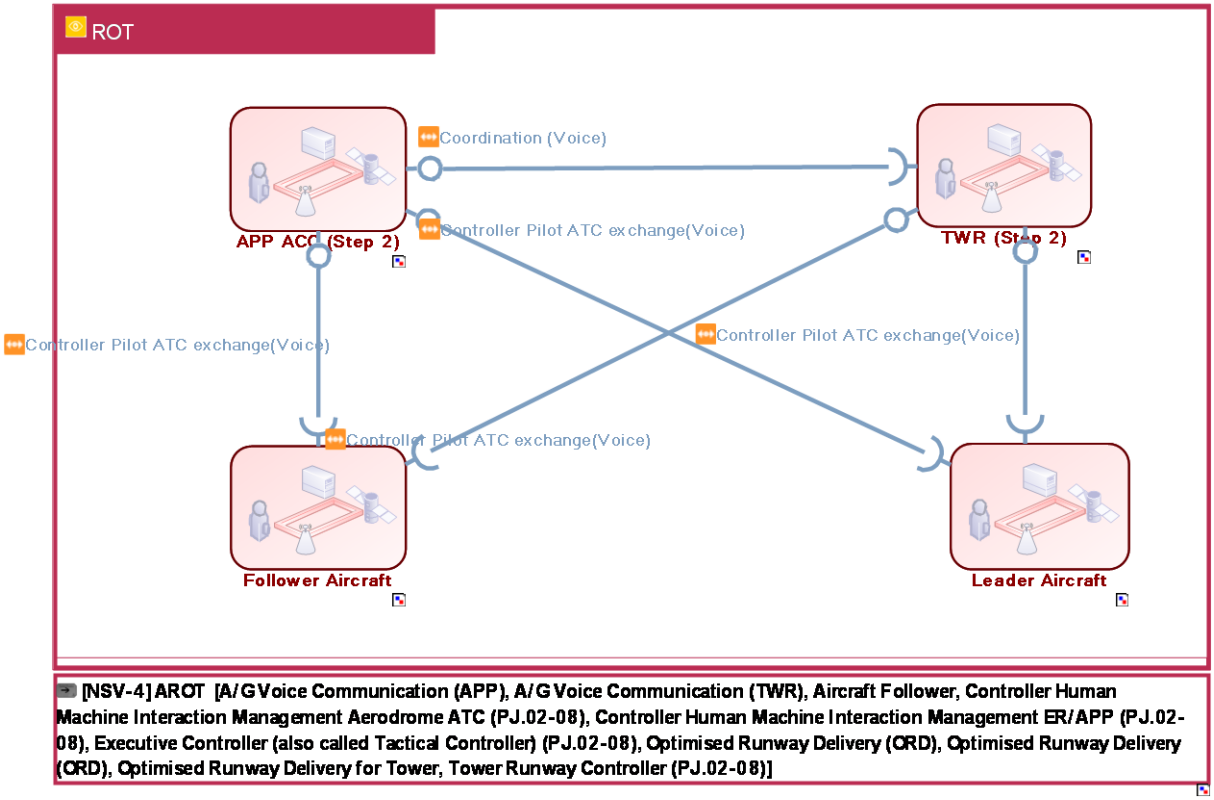

Figure 14: NSV-1 for ROT

4.2.1.2 Resource Orchestration View

The diagram describes how the Runway Occupancy Time is Integrated and used in the Leading Optimised Runway Delivery Tool (ORD) to reduce the separation between Leader and Follower Aircraft based on the Runway Occupancy Time and taking into account the Separation constraints (such Minimum Radar Separation, Wake Separation)

An analysis for each runway is done to determine for each type of aircraft landing on that runway the Runway Occupancy Time (the techniques for this can vary from statistical method to machine learning, and is subject to local decision on the methodology to be followed to determine the ROT)

The Initial Target Display (ITD) for the follower aircraft is displayed on the ATCO Approach controller on final based on the ROT of the leader aircraft, the system computes the ITD and display it on the HMI, if the ROT constraint is infringed different local implementation can be done : either the most constraining separation chevron is displayed, a coordination between APP and Tower takes place to inform him that the ROT for the leader is such that an action shall be taken (ask the leader to expediate), speed instruction to the follower aircraft if still possible, the Final Target Distance (FTD) can also be displayed to show the computed compression between ITD and FTD.

On Tower Position, the FTD is displayed and if it is infringed, the tower controller takes the appropriate action.

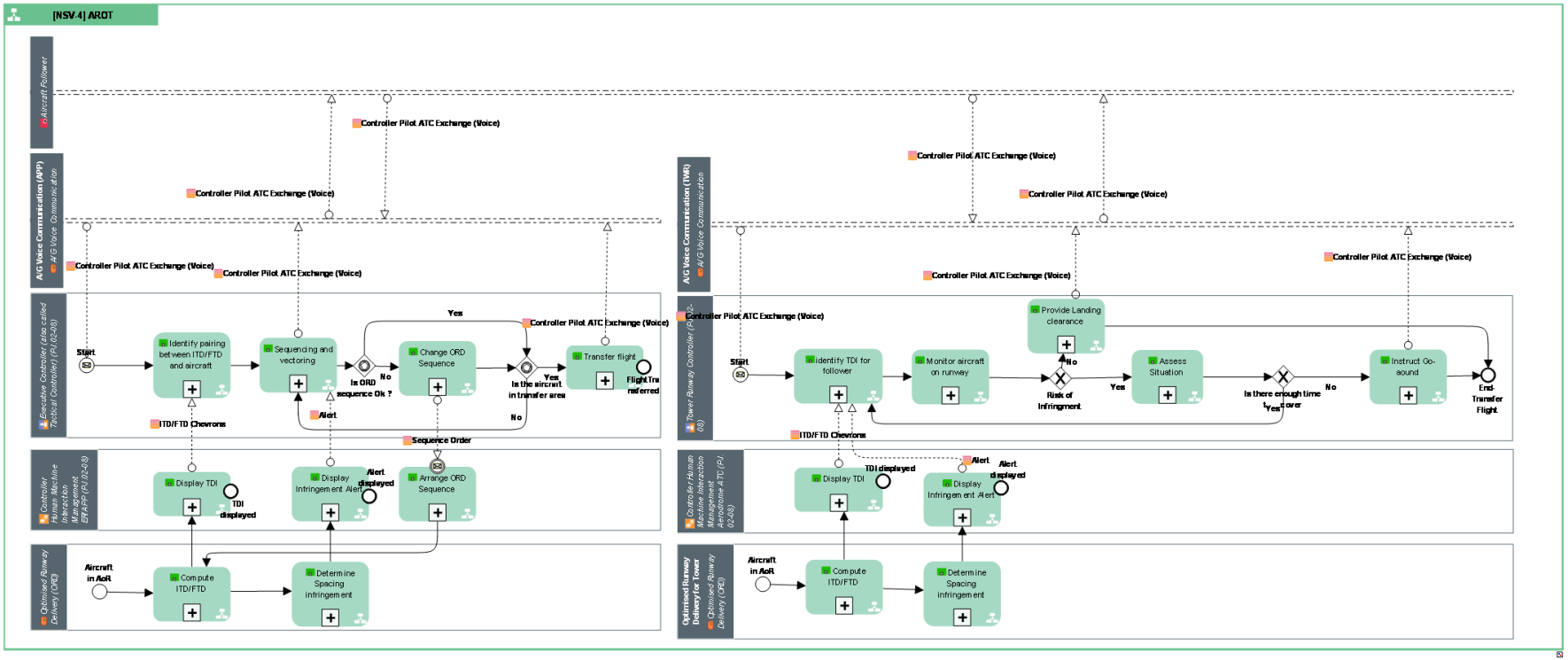

Figure 15: NSV-4 for AROT

Below, a description of the functions in the NVS-4.

Function	Description
Monitor aircraft on runway	This instance is to monitor the leading aircraft, if the leading aircraft is on the runway, the TOWER ATCO will monitor its runway occupation time to be in coherence with the ITD display for the follower.
Sequencing and vectoring	When sequencing and vectoring, the approach controller monitor the separation and if an infringement of the Initial Target Display is infringed and take the necessary actions to handle this.
Arrange ORD Sequence	The System shall allow the ATCO to change the arrival sequence, the ORD computes the separation minima based on this sequence.
Assess Situation	
Change ORD Sequence	The system shall allow the ATCO to change the ORD list to reflect the arrival sequence.
Compute ITD/FTD	The ORD compute the minimum separation according to the rules defined by the local implementation and taking into account the minimum radar separation, Wake and/or ROT. The minimum separation is the FTD and the compression added to the FTD is the ITD. The local implementation can suggest also to add a buffer corresponding to cover all possible errors (wind discrepancy, speed, etc).
Determine Spacing infringement	The ORD Tool computes the difference between the current position and the TDI position and if the aircraft is behind its chevron (value to be specified locally) an alert is sent to the HMI.
Display Infringement Alert	The HMI displays the TDI infringement alert.
Display TDI	This function allows the display of the Target Display Indicator, depending on the implementation and local choice, it can be either ITD, FTD or both.
Identify pairing between ITD/FTD and aircraft	ATCO shall identify the TDI for each aircraft in the ORD computation zone.
identify TDI for follower	The controller identifies TDI for the follower aircraft.
Instruct Go-around	The controller instructs an aircraft to execute go-around.
Provide Landing clearance	The tower controller provides the landing clearance as well as the

	wind information while ensuring that the runway is clear of traffic.
Transfer flight	The controller instructs the aircraft to contact the next ATS Unit.

Table 21: The functions present in the NSV-4 view

4.2.1.3 Infrastructure Connectivity Model

The figure below describes how the systems for Concept 3 interact at the infrastructure level in terms of NSV-2 diagram.

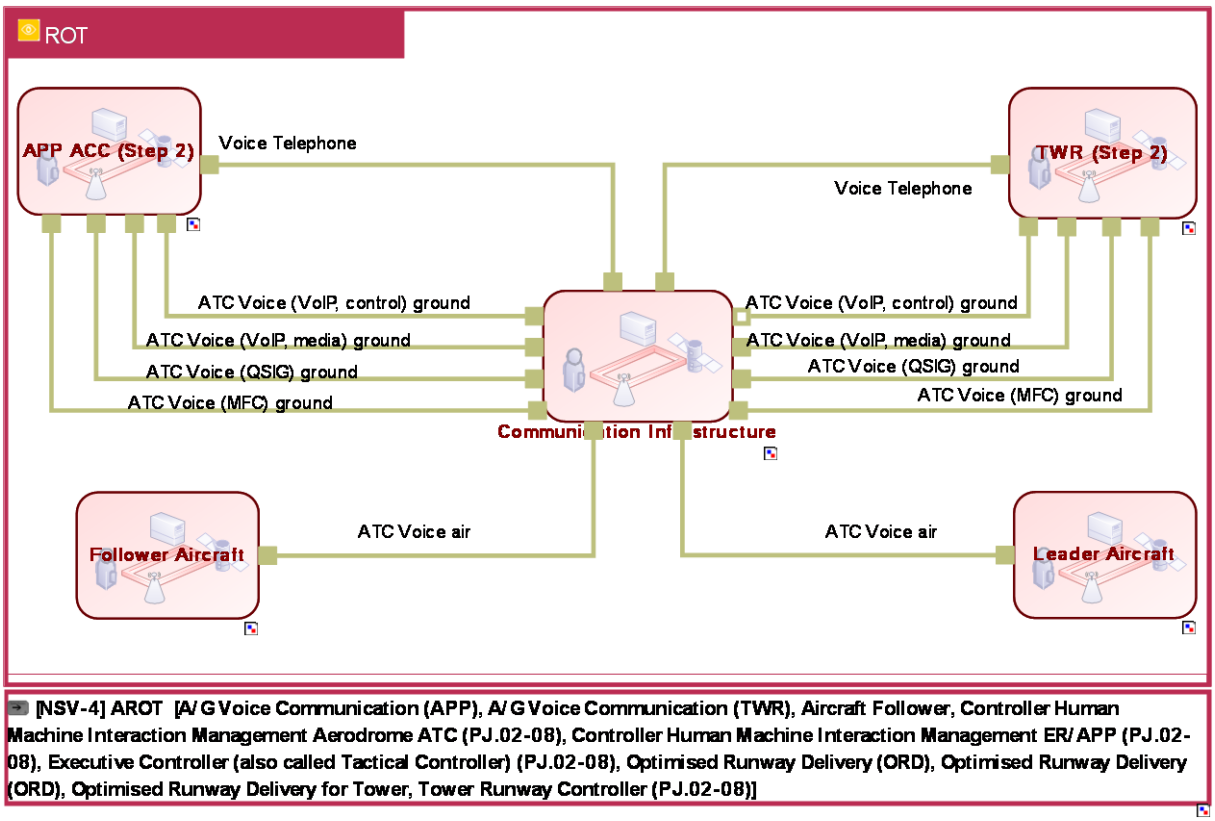

Figure 16: NSV-2 for ROT

4.2.1.4 Service View

4.2.1.4.1 Service Description

COMService:

The only service that is used for concept 3 is the communication via voice to exchange between ATCO and Pilots.

4.2.1.4.2 Service Provisioning

Interaction	Consumer CC	Consumer System	Provider CC	Provider System
Coordination (Voice).APP ACC (Step 2)_CC and TWR (Step 2)_CC	APP ACC (Step 2)	Voice; En-Route / Approach ATC;	TWR (Step 2)	Voice;
Controller Pilot ATC exchange(Voice).Aircraft Leader_CC and TWR (Step 2)_CC	Aircraft Leader	Aircraft;	TWR (Step 2)	Voice;
Controller Pilot ATC exchange(Voice).Aircraft Follower_CC and TWR (Step 2)_CC	Aircraft Follower	Aircraft;	TWR (Step 2)	Voice;
Controller Pilot ATC exchange(Voice).Aircraft Follower_CC and APP ACC (Step 2)_CC	Aircraft Follower	Aircraft;	APP ACC (Step 2)	Voice;
Controller Pilot ATC exchange(Voice).Aircraft Leader_CC and APP ACC (Step 2)_CC	Aircraft Leader	Aircraft;	APP ACC (Step 2)	Voice;

Table 22: Interaction between providers and consumers of the service

4.2.1.4.3 Service Realisation

This section describes the technology use to realise the Services in terms of system ports.

4.2.1.4.3.1 Interaction Controller Pilot ATC exchange(Voice).Aircraft Follower_CC and APP ACC (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2

ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 23: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at APP ACC (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 24: The protocol stack for the system port ATC_VOICE_GND at APP ACC (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 25: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at APP ACC (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP

	IP

Table 26: The protocol stack for the system port ATC_VOICE_GND at APP ACC (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 27: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at APP ACC (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP

ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 28: The protocol stack for the system port ATC_VOICE_GND at APP ACC (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 29: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at APP ACC (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP

	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 30: The protocol stack for the system port ATC_VOICE_GND at APP ACC (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	
	VHF
	HF (selcal)

Table 31: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 32: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	
	VHF
	HF (selcal)

Table 33: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 34: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

4.2.1.4.3.2 Interaction Controller Pilot ATC exchange(Voice).Aircraft Follower_CC and TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 35: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 36: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

OPC (Operational) Voice ground	

Table 37: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 38: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP

ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 39: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 40: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG

ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 41: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 42: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	
	VHF
	HF (selcal)

Table 43: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 44: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	
	VHF
	HF (selcal)

Table 45: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 46: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

4.2.1.4.3.3 Interaction Controller Pilot ATC exchange(Voice).Aircraft Leader_CC and APP ACC (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 47: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at APP ACC (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	

	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 48: The protocol stack for the system port ATC_VOICE_GND at APP ACC (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 49: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at APP ACC (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 50: The protocol stack for the system port ATC_VOICE_GND at APP ACC (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

OPC (Operational) Voice ground	

Table 51: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at APP ACC (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 52: The protocol stack for the system port ATC_VOICE_GND at APP ACC (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP

ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 53: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at APP ACC (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 54: The protocol stack for the system port ATC_VOICE_GND at APP ACC (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	

	VHF
	HF (selcal)

Table 55: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 56: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	
	VHF
	HF (selcal)

Table 57: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 58: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

4.2.1.4.3.4 Interaction Controller Pilot ATC exchange(Voice).Aircraft Leader_CC and TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 59: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP

	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 60: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 61: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	

	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 62: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 63: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 64: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

OPC (Operational) Voice ground	

Table 65: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 66: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	
	VHF
	HF (selcal)

Table 67: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 68: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	
	VHF
	HF (selcal)

Table 69: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 70: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

4.2.1.4.4 Interaction Coordination (Voice).APP ACC (Step 2)_CC and TWR (Step 2)_CC

System Port: VOICE_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
Voice Telephone	
	PSTN

Table 71: The protocol stack for the system port VOICE_GND at Communication Infrastructure_CC

System Port: VOICE_TELEPHONE at APP ACC (Step 2)_CC

Protocol Stack	Protocol
Voice Telephone	
	PSTN

Table 72: The protocol stack for the system port VOICE_TELEPHONE at APP ACC (Step 2)_CC

System Port: VOICE_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
Voice Telephone	
	PSTN

Table 73: The protocol stack for the system port VOICE_GND at Communication Infrastructure_CC

System Port: VOICE_TELEPHONE at TWR (Step 2)_CC

Protocol Stack	Protocol
Voice Telephone	
	PSTN

Table 74: The protocol stack for the system port VOICE_TELEPHONE at TWR (Step 2)_CC

4.2.2 Functional and non-Functional Requirements to the Solution for Concept 3.

For introduction to the specification of the functional and non-functional requirements, see Section 4.1.2.1 The set of functional and non-functional requirements for the Solution for Concept 3 is not complete, and additional requirements is provided by PJ02-01, as stated in section 6.

4.2.2.1 System Interface and Functional requirements

4.2.2.1.1 Airport ATC analyser tool for predicting Runway Occupation Time (ROT)

[REQ]

Identifier	REQ-02.08-TS-FUN03.0001
Title	Indication of MRS considering the ROT constraint.
Requirement	In case the Predicted ROT is identical ROT for all aircraft types of a Wake Turbulence Category (WTC), the system shall provide separation minima that consider the reduced MRS allowed for that WTC.
Status	<Validated>
Rationale	For the controller to apply the adequate minimum separation, taking into account the ROT constraint of the leader aircraft.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN3.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-55
<ALLOCATED_TO>	<Functional block>	Optimised Runway Delivery (ORD)
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Compute ITD/FTD
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN03.0002
Title	ROT Determination
Requirement	The ROT shall be determined according to : • aircraft type • airline • runway exit • runway conditions • expected aircraft speed or time-to-fly profile model on the final approach glide-slope
Status	<Validated>
Rationale	For the separation delivery function to consider the adequate characterized ROT in the computation of the spacing.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN3.0002
<SATISFIES>	<Enabler>	Aerodome-ATC-55
<ALLOCATED_TO>	<Functional block>	Optimised Runway Delivery (ORD)
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Compute ITD/FTD
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN03.0003

Title	Optimum Separation computation
Requirement	The system shall compute the maximum of all applicable separation or spacing minima, including the ROT spacing as given by the Enhanced Prediction of ROT function
Status	<Validated>
Rationale	Mixing several separation minima, the tower and approach controller needs to know the most constraining minima to be applied, including the ROT induced spacing.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN3.0003
<SATISFIES>	<Enabler>	Aerodome-ATC-55
<ALLOCATED_TO>	<Functional block>	Optimised Runway Delivery (ORD)
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Compute ITD/FTD
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-FUN03.0004
Title	ITD Infringement
Requirement	The system shall compute the FTD linked to wake if the separation minima (ITD) is infringed.
Status	<Validated>
Rationale	For the approach and tower controller to be able to detect safety related issue, assess situation and make appropriate recovery

	action.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN3.0005
<SATISFIES>	<Enabler>	Aerodome-ATC-55
<ALLOCATED_TO>	<Functional block>	Optimised Runway Delivery (ORD)
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Determine Spacing infringement
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

4.2.2.1.2 Controller HMI

[REQ]

Identifier	REQ-02.08-TS-HMI03.0001
Title	Target distance indicator considering ROT
Requirement	The system shall display an indication about applicable separation minima between arrival aircraft pairs onto final approach segment and taking into account the Enhanced Prediction of ROT of the leader aircraft.
Status	<Validated>
Rationale	For approach controllers to be able to apply pair wise computed AROT spacing (and Wake separation) according to aircraft pair. In that case controller cannot use anymore a 2 entry separation table, as the separation could vary according to ROT within the same wake turbulence category.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI3.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-55
<ALLOCATED_TO>	<Functional block>	Optimised Runway Delivery (ORD)
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Display TDI
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-HMI03.0002
Title	Final Target distance indicator considering ROT
Requirement	The system shall display an indication about applicable separation minima between arrival aircraft pairs onto Tower CWP taking into account the Enhanced Prediction of ROT of the leader aircraft
Status	<Validated>
Rationale	Tower Runway Controller to be able to apply pair wise computed AROT spacing (and Wake separation) according to aircraft pair. In that case controller cannot use anymore a 2 entry separation table, as the separation could vary according to ROT within the same wake turbulence category
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08

<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-HMI3.0002
<SATISFIES>	<Enabler>	Aerodome-ATC-55
<ALLOCATED_TO>	<Functional block>	Optimised Runway Delivery (ORD)
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Display TDI
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

4.2.3 Requirements for Safety and Security for Concept 3

[REQ]

Identifier	REQ-02.08-TS-SAF03.0001
Title	Enhanced ROT Prediction disabled warning
Requirement	System shall warn operators of loss of Enhanced Prediction of ROT function
Status	<Validated>
Rationale	Upon loss of capability to perform its function system should inform the operator of such circumstances by an appropriate warning.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF3.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-55
<ALLOCATED_TO>	<Functional block>	Optimised Runway Delivery (ORD)
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A

<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SAF03.0002
Title	Enhanced ROT Prediction display disabled
Requirement	System shall automatically disable system display overlay (Target distance indicators, ROT forecast) in case of loss of Enhanced Prediction of ROT function
Status	<Validated>
Rationale	Upon loss of capability to perform its function system should not misinform its operators.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF3.0002
<SATISFIES>	<Enabler>	Aerodome-ATC-55
<ALLOCATED_TO>	<Functional block>	Optimised Runway Delivery (ORD)
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SAF03.0003
Title	Enhanced ROT Prediction display synchronised between Approach and Tower controllers
Requirement	The system shall maintain shared situational awareness between Tower runway controller and Approach controller by providing the same Target distance indicators updated simultaneously
Status	<Validated>
Rationale	Both Tower and Approach Controllers need shared situational awareness to perform their responsibilities optimally.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF3.0003
<SATISFIES>	<Enabler>	Aerodome-ATC-55
<ALLOCATED_TO>	<Functional block>	Optimised Runway Delivery (ORD)
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SAF03.0004
Title	Enhanced ROT Prediction ROT based separation infringement warning
Requirement	The system shall warn ATCOs in case the arrival spacing is less than ROT in addition to a safety margin
Status	<Validated>

Rationale	Any separation infringement potential needs to be immediately brought to the attention of responsible controller.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF3.0004
<SATISFIES>	<Enabler>	Aerodome-ATC-55
<ALLOCATED_TO>	<Functional block>	Optimised Runway Delivery (ORD)
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	Display Infringement Alert
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

4.3 Technical Specification for the Solution for Concept 4

In order to more significantly influence performance, the Enhanced AROT Prediction concept requires further integration into the dedicated ATC systems. The proposed Concept 4 is the simplest integration scenario where Enhanced AROT Predictor is used directly in Tower Runway Controller CWP via modification of the information available via EFS.

In Concept 4 it is assumed that Enhanced AROT Prediction is available at a certain time interval before the estimated time of touchdown for each arriving flight. The prediction algorithm not only takes into account the aircraft type and Wake Category but also other parameters that are related to current approach performance and designated runway condition. In this setting each time an aircraft is on final approach there is an AROT estimate available for this flight at some point in time. Currently based on operational and technical constrains the lead time of AROT prediction is set to be 5 min. before planned touchdown.

Except for AROT the system also estimates the approximate braking distance. As a result, it is able to provide an advisory on the exit taxiway applicable to each flight. In giving this recommendation the Enhanced AROT Predictor considers the approach trajectory and performance, ground situation and runway condition including airport MET situation.

Given AROT and exit TWY information the Tower Runway Controller is then able to optimise two activities:

- Recommend an exit that is both attainable and optimal for the oncoming flight considering the current and predicted weather situation;
- Manage following aircraft velocity on the final approach so that the separation is preserved and, if possible, avoid chance for go around in advance.

As a result, the arriving traffic is more predictable and final approach management is simplified. Not only very experienced controllers have the ability to assess the braking of various aircraft as the knowledge is stored and updated in the ML system that takes into account a wide set of arriving aircraft parameters (both dynamic and static).

The increased stability and predictability of arriving traffic in the mixed mode (which is the dominant runway utilisation mode on medium airports) allows better accommodation of departing flights. This effect is especially pronounced in the peak hours when arriving traffic is using near to minimum allowed separation.

4.3.1 Functional Architecture Overview

This section describes the Functions needed to perform the Solution concepts and provides a functional view of how the technical systems, functional block(s), system ports and roles achieve the operational needs.

Functions required to perform needed Operational Activities can be allocated to Resources of a different type: Human Role, Infrastructure System or Functional Block.

Role	Functional Block	Function
[NSV-4] Optimised use of RWY capacity for regional aerodromes with the use of enhanced prediction of Runway Occupancy Time		
	Enhanced AROT Predictor (PJ.02-08)	Compute ROT and Exit Prediction;
	Controller Human Machine Interaction Management Aerodrome ATC (PJ.02-08)	Display ROT and Exit Prediction for Aircraft Follower; Display ROT and Exit Prediction for Aircraft Leader;
Tower Runway Controller (PJ.02-08)		Analyse ROT and EXIT RWY data; Assess ROT and Exit Prediction for Aircraft Follower; Assess ROT and Exit Prediction for Aircraft Leader; Give Controller Instructions; Give Landing Information and Exit Prediction; Instruct Go-around; Instruct Go-around; Provide Landing Clearance and Exit Prediction; Provide Landing Clearance and Exit

		Prediction;

Table 75: Overview of functions and their allocation to resources

4.3.1.1 Resource Connectivity Model

The following diagram represent the high-level interactions of the CCs involved for the main architecture developed for ROT.

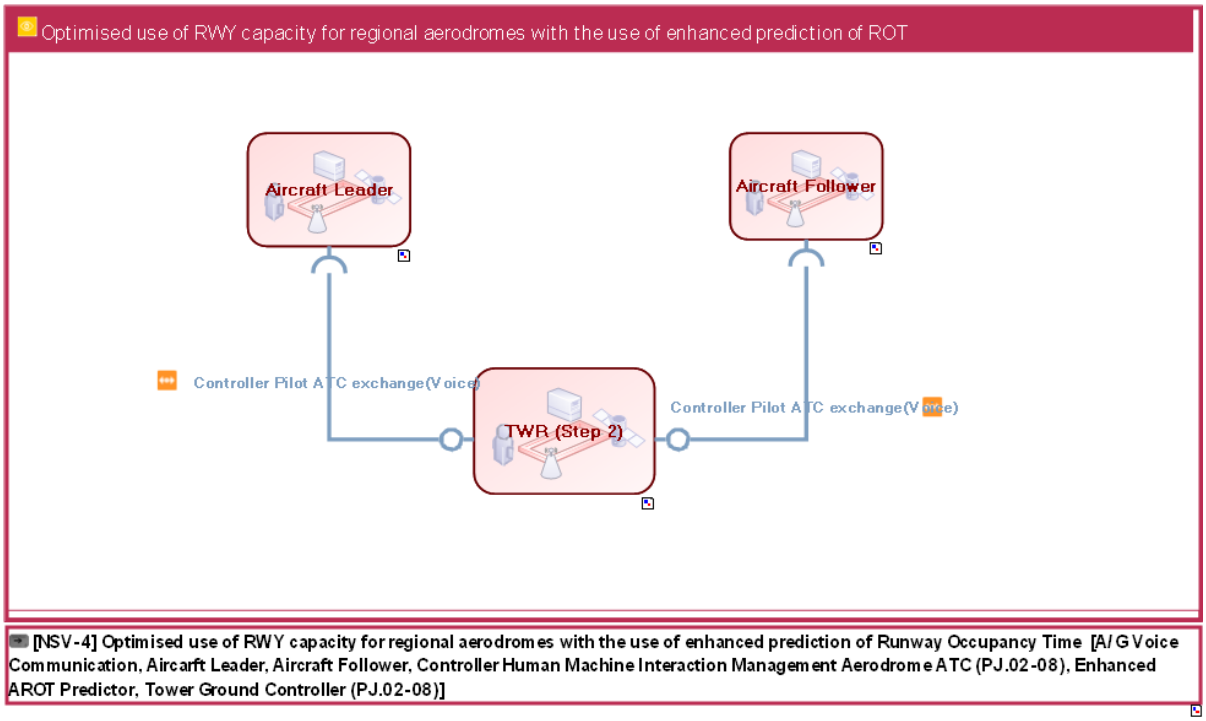

Figure 17: NSV-1 for ROT

4.3.1.2 Resource Orchestration View

The diagram describes how the Enhanced AROT Predictor is used to provide ROT and Exit Prediction to the Tower Controller.

AROT is calculated individually for each flight considering present and predicted weather conditions as well as static aircraft characteristics. The Enhanced AROT Predictor also considers present ground situation as well as dynamic flight path characteristics to make Landing Information available for Tower Runway ATCO 5 min before expected touchdown for each flight. Landing Information consists of ROT calculation result accompanied by the exit taxiway suggestion which is displayed on a modified Tower Runway Controller CWP.

The exit taxiway suggestion is then communicated to the Flight Crew once close to handover from Approach and subsequently together with the landing clearance.

This kind of operations is expected to give benefit once the separation minima are low enough and the incoming traffic intensity is consistently high. This may only be expected during peak hours on medium airports. It is also possible to imagine using this concept on independent runways of larger airports. However, the concept has not been validated in this operational environment.

The concept is straightforward to implement. No additional regulation necessity is foreseen, and only limited training need is expected. Also, the modifications to the TWR CWP are limited and feasible using most presently available EFS tools.

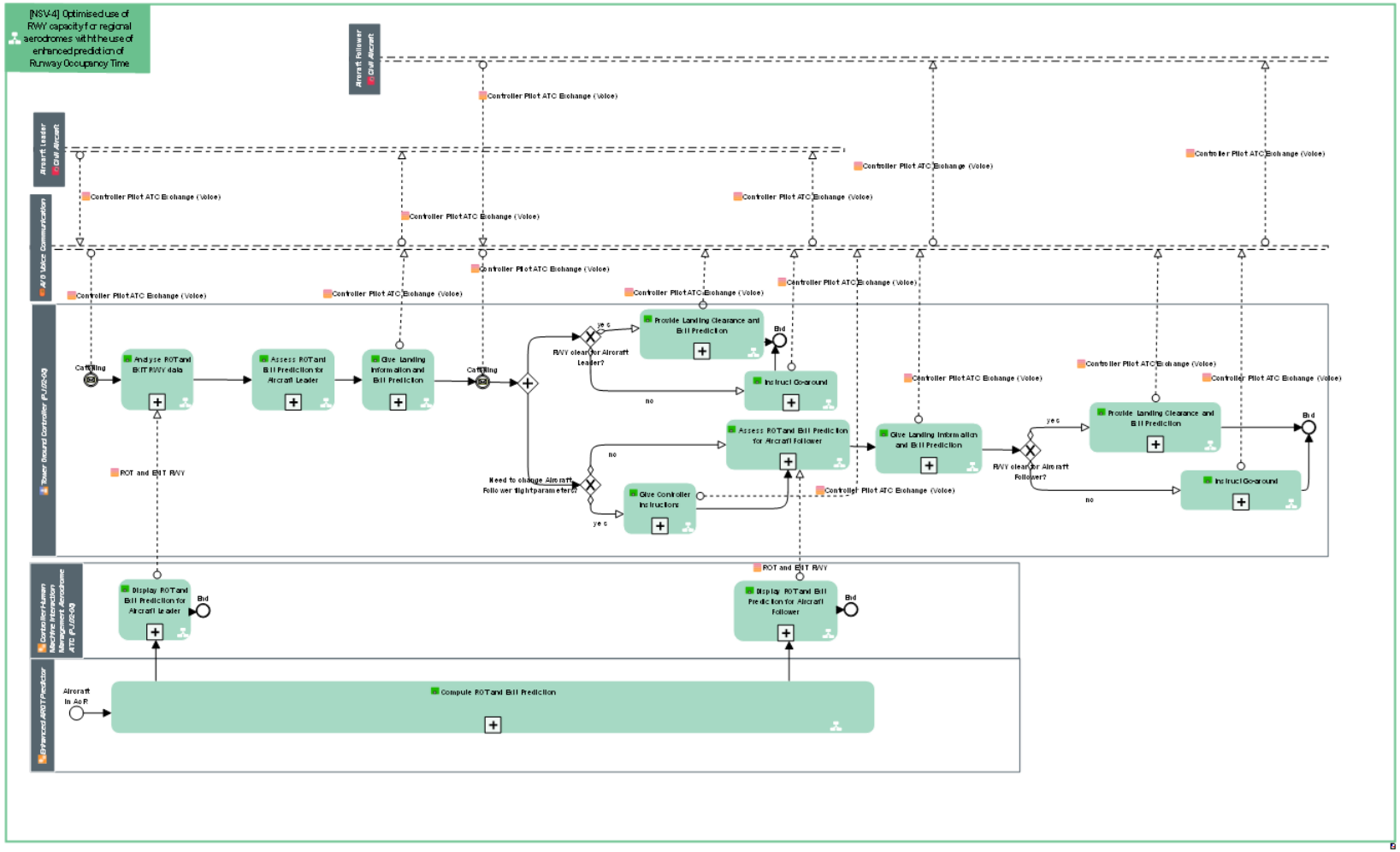

Figure 18: NSV-4 for ROT

Below, a description of the functions in the NVS-4.

Function	Description
Compute ROT and Exit Prediction	The Enhanced AROT Predictor computes the ROT and predicted RWY exit.
Display ROT and Exit Prediction for Aircraft Leader	The HMI displays the ROT and Exit Prediction for Aircraft Leader.
Display ROT and Exit Prediction for Aircraft Follower	The HMI displays the ROT and Exit Prediction for Aircraft Follower.
Analyse ROT and Exit RWY data	The tower controller analyses the ROT and Exit Prediction information displayed by HMI.
Assess ROT and Exit Prediction for Aircraft Leader	The tower controller assesses the final ROT and Exit Prediction for Aircraft Leader.
Assess ROT and Exit Prediction for Aircraft Follower	The tower controller assesses the final ROT and Exit Prediction for Aircraft Follower.
Give Controller Instructions	The tower controller gives proper instructions.
Give Landing Information and Exit Prediction	The tower controller gives the landing and wind information as well as predicted RWY exit information.
Instruct Go-around	The tower controller instructs an aircraft to execute go-around.
Provide Landing Clearance and Exit Prediction	The tower controller provides the landing clearance as well as the wind information and predicted RWY exit information while ensuring that the runway is clear of traffic.

Table 76: The functions present in the NSV-4 view

4.3.1.3 Infrastructure Connectivity Model

The figure below describes how the systems for Concept 4 interact at the infrastructure level in terms of NSV-2 diagram.

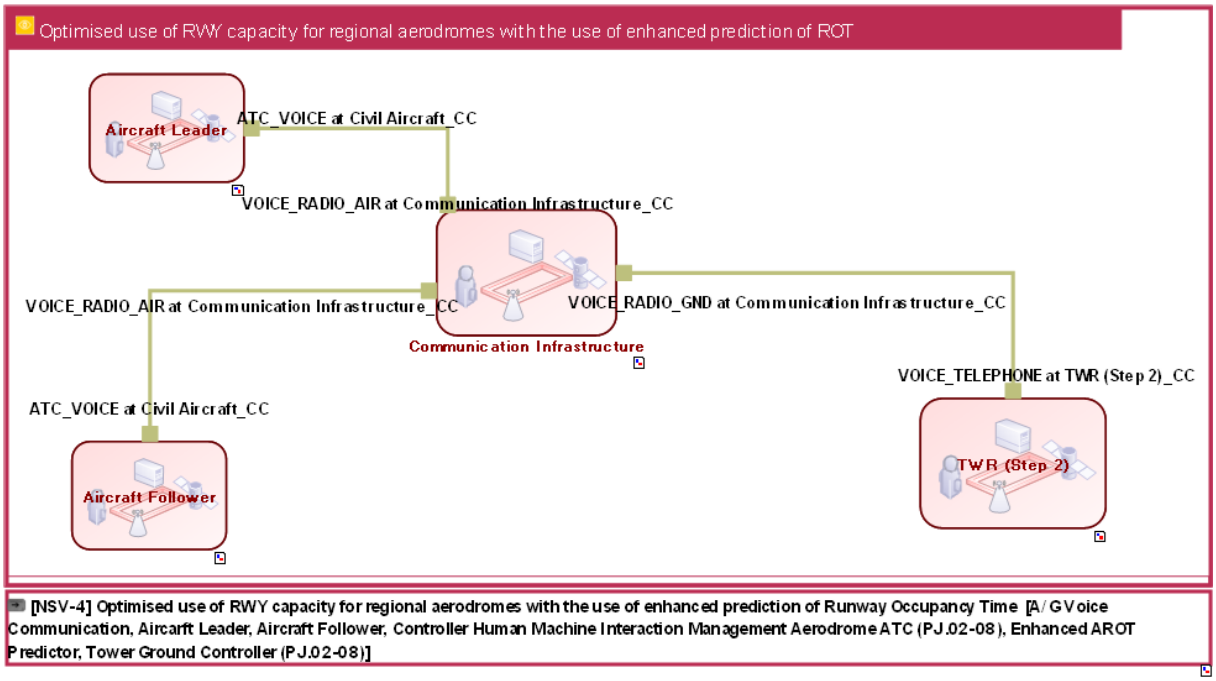

Figure 19: NSV-2 for ROT

4.3.1.4 Service View

4.3.1.4.1 Service Description

COMService: The only service that is used for Concept 4 is the communication via voice to exchange between ATCO and Flight crew.

4.3.1.4.2 Service Provisioning

Interaction	Consumer CC	Consumer System	Provider CC	Provider System
Controller Pilot ATC exchange (Voice). Aircraft Leader_CC and TWR (Step 2)_CC	Aircraft Leader	Aircraft;	TWR (Step 2)	Voice;
Controller Pilot ATC exchange (Voice). Aircraft Follower_CC and TWR (Step 2)_CC	Aircraft Follower	Aircraft;	TWR (Step 2)	Voice;

Table 77: Interaction between providers and consumers of the service

4.3.1.4.3 Service Realisation

This section describes the technology use to realise the Services in terms of system ports.

- Interaction Controller Pilot ATC exchange (Voice). Follower Aircraft_CC and TWR (Step)_CC
- Interaction Controller Pilot ATC exchange (Voice). Leader Aircraft_CC and TWR (Step 2)_CC

4.3.1.4.3.1 Interaction Controller Pilot ATC exchange(Voice).Aircraft Follower_CC and TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 78: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG

ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 79: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 80: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2

ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 81: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 82: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol

ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 83: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 84: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 85: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	
	VHF
	HF (selcal)

Table 86: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 87: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	
	VHF
	HF (selcal)

Table 88: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 89: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

4.3.1.4.3.2 Interaction Controller Pilot ATC exchange(Voice).Aircraft Leader_CC and TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

OPC (Operational) Voice ground	

Table 90: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 91: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP

	UDP
	IP
OPC (Operational) Voice ground	

Table 92: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 93: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP

ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 94: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 95: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	

	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP
OPC (Operational) Voice ground	

Table 96: The protocol stack for the system port VOICE_RADIO_GND at Communication Infrastructure_CC

System Port: ATC_VOICE_GND at TWR (Step 2)_CC

Protocol Stack	Protocol
ATC Voice (MFC) ground	
	ATS MFC R2
ATC Voice (QSIG) ground	
	ATS QSIG
ATC Voice (VoIP, control) ground	
	SIP
	TCP
	IP
ATC Voice (VoIP, media) ground	
	RTP
	UDP
	IP

Table 97: The protocol stack for the system port ATC_VOICE_GND at TWR (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	

	VHF
	HF (selcal)

Table 98: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 99: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

System Port: VOICE_RADIO_AIR at Communication Infrastructure_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz
OPC (Operational) Voice air	
	VHF
	HF (selcal)

Table 100: The protocol stack for the system port VOICE_RADIO_AIR at Communication Infrastructure_CC

System Port: ATC_VOICE at Civil Aircraft (Step 2)_CC

Protocol Stack	Protocol
ATC Voice air	
	VHF - AM 25kHz/8.33kHz
	HF - AM 25kHz

Table 101: The protocol stack for the system port ATC_VOICE at Civil Aircraft (Step 2)_CC

4.3.2 Functional and non-Functional Requirements for Concept 4

For introduction to the specification of the functional and non-functional requirements, see Section 4.1.2.1.

4.3.2.1 System Interface and Functional requirements

4.3.2.1.1 Enhanced Prediction of ROT

[REQ]

Identifier	REQ-PJ02.08-TS-FUN4.0001
Title	Runway exit prediction
Requirement	The system shall provide the exit for each approaching flight, considered optimal by the Enhanced Prediction of ROT.
Status	<In Progress>
Rationale	For the tower controller to be able to detect anomalies as well as give optimal exit recommendation in clearances.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-PJ02.08-SPRINTEROP-FUN4.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-PJ02.08-TS-FUN4.0002

Title	ROT computation
Requirement	The ROT shall be determined accounting for individual features of the flight (e.g. a/c type, operator), surveillance data and environmental conditions (e.g. runway condition, airport MET parameters).
Status	<In Progress>
Rationale	In order to maintain awareness and ability to detect anomalies in oncoming sequence. In Small Airport sub-environment, the airport layout is simpler allowing for more detailed dynamic prediction.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-PJ02.08-SPRINTEROP-FUN4.0002
<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-PJ02.08-TS-FUN4.0003
Title	Exit TWY computation
Requirement	The exit TWY forecast shall be determined accounting for individual features of the flight (e.g. a/c type, operator), surveillance data and environmental condition (e.g. runway condition, airport MET parameters).
Status	<In Progress>

Rationale	This allows Tower Runway Controller to maintain optimal ROT by assigning optimal exit recommendations along with clearances.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-PJ02.08-SPRINTEROP-FUN4.0001
<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-PJ02.08-TS-FUN4.0004
Title	Enhanced Prediction of ROT to record used exit TWY
Requirement	The system shall detect when aircraft are on the runway and record the used exit TWYs when they leave it.
Status	<In Progress>
Rationale	This is for diagnostic or reconfiguration purposes.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-PJ02.08-SPRINTEROP-SAF4.0008

<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-PJ02.08-TS-FUN4.0005
Title	Enhanced Prediction of ROT to record its output
Requirement	The system shall record its output and information on its state including key parameters such as runway occupancy status and the exits and TWYs used by aircraft departing the runways.
Status	<In Progress>
Rationale	This is for diagnostic or reconfiguration purposes.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-PJ02.08-SPRINTEROP-SAF4.0008
<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A

<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-PJ02.08-TS-FUN4.0006
Title	System adaptation to approach sequence
Requirement	Enhanced ROT Prediction shall recalculate its outputs in real time upon approach sequence changes
Status	<In Progress>
Rationale	The system should follow and consider any changes in approach sequence in order to provide accurate output.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-PJ02.08-SPRINTEROP-FUN4.0001
<SATISFIES>	<ATMS Requirement>	REQ-PJ02.08-SPRINTEROP-FUN4.0002
<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-PJ02.08-TS-FUN4.0007
Title	Tower controller ROT and exit estimation timing
Requirement	The system shall be able to calculate and display ROT and exit

	estimations to the tower runway controller with a lead time of at least 3 min
Status	<In Progress>
Rationale	Tower runway controller must have appropriate time to take decisions based on exit and ROT prediction. Moreover, any speed regulations can be more effective if applied with larger lead time.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-PJ02.08-SPRINTEROP-FUN4.0007
<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

4.3.2.1.2 Controller HMI

[REQ]

Identifier	REQ-PJ02.08-TS-HMI4-0001
Title	Indication of ROT and exit TWY
Requirement	The system shall display ROT and exit TWY via appropriate HMI.
Status	< In Progress>
Rationale	Tower Runway Controller to be able to ingest ROT and exit TWY information.
Category	<Interface> <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-PJ02.08-SPRINTEROP-HMI4-0001
<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

4.3.3 Requirements for Safety and Security for Concept 4

[REQ]

Identifier	REQ-02.08-TS-SAF4.0001
Title	Enhanced ROT Prediction disabled warning
Requirement	System shall warn operators of loss of Enhanced Prediction of ROT function.
Status	< In Progress >
Rationale	Upon loss of capability to perform its function system should inform the operator of such circumstances by an appropriate warning. System is displaying adequate error messages per flight.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF4.0001

<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SAF4.0002
Title	Enhanced ROT Prediction display disabled
Requirement	System shall automatically disable system display overlay (ROT forecast, considered exit TWY) in case of loss of Enhanced Prediction of ROT function.
Status	<In Progress>
Rationale	Upon loss of capability to perform its function system should not misinform its operators. The display is replaced with error warnings whenever at least one data source is failing.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-SAF4.0002
<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

[REQ]

Identifier	REQ-02.08-TS-SAF4.0004
Title	AROT predictor HMI integration
Requirement	Enhanced AROT Predictor HMI shall be integrated into EFS system.
Status	<In Progress>
Rationale	AROT HMI usability depends on a correct integration in the CWP.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.02-08
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN4.0001
<SATISFIES>	<ATMS Requirement>	REQ-02.08-SPRINTEROP-FUN4.0002
<SATISFIES>	<Enabler>	Aerodome-ATC-55a
<ALLOCATED_TO>	<Functional block>	Enhanced AROT Predictor
<ALLOCATED_TO>	<Role>	N/A
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A
<ALLOCATED_TO>	<Information exchange>	N/A
<ALLOCATED_TO>	<Data>	N/A
<ALLOCATED_TO>	<System Port>	N/A

5 Implementation Options

5.1 Implementation Options for Concept 1 and Concept 2

This section describes, at a very high level, the different technical implementation options of Solution PJ.02-08. It is anticipated that the options described in this section are ***architectural*** implementation options; consequently, they depend on the system owner deployment decision. Both concepts (corresponding to TS-0301 and TS-0313) can be achieved with all the possible implementation options.

As stated before, this Technical Specification focuses on the implementation options developed in the Validation Exercises performed at V3 maturity level.

- Implementation Option 1: Integrated sequence by coupling AMAN and DMAN with TWR (Step 2) as main CC.

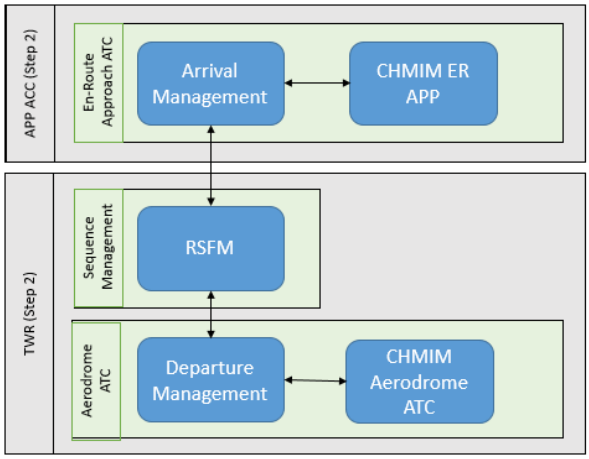

Figure 20: Architectural Overview IO1

- Implementation Option 4b: Integrated Sequence without AMAN and DMAN (and RMAN) with TWR (Step 2) as main CC.

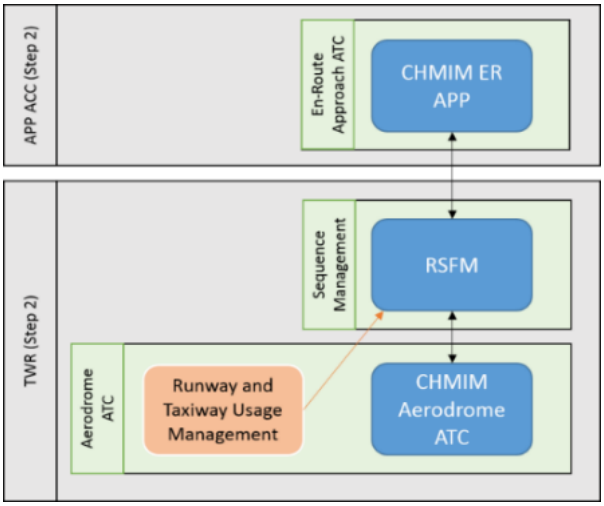

Figure 21: Architectural Overview IO4b

*CCs in grey
Technical Systems in green
Functional Blocks in blue

However, it needs to be possible to flexibly allocate the RSFM Functional Block to TWR (Step 2) and APP ACC (Step 2) Capability Configurations to express all the possible deployment decisions.

Furthermore, considering that the RSFM functional block is able to provide an optimised arrival/departure sequence with or without an Arrival Management and/or a Departure Management FB(s), 16 possible implementation options are considered, as said in **Section 4.1**:

		IMPLEMENTATION OPTION															
		IO1	IO1b	IO2	IO2b	IO3	IO3b	IO4	IO4b	IO5	IO5b	IO6	IO6b	IO7	IO7b	IO8	IO8b
RSFM	Within TWR (Step 2) CC	X	X	X	X	X	X	X	X								
	Within APP ACC (Step 2) CC									X	X	X	X	X	X	X	X
AMAN		X	X	X	X					X	X	X	X				
DMAN		X	X			X	X			X	X			X	X		
RTUM (Only for Concept 2)[5]			X		X		X		x		X		X		X		X

Table 102: Possible Architecture Implementation Options

Implementation options 1 and 4b were considered as the main ones and core of this document as they were the ones developed in the Validation Exercises performed at V3 maturity level. Nevertheless, there are 14 additional options bearing in mind the existence of an AMAN, a DMAN and the allocation of the RSFM Functional Block.

[5] Options for Concept 2 (TS-0313), that add the RTUM functionalities, are named as IOXb. X=1,2,…,8

Other examples of architectural schemes are:

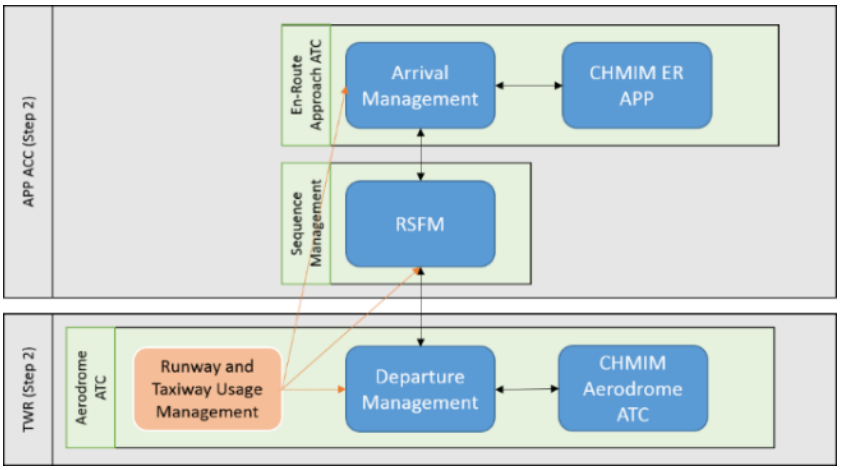

Figure 22: Architectural Overview IO5 (IO5b with RTUM)

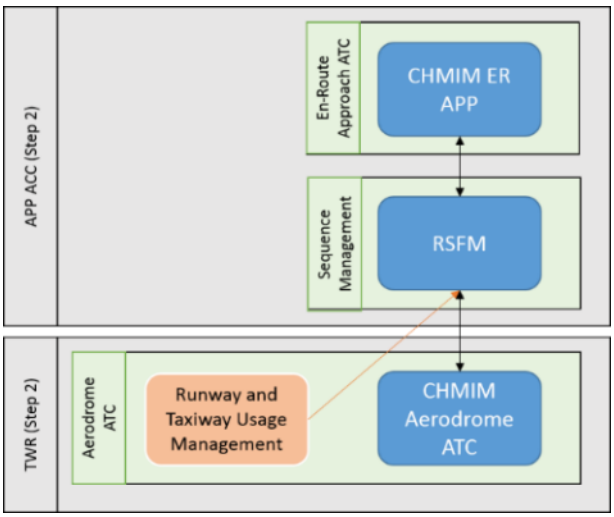

Figure 23: Architectural Overview IO8 (IO8b with RTUM)

*CCs in grey
Technical Systems in green
Functional Blocks in blue. *Additional FB necessary for the Concept 2 in orange

5.2 Implementation Options for Concept 3

For Concept 3, it is envisaged that the implementation can be incremental based on the local decision to implement Time Based Separation, RECAT based on ROT (resulting sub ROT category each approaching aircraft belongs to) or Pair Wise Separation.

5.3 Implementation Options for Concept 4

Not applicable.

5.4 Implementation Options dependent on Airport Configuration

The possible PJ02-08 implementation options dependent on airport configuration are given in the table below.

PJ02-08	OI Step	AIRPORT CONFIGURATION AND DEPLOYMENT OPTIONS					
		AIRPORTS			RUNWAYS		
		Medium	Large	Very Large	Single Runway	Multiple Runways	
						Dependent Runways	Independent Runways
CONCEPT 1 Integrated Runway Sequence Function	**TS-0301**	X	X	X	X	X	X
CONCEPT 2 RMAN	**TS-0313**	X	X	X		X	X
CONCEPT 3 ROCAT	**AO-0337**		X	X	X		
CONCEPT 4 AROT	**AO-0338**	X			X		

Table 103: Possible deployment options dependent on airport configuration

6 Assumptions

It should be noted that the document does not include any requirement dealing with the Runway Manager (RMAN), since this prototype was validated in SESAR1 in the scope of the OFA05.01.01. Technical requirements and a full description of the RMAN can be found in the deliverable SESAR1 12.02.01.D34 – P3 – Final System Requirements [38].

The OI TS-0313 only deals with the integrations between RMAN and any sequence planner, since RMAN works in the planning phase and sequencers work in the execution phase as detailed in section 3.1.1.

This document does not provide the complete set of requirements dealing with the ORD Tool, since the prototype is developed in PJ02-01, all requirements related to the tool are described in the PJ02-01 Technical requirements deliverable.

7 References and Applicable Documents

7.1 Applicable Documents

Content Integration

[1] EATMA Guidance material and report (2018)

[2] EATMA Community pages

[3] SESAR ATM Lexicon

Content Development

[4] Operational Concept Document (OCD) 2018

System and Service Development

[5] 08.01.01 D52: SWIM Foundation v2

[6] 08.01.01 D49: SWIM Compliance Criteria

[7] 08.01.03 D47: AIRM v4.1.0

[8] 08.03.10 D45: ISRM Foundation v00.08.00

[9] B.04.03 D102 SESAR Working Method on Services

[10]B.04.03 D128 ADD SESAR1

[11]B.04.05 Common Service Foundation Method

Performance Management

[12]PJ19.04 - D4.4 Performance Framework (2018) 01 00 00

[13]SESAR2020 Requirements and Validation guidelines

[14]B.05 D86 Guidance on KPIs and Data Collection support to SESAR 2020 transition.

[15]16.06.06-D68 Part 1 –SESAR Cost Benefit Analysis – Integrated Model

[16]16.06.06-D51-SESAR_1 Business Case Consolidated_Deliverable-00.01.00 and CBA

[17]Method to assess cost of European ATM improvements and technologies, EUROCONTROL (2014)

[18]ATM Cost Breakdown Structure_ed02_2014

[19]Standard Inputs for EUROCONTROL Cost Benefit Analyses

[20]16.06.06_D26-08 ATM CBA Quality Checklist

[21]16.06.06_D26_04_Guidelines_for_Producing_Benefit_and_Impact_Mechanisms

Validation

[22]03.00 D16 WP3 Engineering methodology

[23]Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects

[24]European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

System Engineering

[25] SESAR 2020 Requirements and Validation Guidelines

Safety

[26]SESAR, Safety Reference Material, Edition 4.0, April 2016

[27]SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016

[28]SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

[29]SESAR, Resilience Engineering Guidance, May 2016

Human Performance

[30]16.06.05 D 27 HP Reference Material D27

[31]16.04.02 D04 e-HP Repository - Release note

Environment Assessment

[32]SESAR, Environment Reference Material, alias, “Environmental impact assessment as part of the global SESAR validation”, Project 16.06.03, Deliverable D26, 2014.

[33]ICAO CAEP – “Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes” document, Doc 10031.

Security

[34]16.06.02 D103 SESAR Security Ref Material Level

[35]16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[36]16.06.02 D131 Security Database Application (CTRL_S)

7.2 Reference Documents

[37] ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.[6]

[38] SESAR1 12.02.01.D34 - P3_Final System Requirements, Edition 00.02.00, 12/04/2016

[39] SESAR1 12.04.04.D38 - System Requirements Final S2V3, Edition 00.01.00, 26/04/2016

[40] EUROCONTROL Airport CDM Implementation Manual

[41] SESAR Solution 02-08 D6.1.203 SPR-INTEROP/OSED for V3 – Part I, Edition 00.01.00, 26/07/19

[42] SESAR Solution 02-08 D6.1.132 Validation Report (VALR) for V3 , Edition 00.01.00, 26/07/19

[43]OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED

[6] The EUROCAE ED-78A has been used as an initial guidance material. ED-78A is useful, but is not an applicable document, because it mostly addresses the V4-V5 phases, whilst the SESAR R&D programme is focussed on development (V1-V2-V3, and because of its partial compliance with safety regulatory requirements).


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