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Multiple Remote Tower

MULTIPLE REMOTE TOWER MODULE

Abstract

This document is the Technical Specifications (TS) relating to the Multiple Remote Towers development of the SESAR operational concept. It covers the remote provision of Air Traffic Services (ATS) to multiple aerodromes simultaneously: more than one airport to one Multiple Remote Tower Module (MRTM.) Operation of a single aerodrome is, in this TS, viewed to be included in a multiple aerodrome operation.

This edition of PJ05.02 TS, together with PJ05 OSED edition 00.01.01 is considered as the base for four different SESAR2020 validation exercises, and this document has been updated with the feedback received from these exercises.

The architecture is based on requirements, organized in 6 different categories and based on operational requirements listed in the OSED.

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1 Executive summary

This edition of the SESAR2020 PJ05.02 Technical Specification describes the functions of a remote tower solution, and provides a requirement specification for those functions. It is developed aiming for final V3 maturity for Solution PJ05-02.

It is based on SESAR1 project 12.04.07 D09 Remote Tower Technical Specifications [41]. While the SESAR1 TS was written to separate operation of a single aerodrome from the one of a multiple aerodrome, this TS views operation of a single aerodrome to be included in a multiple aerodrome operation.

This edition of PJ05.02 TS considers the outcomes of the following SESAR2020 validation exercises:

- EXE-05.02-V3-002 – COOPANS

- EXE-05.02-V3-003 – INDRA

- EXE-05.02-V3-004 – FSP

- EXE-05.02-V3-005 – ENAV

This TS/IRS document has been updated with the feedback received from the different exercises.

In SESAR2020 the intention is to ensure consistency and coherency between the delivered documents using EATMA, and the architectural diagrams showed in this document are present in EATMA.

The architecture of the main Capability Configuration, roles, technical systems and functional blocks is summarized for solution 2 in the following table:

Capability Configuration	Role	Technical System	Functional Block
TWR (Step 2)	Tower Clearance Delivery Controller Tower Ground Controller Tower Runway Controller	Aerodrome ATC	Out The Window
			CHMIM Aerodrome ATC
			G/G Communication ATC
			Technical Supervision
			Aerodrome Flight Data Processing
			Support Functions Aerodrome ATC
			Aerodrome Weather Information Management
			Aerodrome Surveillance
			Multiple Remote Aerodromes Management
		Voice	A/G Voice Communication

Table 1: Solution 2 architecture of Capability Configuration, roles, technical systems and functional blocks

The architecture is based on requirements, organized in 6 different categories and based on operational requirements listed in the OSED.

2 Introduction

2.1 Purpose of the document

This document describes the functions of a multiple remote tower solution and provides a requirement specification for those functions. The aim is not to answer *how* a multiple remote tower is implemented nor to describe a specific multiple remote tower solution, but to describe on a general level the functionality such a solution must provide in order to fulfil the operational methods and scenarios described in the PJ05 OSED for Remote Provision of ATS to Aerodromes. The purpose is also to provide a requirement description that can be used by stakeholders to procure such a technical solution.

2.2 Scope

This TS is developed aiming for V3 maturity for Solution PJ05-02.

2.3 Intended readership

The intended audience for this document are primarily all the partners involved in SESAR 2020 PJ.05-02.

External to the SESAR project, other stakeholders are to be found among:

- ANS providers;
- ATM infrastructure and equipment suppliers.
- Airspace users;
- Airport owners/providers;
- Affected NSA;
- Affected employee unions;

PJ.05 Solutions:

- PJ.05-03 "Remote Tower Centre with Flexible Allocation of Aerodromes to Multiple Remote Tower Modules"

Other SESAR 2020 Projects/Solutions with dependencies to PJ.05-02:

- PJ.16 (CWP/HMI) CWP-HMI
- PJ.18 4DTM

SESAR 2020 Transversal Projects:

- PJ.19 (CI) Content Integration
- PJ.20 (AMPLE) Master Plan Maintenance
- PJ.22 (SEabird) Validation & Demonstration Engineering

2.4 Background

This document considers the requirements done in SESAR 1 for project included in the deliverable 12.04.07 D09 Remote Tower Technical Specifications [41].

The work done for single remote tower, and remote contingency, are the baseline for the multiple remote tower concepts but are not addressed anymore in this document. See chapter assumptions [1] for the detailed assumption.

While the SESAR1 TS was written to separate the operation of a single aerodrome from the operation of a multiple aerodrome, this TS views the operation of a single aerodrome to be included in a multiple aerodrome operation. This edition of PJ05 TS considers the outcomes of the following SESAR2020 validation exercises:

- EXE-05.02-V3-002 – COOPANS

- EXE-05.02-V3-003 – INDRA

- EXE-05.02-V3-004 – FSP

- EXE-05.02-V3-005 – ENAV

2.5 Structure of the document

This document is organized as follows:

- Chapter 1: Executive Summary

- Chapter 2: Introduction

- Chapter 3: SESAR Solution impacts on Architecture

- Chapter 4: Technical Specifications

    o Section 4.1.1: Resource Connectivity Model

    o Section 4.1.2: Resource Orchestration view

    o Section 4.1.3: Functional Block Descriptions

    o Section 4.1.4: Infrastructure Connectivity Model

    o Section 4.1.5: Service view

    o Section 4.2: Functional and non-Functional Requirements

- Chapter 5: Implementation Options, no content in this edition

- Chapter 6: Assumptions, no content in this edition

- Chapter 7: References and applicable documents

In this edition, there are no Appendix A, Service Description Document, or Appendix B, Service Technical Design Document, added as there are no identified plans for SWIM taken in account in this version.

2.6 Glossary of terms

Term	Definition	Source of the definition
AIR-REPORT	A report from an aircraft in flight prepared in conformity with requirements for position, and operational and/or meteorological reporting.	ICAO, Annex 3
ATS (Air Traffic Service)	A generic term for the three services Flight Information Service (FIS), Alerting Service (ALRS) and Air Traffic Control Service (ATC). In this document, when the term ATS is used, it is usually referring to TWR or AFIS in the context	ICAO, Annex 11
Aerodrome Control Service (TWR)	The air traffic control (ATC) service provided by the Air Traffic Control Officer (ATCO) for an aerodrome.	ICAO, Annex 11
Multiple Remote Tower Module (MRTM)	Term for the complete module including both the CWP(s) and the Visual Presentation display screens. A **MRTM** is defined as a work station for one or two ATCOs able for providing ATS to more than one aerodrome. The **MRTM** will enable the ATCO to maintain a view over the aerodromes including the manoeuvring area and surfaces as stipulated in regulation.	SESAR2020 PJ05 Multiple Remote Tower Project
Remote Tower Module (RTM)	**Remote Tower Module** (RTM) is the term for the complete module including both the CWP and the Visual Presentation display screens. An RTM is defined as a work station for one or two ATCOs able for providing ATS to **one single airport**. The RTM will enable the remote tower operator to maintain a view over the aerodrome including the manoeuvring area and surfaces as stipulated in regulation.	EASA
Technical Enablers	Technical Enablers refer to additional features and functions within a single or a multiple module that enable the provision of ATS	SESAR

	using the concept. These technical features will assist in the areas of visualisation and operational performance. Further information on the requirement status of the Technical Enablers is given within this document.	
Remote Tower	Remote Tower is where ATS is remotely provided through the use of direct visual capture and visual presentation e.g. through the use of cameras.	EASA
Remote Tower Centre (RTC)	A Remote Tower Centre (RTC) is a centralised facility housing one or more MRTMs/RTMs where the provision of a remote ATS may be provided to one or more aerodromes.	EASA
Remote Tower Centre Supervisor (RTC SUP)	Remote Tower Centre Supervisor (RTC SUP) The role of an RTC supervisor may be established in order to provide an efficient set up at all times and guarantee a flexible system by means of; maintaining overall supervision of all aerodromes within the RTC; managing the allocation of staff and Modules (MRTMs/RTMs); performing planning, administration, allocation of tasks and supervision of technical systems.	SESAR2020 PJ05 Multiple Remote Tower Project
Visual Presentation	Visual Presentation is the term for the collected aerodrome sensor data (from cameras and/or other sensors) and presented to the ATCO/AFISO in order to provide situational awareness of the aerodrome and its vicinity. Note that other terms such as Visual Reproduction and Visual Representation have been applied throughout the lifetime of the projects. The definition of the terms should be taken as identical to the	EASA

	definition provided for visual presentation.

Table 2: Glossary

2.7 Acronyms and Terminology

Term	Definition
AFIS	Aerodrome Flight Information Service
A/G	Air/Ground
ANSP	Air Navigation Service Provider
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATS	Air Traffic Service
CHMIM	Controller Human Machine Interaction Management
CTR	Control Zone
CWP	Controller Working Position
EATMA	European ATM Architecture
FB	Functional Block
FP	Flight Plan
G/G	Ground/Ground
ILS	Instrument Landing System
IRS	Interface Requirements Specification
ISRM	Information Services Reference Model
MET	Meteorology, meteorological
MRTM	Multiple Remote Tower Module
NAF	NATO Architecture Framework
NSV	NAF System View
OSED	Operational Service and Environment Definition
OTW	Out-The-Window

PTZ	Pan-Tilt-Zoom
RTC	Remote Tower Centre
RTM	Remote Tower Module
RVR	Runway Visual Range
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SLG	Signal Light Gun
SPR	Safety and Performance Requirements
SWIM	System Wide Information Model
TS	Technical Specification
V&V	Validation and Verification
VCS	Voice Communications System

Table 3: Acronyms and terminology

3 SESAR Solution Impacts on Architecture

3.1 Target Solution Architecture

3.1.1 SESAR Solution(s) Overview

Multiple Remote Tower Module (Solution 02)

PJ.05 Solution 2 is based on the Multiple Remote Tower Module (MRTM). The Multiple Remote Tower Module is the group of functionalities that allow the ATCO to access remotely the functions of each airport that is remotely controlled from the same position. It allows the ATCO to have simultaneous access to all the active services for one or more airports and provides additional enhancement functions (e.g. augmentation and tracking).

The Operational Improvement brought into operation that summarises the PJ.05-02 concept is:

- SDM-0207 – Remotely Provided Air Traffic Service for Multiple Aerodromes (up to 3 aerodromes)

In the video based remote tower approach there are dedicated subcomponents for acquisition, handling and processing of video and audio information, which can be used in combination with the conventional radar based surveillance technologies.

- Video stream management

- Camera Control

- Visual Tracking

- Video Data Fusion

For the multi remote tower scenario, a single MRTM shall provide the required information and allow the ATCO to manage more aerodromes simultaneously. In that case, all the functional blocks shall be extended in order to cover more than one single airport.

Besides, in a RTC with multiple MRTMs, the technical supervision function handles information of multiple airports. The control centre needs to provide an aggregated view of all relevant status information of all remote airports.

For PJ.05 Solution 02, the main elements based on EATMA that are used are stated below. To be highlighted that these are the FBs impacted by the mandatory Enablers of this Solution; therefore, these FBs will be the main impacted ones and the core of this Solution.
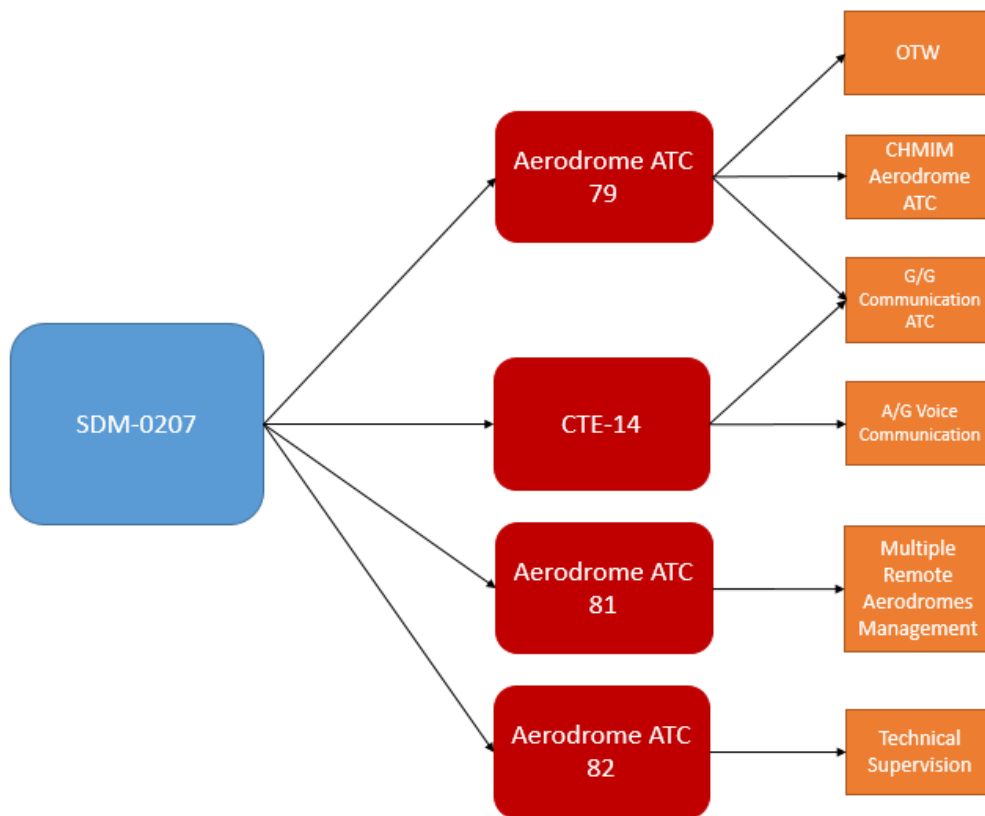
Figure 1: PJ.05 Solution 02 Relations

SESAR Solution ID and Title	Functional Blocks/Role impacted by the SESAR Solution (from EATMA)	Enabler ID (from EATMA)	Enabler Title (from EATMA)	Enabler coverage
PJ.05.02 Remotely Provided Air Traffic Service for Multiple Aerodromes for up to three airports	Out The Window / ATCO	AERODROME-ATC-79	Provide a MRTM that enables one ATCO to control multiple remote towers simultaneously	Fully
	CHMIM Aerodrome ATC / ATCO			
	G/G Communication ATC			
	Multiple Remote Aerodromes Management / ATCO	AERODROME-ATC-81	ATCO Planning tool for a MRTM	Fully

Technical Supervision ATC	AERODROME-ATC-82	Technical supervision from a MRTM	Fully
CHMIM Aerodrome ATC			
G/G Voice Communication	CTE-C14	Advanced VCS (Voice Com System) for a Multiple Remote Tower Module (MRTM)	Fully
A/G Voice Communication			

Table 4: SESAR Solution PJ.05.02 Scope and related Functional Blocks/roles & Enablers

The Roles directly impacted on this Solution are the Tower Ground Controller, Tower Clearance Delivery Controller and the Tower Runway Controller. These Roles perform the same activities that they would do in a conventional tower, but remotely in the MRTM. One single controller can be in charge of the three Roles for more than one aerodrome at the same time, since this is the main objective of PJ.05-02.

It should be noted that in some cases, mostly in the diagrams, these three Roles will be represented by the Tower Runway Controller Role.

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

No deviations are listed in this version.

3.1.1.2 Relevant Use Cases

A technical architecture has been developed in order to cover the following use cases mentioned in the OSED.

UC 1:1 / Provide ATS with simultaneous movements (ground and air) at different aerodromes from one MRTM
UC 1:2 / Provide ATS to co-operative RPAS and normal aircraft at a time to different aerodromes
UC 1:3 / Control of Vehicles in the Manoeuvring Area to different aerodromes
UC 1:4 / Provide ATS to simultaneous landings at different aerodromes
UC 1:5 / Provide ATS to simultaneous departures at different aerodromes
UC 1:6 / Provide ATS to a landing and a departing aircraft simultaneously at different aerodromes
UC 1:7 / VFR flight in the traffic circuit with an arriving IFR flight with simultaneous movements on another aerodrome

UC 1:8 / ATCO planning of movements and workload supported by short term planning tool
UC 1:9 / Failure of parts of the technical system building the Remote Tower Service, e.g. Camera view, screens, voice com
UC 2:1 / Split of aerodromes within an MRTM to meet requested capacity
UC 2:2 / Merge of aerodromes to one MRTM
UC 2:3 / Emergency Situation - Supported by other ATCO in the MRTM during the emergency situation
UC 2:4 / Emergency Situation - Transfer of aerodrome to another MRTM

The Technical Use Cases developed are summarised in the following technical views:

MRTM

The overall working of the MRTM and the interactions between the different parts of the system are presented. It describes how the data (e.g. vehicle or aircraft requests) arrive to the MRTM, flowing through or making use of some systems proper of the Local TWR that is being represented remotely.

Information coming from more than one Local TWR can be managed by a single MRTM.

The Technical UC represents which Functional Block takes care of each part proper of the operation. Some of them are the following:

- The **Out The Window** displays the visual presentation of the remotely controlled aerodrome.
- Data from the remote active aerodromes (e.g. FPs, traffic situation) are collected and managed by the **Multiple Remote Aerodromes Management** and is presented in the **CHMI**.
- **Technical Supervision** checks MRTM and remote aerodrome system status.
- **Aerodrome Surveillance** and **Aerodrome Flight Data Processing** are also involved.

This in mind, Technical UC covers the Use Cases in relation with providing ATS from a MRTM to different remotely controlled aerodromes at the same time.

Request to transfer aerodromes from a fixed MRTM to a spare MRTM to meet requested capacity

This use case describes the flow of an aerodrome transfer when requested traffic levels are higher than ATCO capacity in multiple mode.

An ATCO in a MRTM detects a necessity of transferring an aerodrome due to an excess of workload. The aerodrome transfer procedure is initiated by requesting to another ATCO in a different MRTM to take over an aerodrome(s).

Aerodrome transfer procedure continues in the Technical UC "Coordination between MRTM for aerodrome transfer purposes".

Coordination between MRTM for aerodrome transfer purposes

This use case represents the continuation of an aerodrome transfer procedure. It starts when an ATCO in a MRTM requests an aerodrome transfer to another MRTM.

The MRTM is prepared for the new module corresponding to the aerodrome transferred. The Out The Window displays the visual presentation, and CHMI is set up accordingly.

Coordination between the two ATCOs begins and the ATCO that is about to take over the aerodrome receives the information necessary to do it, e.g. aerodrome situation, traffic picture.

Once the transfer is accepted, the ATCO that is no longer in charge of the aerodrome transferred closes the module corresponding to it and keeps controlling the remaining aerodrome(s) in the MRTM, if any.

3.1.1.2.1 Trace Relevant Use Cases and Technical Models

Table hereunder show the trace of the Technical Use cases developed in the validation against the Operational Use Cases from SESAR Solution 05-02 SPR-INTEROP/OSED for V3 – Part I [41].

Operational Use Case	Op. UC Description	Related Technical Model
UC 1.1 / Provide ATS with simultaneous movements (ground and air) at different aerodromes from one MRTM	This use case describes the baseline for how to provide ATS for both air and ground movements in multiple remote Towers.	*MRTM*
UC 1.2 / Provide ATS to co-operative RPAS and normal aircraft at a time to different aerodromes	This use case describes the provision of air traffic service to a manned aircraft and a remotely controlled aircraft at the same time at different aerodromes	*MRTM*
UC 1.3 / Control of Vehicles in the Manoeuvring Area to different aerodromes	This use case describes how to provide ATS for vehicles on ground in multiple remote Towers.	*MRTM*
UC 1.4 / Provide ATS to simultaneous landings at different aerodromes	This use case describes how to provide ATS to simultaneous landings to different Airports	*MRTM*
UC 1.5 / Provide ATS to simultaneous departures at different aerodromes	This use case describes how to provide ATS to simultaneous departures at different airports	*MRTM*
UC 1.6 / Provide ATS to a landing and a departing aircraft simultaneously at different aerodromes	This use case describes how to provide ATS to a landing and a departing aircraft simultaneously at different airports	*MRTM*
UC 1.7 / VFR flight in the traffic circuit with an arriving IFR flight with simultaneous movements on another aerodrome	This use case describes how to provide ATS to a VFR flight in the traffic circuit while there is an arriving IFR flight to another aerodrome with simultaneous movements in the MRTM	*MRTM*
UC 1.8 / ATCO planning of movements and workload supported by short term	This use case describes how the ATCO is supported by planning tools in order to plan movements and workload up to 6 hours	*MRTM*

Operational Use Case	Op. UC Description	Related Technical Model
planning tool	ahead to avoid task overload.	
UC 1.9 / Failure of parts of the technical system building the Remote Tower Service, e.g. Camera view, screens, voice com	This use case describes a degraded mode where the technical system in the MRTM or at the airport malfunctions, e.g. of systems can be screens, voice com, input devices, cameras, ILS or similar.	
UC 2.1 / Split of aerodromes within an MRTM to meet requested capacity	This use case describes the flow of a split when requested traffic levels are higher than ATCO capacity in multiple mode.	*Request to transfer aerodromes from a fixed MRTM to a spare MRTM to meet requested capacity* *Coordination between MRTM for aerodrome transfer purposes*
UC 2.2 / Merge of aerodromes to one MRTM	This use case describes the flow where one aerodrome is merged to another/other aerodromes in a MRTM, after a situation with higher requested level of traffic than suitable.	*Request to transfer aerodromes from a fixed MRTM to a spare MRTM to meet requested capacity* *Coordination between MRTM for aerodrome transfer purposes*
UC 2.3 / Emergency Situation - Supported by other ATCO in the MRTM during the emergency situation	This use case describes an emergency situation where the ATCO in control is supported by another ATCO in the same MRTM; standing beside or in a similar way (similar to what happens in single remote towers and conventional towers if possible)	*Request to transfer aerodromes from a fixed MRTM to a spare MRTM to meet requested capacity* *Coordination between MRTM for aerodrome transfer purposes*
UC 2.4 / Emergency Situation - Transfer of aerodrome to another MRTM	This use case describes the flow where there is an emergency at one of the aerodromes connected to MRTM, which is mitigated by a split.	*Request to transfer aerodromes from a fixed MRTM to a spare MRTM to meet requested capacity*

Operational Use Case	Op. UC Description	Related Technical Model
		Coordination between MRTM for aerodrome transfer purposes

Table 5: Trace relevant Use Cases vs Technical Models

It has it should be noted that the technical architecture is traced to the operational Use Cases modelled in detail in MEGA.

3.1.1.3 Applicable standards and regulations

Standards and regulations for multiple remote tower operations need to be developed by EASA and EUROCAE based on the ones provided for single remote tower.

[1] EUROCAE ED-240, 'MINIMUM AVIATION SYSTEM PERFORMANCE SPECIFICATION FOR REMOTE TOWER OPTICAL SYSTEMS', September 2016

[2] EASA Minimum aviation system performance specification for remote tower optical systems. ED-240.

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.

SESAR Solution ID and Title	Capability Configurations (CCs) (from EATMA)	Sub-Operating Environment(s) where the CCs operate	Capabilities (from EATMA)	Nodes (from EATMA)	Stakeholders (from EATMA)
PJ.05.02 Remotely Provided Air Traffic Service for Multiple Aerodromes for up to three airports	TWR (Step 2)	Small and Other Airports	None	Aerodrome ATS	ANSPs

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

3.2 Changes imposed by the SESAR Solution on the baseline Architecture

Enabler ID (from EATMA)	Element Type	Element Name	Changes
AERODROME-ATC-79 – Provide a MRTM that enables one ATCO to control multiple remote towers simultaneously	FB	Out The Window (PJ.05)	Out The Window is updated to perform the following Functions: - Display OTW from active aerodromes. Simultaneous OTW data are displayed in the Visual Presentation - Process data from local aerodromes. Data needs from active aerodromes needs to be processed before being displayed
AERODROME-ATC-81 – ATCO Planning tool for MRTM	FB	Multiple Remote Aerodromes Management	FB is created. FB performs the following Functions: - Collect FPs from all the aerodromes under control. In order to distribute the upcoming traffic situation of several remote aerodromes at the same time, the FB needs to collect the FPs of the active ones - Distribute upcoming traffic situation. The upcoming traffic situation calculated is distributed to the controllers.
	FB	Controller Human Machine Interaction Management Aerodrome ATC (PJ.05)	CHMIM is updated to perform the following Functions: - Present upcoming traffic situation.
AERODROME-ATC-82 – Planning tools for Supervisor	FB	Multiple Remote Aerodromes Management	FB is created. This functional block provides functionalities to forecast and plan in a short and medium term the allocation of multiple remote aerodromes and staff to different Multiple Remote Tower Modules (MRTMs) within a Remote Tower Center. For this allocation, different features are taken into account, such as the aerodromes demand, forecasted weather…
	FB	Technical Supervision ATC (PJ.05)	FB is updated to perform the following Functions: - Check MRTM system status. - Check remote aerodromes system

			status. Technical supervision of the remote aerodromes systems' status is continuously being performed.
CTE-C14 – Advanced VCS (Voice Com System) for a Multiple Remote Tower Module (MRTM)	FB	G/G Voice Communication	FB is updated to perform the following Functions: - Capture Voice - Send Voice - Receive Voice

Table 7: List of changes due to the SESAR Solution

4 Technical Specifications

4.1 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.

Some Functional Blocks within the domains impacted by the *Remote Provision of ATS* concept are substantially impacted and will be addressed in detail in this document.

- **Controller Human Machine Interaction Management** provides the controllers with a graphical user interface and with the means to interact with the aerodrome ATC system. CHMIM will allow ATCO, with a graphical user interface, to provide ATS remotely to multiple aerodromes simultaneously from a single working position.

- **Out the Window** provides Tower Controllers with a clear view of the real traffic situation and with all the necessary traffic data concerning a Remote Tower of others aerodrome ATC systems, in order to assist them in their control tasks.

  OTW can also help the Tower Controller to identify targets in Low Visibility with the support of the Aerodrome Surveillance Data. These data are the result of merging the surveillance information provided by the different surveillance sources providing a unique picture of the actual traffic situation.

  The remote tower implementation will use these (with the possible addition of more camera sensors) and provide the ATCO with a visual presentation of the aerodrome to allow ATS to be provided remotely.

- **Multiple Remote Aerodromes Management** provides functionalities to forecast and plan in a short and medium term the allocation of multiple remote aerodromes and staff to different Multiple Remote Tower Modules (MRTMs) within a Remote Tower Center (RTC). For this allocation, different features are taken into account, such as the aerodromes demand, forecasted weather…

- **Technical Supervision:** is in charge of the technical supervision of an Aerodrome ATC system (e.g. monitoring the services provided by the system, starting, stopping or re-starting the system or part of it).

- **G-G / A-G Voice communication:** provides the A-G functions performed by a VCS, and the functions performed to handle ground ATS communication through various communication interfaces.

Some of the functional blocks will be impacted in a minor way only and will only be briefly addressed in this document. They include:

- **Support functions:** Recording of visual aerodrome data.

- **Aerodrome Flight Data Processing:** manages the creation, update and modification of system flight plans up to/from the moment the aircraft takes-off/lands from all the controlled aerodromes.

- **Aerodrome Surveillance:** It merges the surveillance information provided by the different surveillance sources providing a unique picture of the actual traffic situation for each aerodrome under control.

- **Aerodrome Weather Information Management:** This functional block provides to the ATCO the access to the meteorological information that he/she needs to understand the status of the weather in the remote airport.

- **Operational Supervision** allows the supervisor to manage the most appropriate operational configuration, according to traffic demands and needs, and to react in case of system fault, re-assigning and distributing available resources in order to maintain adequate safety levels and quality of service.

The architecture of the main Capability Configuration, roles, technical systems and functional blocks is summarized for Solution 2 in the following table:

Capability Configuration	Role	Technical System	Functional Block
TWR (Step 2)	Tower Clearance Delivery Controller Tower Ground Controller Tower Runway Controller	Aerodrome ATC	Out The Window
			CHMIM Aerodrome ATC
			G/G Communication ATC
			Technical Supervision
			Aerodrome Flight Data Processing
			Support Functions Aerodrome ATC
			Aerodrome Weather Information Management
			Aerodrome Surveillance
			Multiple Remote Aerodromes Management
		Voice	A/G Voice Communication
			G/G Voice Communication

Table 8: Solution 2 architecture of Capability Configuration, roles, technical systems and functional blocks

The table below presents a functional breakdown proper of this Solution. 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.05-02 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

Capability Configuration	Technical System	Functional Block	Function
TWR (Step 2)	Aerodrome ATC	Controller Human Machine Interaction Management Aerodrome ATC (PJ.05)	Set up new aerodrome; Shut Down Aerodrome Transferred; Display system status; Present data from remote active aerodrome(s); Present upcoming traffic situation;
		Out The Window (PJ.05)	Display OTW from active aerodromes; Shut Down OTW from Aerodrome Transferred; Process data from local aerodromes; Collect relevant data from local aerodrome; Distribute data collected from local aerodrome;
		Multiple Remote Aerodromes Management	Collect FPs from all the aerodromes under control; Distribute upcoming traffic situation;
		Technical Supervision ATC (PJ.05)	Check MRTM system status; Check remote aerodromes system status;
	Voice	A/G Voice Communication (PJ.05-02)	Receive Voice; Capture Voice; Send Voice;

Capability Configuration	Technical System	Functional Block	Function
		G/G Voice Communication (PJ.05-02)	Receive Voice; Capture Voice; Send Voice;

Table 9: Functional architecture overview

Capability Configuration	Role	Function
TWR (Step 2)	Tower Runway Controller (PJ.05)	Approve Aerodrome Transfer; Check Traffic Situation; Close Aerodrome Transferred; Control Aerodrome(s); Coordinate with Another MRTM; Prepare Module for New Aerodrome; Receive Aerodrome Transfer Confirmation; Receive Aerodrome Transfer Request; Request to Transfer Aerodrome;

Table 10: Roles impacted by the Solution

4.1.1 Resource Connectivity Model

This project mainly focuses on the TWR (Step 2) Capability Configuration as it is the one that is adding features to the current architecture. Other CCs are presented in the models in order to understand the full operation of the system; nevertheless, they will not be focused since they are out of the scope of the Solution.

The following diagram represents the high level interactions between the CCs involved. The Resource Connectivity for Solution PJ.05-02 is described. The view is also applicable to PJ.05-03. One Service, i.e. AerodromeTransfer, has been created for this Solution.
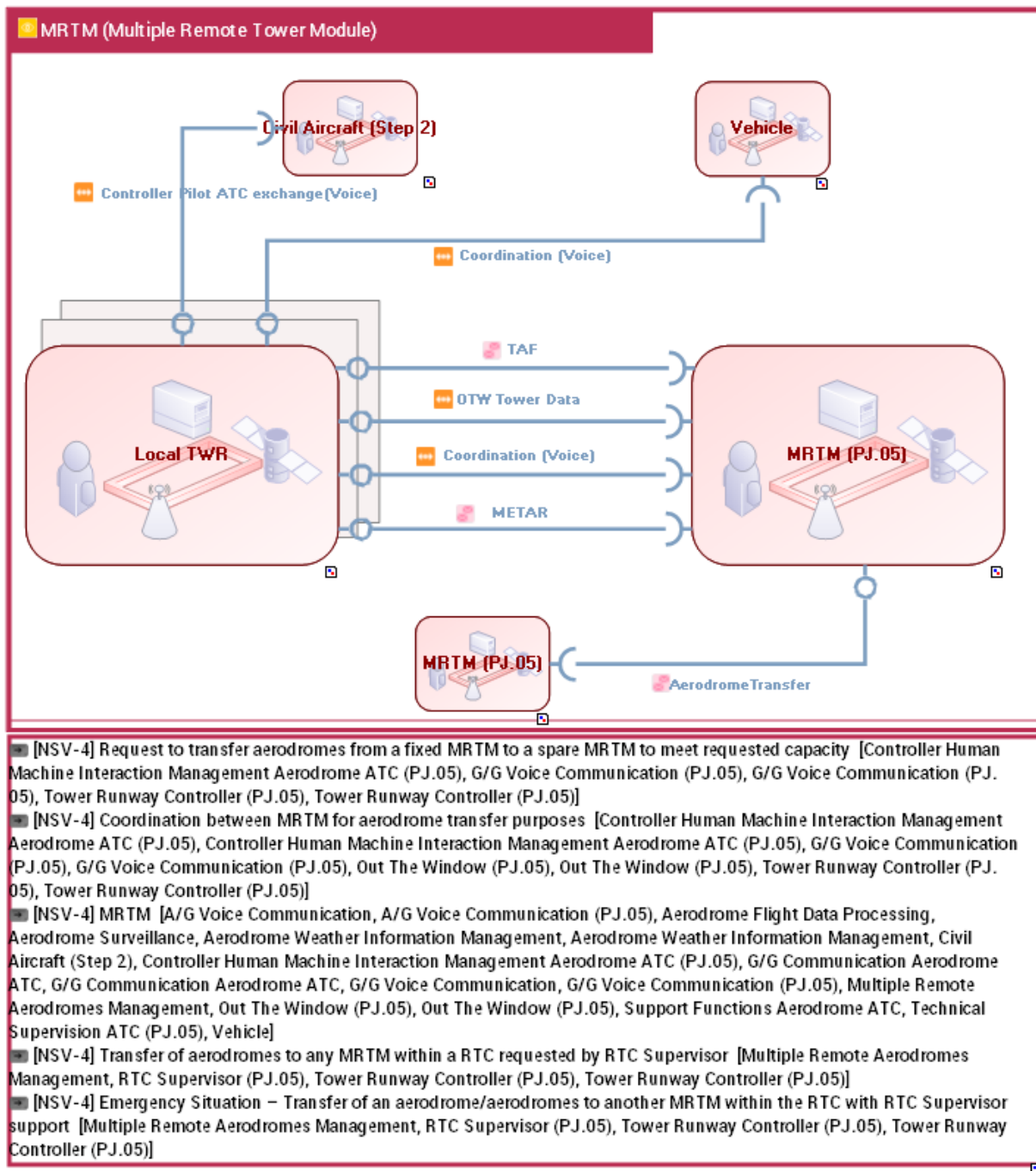
Figure 2. Resource Connectivity Model NSV-1 for PJ.05-02 and PJ.05-03

4.1.2 Resource Orchestration view

The logical architecture is modelled in MEGA, and therefore compliant with EATMA, and lists all functional components of the remote tower solutions and their dependencies and relations.

Furthermore, external systems or sensors which are related to the remote tower systems are not shown in the NSV architecture as they are physic systems; however, they belong to the FB shown in this diagram. It is understood that they need to exist for the correct performance of the whole

system. The logical information flow of flight data, support information and voice communication is the same as for the conventional towers. Main difference is the remote connection to dedicated information sources at the local airport and the acquisition of this information via the WAN infrastructure.

The diagrams within this section represent the interactions of the main FBs involved. Due to the dimension of one of the models ([NSV-4] MRTM), the interactions and the different elements are barely appreciated in this document. In order to make the architecture understandable for the reader, the model has been divided in 4 sections and zoomed in 4 different pictures, one for each area defined. Nonetheless, this model, with a better resolution, is available in MEGA/EATMA.

(https://www.srvs.nm.eurocontrol.int/mega_prod/hopex/default.aspx#start).

Please, refer to Section 3.1.1.2 to read the description for each model.
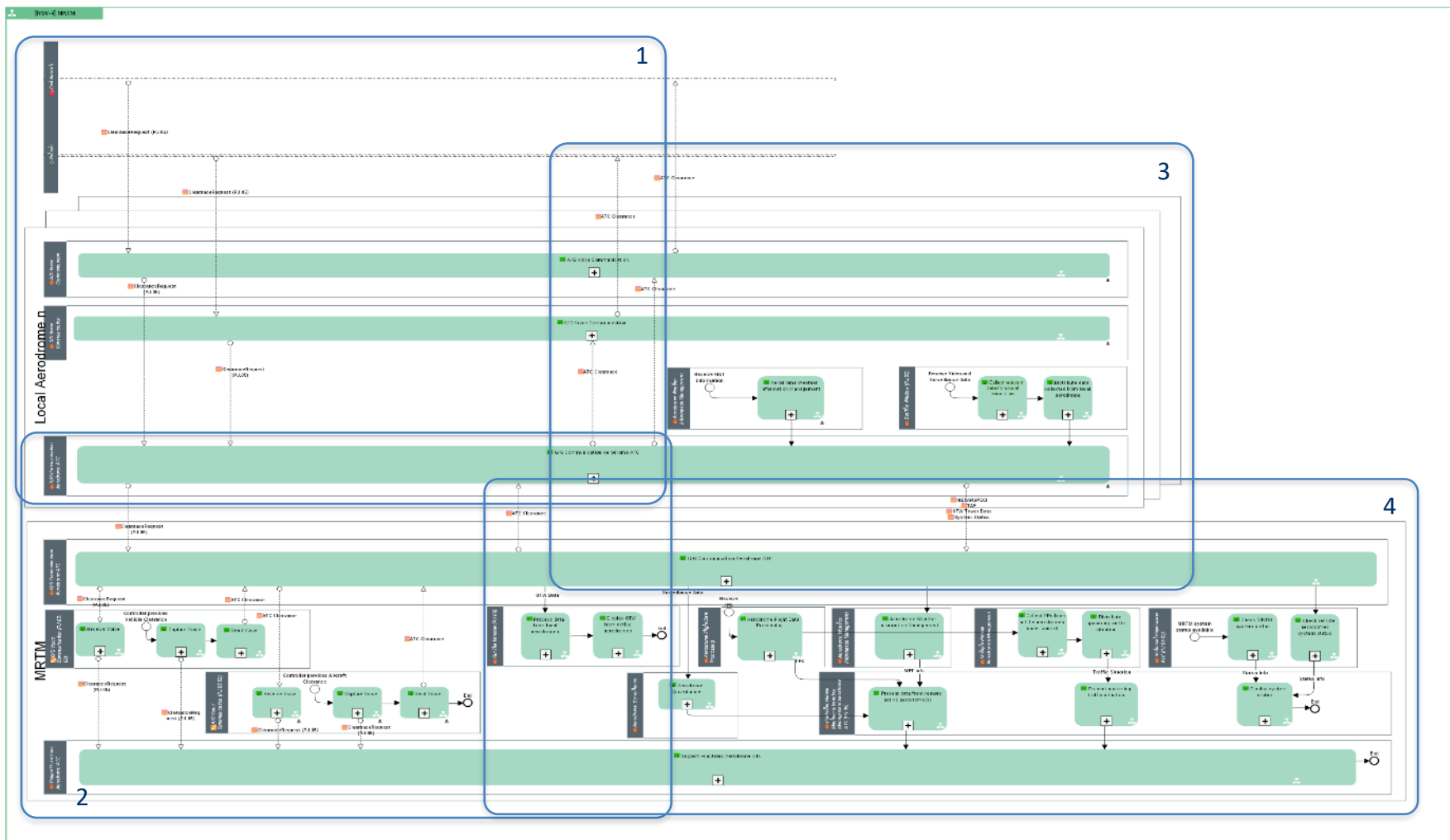
Figure 3: Resource Orchestration Model [NSV-4] MRTM (General view)
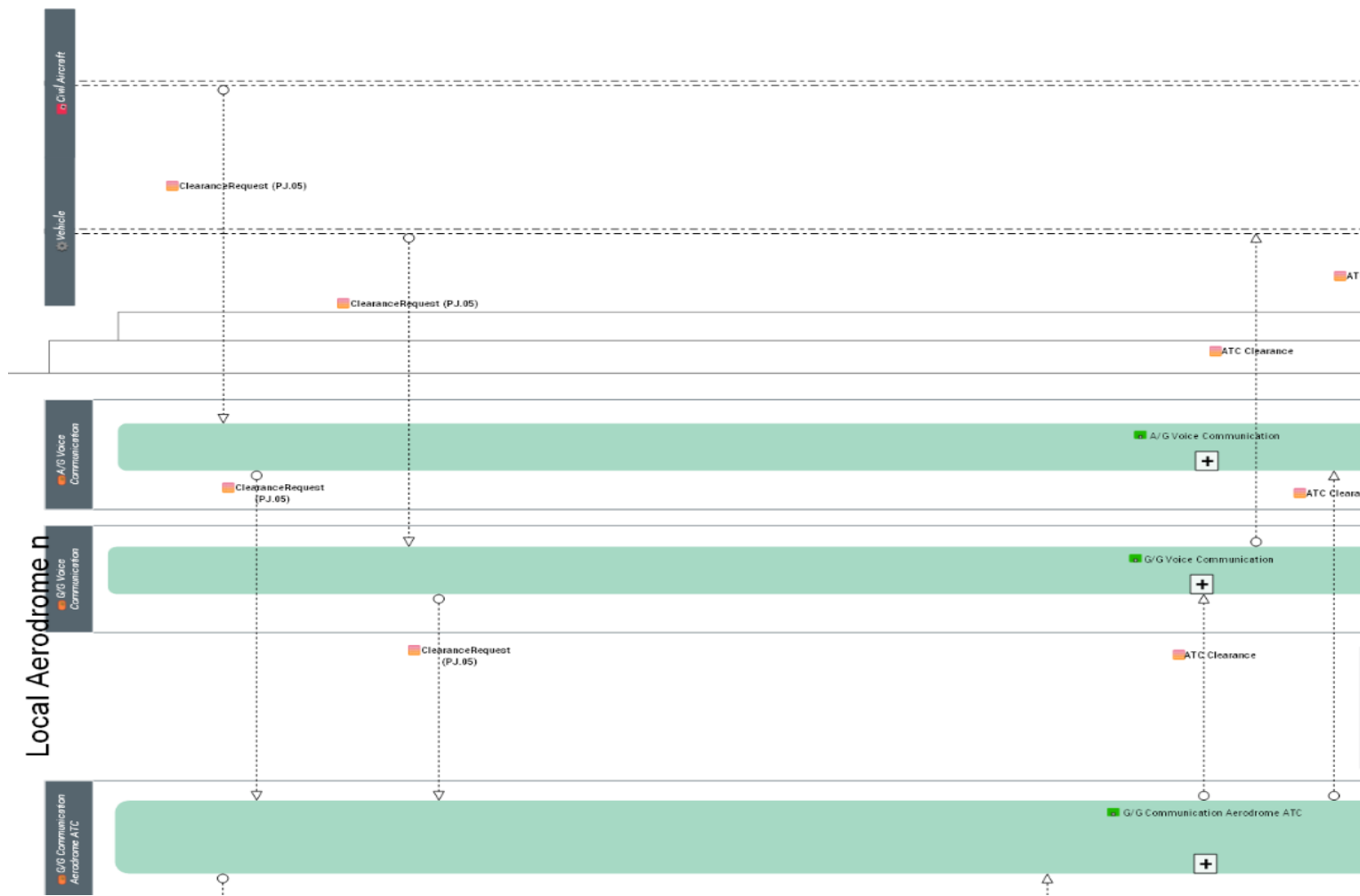
Figure 4: Resource Orchestration Model [NSV-4] MRTM (number 1)
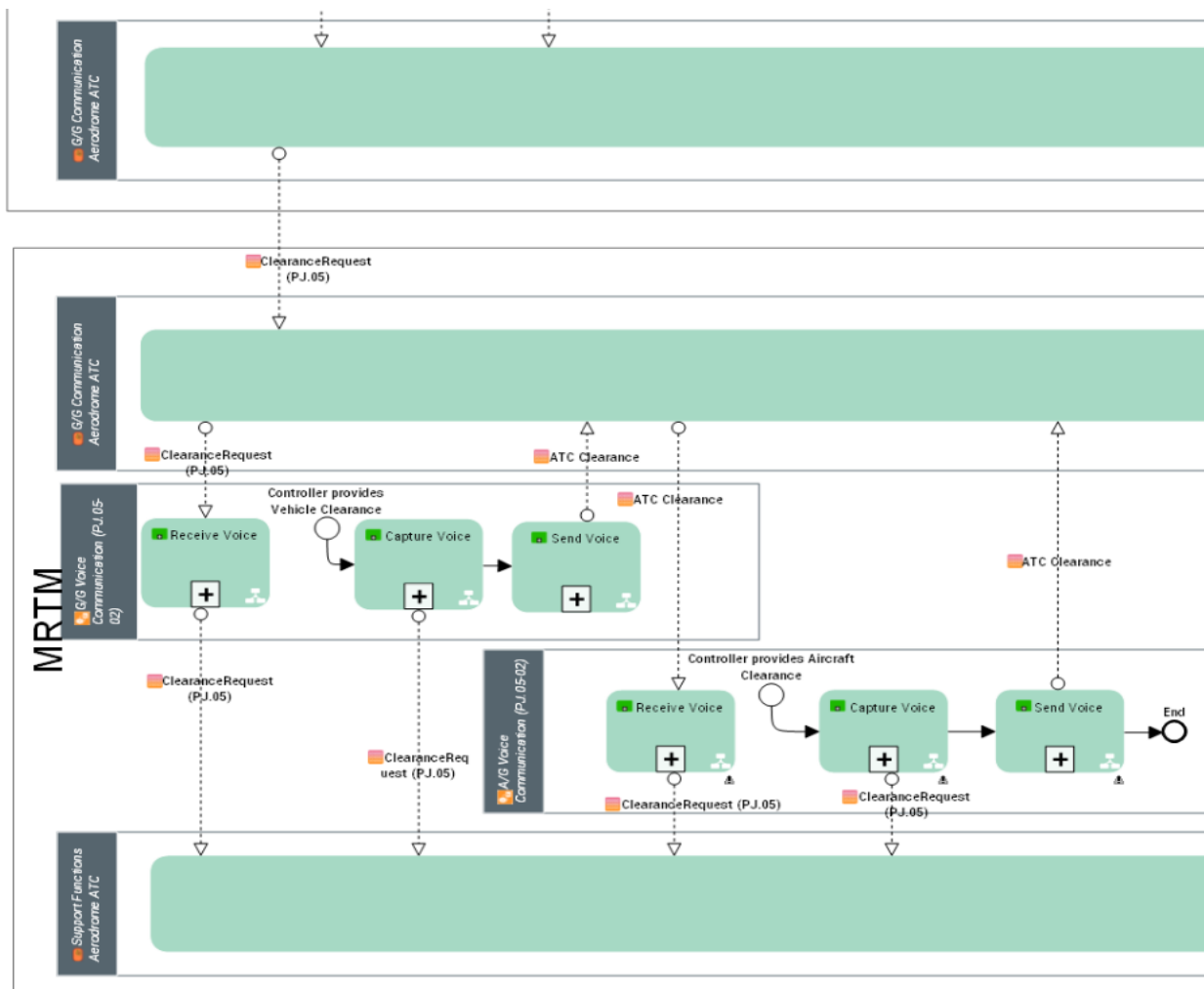
Figure 5: Resource Orchestration Model [NSV-4] MRTM (number 2)
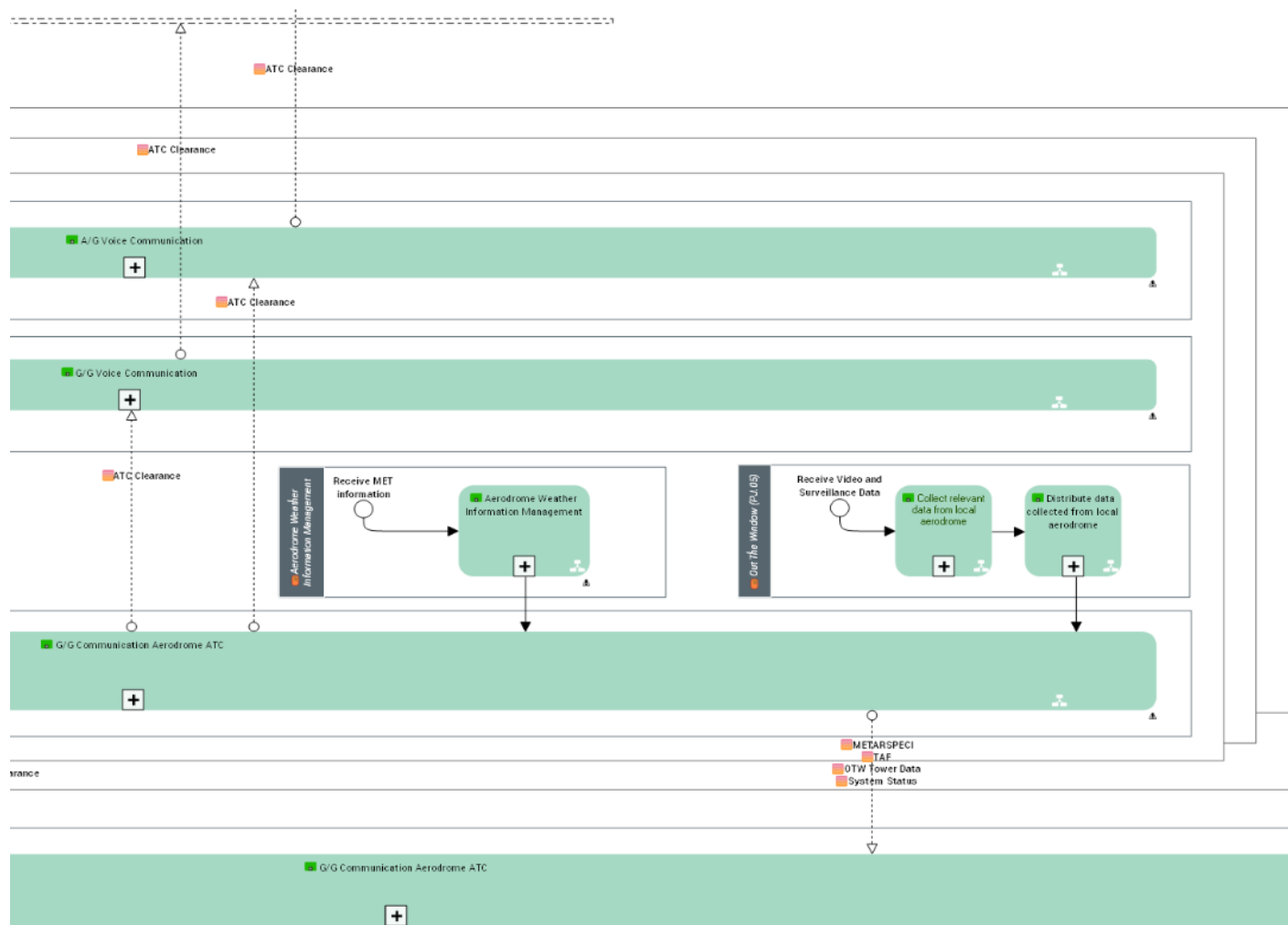
Figure 6**: Resource Orchestration Model [NSV-4] MRTM (number 3)**
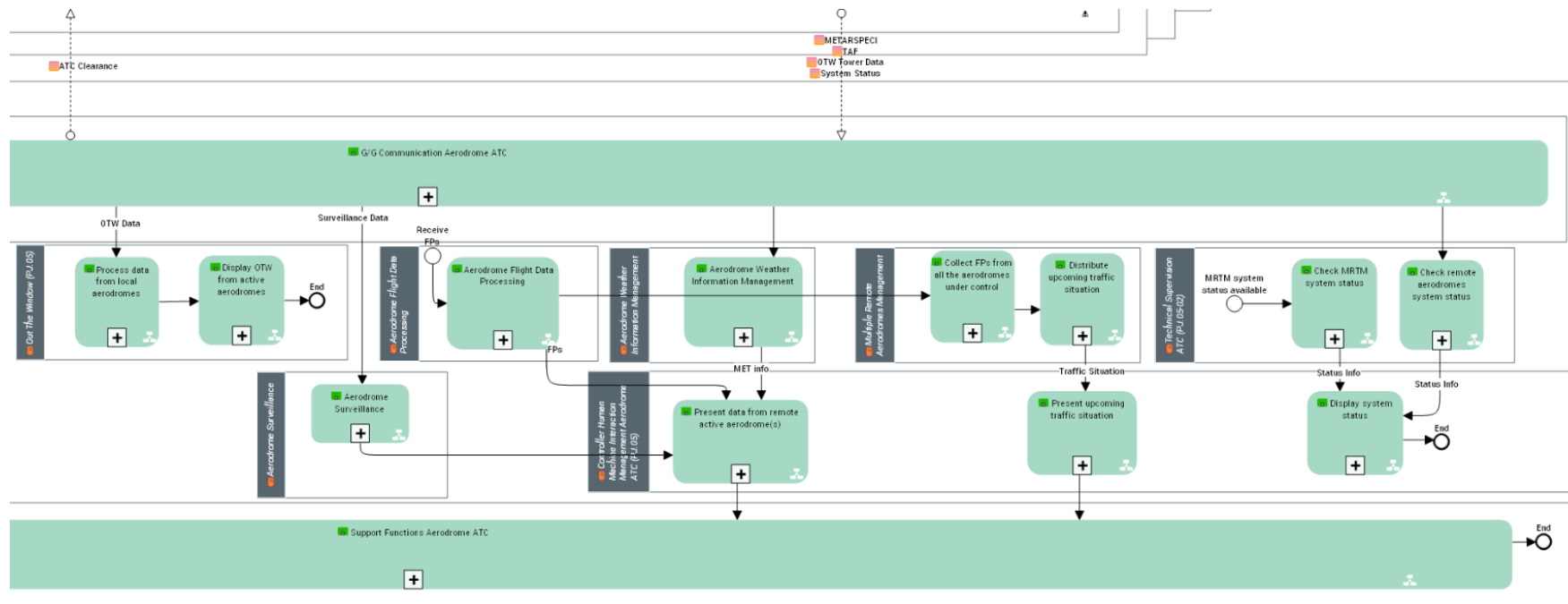
Figure 7: Resource Orchestration Model [NSV-4] MRTM (number 4)
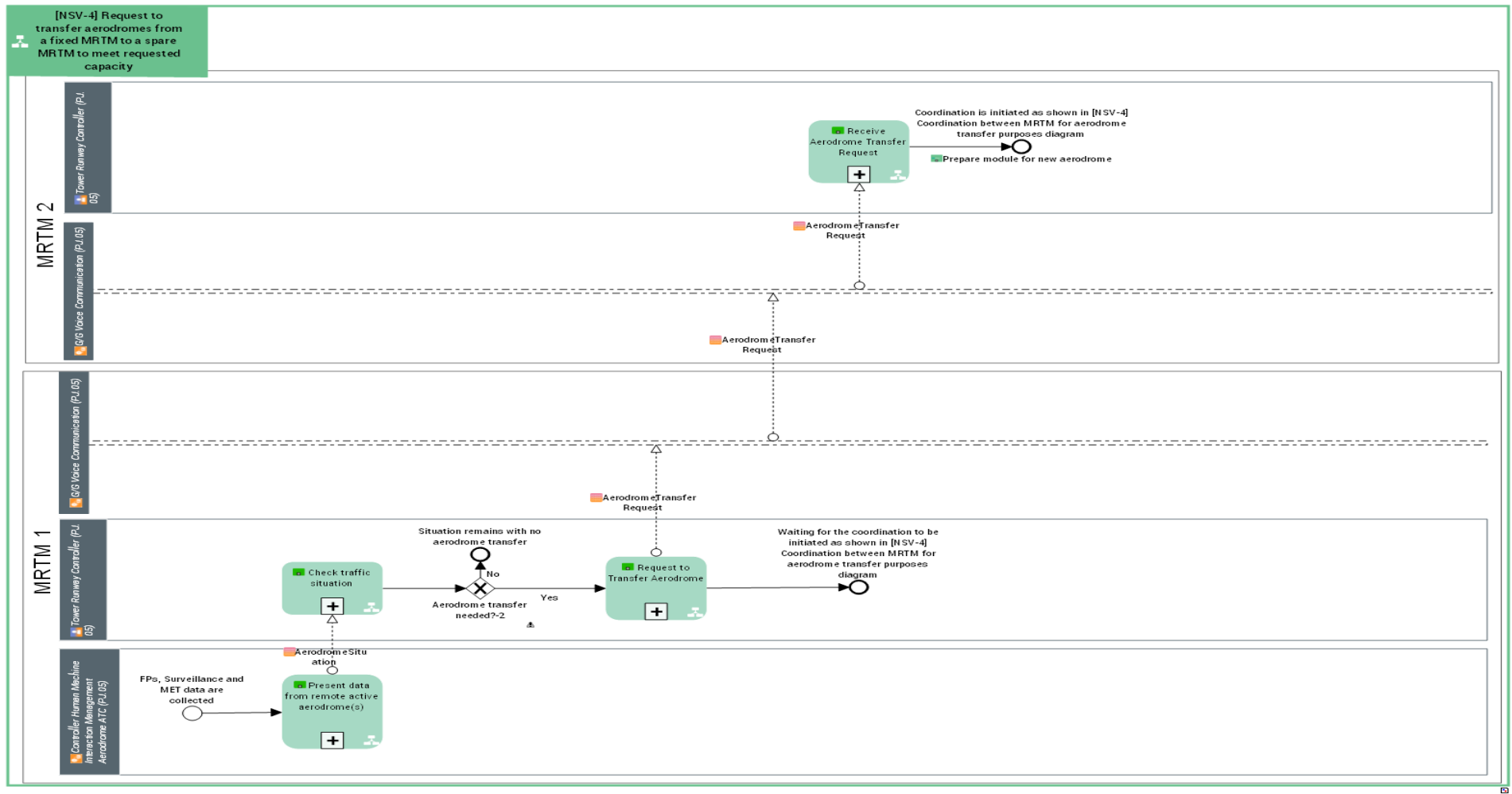
Figure 8: [NSV-4] Request to transfer aerodromes from a fixed MRTM to a spare MRTM to meet requested capacity
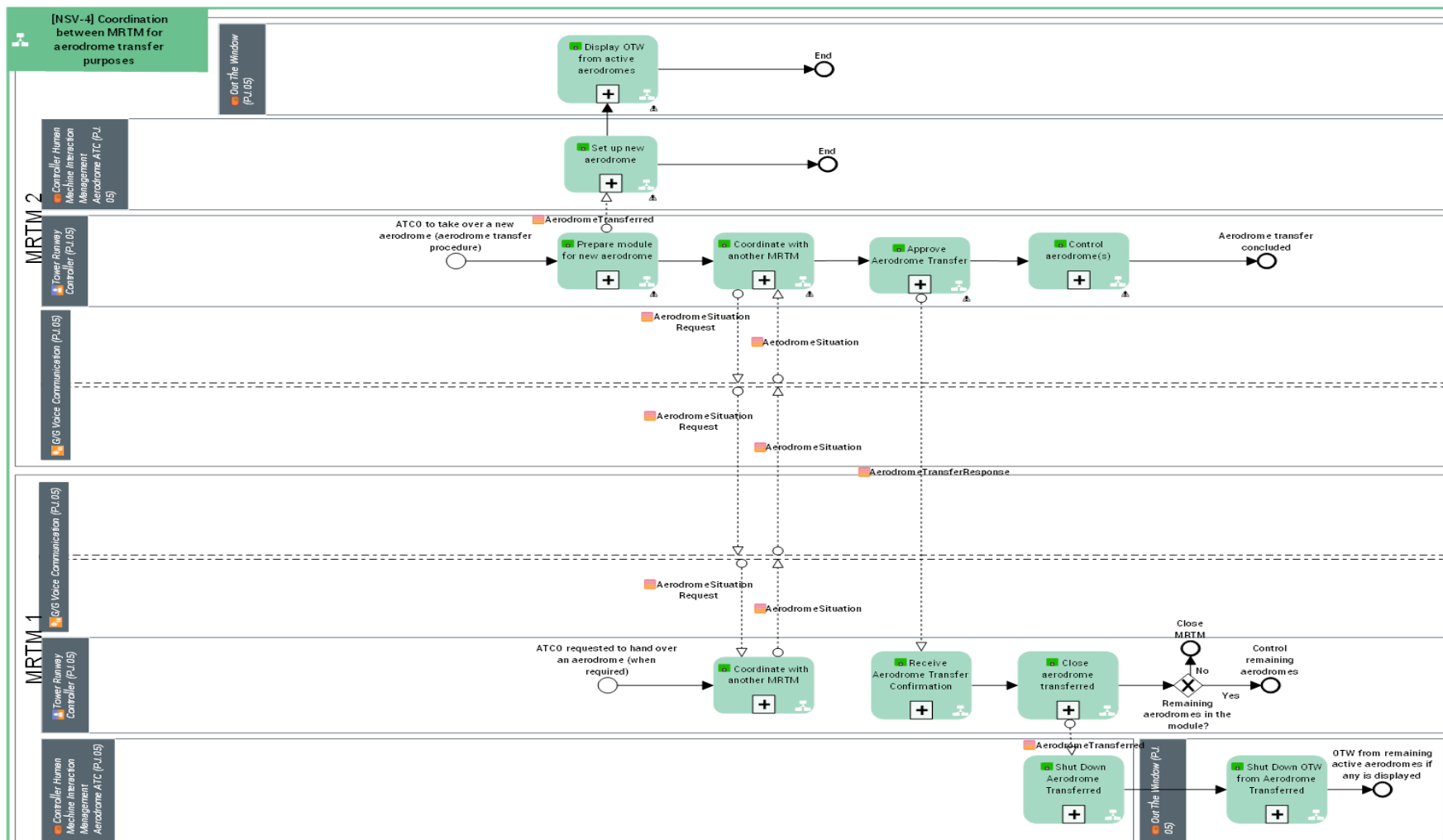
Figure 9: [NSV-4] Coordination between MRTM for aerodrome transfer purposes

PJ.05 Solution 02 focuses mainly on Multiple Remote Tower Modules (MRTM). The central elements are the CHMIM, the OTW, and Remote Aerodromes Management planning tool focused.

A remote tower specific part is the *OTW* View component. It provides MRTMs controllers with a clear view of the real traffic situation and with all the necessary traffic data concerning a Remote Tower of another Aerodrome ATC system, in order to assist them in their control tasks. It can also help the controllers to identify targets in Low Visibility with the support of the Aerodrome Surveillance Data. These data are the result of merging the surveillance video and data information provided by the different surveillance sources providing a unique picture of the actual traffic situation.

The *CHMIM* provides controllers with a graphical user interface and with the means to interact with the Aerodrome ATC systems. It receives necessary data for display, such as alerts from the detection systems, the Flight Plans, the short-term planning from the planning tool, the nowcast and forecast MET information and the systems status.

The *Technical Supervision* is in charge of the technical supervision of an Aerodrome ATC system and will receive heartbeats of every system from both the local tower and the MRTM. The Technical Supervision encompasses the following functions:

- Presenting technical and functional systems status: monitor system availability. Acquire, synthesize and display technical and functional status on all the system hardware/software resources.

- Providing failure detection and analysis assistance: generate alarm or warning on failure detection. Provide support for analysis supervision data (enable queries on historic of events).

- Providing supervision commands and actions.

Support functions will synchronize the CHMIM data and perform the recording of the system data, and, buffering those data on a persistent database. It also provides support for safety aspects.

The *Multiple Remote Aerodrome Management* will send to the CHMIM information about the upcoming traffic and weather situation at the aerodromes under control.

4.1.3 Functional Block Descriptions

4.1.3.1 OTW (Out The Window)

The OTW (Out The Window) functional block allows to ATCOs to have an opportune representation of what is seen out the window in one or more conventional tower(s) in normal operation, in order to support the ATCO in the air traffic management. The OTW functionality provides to the Tower Controllers with a clear view of what usually ATCO can see out the airport tower window and view of all the necessary traffic, via a Visual Presentation, (such as aircraft and vehicle localization, etc.) concerning a Remote Tower of Aerodrome ATC system, in order to assist them in their control tasks.

OTW may also help the ATCO to identify targets in low visibility, with the support of the Aerodrome Surveillance Data. These data are the result of merging the surveillance information provided by the different surveillance sources providing a unique picture of the actual traffic situation.

Inside the OTW (Out The Window) functional block, different functions, that will be better explained in the next paragraphs, are included:

- Visual presentation

- PTZ cameras

- Additional views, e.g. IR cameras;

- Tracking function

4.1.3.1.1 Visual Presentation

In the Remote Tower, together with the CWP, an opportune OTW display function will allow to the ATCOs to have a view of the airport and its vicinity that will support them in the air traffic management.

The remote aerodrome captured data (e.g. Video) is sent to the Multiple Remote Tower Module. The OTW Functional Block within the MRTM system displays on the Visual Presentation the data in order to let the ATCO to see the actual view of the multiple control towers.

4.1.3.1.2 Pan-Tilt-Zoom (PTZ) Cameras

In the Remote tower field, the system makes a large use of cameras that collect and send to the MRTM images of the airport in order to provide to the remote ATCOs the possibility to have the same view as conventional ATCOs. Moreover, the remote tower environment shall have PTZ (Pan Tilt Zoom) cameras that the ATCO can remotely manage in order to focus the image on a specific area of the airport with the correct zoom. Thanks to the use of PTZ cameras additional functionalities could be incorporated in the system, such as, automatic tracking, anomalies detection, etc.

For a multi remote tower scenario all control functions for dedicated resources (e.g. PTZ control or camera settings) have to be managed in a way that conflicting situations are avoided, such as the interference of vehicles in the aircraft movement.

4.1.3.1.3 Additional View

In addition to the cameras, conventional or PTZ, the remote tower system can be equipped with additional sensors able to support the ATCOs, for example in case of low visibility or during the night hours. The additional sensors usually are placed in the aerodrome in order to support the viewing of critical and obscure areas where the visibility is avoided or reduced.

The system can be supported by Infra-Red (IR) cameras, or by A-SMGCS, or by laser system that provide additional information on the position of the aircraft and/or vehicle on the runway.

4.1.3.1.4 Tracking

This component performs automatic object tracking functions based on the managed video streams. Output of this component is position information of the identified object or marking of the identified object in the video stream. The tracking can be made exploiting only the video data or exploiting a combination of the position information coming from different sensors.

Data fusion combines different inputs from surveillance sensors and generates an aggregated system track for a dedicated object.

The data fusion could take data both from the conventional surveillance sensors (like radars, Mode S, A-SMGCS, etc.) and sensors dedicated to the remote tower purpose (like cameras, IR, etc.) and will provide to the remote ATCO a common picture, for normal and Low visibility, in a OTW dedicated or separate display.

4.1.3.1.5 Moving cameras, Anomaly Detection

Thanks to the use of cameras, tracking, data fusion, radar, A-SMGCS etc., anomaly detection function could provide alert to the ATCO and to AFISO (aerodrome flight information service officer) in case of detection of anomaly in airport area.

4.1.3.2 Controller Human Machine Interaction Management (CHMIM)

The CHMIM Functional Block provides ATCOs with a graphical user interface and with the means to interact with ATC of several aerodromes (2 -3) in parallel. The main responsibility is to provide most relevant information concerning the domains communication, support information flight data handling and provide a friendly user interface to the ATCO. Most important is that all information is organized in a way to provide an efficient and safe working environment and additional functions support the controller keeping situation awareness at multiple airports.

In addition to the information that usually the ATCO needs for the ATC, in the remote tower environment the CHMIM shall provide further information related to the environment, such as video from external cameras, real-time weather information, etc.

4.1.3.2.1 Airport Connection HMI

This function allows to the ATCO through an opportune HMI, instruction for management of the airport and to monitor the state of the airport.

4.1.3.3 Multiple Remote Aerodromes Management

The Multiple Remote Aerodromes Management (MRAM) functional block allows to ATCO / RTC Supervisor to have an opportune planning. The MRAM functionality provides both the ATCO and the RTC Supervisor a clearer view of what is to come, taking into account data as FPs and MET info from the aerodromes under control, to make them aware of future situations and to act and organize in advance.

Two main functions are included in this FB, one for short-term planning and one for mid/long-term planning. This solution is focused on the short-term planning one.

The ATCO will be supported by a short-term planning tool that should display in the MRTM's HMI information about the upcoming traffic situation at the airports under control to make him aware of parallel traffic activities at different airports.

4.1.3.4 Support Functions

In context of a video based remote tower supporting functions will be extended by recording of video streams and additional audio feed (from the airport environment).

The Support functions do not affect directly the provision of ATM Services at operational time. They contain at least the following:

- Recording - performing the recording of the ATM System data related to the Aerodrome ATC, and storing those data on a persistent database.

In addition, Support functions can optionally also contain one or more of the following:

- Playback - providing support for display and voice recording, display and voice playback, other data recording reproduction, etc.

- Data analysis - providing support for maintenance, investigation etc.

The data distribution system will collect data from the sensors located in the remote airport and, after opportune processing and compressions, distribute them, by datalink, in the Remote Tower Centre where the information will be opportunely displayed in the HMI systems.

The Video Stream Management component includes handling of video data from several local cameras and transferring this data to the remote tower centre. It includes bandwidth management and compression, monitoring of delay times, frame rate and access control

4.1.3.4.1 Recording

The recording function allows to collect and store all the data (ATC data, cameras, audio, IR, etc.) used for the monitoring.

4.1.3.5 Technical Supervision

This functional block is in charge of the technical supervision of an Aerodrome ATC system (e.g. monitoring the services provided by the system, starting, stopping or re-starting the system or part of it).

The Technical Supervision encompasses the following functions:

- Presenting technical and functional systems status: monitor system availability. Acquire, synthesize and display technical and functional status on all the system hardware/software resources.

- Providing failure detection and analysis assistance: generate alarm or warning on failure detection. Provide support for analysis of supervision data (enable queries on historic of events).

- Providing supervision commands and actions: accept supervision commands/actions (e.g. (Re) start/stop/stand-by/reset/switch-over) from eligible operators and give the capability to perform maintenance activities.

In context of the remote tower the technical supervision is deployed in a distributed environment and has to cover equipment hosted at the airport and the remote tower centre.

4.1.3.6 A/G Voice Communication

This functional block provides, as main function, the functions performed by a Radio VCS

In the remote tower operation scenario, the air ground communication is not directly interconnected to the local radio. The remote located remote tower centre needs a dedicated connection to the local radio to access air ground communication. Therefore, additional infrastructure and an access gateway for the radio will be required.

Especially for a backup or emergency radio system a dedicated backup connection between the local tower and the remote tower centre will be required. Standard fall back solution such as handheld radios used directly in the tower is not applicable for the remote tower scenario.

In a multi remote tower scenario the VCS system has to combine and handle all frequencies of the related airports. Based on a role concept an assigned function of frequencies or coupling of frequencies has to be provided to an ATCO.

4.1.3.6.1 Aeronautical mobile service

The aeronautical mobile service allows the ATCO to enter in contact directly with the pilot in the aircraft, as for the conventional ATCOs. An opportune data link for the air-ground communication has to be considered.

4.1.3.6.2 SLG

In the case of a radio failure or aircraft not equipped with a radio, or in the case of a deaf pilot, air traffic control may use a signal lamp to direct the aircraft. The signal lamp or Signal Light Gun (SLG) has a focused bright beam and is capable of emitting three different colours: red, white and green. The remote ATCO, in this case, needs a connection with SLG that have to be remotely controlled.

4.1.3.7 G/G Voice Communication

This functional block provides the function that allows to the ATCO using the communication infrastructure to connect the remote ATCO with the remote airports, in particular aeronautical services and the surface vehicles.

This connection can be performed exploiting traditional voice system or innovative Ground Datalink.

4.1.3.8 Other functions

The functions described in this section are the same functions used in the conventional airport management and can be used just as in a traditional tower. Therefore a detailed description of these functions is not included in this deliverable, because they are not changed for usage in a remote tower.

4.1.3.8.1 Outdoor sound

The airport sound reproduction functional block provides to the ATCOs the possibility to increase the awareness of the airport status also exploiting the reproduction of the sound in the remote airport. In the conventional airport the ATCO is inside the airport environment and can exploit all the senses to make the situation awareness, in the case of the remote tower, specific instrument (like microphone) have to collect the sounds in the airport and send them to the MRTM.

4.1.3.8.2 Aerodrome Weather Information Management

This function block provides to the ATCO the access to the meteorological information that he/she needs to understand the status of the weather in the remote airport. All the meteorological information have to be provide continuously and in the real time in order to allow to the ATCO to take into account this information to manage the air traffic.

4.1.3.8.3 Function for control of airport systems (visual and non-visual)

The functions conventionally used for the control of the airport system, such as navigational aids, ground lighting, etc., could be used also for the remote airports. The main difference among the conventional and the remote airport is that in the conventional airport the control system are locally controlled while in the remote airport we needs external system that have to manage the control systems (navigational aids, ground lighting, etc.)

4.1.3.8.4 Functions for receiving radar data and ATS messages

A function that manage the connection among the system that collects ATM data (primary and secondary radar, a-SMGC, etc.) should be foreseen in order to allow to the ATCO to have the view of the position of the different vehicles on the airport.

4.1.3.8.5 Aerodrome Flight Data Processing

In order to manage the airport resources (especially runways and parking bays), the ATCO should have access to the flight plan data.

4.1.4 Infrastructure connectivity model

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

This Supporting Infrastructure is the set of:

- Capability Configurations:
    - o TWR (Step 2)

- o Aircraft

- o Airport

- Main Technical Systems:

  - o Aerodrome ATC

  - o Voice

  - o Vehicle

- System Ports:

  - o ATC_Voice

  - o Transport Secured-Web Services

  - o SUR_VIDEO_GND

  - o VIDEO_STATUS_GND
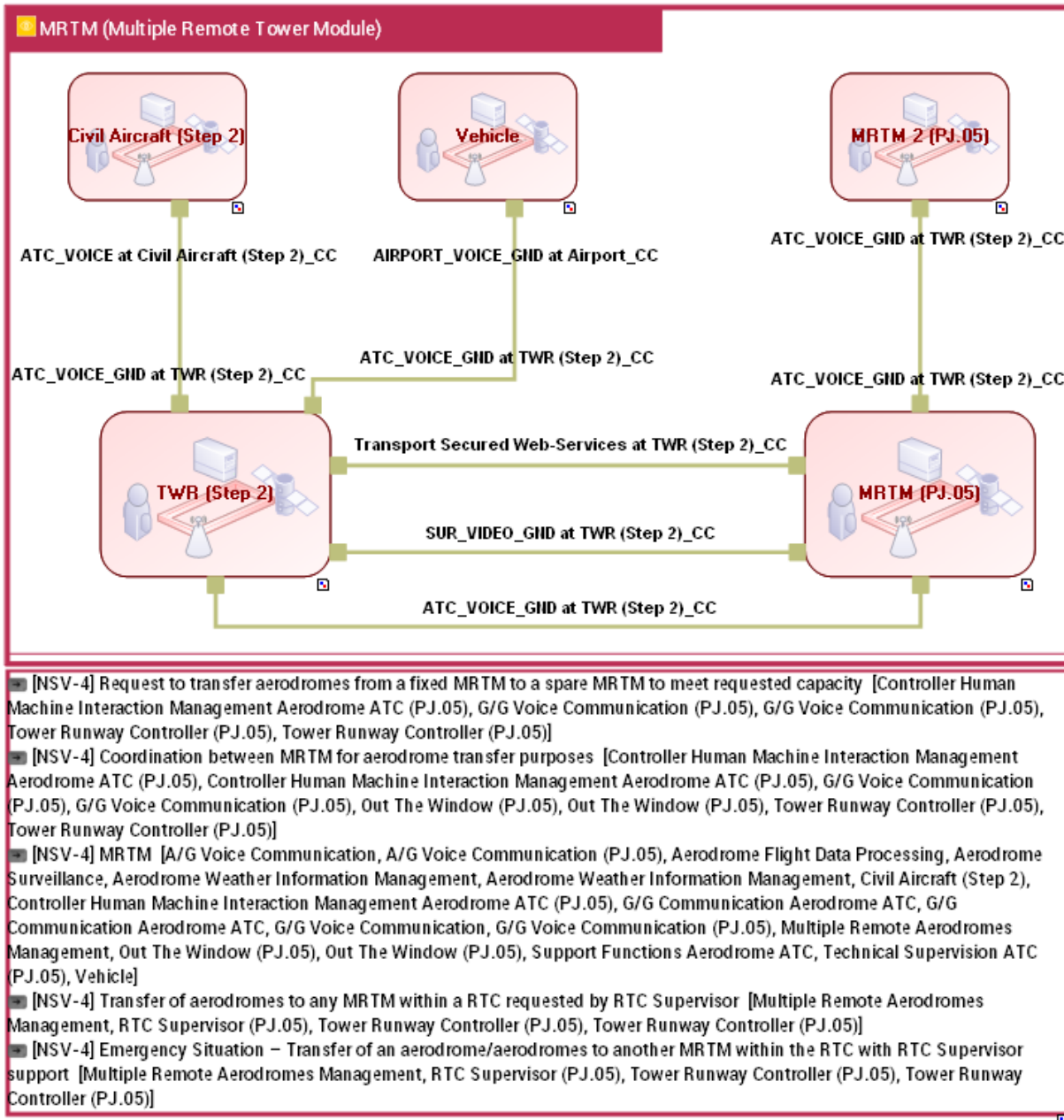
Figure 10. Infrastructure Connectivity Model NSV-2 for PJ.05 Solutions 02 and 03

4.1.5 Service view

A Service called AerodromeTransfer has been created within PJ.05 framework. However, this service has not been validated.

4.1.5.1 Service description

AerodromeTransfer

This service allows the aerodrome transfer procedure between MRTMs within the same Remote Tower Centre.

When needed, an ATCO in a MRTM can make a request to transfer one of the active aerodromes in the MRTM to another ATCO in a different MRTM. ATCOs can as well receive an aerodrome transfer request from the RTC Supervisor if he or she deems it necessary.

The Service consists of the aerodrome transfer request and response, and the coordination that is done in the meantime between both the ATCO that is transferring the aerodrome and the one that is taking over it.

For the moment, these operations are planned to be done via Voice between controllers. This could be a reason for not creating a Service ad-hoc for this matter. It could not be required or perhaps a Resource Interaction could be sufficient for it.

However, at some time, the infrastructure and physical architecture for these data exchanges can change, as new communication channels can be used. That in mind, it has been decided to create the logical architecture for the Service.

Thus, the operations that are proper of this Service are:

- Aerodrome transfer request; ATCO that is intended to take over an aerodrome is provided with the aerodrome in question and the transfer request.

- Coordination for aerodrome transfer; Both ATCOs involved in the transfer procedure exchange data about the aerodrome situation, traffic picture, short-term events and any other information that could be needed for taking over an aerodrome with full awareness of the situation.

- Aerodrome transfer response; the ATCO that is intended to take over the aerodrome accepts the transfer once he or she is fully aware of the situation and confident to proceed.

Service	Service description
AerodromeTransfer	A service allowing the aerodrome transfer procedure between Multiple Remote Tower Modules within the same Remote Tower Centre

Table 11: Services Description for Services created by PJ.05

Besides, some Services are used as well by the Solution. It should be noted that none of these Services have been validated in the Solution.

Service	Service description
METAR	A service providing the METAR bulletin according to ICAO Annex 3 requirements
TAF	A service providing the TAF bullettin according to ICAO Annex 3

	requirements

Table 12: Service Description for Services used by PJ.05

4.1.5.2 Service Provisioning

Interaction	Consumer CC	Consumer System	Provider CC	Provider System
AerodromeTransfer	MRTM	Aerodrome ATC;	MRTM	Aerodrome ATC;
TAF	MRTM	Aerodrome ATC;	Local TWR	Aerodrome ATC;
METAR	MRTM	Aerodrome ATC;	Local TWR	Aerodrome ATC;
Controller Pilot ATC exchange(Voice)	Civil Aircraft (Step 2)	Aircraft;	Local TWR	Voice;
OTW Tower Data	MRTM	Aerodrome ATC;	Local TWR	Aerodrome ATC;
Coordination (Voice)	Vehicle	Airport Operations Centre;	Local TWR	Voice;
Pilot - Controller ATC Communication	MRTM	Voice;	Local TWR	Voice;

Table 13: Service Provisioning

4.1.5.3 Service Realization

This section describes the technology use to realise the Services.

- System Ports:

    o ATC_Voice

    o Transport Secured-Web Services

    o SUR_VIDEO_GND

    o VIDEO_STATUS_GND

4.2 Functional and non-Functional Requirements

4.2.1 Multiple Remote Tower Module (MRTM)

4.2.1.1 Communications

4.2.1.1.1 Voice Communication System (VCS)

[REQ]

Identifier	REQ-05.00-TS-CO03.0001
Title	"Listen to all" functionality

Requirement	The VCS of the MRTM should be able to receive aeronautical mobile services (air-ground communications) communication channels for all aerodromes being served to the ATCO.
Status	<Validated>
Rationale	When ATS is performed to more than one aerodrome simultaneously from one MRTM, the ATCO shall listen to all aeronautical mobile service (air-ground communications) communication channels for all aerodromes being served. Note: If a separate ground controller position is introduced, a separate communication channel for the control of traffic operating on the manoeuvring area would be needed for each aerodrome served by a ground controller.
Category	<Functional> <IRS>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-CO03.0003
<SATISFIES>	<Enabler>	CTE-C14
<ALLOCATED_TO>	<Functional block>	A/G Voice Communication
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-CO03.0002
Title	"Transmit to all/individual" functionality
Requirement	The VCS of the MRTM should enable the ATCO to transmit aeronautical mobile services (air-ground communications) either to "all aerodromes" being served or to an "individual aerodrome" when ATS is performed to

	more than one aerodrome simultaneously.
Status	<Validated>
Rationale	When ATS is performed to more than one aerodrome simultaneously from one MRTM, the ATCO shall for the aeronautical mobile service (air-ground communications), be able to transmit either to "all aerodromes" being served or to an "individual aerodrome".
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-CO03.0003
<SATISFIES>	<Enabler>	CTE-C14
<ALLOCATED_TO>	<Functional block>	A/G Voice communication
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-CO03.0003
Title	"Relay/retransmit between all aerodromes" functionality
Requirement	The VCS of the MRTM should enable retransmission and relay of aeronautical mobile service (air-ground communications) between all aerodromes being served from the MRTM.
Status	<Validated>
Rationale	When ATS is performed to more than one aerodrome simultaneously from one MRTM, aeronautical mobile service (air-ground communications) should be retransmitted / relayed between all aerodromes being served

	from the MRTM.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-CO03.0003
<SATISFIES>	<Enabler>	CTE-C14
<ALLOCATED_TO>	<Functional block>	A/G Voice communication
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-CO03.0004
Title	MRTM Aerodromes Communication
Requirement	The VCS of the MRTM shall be capable to cover communications with all units relevant to the aerodromes allocated into the MRTM
Status	<Validated>
Rationale	Each MRTM has the necessity to have all the information of the aerodromes the ATCO has under control
Category	<Functional> <Safety> <Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03

Relationship	Linked Element Type	Identifier
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-CO03.0004
<SATISFIES>	<Enabler>	CTE-C14
<ALLOCATED_TO>	<Functional block>	A/G Voice Communication
<ALLOCATED_TO>	<Functional block>	G/G Voice Communication
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-CO03.0005
Title	Surface movement listen to all functionality
Requirement	The VCS of the MRTM should enable the ATCO to listen to all surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes) communication channels for all aerodromes being served.
Status	<Validated>
Rationale	When ATS is performed to more than one aerodrome simultaneously from one MRTM, the ATCO shall be able to listen to all surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes) communication channels for all aerodromes being served.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-CO03.0006
<SATISFIES>	<Enabler>	CTE-C14

<ALLOCATED_TO>	<Functional block>	G/G Voice Communication
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-CO03.0006
Title	Surface Transmit to individual functionality
Requirement	The VCS of the MRTM should be able to transmit to individual aerodromes to provide access to surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes)
Status	<Validated>
Rationale	ICAO Annex 11, Chapter 6.3
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-CO03.0006
<SATISFIES>	<Enabler>	CTE-C14
<ALLOCATED_TO>	<Functional block>	G/G Voice Communication
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-CO03.0007
Title	Surface Movement Control Service, "push buttons symmetry in Multiple"
Requirement	The transmit push buttons for the ground frequencies (surface movement control service) shall be integrated in the CWP in a way that they are easily distinguishable between airports (e.g. if airports are represented side by side the push buttons shall be respectively located on each side).
Status	<Validated>
Rationale	With a multiple remote tower display, symmetry is considered a strong supporting barrier in helping ATCOs distinguish the input/ output devices per each aerodrome. This REQ originates from REQ.05.00_HPdesign_10 of the [HPAR].
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-CO03.0007
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	Out The Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

4.2.1.2 Visualization

4.2.1.2.1 General

[REQ]

Identifier	REQ-05.00-TS-VS02.0006
Title	Possibility to scan/view all parts of the CTR
Requirement	The MRTM shall provide parts of the CTR not presented by default to be available through pan or binocular functionality. If the VP enables a possibility turn/pan the view, then a feature that would allow the view to return to a "fixed" position should be available.
Status	<Validated>
Rationale	This would allow the ATCOs to access the remaining part of the CTR which is not covered by the standard Visual Presentation (for weather observations, specific traffic situations etc.). This REQ originates from REQ.05.00 HPdesign_22 and HPdesign_16of the [HPAR].
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-VS02.0008
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Out the Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

4.2.1.2.2 Augmentation

[REQ]

Identifier	REQ-05.00-TS-VG01.0002
Title	Visual presentation additional information
Requirement	The MRTM should overlay the visual presentation with additional (digital) information to provide the ATCO a greater level of situational awareness and minimise head down time.
Status	<Validated>
Rationale	The aim with this requirement is to present additional information directly in the visual presentation (compare with head up displays in aircrafts) in order to minimise ATCO head down time.
Category	<Functional> <HMI>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-VG01.0002
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Out the Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-VG01.0004
Title	Visual presentation overlaid information 2
Requirement	Tracked targets should be presented as overlaid information within the visual presentation.

Status	<Validated>
Rationale	Tracked targets need to be displayed for the controllers to increase situational awareness
Category	<Functional><HMI>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-VG01.0004
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	Out the Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-VG01.0005
Title	Visual presentation overlaid information 1
Requirement	The visual presentation should include overlaid information to indicate / high light specific parts of the aerodrome or responsibility areas.
Status	<Validated>
Rationale	This requirement primarily targets framings around runways, taxiways, aprons etc., in order to enhance the ATCO situational awareness. The exact configuration of these features is to be determined in the scope of local implementations. Requirement likely to be more important in a Multiple Aerodrome application environment or in a high traffic density environment.

Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	Q-05.02-SPRINTEROP-VG01.0005
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	Out the Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-VG01.0006
Title	Visual presentation overlaid information 3
Requirement	The visual presentation should include overlaid information such as meteo or UTC time to the controller corresponding to the area of responsibility or area of interest.
Status	<Validated>
Rationale	This requirement is primarily targeting geographic, meteorological and operational and service status and handover information. Instances of element classes include: - Geographic: cardinal / compass directions - Meteorological: current wind and RVR values, met report, METAR; TAF - Operational and service: runway/taxiway/apron designators, aerodrome systems status such as lighting, clock, checklists, maps - Visual reminders such as "RWY blocked" markings to aid with runway incursion prevention.

	Requirement likely to be more important in a Multiple Aerodrome application environment or in a high traffic density environment.
Category	<Metadata>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-VG01.0006
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Out the Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-VG01.0007
Title	Enable/Disable overlaid presentation
Requirement	The visual presentation shall provide a possibility for the ATCO to toggle on/off the overlay information as well as adjust in light intensity.
Status	<Validated>
Rationale	All information presented in the MRTM must be able to be switched on and off according to controller needs.
Category	<Functional><HMI>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-VG01.0007
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Out the Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-VG01.0008
Title	Overlay HF design principles.
Requirement	The overlay options shall be embedded on the visual presentation using HF design principles.
Status	<Validated>
Rationale	The overlay options shall be embedded ensuring an appropriate location of the information, no clutter on the screens, harmonised displays between the aerodromes etc.
Category	<Functional><HMI>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-VG01.0009
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	Out the Window

<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

4.2.1.2.3 Binocular Functionality

[REQ]

Identifier	REQ-05.00-TS-BF01.0001
Title	MRTM Binocular functionality 1
Requirement	The visual reproduction shall provide functionality corresponding to the binoculars in a local Tower (including a moveable zoom feature with a visual indication of the direction of boresight).
Status	<Validated>
Rationale	Functionality corresponding to the binoculars in a local tower, including moveable zoom feature with a visual indication of the direction of sight
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-BF01.0001
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Out The Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A

| <ALLOCATED_TO> | <Service> | N/A |

4.2.1.3 Other ATS System/Functions

[REQ]

Identifier	REQ-05.00-TS-FN01.0001
Title	MRTM surveillance data
Requirement	The MRTM should allow the ATCO to access surveillance data such as radar presentation, when available, from the active Remote Airport(s).
Status	<Validated>
Rationale	ICAO Doc 4444, Chapter 7.1.1.2
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-FN01.0001
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Aerodrome Surveillance
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-FN02.0001

Title	Electronic Flight strips integration
Requirement	The MRTM should provide an integrated presentation of the electronic flight strips for all controlled aerodromes.
Status	<Validated>
Rationale	ICAO Doc 4444 Chapter 4.13 E-strip is a supportive tool in the Multiple environment. Validated in SESAR1 REQ-06.09.03-OSED-FN03.3001
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-FN02.0001
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Out the Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-FN03.0001
Title	Aircraft and vehicle runway conformance monitoring
Requirement	The MRTM should include an automated ATIS for all controlled aerodromes to reduce the ATCO workload.
Status	<Validated>

Rationale	ATIS would support and reduce workload in a Multiple environment.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-FN03.0001
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	Conformance Monitoring
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

4.2.1.4 Technical Supervision

[REQ]

Identifier	REQ-05.00-TS-TS01.0002
Title	Alarms and alerts – HF design principles
Requirement	The provided alarms and alerts provided by the MRTM shall be developed in line with HF design principles.
Status	<Validated>
Rationale	To ensure appropriate visibility and user friendliness, without confusions.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-TS01.0002
<SATISFIES>	<Enabler>	AERODROME-ATC-82
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Technical Supervision ATC
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-TS01.0003
Title	Alarms and alerts in Multiple
Requirement	The same type of alarms and alerts used shall be available on all aerodromes clustered for multiple remote tower operations.
Status	<Validated>
Rationale	The symmetry of information between the aerodromes would help the ATCO easily identify the relevant information.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-TS01.0003
<SATISFIES>	<Enabler>	AERODROME-ATC-82
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Technical Supervision ATC

<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

4.2.1.5 ATCO Planning Tool

[REQ]

Identifier	REQ-05.00-TS-AP01.0001
Title	Aerodromes Traffic Information
Requirement	The MRTM shall display to the controller information about the upcoming traffic situation at the airports under control to make him aware of parallel traffic activities at different airports
Status	<Validated>
Rationale	This will help the ATCO to adjust and plan traffic to any constraints
Category	<Functional>,<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-AP01.0001
<SATISFIES>	<Enabler>	AERODROME-ATC-81
<ALLOCATED_TO>	<Functional block>	Multiple Remote Aerodromes Management
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.00-TS-AP01.0002
Title	ATCO Planning tool
Requirement	The MRTM should display a planning tool with the expected traffic. The tools shall display information relevant for tactical short term prioritising tasks (e.g. providing landing clearance or taxi clearance)
Status	<Validated>
Rationale	This will help the ATCO in prioritising tasks
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-AP01.0001
<SATISFIES>	<Enabler>	AERODROME-ATC-81
<ALLOCATED_TO>	<Functional block>	Multiple Remote Aerodromes Management
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

4.2.1.6 Automation Functionalities

[REQ]

Identifier	REQ-05.00-TS-AF01.0001
Title	Aerodrome on Frequency Identification
Requirement	The MRTM should allow the identification of the aerodrome and aircraft that is on frequency in each moment
Status	<Validated>

Rationale	This identification will help the ATCO to easily identify which aircraft in which aerodrome is under his/her control
Category	<Functional>,<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.03
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-AF01.0001
<SATISFIES>	<Enabler>	AERODROME-ATC-85
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	Function Identifier
<ALLOCATED_TO>	<Service>	Service Identifier
<ALLOCATED_TO>	<Information exchange>	Information Exchange Identifier
<ALLOCATED_TO>	<Data>	Data Identifier
<ALLOCATED_TO>	<System Port>	System Port Identifier

4.2.2 Transfer/Merging

4.2.2.1 Static

[REQ]

Identifier	REQ-05.02-TS-TM02.0001
Title	Aerodrome Transfer 1
Requirement	The MRTM shall be able to transfer aerodrome data and video to another MRTM
Status	<Validated>
Rationale	In case of overload or an RTC supervisor decision, a controlled aerodrome can be transferred from one MRTM to another.
Category	<Functional>,<Safety>,<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-TM02.0001
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Out the Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.02-TS-TM02.0002
Title	Aerodrome Transfer 2
Requirement	An MRTM shall be able to receive aerodrome data and video from another MRTM
Status	<Validated>
Rationale	In case of overload or an RTC supervisor decision, a controlled aerodrome can be transferred from one MRTM to another.
Category	<Functional> <Safety> <Data> <IRS>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<ATMS Requirement>	REQ-05.00-SPRINTEROP-TM02.0002
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC

<ALLOCATED_TO>	<Functional block>	Out the Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

[REQ]

Identifier	REQ-05.02-TS-TM02.0003
Title	Aerodromes Replicas
Requirement	When a split is done, aerodromes data replicas shall be displayed in both MRTMs until the transfer is completely done.
Status	<Validated>
Rationale	When a transfer is going to be done, the ATCO receiving the control of the aerodrome needs to ensure if he/she can safely take it. For this purpose, both ATCOs need to have the aerodrome data until the transition is done.
Category	<Functional> <Safety> <Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.05.02
<SATISFIES>	<ATMS Requirement>	REQ-05.02-SPRINTEROP-TM02.0004
<SATISFIES>	<Enabler>	AERODROME-ATC-79
<ALLOCATED_TO>	<Functional block>	CHMIM Aerodrome ATC
<ALLOCATED_TO>	<Functional block>	Out The Window
<ALLOCATED_TO>	<Role>	Tower Runway Controller
<ALLOCATED_TO>	<Function>	N/A
<ALLOCATED_TO>	<Service>	N/A

5 Implementation Options

In this edition there are not different available options identified that can be chosen when implementing the solution.

6 Assumptions

There is in this edition one assumption made that have an impact on the technical specification:

1. It has been assumed by the project that all requirements referred to cameras and technical installation defined, verified and validated in SESAR1 are valid for PJ05 project. It should be noted that Solution 02 is more focused on addressing the capability of the ATCO to manage three airports simultaneously through Real Time Simulations more than in the technology solution.

7 References and Applicable Documents

7.1 Applicable Documents

This TS complies with the requirements set out in the following documents:

Content Integration

[1] B.04.01 D138 EATMA Guidance Material

[2] EATMA Community pages

[3] SESAR ATM Lexicon

Content Development

[4] B4.2 D106 Transition Concept of Operations SESAR 2020

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] B.04.01 D108 SESAR 2020 Transition Performance Framework

[13] B.04.01 D42 SESAR2020 Transition Validation

[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

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[30]16.06.05 D 27 HP Reference Material D27

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

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7.2 Reference Documents

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[38]   SESAR Solution PJ05 SPR-INTEROP/OSED for V2 - Part I ver 00.01.03

[39]   SESAR Solution PJ.05-02: Validation Plan (VALP) for V2 - Part I ver [00.01.00]

[40]   SESAR Solution PJ.05.02 Validation Report (VALR) for V2 - Part I ver 00.01.01

[41]   SESAR 1 12.04.07.D09 – Technical Specifications, 01.00.00, 07/03/2016

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