



# SESAR Solution PJ05.02 SPR-INTEROP/OSED for V3 - Part I

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# Multiple Remote Tower

## MULTIPLE REMOTE TOWER

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### Abstract

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The Remote Tower concept is changing the provision of Air Traffic Services (ATS) in a way that it is more service tailored, dynamically positioned and available when and where needed, enabled by digital solutions replacing the physical presence of controllers and control towers at aerodromes.

Remotely Provided Air Traffic Service for Multiple Aerodromes and development of the Remote Tower Centre are part of this development which started with Single Remote Towers.

This document is the Operational Services and Environment Description (OSED), SPR and INTEROP relating to the PJ.05.02 part of the Multiple Remote Tower development of SESAR. It also takes the role of a Safety and Performance Requirements Document (SPR) for PJ.0502.

The main driver for the Multiple Remote Tower concept development (PJ.05) in SESAR is increased cost efficiency, which cannot directly be validated in the exercises. Key element for validity of Remote Towers is safety which is highly influenced by the Human Machine Interface wherefore human performance will be a key element to measure.

The OI steps that are addressed are:

#### PJ.05.02 (this OSED)

- **SDM-0207: Multiple Remote Tower Module, MRTM (for up to 3 airports)**

#### PJ.05.03 (another OSED)

- SDM-0210: Highly Flexible Allocation of Aerodromes to Remote Tower Modules.

The SPR/INTEROP-OSED Template includes the following parts:

- **SPR/INTEROP-OSED Template – Part I (this volume)**
- SPR/INTEROP-OSED Template – Part II Safety Assessment Report (SAR)
- SPR/INTEROP – OSED Template – Part III Security Assessment Report (SeAR)

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- SPR/INTEROP – OSED Template – Part IV Human Performance Assessment Report (HPAR)
- SPR/INTEROP – OSED Template – Part V Performance Assessment Report (PAR)

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# 1 Executive Summary

This document is the OSED (Operational Services and Environment Description), SPR and INTEROP relating to the Multiple Remote Towers development of the SESAR operational concept for the operational solution 2 to a V3 maturity level. Both solution PJ.05.02 and PJ.05.03 are presented within this Executive Summary for consistency of both solutions and to provide an overview.

The objective of PJ05.02 is to enlarge the scope of the multiple remote tower solutions addressing higher traffic volumes including a new range of airports that are simultaneously controlled by one ATCO in order to further increase cost efficiency. The validations were focused on evaluation of human performance and safety aspects. PJ05 addresses this in the following two solutions:

- Solution PJ.05-02  
Multiple Remote Tower Module
- Solution PJ.05-03  
RTC with Flexible Allocation of Aerodromes to MRTMs

The two solutions describe the sequential steps for enlarging the scope of multiple remote tower services. Solution PJ.05-02 addresses the next implementation step aiming for V3 maturity level at the end of wave 1. This is complemented by more advanced features in solution PJ.05-03 aiming for V2 maturity level at the end of wave 1 (and V3 level to be reached at the end of wave 2).

The following table provides an overview on the main characteristics of the two solutions:

	Solution PJ.05-02	Solution PJ.05-03
<b>Number of Airports controlled by one ATCO</b>	Two small airports (corresponding to the PJ.20 Operation environment description for a ‘Small Airport Operating Environment’) or three other airports (corresponding to the PJ.20 Operation environment description for an ‘Other Airport Operating Environment’)	Three small airports (corresponding to the PJ.20 Operation environment description for a ‘Small Airport Operating Environment’)
<b>Traffic volumes</b>	Up to 20 movements/hour in total for all airports (up to ~10 movements/hour per airport) or up to 15 movements/hour in total (up to ~5 movements/hour per airport) respectively.	Up to 25 movements/hour in total for all airports
<b>Allocation of Airports to MRTMs</b>	Static allocation of airports to dedicated MRTM(s)	Dynamic allocation of airports to any MRTM in the RTC

<b>Planning tool for ATCO</b>	ATCO is supported by a planning tool to present traffic and tasks further ahead for the aerodromes (up to three) the ATCO has control of.	ATCO is supported by a planning tool to present traffic and tasks further ahead for the aerodromes (up to three) the ATCO has control of.
<b>Planning Tool for Supervisor</b>	-	Supervisor is supported in dynamic allocation of all related airports to the MRTMs in order to balance ATCO workload and traffic volumes

**Table 1: Main characteristics for solution 2 and 3**

Both solutions have validated the concept for different kinds of environments that may be composed of:

- different level of airport complexity (RWY’s, taxiways, etc.),
- traffic volumes and their distribution over the controlled aerodromes
- various conditions at the different aerodromes (weather, daylight, geographical difference)
- variable traffic mix (VFR- IFR-mix, rotor-fixed wing, special, RPAS),
- different technology regarding surveillance (e.g. Radar, ADS-B)

Technical aspects, such as network quality of service, SWIM infrastructure and other resilience/redundancy related issues that are of key importance to the regulatory authorities need to be addressed.

Furthermore, the information needs for maintaining situational awareness including the local actual and forecasted weather (MET) and the local actual and forecasted status of the infrastructure (AIM) will need to be addressed from various operational perspectives.

Training and endorsement aspects will be considered in order to be prepared for the deployment phase.

## 2 Introduction

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### 2.1 Purpose of the document

This document provides the requirements specification, covering functional, non-functional and interface requirements related to SESAR Solution PJ05-02, Multiple Remote Tower research on V3 level. Similarities and differences between PJ.05.02 and PJ.05.03 are sometimes described in sub-chapters or tables through this document for consistency between the solutions.

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 SPR-INTEROP/OSED represents one of the key parts of this SESAR Solution data pack.

The SPR-INTEROP/OSED is composed of different parts:

Part I of this document provides the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP), related to a SESAR Solution, which have been validated during validation activities at a V2 and V3 level. They are presented in the context of the Operational Service and Environment Definition (OSED) which describes the environment, assumptions, etc. that are applicable to the SPR and INTEROP requirements.

These requirements covered safety, performance, operational aspects as well as the interoperability aspects (related to a specific technology to support the SESAR Solution).

The document is completed by appendices including the Benefit and cost Mechanisms, showing how the SESAR Solution elements contribute (positively or negatively) to the delivery of performance benefits and the costs.

In addition to this document, parts II to V provide the series of assessments performed at SESAR Solution level that justify the SPR and INTEROP requirements:

- Part II:  
The Safety Assessment Report describes the results of the safety assessment work for the SESAR Solution.
- Part III:  
The Security Assessment Report describes the results of the security assessment work for the SESAR Solution.
- Part IV:  
The Human Performance Assessment Report describes the results of the Human Performance assessment work for the SESAR Solution.
- Part V:  
the Performance Assessment Report (PAR) that consolidates the performance results obtained in different validation activities at SESAR Solution level.

## 2.2 Scope

This document describes the concept of operations (ConOps) related to Remote Tower Services in a Multiple Remote Tower Module (MRTM) – PJ.05-02.

The full Multiple Remote Tower development within SESAR 2020 wave 1 is categorised as:

- Solution PJ.05-02 (covering SDM-0207)  
Multiple Remote Tower Module
- Solution PJ.05-03 (covering SDM-0210)  
RTC with Flexible Allocation of Aerodromes to MRTMs

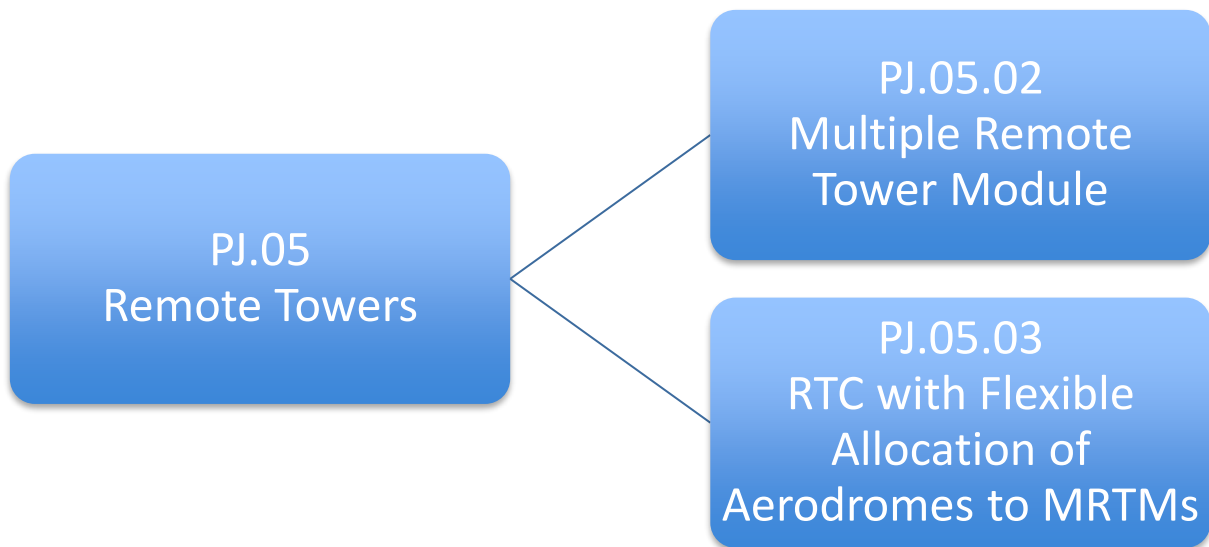


Figure 1 – The full Multiple Remote Tower development within SESAR 2020 wave 1.

The requirements in this document cover safety, performance, operational aspects as well as the interoperability aspects related to a specific technology to support the SESAR Solution.

This version describes the final OSED/SPR/INTEROP for solution 2.

### 2.2.1 Scope Solution PJ05-02

This SPR-INTEROP/OSED for Solution PJ05-02 has been developed for V3 maturity.

The objective for PJ.05-02 is to develop and validate a MRTM that allows the ATCO to maintain situational awareness for 2 or 3 airports simultaneously. The following traffic characteristics define the scope of Solution PJ05-02 regarding **traffic volumes** (including mix of IFR and VFR):

- 2 small airports (corresponding to the PJ.20 Operation environment description for a ‘Small Airport Operating Environment’) with up to 20 movements/hour in total for all airports

- 3 other airports (corresponding to the PJ.20 Operation environment description for an ‘Other Airport Operating Environment’) with up to 15 movements/hour in total

The traffic volumes in specific situations might deviate from this indication depending on traffic complexity and other factors influencing task load for the controller.

In order to be able to allow more airports and/or higher traffic volumes to be controlled simultaneously from one MRTM compared to SESAR 1 solution #52 or #12, the solution validates advanced features of the visual reproduction as well as additional voice services being integrated into the MRTM.

It is assumed that an ATCO can hold endorsements for up to 3 (single) different airports.

There is a fixed allocation of airports to a set of MRTMs. However, in case of ATCO high workload, due to e.g. emergency, high traffic volumes or degraded mode, the ATCO can split one airport into a spare MRTM if required.

## 2.3 Intended readership

The intended audience for this document are primarily all the partners involved in SESAR 2020 (PJ05) addressing solution 02 and solution 03.

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;

SESAR 2020 Projects/Solutions with dependencies to PJ05.02:

- PJ.16 (CWP/HMI) CWP-HMI
- PJ.05.03, RTC with Flexible Allocation of Aerodromes to MRTMs

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 work done in SESAR 1 for solution #52 “Remote tower for two low-density aerodromes”.

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. Information can be found in the data packs for the following operational improvements:

- SDM-0201 - Single Remote Tower for low density aerodromes
- SDM-0204 - Contingency solutions for aerodromes with one main RWY
- SDM-0205 - Multiple solution for two low density aerodromes simultaneously

Resulting in the following SESAR solutions:

- Solution #71  
Single Remote Tower Services for small airports
- Solution #52  
Remote Tower Services for two low-density aerodromes
- Solution #12  
Single Remote Tower Services for medium traffic volumes
- Solution #13  
Remotely-provided air traffic services for contingency situations at aerodromes

The solutions for Single Remote Tower and Contingency formed the baseline for remote tower operations providing initial benefits in terms of cost efficiency (single remote tower) and resilience (contingency) while providing the required level of safety.

Based on this work the development of the first solution related to multiple remote tower was successfully validated up to V3 level for two low traffic density aerodromes, traffic levels comparable to other environment airports (0 to 10.000 annual movements).

## 2.5 Structure of the document

This document addresses the solutions PJ05-02 and PJ05-03 as both solutions are focusing on Remote Towers and development of Multiple Remote Tower. Whenever there is an indication that the content is not common to both solutions, separate headlines are introduced; columns are used to describe different areas of research for solution 2 and 3.

The structure of the document is as follows:

Section 1: Contains the executive summary of the document;

Section 2: This section introduces the document and scopes the document.

Section 3: Describes the operational service and environment that is applicable for each SESAR Solution

Section 4: Contains the Safety, Performance and Interoperability Requirements and their allocation to the solutions.

Section 5: List of the reference documents used in the production of this OSED



## 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
ATS (Air Traffic Service)	A generic term meaning variously, Flight Information Service (FIS), Alerting Service (ALRS) and Air Traffic Control Service (ATC) (area control service, approach control service or aerodrome control service). In this document, when the term ATS is used, it is usually referring to TWR or AFIS.	ICAO, Annex 11
Aerodrome ATS	Aerodrome ATS means air traffic service for aerodrome traffic, in the form of ‘aerodrome control service (ATC) or ‘aerodrome flight information service’ (AFIS).	EASA
Aerodrome Control Service (TWR)	The air traffic control (ATC) service provided by the Air Traffic Control Officer (ATCO) for aerodrome traffic. Air traffic control service is a service provided for the purpose of: <ul style="list-style-type: none"> <li>• preventing collisions:</li> <li>• between aircraft, and</li> <li>• on the manoeuvring area between aircraft and obstructions; and</li> <li>• expediting and maintaining an orderly flow of air traffic.</li> </ul>	ICAO, Annex 11
APP (Approach control service)	<b>APP</b> (Approach control service) is the service for Arrival and Departing traffic (before and after they will be/have been under the TWR control. APP is provided by a single ATCO for one or more airports, either separate or in combination with TWR (TWR & APP from the Tower).	ICAO
Conventional Tower	Conventional Tower means a facility located at an aerodrome from which aerodrome ATS is provided principally through direct out-of-the-window observation of the aerodrome and its vicinity.	EASA

Multiple mode of operation	Multiple mode of operation means the provision of ATS from one remote tower/remote tower module for two or more aerodromes at the same time (i.e. simultaneously).	EASA
Multiple Remote Tower Module (MRTM)	Multiple Remote Tower Module (MRTM) is a term used by project PJ.05 and in this document to specifically indicate a Remote Tower Module (RTM) which enables the possibility to provide ATS to two or more aerodromes at the same time (i.e. simultaneously).	PJ.05 definition
Out-of-the-window (OTW) view'	'Out-of-the-window (OTW) view means a view of the area of responsibility of the aerodrome ATS unit from a conventional tower, obtained via direct visual observation.	EASA
Remote Tower	Remote Tower means a geographically independent facility from which aerodrome ATS is provided principally through indirect observation of the aerodrome and its vicinity, by means of a visual surveillance system. (It is to be seen as a generic term, equivalent in level to a conventional tower).	EASA
Remote Tower Centre (RTC)	A Remote Tower Centre (RTC) means a facility housing one or more remote tower modules.	EASA
Remote Tower Module (RTM)	Remote Tower Module (RTM) means a combination of systems and constituents from where remote aerodrome ATS can be provided, including one or more ATCO/AFISO workstation(s) and the visual presentation. (It can be compared with the tower cabin of an aerodrome conventional tower.)	EASA
Simultaneous movements	Simultaneous movements are all aircraft and vehicle movements under the control of the ATCO or on the frequency at the same time.	PJ.05 definition
Single mode of operation	Single mode of operation means the provision of ATS from one remote tower/remote tower module for one aerodrome at a time.	EASA
Technical Enablers	Technical Enablers refer to additional features and functions within a single or a multiple module that enable the provision of ATS 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.	
Visual Presentation	Visual Presentation means a view of the area(s) of responsibility of the aerodrome ATS unit, provided by a visual display.	EASA
Visual Surveillance System	Visual Surveillance System means of a number of integrated elements, normally consisting of optical sensor(s), data transmission links, data processing systems and situation displays providing an electronic visual presentation of traffic and any other information necessary to maintain situational awareness at an aerodrome and its vicinity. <b>Note:</b> EUROCAE ED-240/ED-240A is using the term 'remote tower optical system' for the same.	ICAO, Doc 4444 EASA

Table 2: Glossary of terms

## 2.7 List of Acronyms

Acronym	Definition
ACC	Area Control Centre
AFIS	Aerodrome Flight Information Service
AIM	Aeronautical Information Management
ALRS	Alerting Service
APP	Approach Control
ATCC	Air Traffic Control Centre
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATS	Air Traffic Service
AVF	Advance Visual Features
CNS	Communication Navigation and Surveillance
CONOPS	Concept of Operations
CR	Change Request
CTR	Control Zone
CWP	Controller Working Position
DME	Distance Measuring Equipment
EASA	European Aviation Safety Agency

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<b>EATMA</b>	European ATM Architecture
<b>E-ATMS</b>	European Air Traffic Management System
<b>FATO</b>	Final approach and takeoff area
<b>HPAR</b>	Human Performance Assessment Report
<b>IFR</b>	Instrument Flight Rules
<b>ILS</b>	Instrument Landing System
<b>INTEROP</b>	Interoperability Requirements
<b>KPA</b>	Key Performance Area
<b>LVO</b>	Low Visibility Operations
<b>LVP</b>	Low Visibility Procedures
<b>MET</b>	Meteorology, meteorological
<b>MRTM</b>	Multiple Remote Tower Module
<b>NDB</b>	Non Directional Beacon
<b>OI</b>	Operational Improvement
<b>OSED</b>	Operational Service and Environment Definition
<b>OTW</b>	Out-The-Window
<b>PAR</b>	Performance Assessment Report
<b>PTZ</b>	Pan-Tilt-Zoom
<b>QoS</b>	Quality of Service
<b>RNAV</b>	Area Navigation (Random Navigation)
<b>RPAS</b>	Remotely Piloted Aircraft Systems
<b>RTC</b>	Remote Tower Centre
<b>RTM</b>	Remote Tower Module
<b>RTO</b>	Remote Tower Operations
<b>RVR</b>	Runway Visual Range
<b>RWS</b>	RTC supervisor
<b>SAC</b>	Safety Criteria
<b>SAR</b>	Safety Assessment Report
<b>SecAR</b>	Security Assessment Report
<b>SESAR</b>	Single European Sky ATM Research Programme
<b>SJU</b>	SESAR Joint Undertaking (Agency of the European Commission)
<b>SPR</b>	Safety and Performance Requirements



<b>SWIM</b>	System Wide Information Model
<b>TS</b>	Technical Specification
<b>VCS</b>	Voice Communications System
<b>VFR</b>	Visual Flight Rules

**Table 3: List of acronyms**

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## 3 Operational Service and Environment Definition

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In the following sub-sections, the document describes the operational environment that is applicable for the SESAR Solution under the scope of the deliverable as the context for assessing and establishing operational, safety, performance requirements

### 3.1 SESAR Solution PJ.05: a summary

Solution 02 and Solution 03 are focusing on increased cost efficiency for local air traffic service at small to medium sized aerodromes.

Solution PJ.05.02 builds on results from SDM.0205 (2 low density aerodromes) and will continue to investigate multiple remote tower modules, MRTMs, for 2 medium sized or 3 small aerodromes. One remaining aspect for more traffic is planning tools supporting the ATCO in his/her decision to split up aerodromes in a MRTM before workload is exceeded.

Solution PJ.05-03 will address new features compared to solution PJ.05-02 but will take into account the results from solution 02.

Validation will address different setups of the MRTMs that allow handling higher traffic volumes and/or more airports from one MRTM. Different complementary approaches supporting this objective will be validated:

- Planning tools (balancing ATCO workload and traffic demand) supporting the Supervisor in allocating airports and staff to MRTMs
- Harmonisation of procedures and systems allowing dynamic allocation of airports to MRTMs
- Increased automation support for the ATCOs

Research within SESAR LSD.02.05 has shown that equipment costs can be reduced further for AFIS. As PJ.05 is focusing on more complex environments and increased traffic AFIS is not considered as an R&D objective even though the fact that all parts are applicable for such a service, but with different impact on savings.

#### 3.1.1 SESAR Solution PJ05-02: a summary

The objective for PJ.05-02 is to develop and validate a MRTM with a fixed allocation that allows the ATCO to maintain situational awareness for 2 or 3 airports simultaneously with the following traffic characteristics (including mix of IFR and VFR):

- 2 small airports (corresponding to the PJ.20 Operation environment description for a ‘Small Airport Operating Environment’) with up to 20 movements/hour in total for all airports.

- 3 other airports (corresponding to the PJ.20 Operation environment description for an ‘Other Airport Operating Environment’) with up to 15 movements/hour in total.

The traffic characteristics are just providing an **indication of the traffic volumes** – traffic volumes in specific situations might deviate from this indication depending on traffic complexity, weather conditions and other factors influencing workload.

In order to be able to allow more airports and/or higher traffic volumes to be controlled simultaneously from one MRTM compared to SESAR 1 solution #52 or #12, the solution validates advanced features of the visual reproduction as well as additional voice services being integrated into the MRTM, specific aspects remain for medium sized aerodromes and three simultaneous aerodromes such as increased automation on existing tools (e.g. PTZ, tracking)..

It is assumed that an ATCO can hold endorsements for up to 3 (single) different airports.

The following figure shows the OIs and allocation of Enablers:

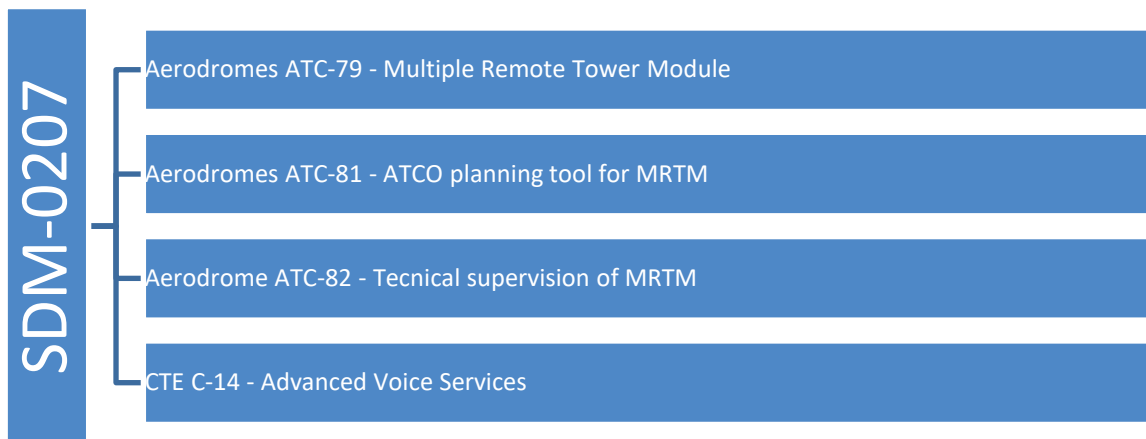


Figure 2 OI’s and enablers for solution 2

The ATCO is supported in evaluating traffic volumes and workload by a planning tool that considers the connected airports.

In case of ATCO high workload, due to e.g. emergency, high traffic volumes or degraded mode, the ATCO can split one airport into a spare MRTM if required to be used temporarily.

SESAR Solution ID	SESAR Solution Title	OI Steps ID ref. (coming from EATMA)	OI Steps Title (coming from EATMA)	OI Step Coverage
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PJ05-02	Multiple Module	Remote	Tower	SDM-0207	Remotely Provided Air Traffic Service for Multiple Aerodromes	Fully
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Table 4: SESAR Solution PJ05-02 Scope and related OI steps

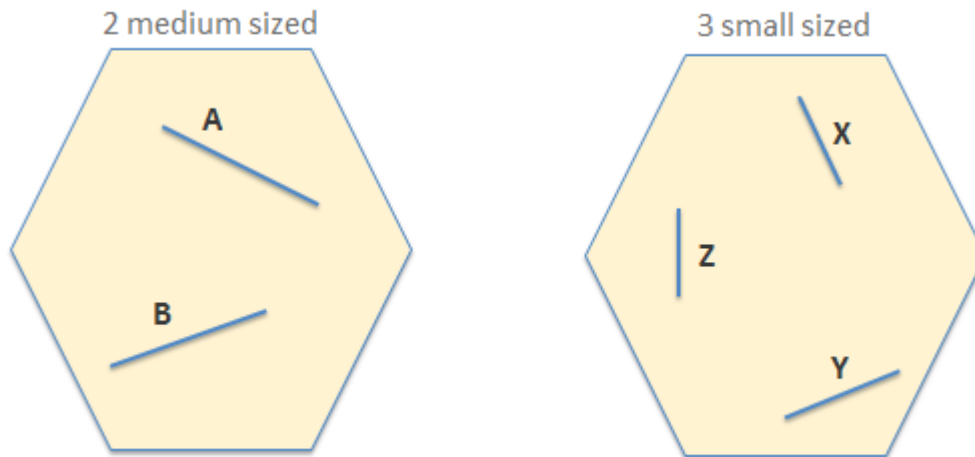
High Level CONOPS Requirement ID	High Level CONOPS Requirement	Reference to relevant CONOPS Sections e.g. Operational Scenario applicable to the SESAR Solution
<b>P05-TLOR-01</b>	<p>The provision of ATS from remote tower for multiple airports shall take into account the following aspects:</p> <ul style="list-style-type: none"> <li>To develop to a multi remote TWR concept, especially in simultaneous mode.</li> <li>To integrate SWIM-enabled functions.</li> <li>To maintain or even increase operational situation awareness.</li> <li>To address human performance and roles needed for supporting ATS.</li> </ul> <p>While:</p> <ul style="list-style-type: none"> <li>Maintaining safe working methods as safe as current service provision.</li> <li>Addressing different kind of operational environments considering the mix of complexity, weather conditions, controller workload and type of traffic.</li> <li>Maintaining an acceptable network quality of service and operational resilience.</li> <li>Further developing Controller working position (CWP).</li> <li>Considering additional automation functionalities.</li> <li>Gradually increasing the operating range of the concept.</li> <li>Addressing fall back and standardisation needs.</li> </ul>	Chapter 5.6
<b>S05-02-HLOR-01</b>	<p>Remotely Provided Air Traffic Service for Multiple Aerodromes shall increase MRTM cost efficiency :</p> <p>by incorporating into the MRTM:</p> <ul style="list-style-type: none"> <li>features for automation and support for operators in an environment with several connected aerodromes</li> <li>representations of MET information for multiple airports and airports with more than one runway</li> <li>enhanced PTZ functionality for a CWP suitable for several aerodromes</li> <li>enhanced VCS</li> <li>overlays to cope with several aerodromes at the same time</li> <li>developing ATCO planning tools in the Multiple RTM (MRTM)</li> </ul>	



	while: <ul style="list-style-type: none"> <li>• addressing cyber security</li> <li>• addressing SWIM related service models</li> <li>• handling planning issues such as the daily operative work</li> </ul>	
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**Table 5: CONOPS description PJ.05.02**

Figure below presents how the connected aerodromes can be combined in a Multiple Remote Tower Module.



**Figure 3 Multiple aerodrome combinations for solution 2**

Table below adds an overview of how the combination of aerodromes can be handled for remotely connected aerodromes. The preferred model show how 2 or three aerodromes are combined in multiple mode. In cases where an ATCO need to split the aerodromes to meet a higher traffic volume than possible, or in other cases such as malfunction, is described as a case during task high workload.

	CASE	2 AIRPORTS		3 AIRPORTS	
		MRTM1	MRTM2	MRTM3	MRTM4
1	Preferred model	Airport A and Airport B	Spare	Airport X, Airport Y and Airport Z	Spare
	CASE	2 AIRPORTS		3 AIRPORTS	
		MRTM1	MRTM2	MRTM1	MRTM2
2	ATCO high workload	Airport A	Airport B	Airport X and Y	Airport Z
3		Airport B	Airport A	Airport X and Z	Airport Y
4				Airport Y and Z	Airport X

Table 6: MRTM, distribution example for 2 or 3 aerodromes

Following image presents the table above and how an aerodrome can be handed to the spare MRTM.

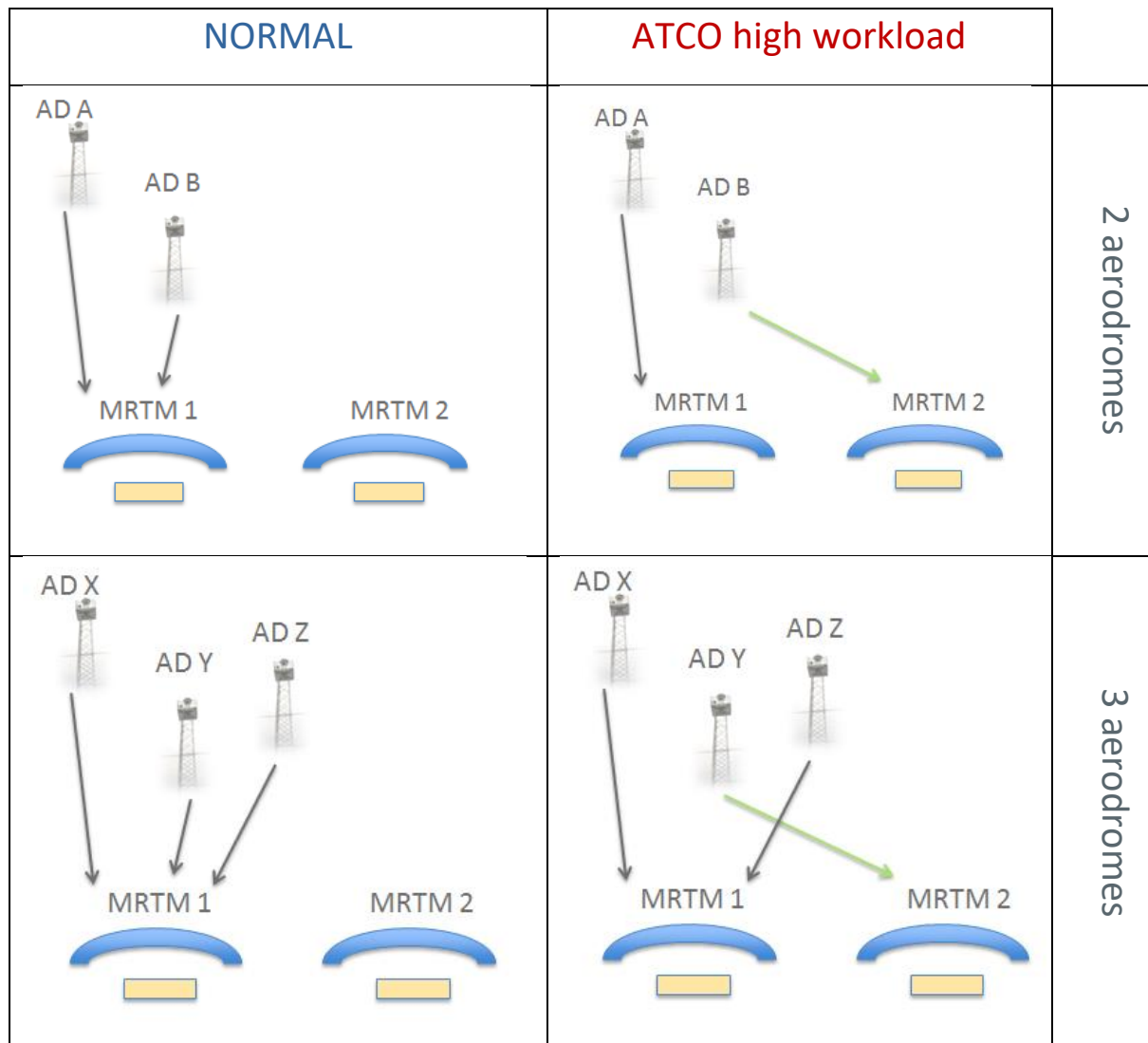


Figure 4 Example image of aerodrome distribution for ATCO high workload for 2 or 3 aerodromes

### 3.1.2 Deviations with respect to the SESAR Solution(s) definition

The SESAR Solutions are described according to CONOPS update, there are no deviations from DS 19.

## 3.2 Detailed Operational Environment

### 3.2.1 Operational Environment in EATMA

The EATMA elements impacted by PJ.05 are shown below.

These matrix shows, according to EATMA elements, which nodes operate in the different environments involved in the PJ.05. The matrix is valid for both solutions.

Operating Environment	Node
Airport Low Utilisation Complex layout	Aerodrome ATS (Remote Tower)
Airport Low Utilisation Simple Layout	Aerodrome ATS (Remote Tower)

Table 7: Nodes related to Operating Environments

The capabilities affected by this project are shown in the table hereunder.

Capability
ATM Performance Management
ATM Service Management / Remote Tower Operations Provision
Collision Avoidance (Only sol 03)

Table 8: Capabilities

No measures available in EATMA for this project as it is focused in Human Performance and Safety.

The main Stakeholders within this project are ATCOs (not defined any STK in EATMA yet).

### 3.2.2 Operational Characteristics

Solutions PJ05-02 and PJ05-03 can be applied in the same operational environments. The difference is that PJ05-03 extends the scope in terms of which aerodromes that can be controlled by one or two ATCO/ATCOs from an MRTM. PJ05-03 adds the need for a RTC with a flexible allocation of aerodromes. An extended scope will call for a need of a RTC planning tool in order to maintain a safe and smooth handling of aerodromes.

The operational characteristics for environments where the solutions can be applied are outlined in the table below. ATC for medium size airports is addressed. Small airports are not addressed explicitly as they can be understood as a sub-environment of medium size airports.

The characteristics should be interpreted as common across all candidate countries and ANSPs and are not restrictive i.e. they represent a baseline operating environment that may be slightly different in each individual country or ANSP.

Solution PJ.05.02 and PJ.05.03 are both aiming for an increased cost efficiency for ATC services compared to conventional air traffic services. Both are applicable for AFIS as service provided in the same way as a conventional tower that is feasible for both AFIS and ATC.

		Environment
Services	TWR	Yes (Including Clearance delivery / Ground Control / Tower Control / TWR Apron Control). Roles EATMA involved: Tower Clearance Delivery Controller, Tower Ground Controller, Tower Runway Controller, Apron Manager
	APP	Optional Roles EATMA involved: Approach Controller
	Opening Hours	Up to 24H (including night)
Staffing	Number of ATS staff	One ATCO per MRTM More than one ATCO in the RTC, including MRTMs and RTC Supervisor
	Ratings	ADI, possibly APP, APS/RAD (ratings are optional dependent on service delivered from the RTC or MRTM)
Airspace	Airspace Classification	Class C and/or D
	CTR	10- 15 NM radius/rectangular, Vertical extension up to 3000 ft MSL
	TMA	Optional (dependent on regional regulations/procedures)
	Procedures	Specific IFR routes & approach procedures Established VFR routes
Aerodrome	Number of RWY	One to two runways (and or with a FATO)
	Taxiway and runway entries	Typically one major taxiway parallel with the RWY, number of RWY intersections/entries varying typically between 1 and 3.
	Aprons	Typically 1 or 2 (ordinary and GA/freight)
Traffic	Number of movements	

	Number of simultaneous movements	<p>Corresponding to the ‘other’ and ‘small’ airport operating environments (as described in the PJ.20 Operation environment description’)</p> <p>The solutions PJ05-02 and PJ05-03 only apply when the traffic volume can be controlled by one ATCO from the MRTM (which might be limited to certain time periods)</p> <p>The number of simultaneous movements depends on the traffic complexity.</p>
	Traffic Type	<p>VFR and IFR</p> <p>Mainly scheduled, charter and GA.</p>
	Aircraft Fleet mix	<p>All types of aircraft including cooperative-RPAS</p>

**Table 9: Operational Environment Characteristics for PJ05-02 and PJ05-03**

The airspace users are receivers of the ATS service. However neither their role nor their responsibility will change as a result of the introduction of multiple remote ATS.

The primary actors impacted by multiple remotely provided ATS are the ATCOs. Based on the single remote tower environment, the overall roles and responsibilities of the ATCO will not change, in so far as they will remain responsible for the provision of the required services at the airport/airports.

It will be the responsibility of the airport authority / service provider to ensure that the equipment is properly maintained and kept in acceptable condition. It is not an ATCO task to perform maintenance. These issues will be addressed by qualified engineers and technicians responsible for the calibration, maintenance and flight testing.

All roles described in this chapter are performed by the ATCO (similar to conventional tower work), it is common that the roles are covered by one ATCO wherefore focus for both solutions is a single staffed MRTM. Extra staff can be used for specific use cases.

This section describes who is involved in the use of the operational activities and what the roles and responsibilities of the various actors for solutions 2 and solution 3 are, (all covered by one ATCO):

- Apron Manager
- Tower Clearance Delivery Controller
- Tower Ground Controller
- Tower Runway Controller
- Supervisor or similar role for an RTC (only valid for solution 3)

### 3.2.3 Technical Characteristics

The operational environment is described with single remote tower as a baseline in the table below. These technical characteristics give an overview of the technical R&D needs in a Multiple Remote Tower environment and a Remote Tower Centre.

	Solution PJ05-02	Solution PJ05-03
Visual observation	<ul style="list-style-type: none"> <li>Visual information replacing the tower view with the Out The Window view (OTW)</li> </ul>	
Surveillance	<ul style="list-style-type: none"> <li>Air surveillance (optional)</li> </ul>	<ul style="list-style-type: none"> <li>Ground surveillance (optional)</li> </ul>
Visual features	<ul style="list-style-type: none"> <li>Visual tracking / object bounding</li> <li>Radar tracking (optional)</li> </ul>	
Flight Plan Data Processing	<ul style="list-style-type: none"> <li>Electronic Flight Strips (Presentation and updating of flight plan and control data) or flight lists</li> </ul>	
Communication (PJ.14 related)	<ul style="list-style-type: none"> <li>ATC Voice Communications for multiple aerodromes</li> <li>VHF and UHF-transmitters/receivers, Ground Radio System, Autonomous VHF-radio, SAR radio.</li> </ul>	
Voice Services (PJ.14 related)	<ul style="list-style-type: none"> <li>Advanced Voice Services</li> </ul>	<ul style="list-style-type: none"> <li>Advanced Voice Services</li> <li>Advanced Voice Services including Voice Recognition (optional)</li> </ul>
Navigation	<ul style="list-style-type: none"> <li>Monitoring and manoeuvring of navigation specifications including ILS, RNAV, NDB, DME.</li> </ul>	
Planning tools	<ul style="list-style-type: none"> <li>ATCO planning tools for planning ahead</li> </ul>	<ul style="list-style-type: none"> <li>ATCO planning tools for planning ahead</li> <li>RTC Supervisor planning tools for planning of an entire RTC and allocation of aerodromes to MRTM's</li> </ul>
Other Systems	<p>The remote facility shall include all other technical functions and systems, currently found in an RTM and necessary to provide the services e.g.:</p> <ul style="list-style-type: none"> <li>Monitoring and control of ground lighting, navigation aids, alarms, etc.;</li> <li>Signal light gun;</li> <li>Pan Tilt Zoom camera, PTZ;</li> <li>MET presentation and information</li> <li>AIM</li> </ul>	

Table 10: Technical Characteristics – Solutions PJ05-02 and PJ05-03

### 3.2.4 Applicable standards and regulations

#### 3.2.4.1 EUROCAE

EUROCAE Working Group 100 (WG-100), dealing with “Remote and Virtual Towers”, published the initial version of ED-240, ‘MINIMUM AVIATION SYSTEM PERFORMANCE SPECIFICATION FOR REMOTE TOWER OPTICAL SYSTEMS’, in September 2016, specifying the end-to-end performance of the optical (camera) system. However this first version did not consider/cover any augmentation functions or sensors other than cameras.

*This standardisation activity is captured by the enabler STD-014, linked to SDM-0201. It could also be partly related to STD-HNA-06 and -07, also linked to SDM-0201.*

A second revision (ED-240A) was published in October 2018 and included also performance requirements related to the visual tracking function.

WG-100 is now continuing its work with further revision/extension (ED-240B), which will include also performance requirements related to the incorporation of information from non-optical surveillance systems/sensors (e.i. the so called “radar tracking”/”radar labels” function), anticipated late 2020.

EUROCAE ED-240 is not specifically addressing single or multiple aerodrome remote control requirements, as it is considered that the requirements set forth by ED-240/ED-240A/ED-240B are applicable regardless of Single or Multiple mode of operation. PJ.05 baseline is Single Remote Tower wherefore requirements on optical systems remain unchanged.

A new system enabler specifically introduced for multiple remote towers is CTE-C14, “Advanced VCS (Voice Com System) for a Multiple Remote Tower Module (MRTM)”, currently only linked to SDM-0207 has been validate at V2 and V3 level.

*This standardisation activity is captured by the enabler STD-014, linked to SDM-0201.*

### **3.2.4.2 EASA**

EASA rulemaking task RMT.0624 (Remote aerodrome ATS) was established to provide/develop a regulatory framework and guidance for remote tower operations/remote aerodrome ATS. Following the first phase of RMT.0624, EASA published ‘Guidance Material on the implementation of the remote tower concept for single mode of operation’ (Executive Director Decision 2015/014/R), as well as ‘Requirements on Air Traffic Controller licensing regarding remote tower operations’ (Executive Director Decision 2015/015/R), in July 2015.

*This regulatory activity is captured by the enabler REG-0509, linked to SDM-0201.*

Following a second phase of RMT.0624, EASA issued ‘Guidance Material on remote aerodrome air traffic services’ — Issue 2 and ‘AMC & GM to Part ATCO’ — Issue 1, Amendment 2 (Executive Director Decision 2019/004/R), in February 2019, replacing the previously published EASA guidance in 2015. This new updated guidance takes into consideration the further evolution of the concept as well as experiences gained from R&D activities (e.g. all the SESAR 1 validation activities and Solutions) and initial implementations throughout the EU and US and it addresses also multiple and more complex modes of operation. Thus the regulatory support/framework needed for Multiple mode of operation is now in place.

*This regulatory activity is captured by the enabler REG-0525, linked to SDM-0205.*

EASA will monitor the implementation of remote aerodrome ATS and any future technological and operational developments (e.g. the PJ.05 Solutions/SESAR 2020 results), and may amend and/or further evolve the existing guidance if/as deemed necessary (although the existing regulatory guidance/framework provided by EASA related to Multiple is generic enough to likely be able to accommodate also the upcoming PJ.05 Solutions.)

*This potential regulatory activity could be captured by a new REG-XXX enabler, linked to SDM-0207.*

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### 3.2.4.3 ICAO

The Air Traffic Management Operations Panel (ATMOPSP) developed proposed amendments to Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444) to facilitate the use of envisaged technology in the provision of remote aerodrome control service. This amendment was introduced in ICAO PANS-ATM Doc 4444 by Amendment 8, in force since 8 November 2018, thereby fully enabling remote aerodrome ATS in the ICAO context.

The amendments include, inter alia;

- A new definition ‘visual surveillance system’ definition.
- A new chapter 7.1.1.2.1 stating that visual observation can be achieved through direct out-of-the-window observation or through indirect observation utilizing a visual surveillance system.
- A new “Note” referring to the EASA Guidance Material, thereby giving it global recognition.

*This standardisation activity is potentially covered by the enablers STD-HNA-04 and 05, linked to SDM-0201.*

## 3.3 Detailed Operating Method

### 3.3.1 Previous Operating Method

Air Traffic Services are currently not being provided to multiple aerodromes by a single ATCO.

The baseline for multiple remote tower operations is the single remote tower operations, SDM-0201 solution #12, (which should be implemented as a baseline) and applies to both solutions PJ05-02 and PJ05-03. Transfer from conventional tower service local at the aerodrome to multiple Remote tower is foreseen to take the step via Single Remotely controlled Air Traffic Service before a combination of more than one aerodrome in Multiple mode is in place.

*Note: Remote Air Traffic Services are currently being provided for three separate airports in Sweden, as well as for Saarbrücken airport in Germany and Röst airport in Norway. Furthermore, contingency Remote Air Traffic Services are being provided for Budapest airport in Hungary. The first operational airport started in April 2015.*

### 3.3.2 New SESAR Operating Method

The objective of remote tower control for multiple aerodromes is to provide the ATS defined in ICAO Annex 11 [41], Documents 4444 [42], 9426 [43] for more than one aerodrome simultaneously.

The full range of ATS should be offered in such a way that the possible negative impact on the airspace users is reduced to a minimum while maintaining a safe and efficient service in comparison to the single remote tower operations. With the help of ATCO planning tools and RTC planning tools for the supervisor the balance of traffic load for the ATCO can be cared for in time. It will help in the decision making on when to transfer airports between MRTMs. It will also help in the decision on which airports to combine when there is a choice in doing so, taking into consideration e.g. suitable airport combinations and ATCO endorsements.

Providing ATS to more than one airport by one ATCO, when it is safe and practical, will add benefits to airport providers, ANSPs, airlines and eventually the flying customers through a cut in costs and /or the provision of ATC to airports earlier not served. The multiple remote tower concept will further enhance airport operators possibility to adapt opening hours at the airports.

When providing ATS to multiple aerodromes from an MRTM there are certain specific considerations that should be taken, due to the requirement to share or duplicate certain features required for the provision of ATS to more than one aerodrome.

Technical enablers, AVFs, communications, radar displays and other features/function to assist with the provision of ATS shall have varying degrees of integration and sharing between aerodromes.

Other features that are required continuously (such as the strip bay etc.) require duplication for each aerodrome. Any duplication of equipment/features that occurs in the RTM may be accompanied by distinctive features to allow easy and instant recognition of the aerodrome the feature relates to.

The provision of ATS to more than one aerodrome will be made possible by the provision of visual presentations that allow for the constant monitoring of each aerodrome. The screens will display each aerodrome simultaneously and continue to do so even when the ATCO is providing ATS to one specific aerodrome. It is vitally important that the operator is, at all times, able to distinguish which aerodrome they are currently operating and which aerodrome any single set of displays or peripherals are linked to.

### 3.3.2.1 Operating Method EATMA Elements

As said at 3.2, the main affected node is **Aerodrome ATS**, in particular, the Remote Tower one has been created in DS18a. This Node will have different and new activities to be defined (some of them shown in the table below), nevertheless the communications and procedures between ATCO and crew are going to be almost the same with one main difference: the pilot should be notified that he/she is under remote control. Therefore, the only novelty in the NOV-2 diagram is this information exchange (ATC Remote Provision) between Aerodrome ATS and Flight Deck.

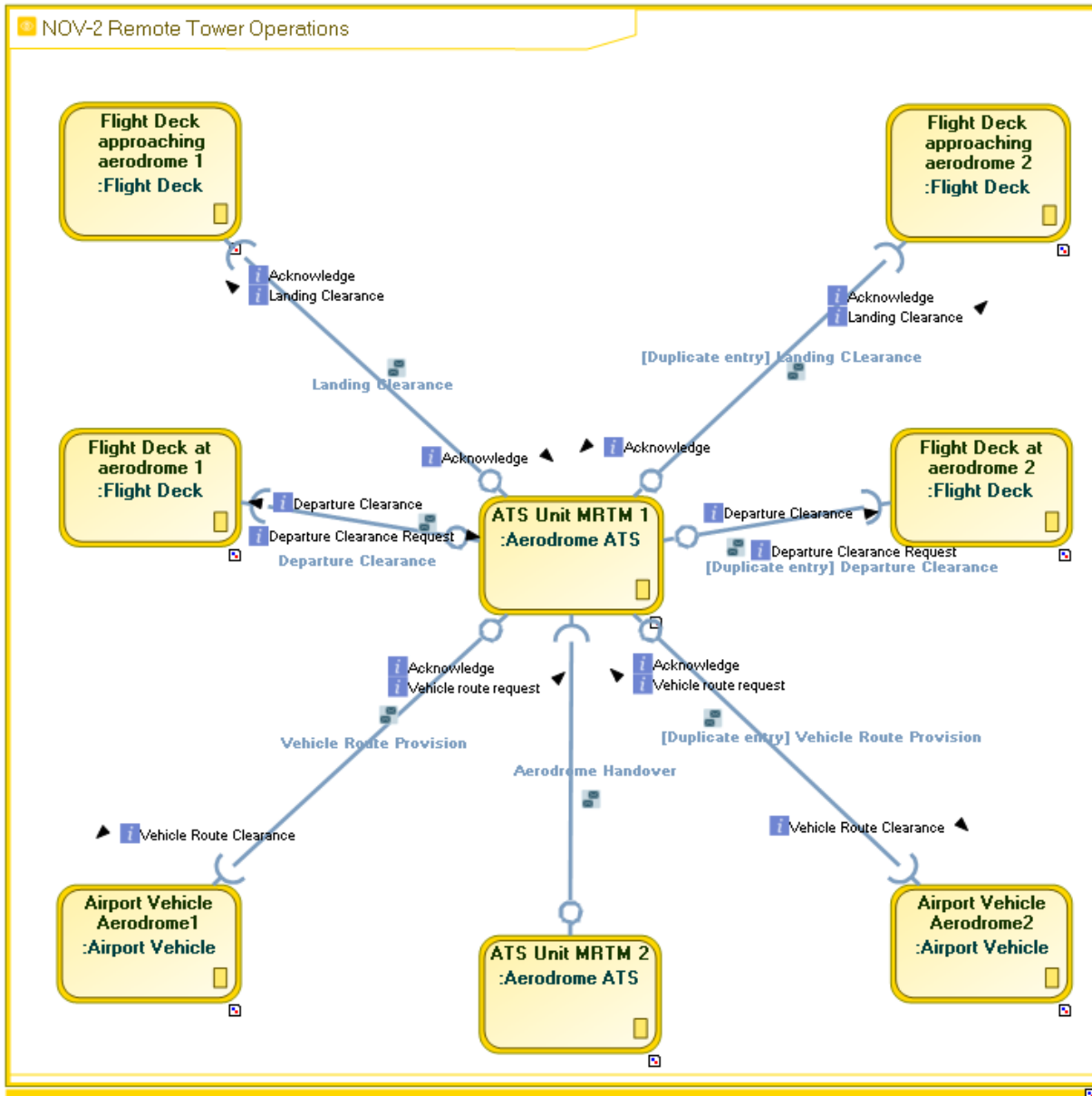


Figure 5: NOV-2 First Approach

Activities SOL 02	Activities SOL 03
Assess Aerodromes Under Control	Assess Aerodromes distribution
Assume Aerodromes	Execute Aerodromes Distribution
Assume Flight from an Aerodrome	Assess Aerodrome Split
Provide Clearance	
Decide which Aerodrome Split	
Assess Merging Aerodrome	
Confirm Aerodrome Control	

**Table 11: First Activities Approach**

Both figure and table show the approach of the EATMA Activities and Information Exchange elements that concern our project according to the architecture done based on the use cases presented in chapter 3.3.2.2 Use Cases.

### 3.3.2.2 Use Cases

The OSED attempts to describe the key parts of remote provision of ATS. Many elements and functions of the service provision will be the same when provided remotely as if they had been provided locally and so may not be repeated in detail for the use cases in this OSED.

The objective of PJ05 is to enlarge the scope of the multiple remote tower solutions addressing higher traffic volumes and higher number of airports that are simultaneously controlled by one ATCO in order to further increase cost efficiency.

The selected use cases are based on certain criteria to give coverage against ICAO Doc 4444 [TBD], ICAO Doc 9426 [TBD]. The Normal conditions, Abnormal conditions and Degraded modes are described in the SESAR Safety Reference Material:

- ‘Normal conditions’ are those conditions of the operational environment the ATM/ANS functional system is expected to encounter in day-to-day operations and for which the system must always deliver full functionality and performance.
- ‘Abnormal conditions’ are those external changes in the operational environment that the ATM/ANS functional system may exceptionally encounter (e.g. severe WX, airport closure, etc.) under which the system may be allowed to enter a degraded state provided that it can easily be recovered when the abnormal condition passes and the risk during the period of the degraded state is shown to be tolerable.
- ‘Degraded mode of operation’ is a pre-defined reduced level of operational service invoked by equipment outage or malfunction, staff shortage or procedures. Degraded mode covers the aspect of failure of parts of the system.

The following table provides an overview on the use cases that are described in detail in the chapters below for solution PJ05-02 and PJ05-03 and are divided according to:

- UC 1:x – common for both solutions

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- UC 2:x – Only valid for solution 2
- UC 3:x – Only valid for solution 3

PJ05-02	PJ05-03
NORMAL CONDITIONS	
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 2:1 / Split of aerodromes within an MRTM to meet requested capacity.	UC 3:1 / Transfer of aerodrome between MRTMs within a RTC, initiated by RTC supervisor
UC 2:2 / Merge of aerodromes to one MRTM	
	UC 3:2 / RTC supervisor capacity and workload planning
ABNORMAL CONDITIONS	
UC 2:3 / Emergency Situation - Supported by other ATCO in the MRTM during the emergency situation	UC 3:3 / Emergency Situation - Supported by Supervisor
UC 2:4 / Emergency Situation - Transfer of aerodrome to another MRTM	UC 3:4 / Emergency Situation - Transfer of aerodrome(s) to another MRTM within the RTC
DEGRADED MODES	

UC 1:9 / Failure of parts of the technical system building the Remote Tower Service, e.g. Camera view, screens, voice com

**Table 12: Use cases for both solutions**

*Note: More detailed degraded modes will be part of the Safety assessment*

No further assessment needed – validated in SESAR1 P 06.09.03 [44]

- Arriving aircraft handled by remotely provided ATS
- Two departing IFR flights during Low Visibility
- Transition of ATS provision from local TWR to Remote TWR
- Two arriving aircraft to two different aerodromes
- Arriving and departing aircraft at two different aerodromes
- Runway Inspection at Multiple Aerodromes during Night

These use case scenarios exemplify how ATS can be provided from a Remote location, they are not intended to be a comprehensive description of all possible scenarios and focus is given to standard nominal scenarios. The precise operating methods to be applied in the handling of non-nominal or other nominal scenarios will, in many cases, be dependent on the local operating procedures and the specific nuances of the implementation environment.

In case of an unexpected event, such as an emergency situation, at one of the airports - significantly increasing the ATCO workload and affecting her/his capability to continue to provide ATS to all airports under responsibility, the ATCO need to be able to handle the abnormal situation. Examples on actions can be to temporarily stop traffic at the other airport(s), transfer one aerodrome to another MRTM or other actions.

### 3.3.2.2.1 Use Cases – Common to Solution PJ05-02 and PJ05-03

Research within both solutions is development of the Multiple Remote Tower concept and the Multiple Remote Tower Module, MRTM. As development of the Single Remote Tower concept was finished in SESAR 1, no further development will take place if any use case causes a need of a split from Multiple to Single mode.

Figure below show the flow from Multiple Remote Tower to Single Remote Tower, and back to Multiple operations.

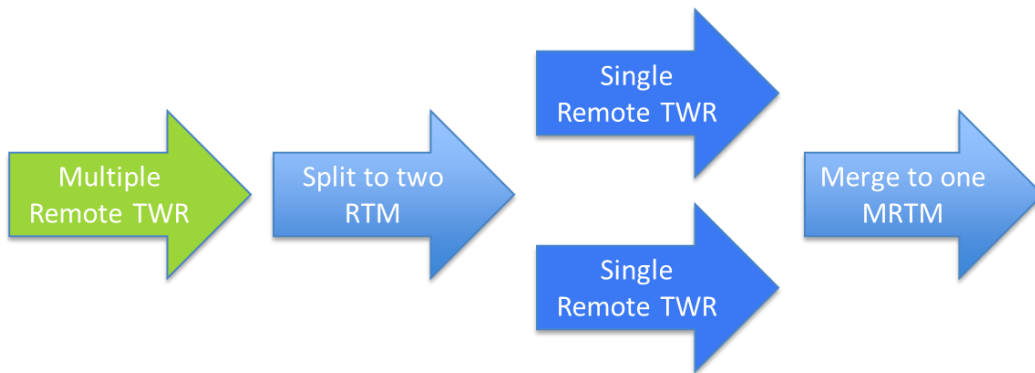


Figure 6 Flow from Multiple mode to Single mode and back

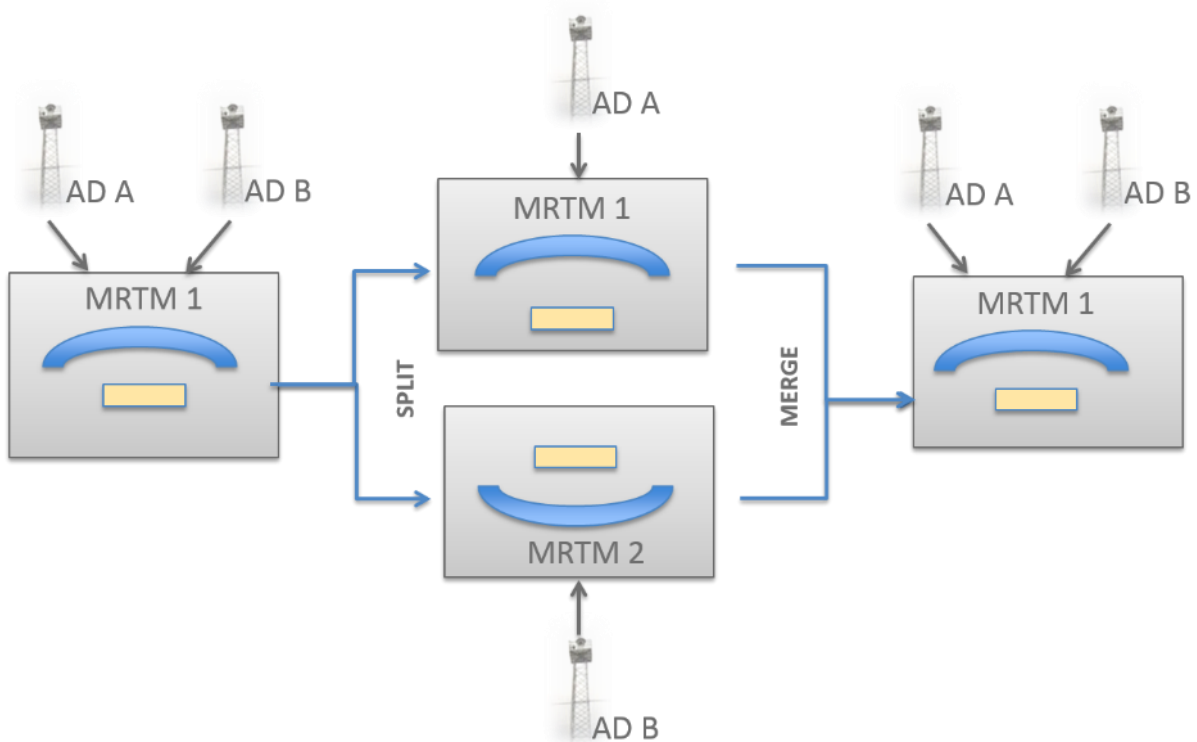


Figure 7 Example of distribution of 2 airports within the MRTM from Multiple to Single mode

### 3.3.2.2.2 Use Cases – Solution PJ05-02

Solution PJ.05.02 is solitary focusing on the Multiple Remote Tower Module and the provision of Air Traffic Service from a Multiple Remote Tower Module. The solution is dependent of a possibility to split or merge the connected aerodromes to another (fixed) MRTM in case of an increase in traffic that calls for a split, malfunction or a distressed situation.

The solution need to investigate how to combine different airports when it comes to variable characteristics such as:

- Airport layouts, RWY directions, complexity
- Geographical differences, weather, seasonal, day light

### 3.3.2.2.3 Use Cases – Solution PJ05-03

Solution PJ.05.03 are focusing on the extended scope where the RTMs are situated in an RTC with several connected aerodromes enabling a possibility to flexible allocate the connected aerodromes to a suitable MRTM within the RTC.

The RTC adds a need of planning functionality presented as the RTC supervisor (RWS) role and RTC supervisor planning tools. The increased use case also adds a need for advanced tools and features for the Multiple Remote Tower Module to enable a flexible allocation of aerodromes.

The solution need to investigate the complexity of combination of airports in an RTC regarding tasks.



### 3.3.2.2.4 UC 1:1 / Provide ATS with simultaneous movements (ground and air) at different aerodromes from one MRTM

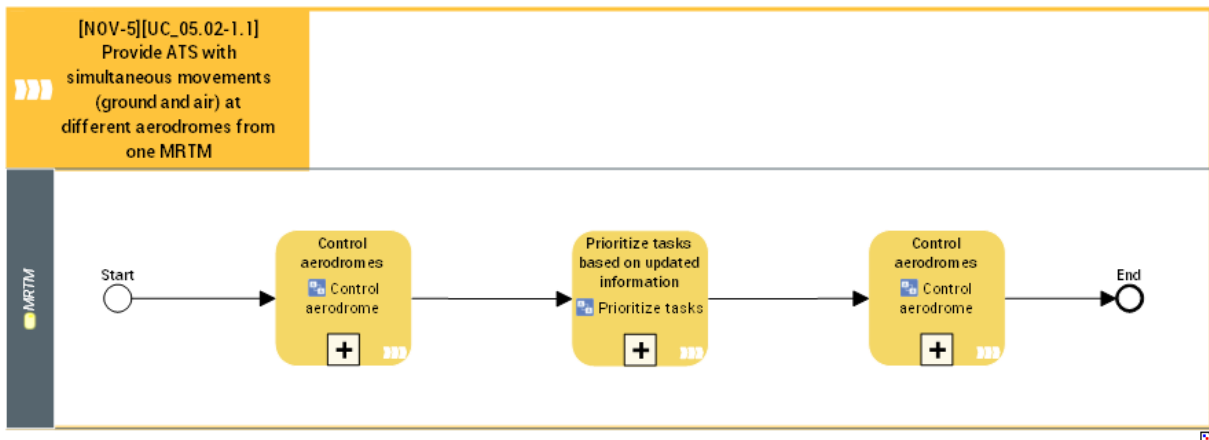


Figure 8 Use Case 1:1

#### General conditions

This use case describes the baseline for how to provide ATS for both air and ground movements in multiple remote towers.

#### Pre-conditions

The ATCO has a view and is equipped with all technical systems needed for all aerodromes connected to the MRTM

#### Post conditions

The ATCO provides ATS to the aerodromes connected to the MRTM with the same level of service as if they were controlled in single remote tower mode.

#### Actors

ATCO, flight crew (pilots) and vehicle drivers

#### Operating method / main flow

1. A movement is active within the manoeuvring area or is established on final or in the CTR at one of the aerodromes connected to the MRTM
2. A movement, air or ground, becomes active on the other connected aerodrome to the MRTM
3. The ATCO is in control of all movements at the different aerodromes
4. The ATCO can prioritize and sequence the movements in order to maintain a safe and controlled air traffic service to all aerodromes
5. The ATCO follows up on the movements and is ready for a new movement
6. The use case is ended

Founding Members





### **Operating method / alternative flow**

7. The ATCO has to prioritize the existing movements
8. The ATCO keep other movements out of the flow by e.g. keeping vehicles outside the manoeuvring area, keeping aircraft on ground rather than departing a third movement, keep arriving aircraft outside the CTR
9. When traffic so permits the ATCO take care of new movements at the different aerodromes
10. The alternative flow is ended

Founding Members



### 3.3.2.2.5 UC 1:2 / Provide ATS to co-operative RPAS and normal aircraft at a time to different aerodromes

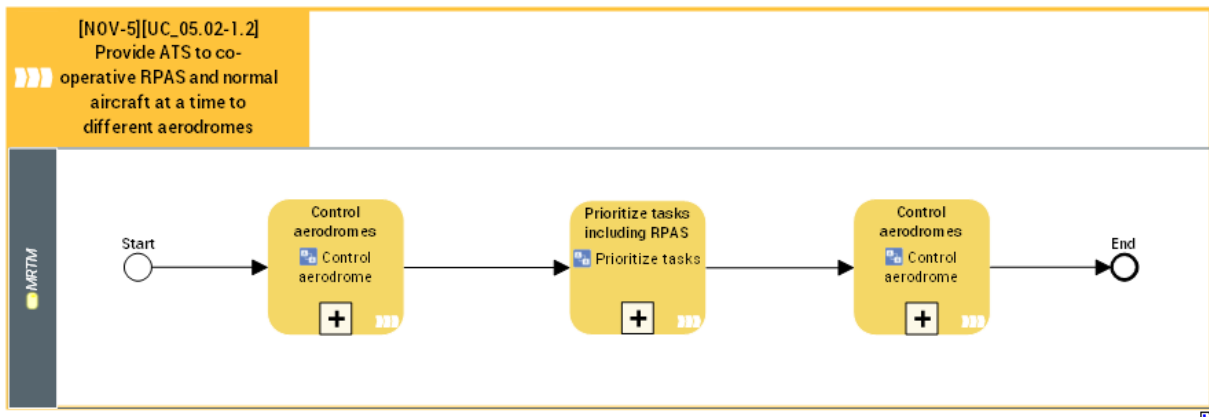


Figure 9 Use Case 1:2

#### General conditions

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

#### Pre-conditions

The ATCO is in control and in contact with both pilots at the same time and both pilots are able to follow clearances

#### Post conditions

The ATCO provides a safe and efficient service to both aircraft and both pilots are able to perform their tasks.

#### Actors

ATCO and flight crew (pilots)

#### Operating method / main flow

1. An RPAS is requesting a clearance to fly within the CTR (or near the aerodrome) at one of the aerodromes
2. A manned aircraft arrives or departs at the other aerodromes
3. The ATCO is in control of both aircraft at the different aerodromes
4. The ATCO can prioritize and sequence the simultaneous movements in order to maintain a safe and efficient air traffic service
5. The ATCO follows up on the movements
6. The use case is ended



### Operating method / alternative flow

7. The ATCO has to prioritize the existing movements
8. The ATCO has to delay one of the requested movements which can cause more than a common prioritisation which might cause a constrain for the pilot's planned activity
9. When traffic so permits the ATCO take care of the pilot's request
10. The alternative flow is ended

Founding Members



### 3.3.2.2.6 UC 1:3 / Control of Vehicles in the Manoeuvring Area to different aerodromes

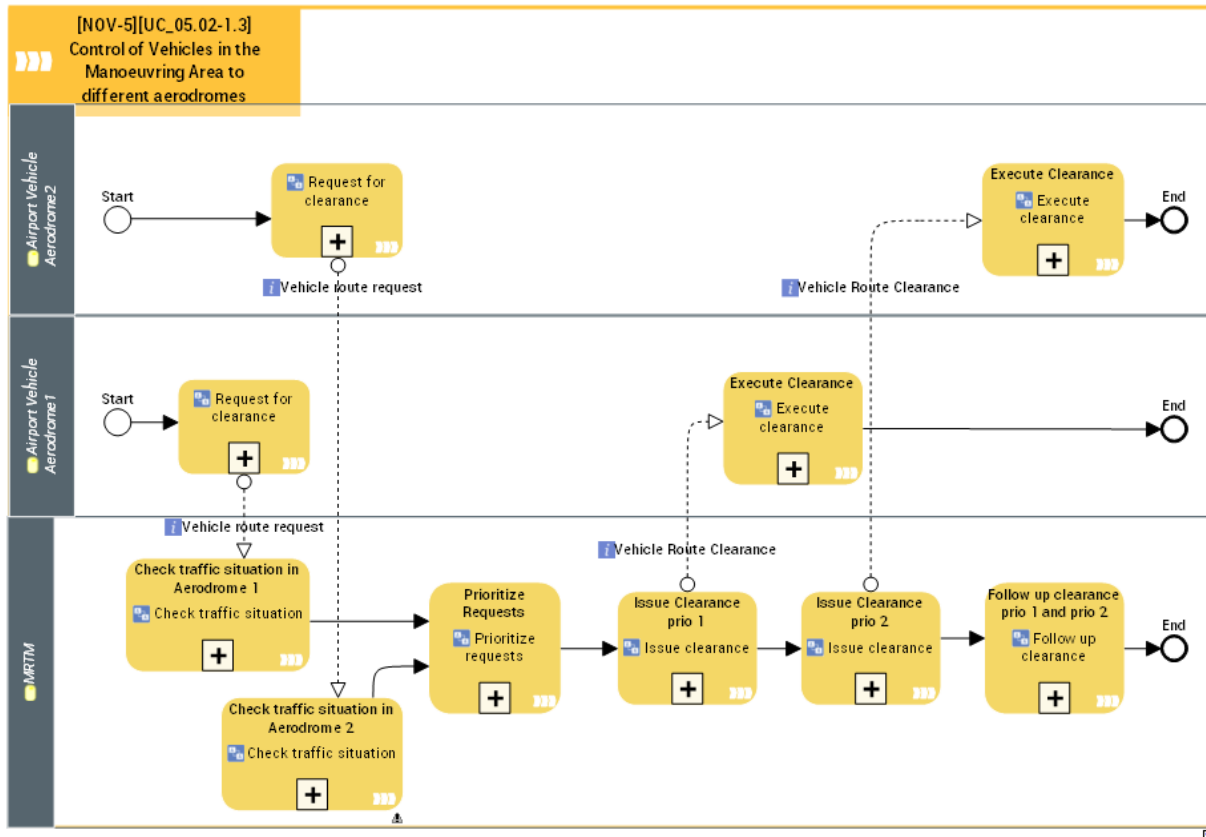


Figure 10 Use Case 1:3

#### General conditions

This use case describes how to provide ATS for vehicles on ground in multiple remote towers.

#### Pre-conditions

Vehicle drivers request a clearance to enter the manoeuvring area at different aerodromes simultaneously at the different aerodromes.

#### Post conditions

The ATCO provides ATS to vehicle drivers at different aerodromes and the vehicle drivers are able to perform their requested tasks.

#### Actors

ATCO and vehicle drivers

#### Operating method / main flow

1. A vehicle driver (or several) request a clearance to enter the manoeuvring are (TWY and/or RWY) at one of the aerodromes

Founding Members



2. Vehicle driver/drivers at the other (or all other) aerodromes request a clearance to enter the manoeuvring area
3. The vehicle drivers enters the manoeuvring areas at the different aerodromes
4. The ATCO controls movements at all aerodromes simultaneously
5. The ATCO follows up on the vehicles and is ready for a new movement
6. The use case is ended

#### **Operating method / alternative flow**

7. The ATCO has to prioritize the existing movements
8. The ATCO has to instruct a vehicle driver to vacate from the manoeuvring area (or extend the traffic circuit for an arriving aircraft) earlier than expected to be able to avoid a situation with a need for closely monitoring of a situation at one aerodrome due to the need of split vision between the different activities at the aerodromes
9. The ATCO take care of the previous request when the situation permits
10. The alternative flow is ended

#### **Operating method / failure flow**

11. The ATCO has a high workload and is unable to vacate the runway in time
12. The ATCO is not able to plan and prioritize in time due to all vehicles combined. That causes a situation where a new movement, example: arriving aircraft, has to be given a go around clearance to safely solve the situation
13. The ATCO has to instruct a vehicle driver to vacate the runway in time before the aircraft is on final approach again
14. The failure flow is ended

### 3.3.2.2.7 UC 1:4 / Provide ATS to simultaneous landings at different aerodromes

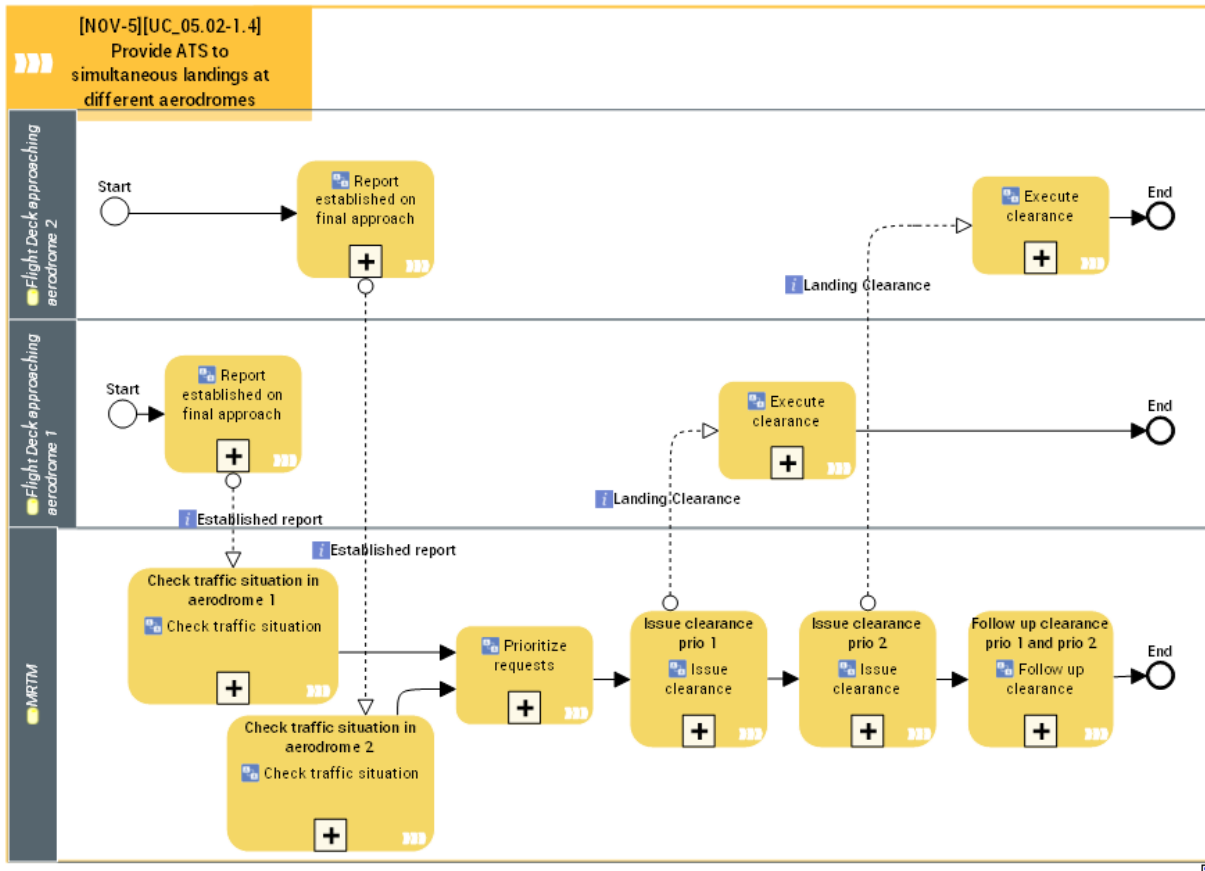


Figure 11 Use Case 1:4

#### General conditions

This use case describes how to provide ATS to simultaneous landings to different airports

#### Pre-conditions

The ATCO is in control and in contact with both pilots at the same time and both pilots are able to follow clearances

#### Post conditions

The ATCO provides a safe and efficient service to both aircraft and both pilots are able to perform their tasks.

#### Actors

ATCO and flight crew (pilots)

#### Operating method / main flow

1. An aircraft is on final to one aerodrome in the MRTM requesting permission to land

Founding Members



2. Simultaneously an aircraft is on final to another aerodrome in the MRTM requesting permission to land
3. The ATCO is in control of all movements at the different aerodromes
4. The ATCO can prioritize and sequence the movements in order to maintain a safe and controlled air traffic service to all aerodromes
5. The ATCO follows up on the movements and is ready for a new movement
6. The use case is ended

#### **Operating method / alternative flow**

7. The ATCO has to prioritize the existing movements
8. If the ATCO has to delay one of the requested movements, it can be done by e.g. reducing speed on one of the landings, in advance asking the approach control to take measures to “stagger” the different approaches, with the intention, not to touch down at the exact same time at the different aerodromes.
9. The ATCO follows up on the movements at the different aerodromes
10. The alternative flow is ended



### 3.3.2.2.8 UC 1:5 / Provide ATS to simultaneous departures at different aerodromes

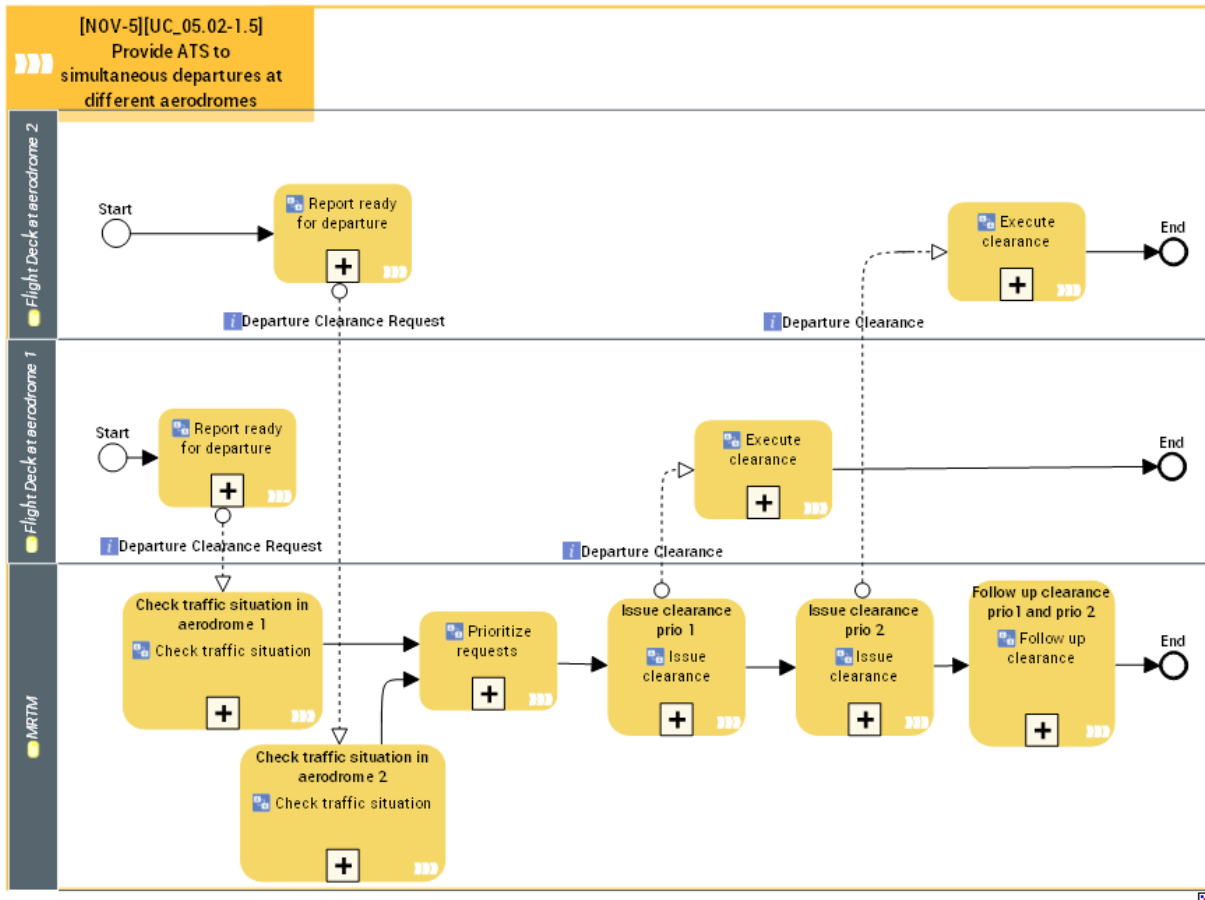


Figure 12 Use Case 1:5

#### General conditions

This use case describes how to provide ATS to simultaneous departures at different airports

#### Pre-conditions

The ATCO is in control and in contact with both pilots at the same time and both pilots are able to follow clearances

#### Post conditions

The ATCO provides a safe and efficient service to both aircrafts at a time and both pilots are able to perform their tasks.

#### Actors

ATCO and flight crew (pilots)

#### Operating method / main flow

1. An aircraft requests to depart from one aerodrome in the MRTM

Founding Members



2. Simultaneously an aircraft at another aerodrome in the MRTM requests to depart
3. The ATCO are in control of all movements at the different aerodromes
4. The ATCO can prioritize and sequence the movements in order to maintain a safe and controlled air traffic service to all aerodromes
5. The ATCO follows up on the movements and is ready for a new movement
6. The use case is ended

**Operating method / alternative flow**

7. The ATCO has to prioritize the existing movements
8. The ATCO can, in order to give full attention to one departure at a time , e.g. hold one of the departing aircraft on ground at one aerodrome until the one departing from the other aerodrome is in the air
9. When traffic so permits the ATCO take care of new movements at the different aerodromes
10. The alternative flow is ended

### 3.3.2.2.9 UC 1:6 / Provide ATS to a landing and a departing aircraft simultaneously at different aerodromes

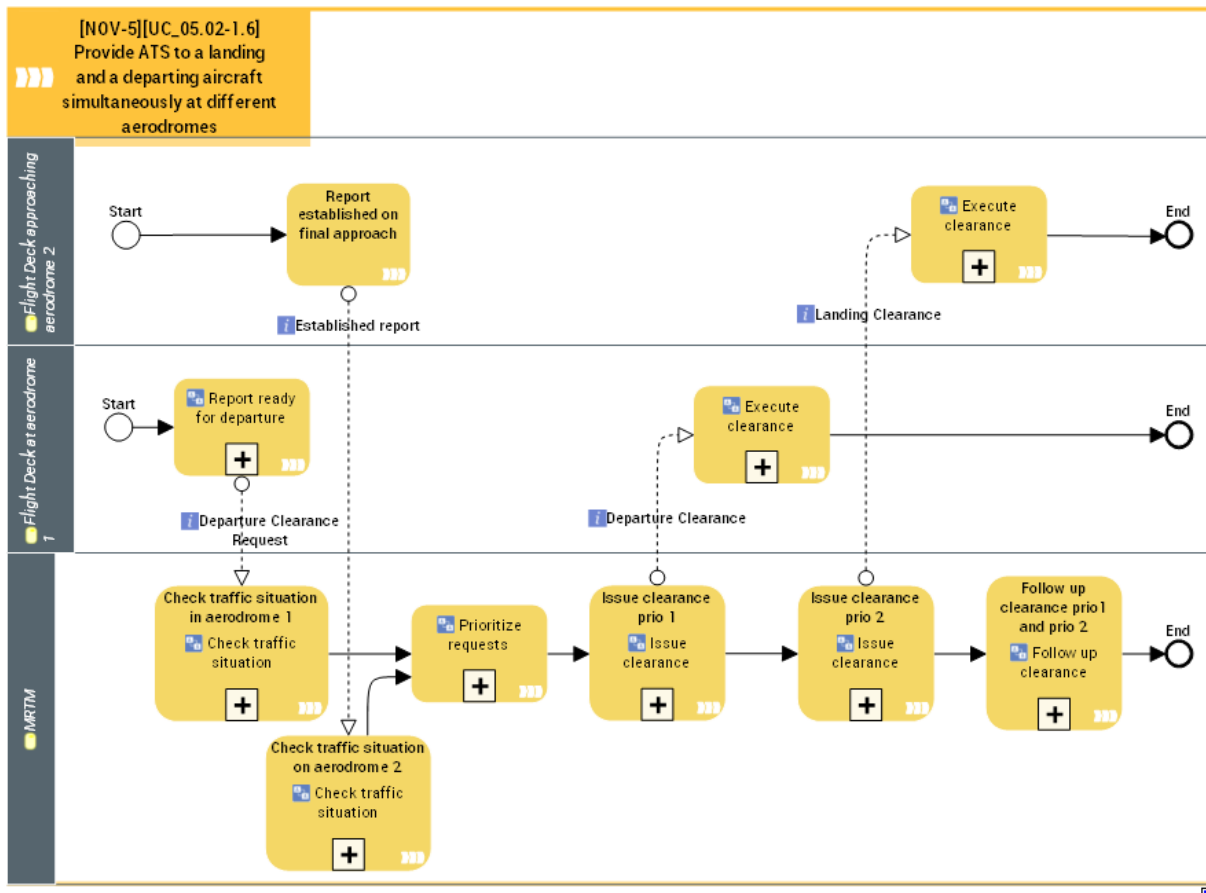


Figure 13 Use Case 1:6

#### General conditions

This use case describes how to provide ATS to a landing and a departing aircraft simultaneously at different airports

#### Pre-conditions

The ATCO is in control and in contact with both aircraft at the same time and both pilots are able to follow clearances

#### Post conditions

The ATCO provides a safe and efficient service to both aircraft and both pilots are able to perform their tasks.

#### Actors

ATCO and flight crew (pilots)

#### Operating method / main flow

Founding Members



1. An aircraft requests to depart from one aerodrome in the MRTM
2. Simultaneously an aircraft is on final to another aerodrome in the MRTM requesting permission to land
3. The ATCO is in control of all movements at the different aerodromes
4. The ATCO can prioritize and sequence the movements in order to maintain a safe and controlled air traffic service to all aerodromes
5. The ATCO follows up on the movements and is ready for a new movement
6. The use case is ended

#### **Operating method / alternative flow**

7. The ATCO has to prioritize the existing movements
8. The ATCO can, in order to give full attention to one movement at a time, e.g. hold the departing aircraft on ground at one aerodrome until the approaching aircraft at the other aerodrome has landed
9. When traffic so permits the ATCO take care of new movements at the different aerodromes
10. The alternative flow is ended

### 3.3.2.2.10UC 1:7 / VFR flight in the traffic circuit with an arriving IFR flight with simultaneous movements on another aerodrome

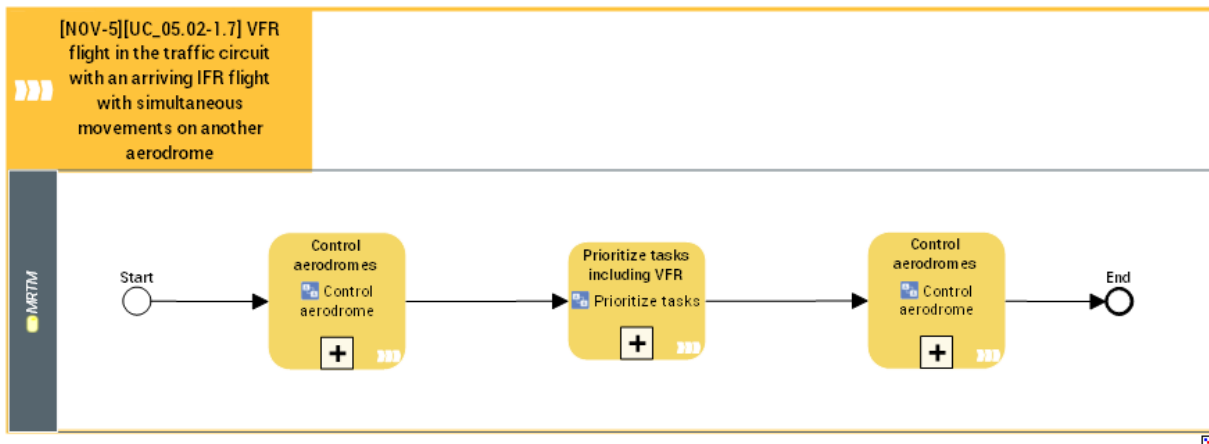


Figure 14 Use Case 1:7

#### General conditions

This use case describes how to provide ATIS to a VFR flight in the traffic circuit while there is an arriving IFR flight to another aerodrome with simultaneous movements in the MRTM

#### Pre-conditions

The ATCO is in control and in contact with all involved aircraft at the same time and the pilots are able to follow clearances

#### Post conditions

The ATCO provides a safe and efficient service to all involved aircraft and involved pilots are able to perform their tasks.

#### Actors

ATCO, flight crew (pilots) and vehicle drivers

#### Operating method / main flow

1. A VFR flight is flying in the traffic circuit at one of the aerodromes connected to the MRTM
2. An IFR flight is arriving to another connected aerodrome to the MRTM in which there is also other activity ongoing e.g. an aircraft, with the intention of departing, requesting pre-flight information or starting up or possibly a vehicle requesting to perform a runway inspection.
3. The ATCO is in control of all movements at the different aerodromes
4. The ATCO can prioritize and sequence the movements in order to maintain a safe and controlled air traffic service to all aerodromes
5. The ATCO follows up on the movements and is ready for a new movement



6. The use case is ended

**Operating method / alternative flow**

7. The ATCO has to prioritize the existing movements
8. The ATCO, in order to avoid overload, keep other movements out of the flow by e.g. keeping vehicles outside the manoeuvring area, keeping aircrafts on ground rather than departing a third movement, etc
9. When traffic so permits the ATCO take care of new movements at the different aerodromes
10. The alternative flow is ended

### 3.3.2.2.11 UC 1:8 / ATCO planning of movements and workload supported by short term planning tool

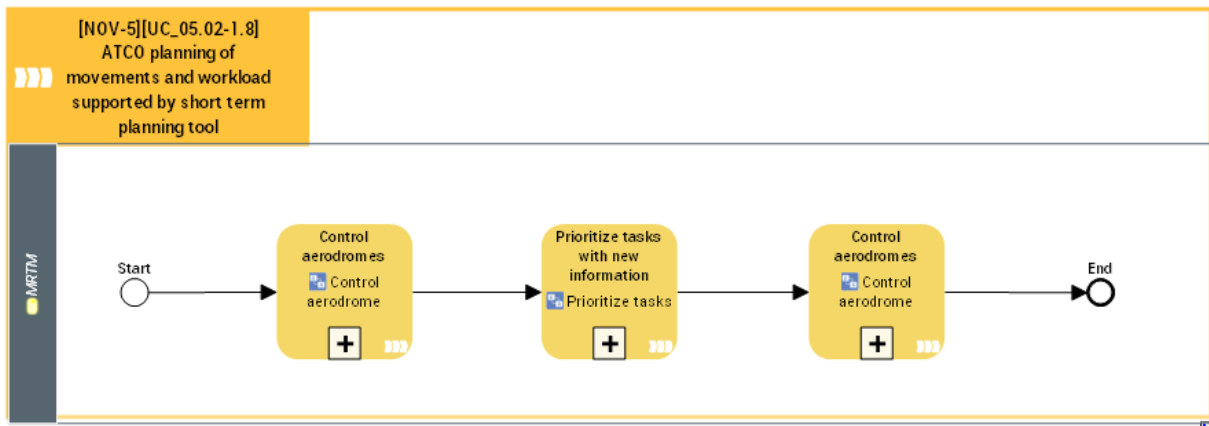


Figure 15 Use Case 1:8

#### General conditions

This use case describes how the ATCO is supported by planning tools in order to plan movements and workload up to 6 hours ahead to avoid task overload.

#### Pre-conditions

The MRTM has a short term planning tool enabling the ATCO with a possibility to plan beyond the horizon of 30 minutes.

#### Post conditions

The ATCO plans and prioritizes tasks for all aerodromes connected to the MRTM.

#### Actors

ATCO, flight crew (pilots) and vehicle drivers

#### Operating method / main flow

1. Movements are already active at the different aerodromes, e.g. vehicles on the manoeuvring area, aircrafts in traffic circuit, aircrafts getting ready for departure.
2. The ATCO becomes aware of new movements that will appear in 30 minutes, e.g. several arrivals/departures at one or both aerodromes, a VFR with plan to make continuous touch & go landings, TGL, snow sweeping (or causing a need for snow sweeping)
3. The ATCO prioritizes ahead of time by e.g. introducing snow-sweeping prior to a future landing/departure, informs a lawn mower about arriving traffic further ahead, limits the TGL landing to a lower number of TGLs or introduces a split in advance to hand over one aerodrome to another ATCO in another MRTM
4. The movements are prioritized and sequenced with minor delays, e.g. approach is asked to extend arrivals, asking a VFR to enter a holding or exiting the CTR

Founding Members



5. The ATCO follows up the situation and ensures that vehicles are ready in time or that aircrafts acts as requested according to demand or hands over an aerodrome in a split.
6. The use case is ended

**Operating method / alternative flow**

7. The movements pop up unexpected for the ATCO
8. The ATCO has to prioritize existing movements and actions needed to ensure there requests. That leads to a situation where e.g. arriving traffic has to be cleared in to a holding pattern, departures has to wait at stand/apron or wait for split where another ATCO is ready for taking over one of the aerodromes in another MRTM
9. Existing tasks are reduced or another ATCO is ready to take over one of the aerodromes and traffic can continue as requested
10. The alternative flow is ended



### 3.3.2.2.12 UC 1:9 / Failure of parts of the technical system building the Remote Tower Service, e.g. Camera view, screens, voice com

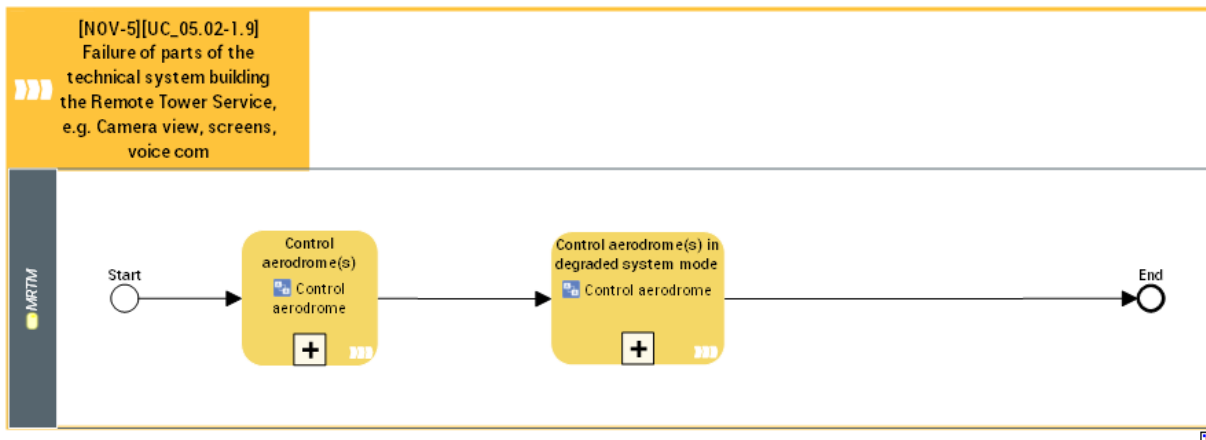


Figure 16 Use Case 1:9

#### General conditions

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.

#### Pre-conditions

The MRTM and airport equipment is functional and system failures are not limiting capacity when a degradation of a system occurs causing a reduction of capacity.

*Note: This use case has examples of system failures. System implementations need to find necessary mitigations and methods for continuous work in degraded modes.*

#### Post conditions

The aerodromes are open, even though limitations of traffic volumes may occur, with a degradation of the systems available for Remote Air Traffic Service.

#### Actors

ATCO, flight crew (pilots), vehicle drivers and technician.

#### Operating method / main flow

1. All, to the MRTM, connected aerodromes have traffic volumes without any kind of degradation of systems, causing a reduction on capacity.
2. The MRTM gets a screen failure, failure of flight-plan data or degradation at the airport such as camera failure or ILS u/s
3. The ATCO follows the check list for the concerned technical failure, which could imply e.g. any of the following actions;
  - a. implying traffic restrictions as needed, e.g.: keep aircraft on ground, delay arrivals;

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- b. report the failure to a technician;
  - c. if needed, coordinate with affected stakeholders.
4. The ATCO is able to control the situation with the actions taken in the degraded system mode and/or follow guidelines at system degradations at one or all of the aerodromes
5. The ATCO have an overview of the situation and is able to continue to handle traffic at all aerodromes, if needed with a limitation of number of movements due to system malfunction
6. The use case is ended

**Operating method / alternative flow**

7. The system degradation causes an increased workload which leads to a stop of all movements at both airports
8. The ATCO contacts the approach unit to stop arriving traffic and keeps any pending departing traffic on ground.
9. When limitations caused by the technical degradation are clear, the ATCO continues with traffic according to limitations caused by the systems. Example of mitigations can be, support by another controller, limitations of traffic or split of airports to another MRTM/MRTMs
10. The alternative flow is ended

### 3.3.2.3 Use cases solution 2

#### 3.3.2.3.1 UC 2:1 / Split of aerodromes within an MRTM to meet requested capacity.

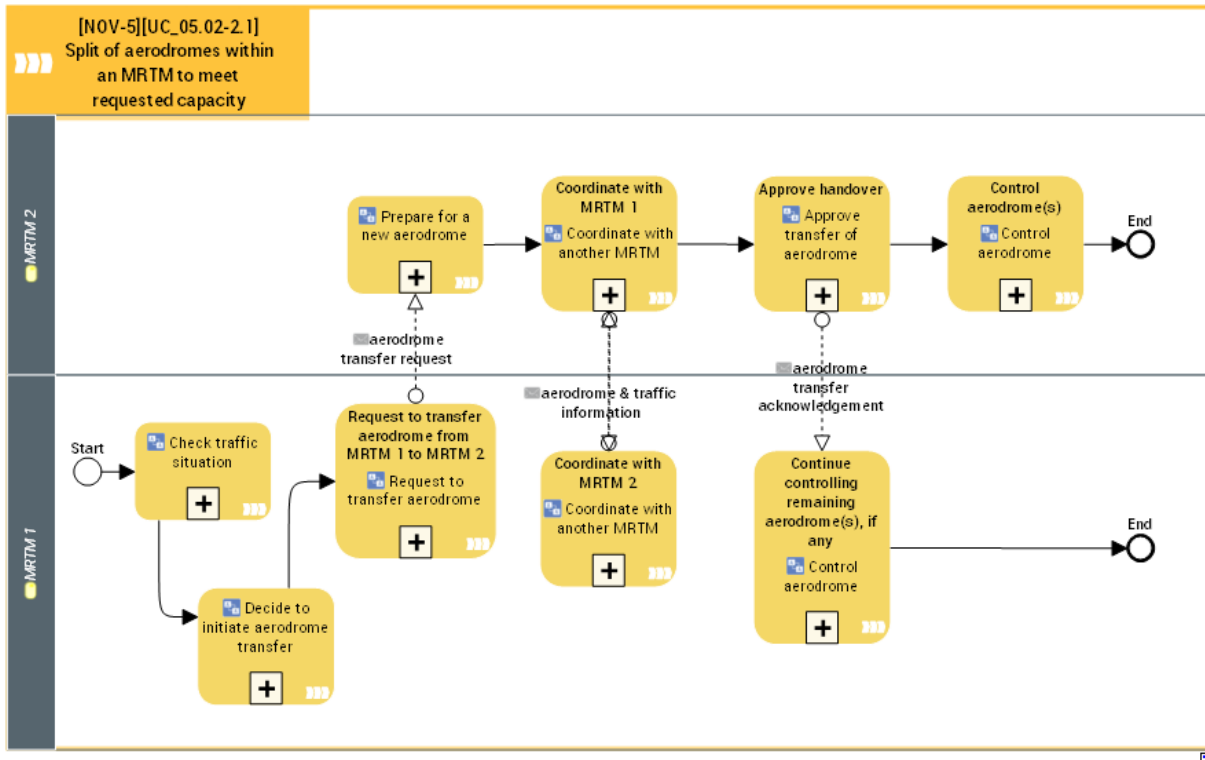


Figure 17 Use Case 2:1

#### General conditions

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

#### Pre-conditions

The ATCO has an overview of requested traffic levels over time (approximately 6 hours ahead) and plans for a split of the aerodromes to transfer one aerodrome to another ATCO in a spare MRTM, solution 2, or another ATCO in an MRTM within the RTC, solution 3.

#### Post conditions

The, to the MRTM, connected aerodromes are split up to meet requested traffic levels during a short or longer period of time with higher requests than capable for one ATCO from one MRTM.

#### Actors

ATCOs

#### Operating method / main flow

1. The ATCO is working with more than one aerodrome in the MRTM and movements are according to capacity
2. Levels of requested movements will be increased at one or both of the aerodromes causing a need to reduce the total amount of movements
3. The ATCO initiates a split of the aerodromes, prior to the situation where requested capacity is too high, by asking another ATCO (solution 3 will enable the Supervisor to support) to prepare for taking over one of the aerodromes in a spare MRTM.
4. The second ATCO is ready for the transfer in the spare MRTM
5. The ATCO working with traffic initiates the transfer of one of the aerodromes to the second ATCO in the spare MRTM and performs the transfer reducing the total level of traffic
6. The use case is ended

#### **Operating method / alternative flow**

7. The ATCO initiates the split too late, or the second ATCO is unavailable for taking over an aerodrome
8. Levels of traffic are too high causing problems for the ATCO to transfer an aerodrome, with the extra capacity needed for a transfer.
9. Traffic is limited by e.g. delaying of departures, stop of work at airports (on or near manoeuvring area), clearing arrivals in holding, until the levels are lower and the transfer can be initiated
10. The alternative flow is ended

### 3.3.2.3.2 UC 2:2 / Merge of aerodromes to one MRTM

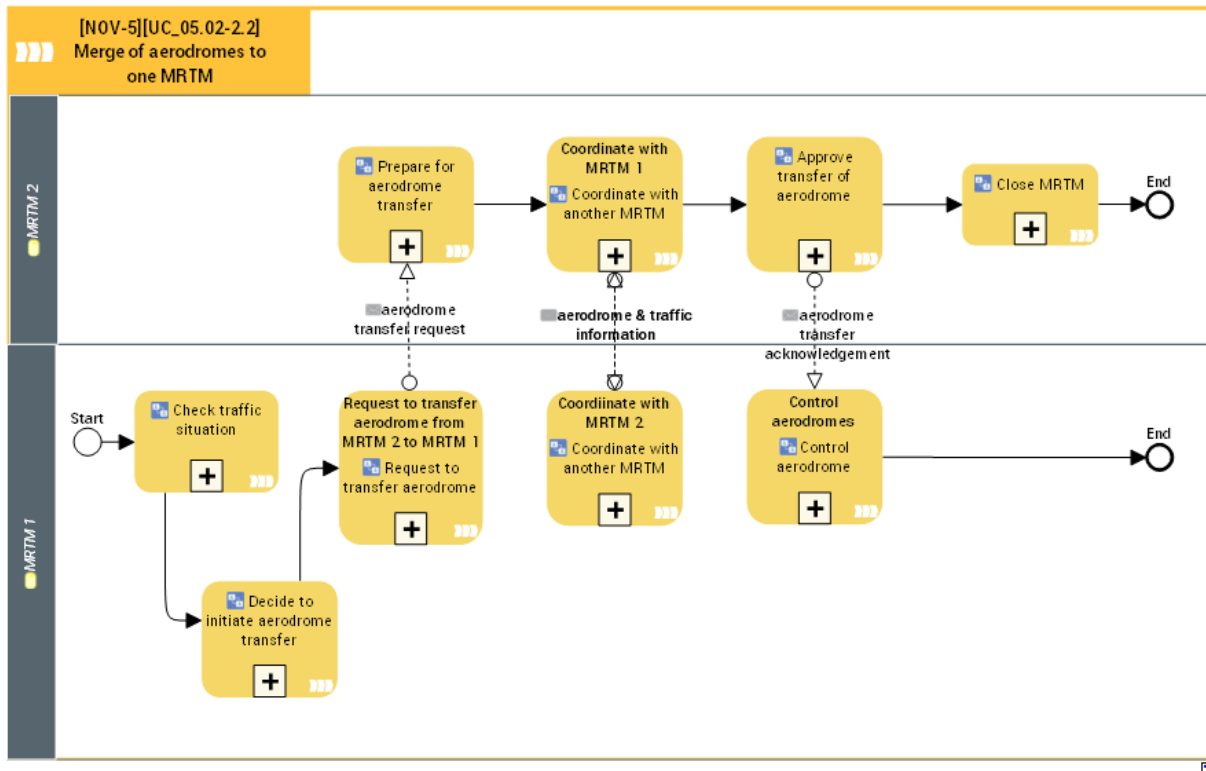


Figure 18 Use Case 2:2

#### General conditions

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.

#### Pre-conditions

Two ATCOs are working with aerodromes in different MRTMs and are able to merge them to one ATCO in one MRTM

#### Post conditions

One ATCO are working with the merged aerodromes from one MRTM

#### Actors

ATCOs

#### Operating method / main flow

1. Levels of traffic are at a low level for two ATCOs in different MRTMs
2. One of the ATCOs initiates a merge of the aerodromes in the different MRTMs
3. The ATCO taking over an aerodrome prepares for merge of a new aerodrome to the MRTM

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4. Traffic, technical status of the aerodrome and other needed information is communicated from the ATCO, whom is transferring an aerodrome
5. The ATCO in control of all, to the MRTM, connected aerodromes are in control
6. Aerodromes are merged and the use case is ended

**Operating method / alternative flow**

7. Levels of traffic are suddenly increasing or technical degradation at one of the aerodromes occurs
8. Both ATCOs stop the transfer process initiated by either one of them
9. The process of merging is reinitiated as soon as the situation is sorted out or is cancelled due to new requested tasks
10. The alternative flow is ended

### 3.3.2.3.3 UC 2:3 / Emergency Situation – Supported by other ATCO in the MRTM during the emergency situation

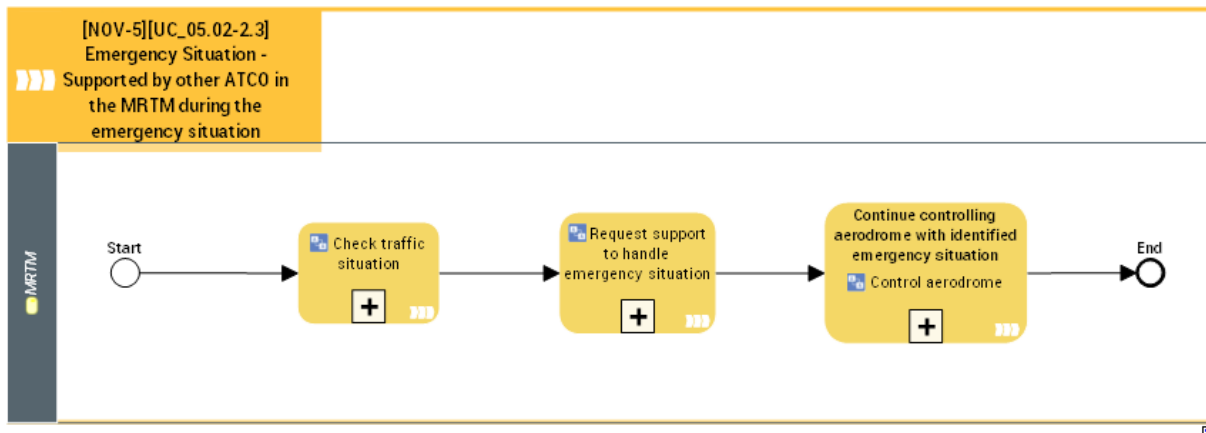


Figure 19 Use Case 2:3

#### General conditions

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)

#### Pre-conditions

The ATCO delivers air traffic service to the aerodromes when an emergency situation occurs, such as; aircraft arriving with one engine inoperable, flat tire after landing, fire on or in the vicinity of the aerodrome. The ATCO calls for support in the situation.

*Note, The emergency situations are only examples of situations that can occur.*

#### Post conditions

The ATCO is supported in the situation by another ATCO, not necessary with an endorsement on the aerodrome.

#### Actors

ATCOs

#### Operating method / main flow

1. All aerodromes are controlled by the ATCO from the MRTM
2. There is an aircraft arriving with engine failure on one engine, or there is a fire near the aerodrome
3. The ATCO calls for support from a colleague to have two persons having an overview of the situation and to support with the alarm service



4. The second ATCO, not operational in the MRTM (only support), assists the ATCO in control in the chain of alarming and coordination's that is initiated for an aircraft in distress
5. The aircraft in distress is able to land and can taxi, or be towed away (or fire is detected by fire brigade), and the alarm service is determined by both ATCOs
6. The use case is ended

**Operating method / alternative flow**

7. The ATCO is affected by a very high level of stress during the distressed situation
8. There is a need to replace the ATCO in charge with a new person to enable the MRTM to continue in multiple mode wherefore the support ATCO stays with the ATCO until someone who can take over is at place
9. The MRTM and aerodromes are handed over to the new ATCO wherefore both ATCOs involved in the situation is relieved from duty
10. The alternative flow is ended



### 3.3.2.3.4 UC 2:4 / Emergency Situation – Transfer of aerodrome to another MRTM

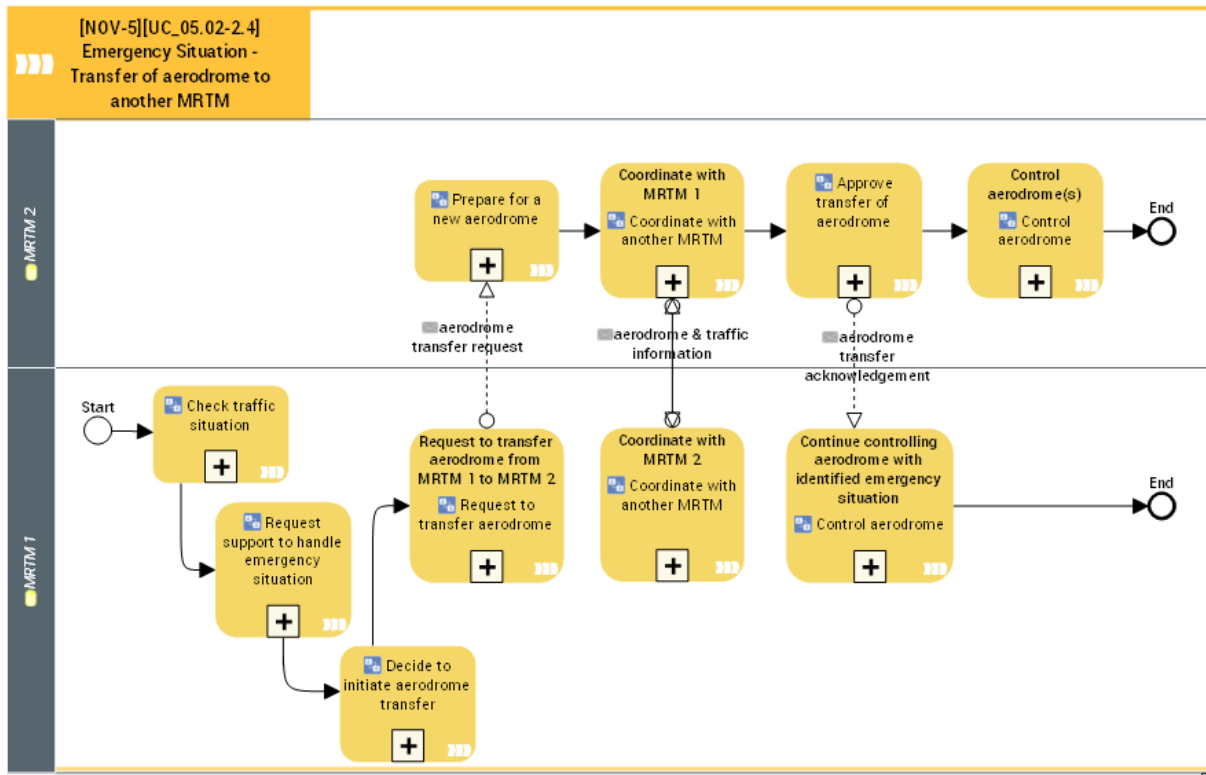


Figure 20 Use Case 2:4

#### General conditions

This use case describes the flow where there is an emergency situation at one of the aerodromes connected to MRTM which is mitigated by a split.

#### Pre-conditions

The ATCO delivers air traffic service to the aerodromes when an emergency situation occurs, such as; fire due to overheated brakes, flat tire after landing, aircraft arriving with com/failure, CF. The ATCO calls for a transfer of one of the aerodromes

*Note, The emergency situations are only examples of situations that can occur.*

#### Post conditions

The ATCO keeps on dealing with the aerodrome where the distressed situation is happening and has transferred the other aerodrome(s) to another ATCO in a spare MRTM.

#### Actors

ATCOs

#### Operating method / main flow

1. All aerodromes are controlled by the ATCO from the MRTM

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2. There is an aircraft which get a flat tire after landing (or overheated breaks causing a fire) at one of the aerodromes
3. The ATCO calls for back up of another ATCO to split the aerodromes to be able to focus on the distressed situation without losing capacity on the other aerodrome/aerodromes
4. Another ATCO arrives at a spare MRTM and start up all technical systems to get an overview of the entire situation and prepare for a fast transfer.

*Note1: The second ATCO could also start the process by checking the MRTM and with the ATCO where a situation occurs.*

*Note 2: The common solution is not to move a distressed situation to a second MRTM.*

5. Either one of the ATCOs initiates the transfer of the aerodromes depending on the situation and the aerodrome/aerodromes in normal operation is transferred
6. The use case is ended

#### **Operating method / alternative flow**

7. The ATCO is unable to get support from a spare ATCO to split the connected aerodromes
8. The ATCO cancel all arriving and departing traffic at any of the other aerodromes or reduces movements to a minimum to be able to focus on the distressed situation according to capacity for any other situation that could happen
9. When the situation is dealt with, the ATCO starts to increase traffic at the other aerodromes

*Note: There is a risk for a closure of an aerodrome depending on the abnormal situation*

10. The alternative flow is ended

### 3.3.3 Differences between new and previous Operating Methods

The difference between the new and previous operating method is mainly concerned with the ATCOs ability to provide ATS to more than one aerodrome simultaneously.

An ATCO provides ATS to one aerodrome in Single Remote Tower operations. Development aims to enable one ATCO to perform ATS to several aerodromes simultaneously. The ATCO needs to have knowledge of the procedures for all aerodromes in control. This is part of the endorsement training.

Detailed differences might occur depending on each technical system on the validation platforms. Focus for all solutions are to use the same rules and regulations that is applicable for local air traffic service at an aerodrome.

#### 3.3.3.1 Differences between new and previous Operating Methods in S 05.02


The difference between solution 02 and implemented single Remote Towers is capacity in Multiple Remote Tower mode and the number of aerodromes being controlled by a single ATCO. To meet the increased traffic, a planning tool for the ATCO is needed, to enable a capability to cope with the increased complexity. Different technical solutions will be used at the different sites to meet the operational needs.

# 4 Safety, Performance and Interoperability Requirements (SPR-INTEROP)

Requirements for PJ.05 build upon the SESAR 1 requirements related to the remote tower concept.

The relevant requirements from SESAR 1 that form the baseline for PJ.05 Solutions are presented in Appendix B “Single Remote Tower baseline requirements (from SESAR 1)”. This chapter presents the new requirements related to the PJ.05.02 Solution. The requirements have been developed, matured and validated within the PJ.05.02 validation activities and are now to be considered as final.

Several of the requirements are shared between solution PJ05.02 and solution PJ.05.03. These shared requirements are indicated by a requirement identifier beginning with “REQ-05.00-..”. Requirements that are specific to PJ05.02 are indicated as “REQ-05.02-“ in the beginning of the requirement identifier.

Note that some text and the REQ trace are hidden. Press  for the full text.

## 4.1 Performance Requirements (Common for S02/03)

[REQ]

Identifier	REQ-05.00-SPRINTEROP-PR01.0003
Title	KPA Cost Effectiveness, Multiple
Requirement	The Multiple Aerodrome Application part of the Remote Tower Concept shall reduce the direct cost of gate-to-gate ATM by 1,33%.
Status	<Validated>
Rationale	Through progressive implementation of new systems and procedures the European gate-to-gate ATM costs shall reduce.  Validation Targets for PJ.05-03 published in D4.8 PJ19: Validation Targets (2019). It means that CEF2 Validation target for PJ.05-02 and PJ.05-03 is 1.33 % and CEF3 Validation target for PJ.05-03 is 1.745 %.  Cost Effectiveness has not been assessed directly through the validation exercises. Instead the focus of the validation exercises has been to validate the assumption in the business case i.e. that it is operationally feasible to provide ATS from a remote location for multiple aerodromes.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
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< ALLOCATED_TO >	<Functional Block>	N/A
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

## 4.2 Multiple handling/procedures (Common for S02/03)

[REQ]

Identifier	REQ-05.00-SPRINTEROP-MP01.0001
Title	Handling high workload situations in Multiple
Requirement	<p>In case of an high workload situations, such as an emergency situation, at one of the airports - significantly increasing the ATCO/AFISO workload and affecting her/his capability to continue to provide ATS to all airports under responsibility - the ATCO may perform one of the following actions in order to be able to manage the high workload situation,:</p> <ul style="list-style-type: none"> <li>temporarily stop/delay traffic at the other/all airport(s),</li> <li>transfer the provision of ATS for the airport(s) not experiencing the unexpected event to another MRTM,</li> <li>request the support of another ATCO, to be able to continue the service provision for all aerodromes from the existing RTM.</li> </ul> <p>Note: The RTC Supervisor, if implemented in solution 03, may support the controller to apply these procedures.</p>
Status	<Validated>
Rationale	<p>Based on experiences gained during validation exercises and workshops.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-17.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-MP04.0001</b></p>
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-MP01.0002
Title	Airport clustering considerations in Multiple
Requirement	The clustering of aerodromes in an MRTM shall be done taking into account factors such as; traffic levels and complexity, aerodrome layout, geographical specificities, runway orientations/directions, operational procedures/conditions, weather patterns.
Status	<Validated>
Rationale	<p>Based on experiences gained during validation exercises and workshops.</p> <p>In order to identify/avoid any potential interactions that could potentially create confusions for ATCOs.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-26.</p> <p>This REQ originates partly from REQ.05.00_HPOps_16 of [HPAR].</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-MP04.0002</b></p>
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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< ALLOCATED_TO >	<Functional Block>	N/A
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< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-TM01.0004
Title	Spare controller – local definition of availability
Requirement	In case a back-up ATCO or an assistant is needed, the availability of the additional ATCO/assistant needs to be locally defined.
Status	<Validated>
Rationale	<p>Local assessment shall define the availability of the spare ATCO or assistant in order to ensure an appropriate response time in case of emergency/ complex situations.</p> <p>This REQ originates from [HPAR] REQ.05.00_HPops_13.</p> <p>REC.05.00_HPops9: Local guidelines with regard to when the support from an additional ATCO or assistant shall be asked for, shall be locally defined</p> <p>Rationale: REC.05.00_HPops9: The local guidelines are meant to support the ATCOs in making the right decision (avoiding reaching an overload). However, it is recommended that the decision remains with the ATCO, as inter-subject variabilities will influence the way an ATCO perceives workload as compared to another.</p>
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A

Founding Members



< ALLOCATED_TO >	<Functional Block>	N/A
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-TM01.0003
Title	Spare controller – local definition of roles, responsibilities and coordination
Requirement	If an additional spare ATCO or assistant is required, the corresponding roles and responsibilities and the coordination procedures shall be locally defined.
Status	<Validated>
Rationale	In order to ensure all actors understand and accept their roles and responsibilities as well as the corresponding tasks/ coordination.  This REQ originates from [HPAR] REQ.05.00_HPOps_12.
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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< ALLOCATED_TO >	<Functional Block>	N/A
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-TM01.0002
Title	Spare controller



Requirement	The simultaneous control of 3 aerodromes shall ensure the availability of a spare controller or an assistant, in case the termination of service is not locally acceptable.
Status	<Validated>
Rationale	The spare ATCO or assistant could assist the TWR ATCO in order to manage workload and prevent overload by supporting with communication and coordination tasks or by adding delays in traffic or reducing capacity for emergency or complex situations.  This REQ originates from [HPAR] REQ.05.00_HPOps_11.
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

### 4.3 Multiple Remote Tower Module (MRTM)

#### 4.3.1 General Requirements (Common for S02/03)

Requirements in this chapter are linked to enabler, AERODROME-ATC-79

[REQ]

Identifier	REQ-05.00-SPRINTEROP-CO01.0005
Title	Spare MRTMs
Requirement	The RTC should host enough MRTMs to be able to split all aerodromes, i.e. each aerodrome can be allocated to a single MRTM.
Status	<Validated>

Founding Members



Rationale	Splitting all aerodromes to separate MRTMs as a backup procedure allows safe provision of ATS in case that traffic or other factors increase workload to an amount that does not allow provision of ATS to multiple aerodromes.
Category	<Operational>,<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	A/G Voice Communication
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

### 4.3.2 Communications (Common for S02/03)

#### 4.3.2.1 Voice Communication System (VCS)

[REQ]

Identifier	REQ-05.00-SPRINTEROP-CO03.0003
Title	Aeronautical Mobile Service in Multiple
Requirement	When ATS is performed to more than one aerodrome simultaneously from one MRTM, the standard practise should be to cross-couple the aeronautical mobile service (air-ground communications) frequencies for all aerodromes being served from that MRTM.
Status	<Validated>
Rationale	<p>This is to avoid simultaneous transmissions on the different frequencies /aerodromes under the responsibility of one RTM.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-05, SR-07, SR-08.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-MC04.2001, REQ-06.09.03-OSED-MC04.2002 &amp; REQ-06.09.03-OSED-MC04.2003</b></p>

Category	<Operational>,<Safety>,<Human Performance>
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[REQ Trace]

Relationship	Linked Element Type	Identifier
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< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
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< ALLOCATED_TO >	<Functional Block>	A/G Voice Communication
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-CO03.0004
Title	Aeronautical Fixed Service in Multiple
Requirement	When ATS is performed to more than one aerodrome simultaneously from one MRTM, aeronautical fixed service (ground-ground communications) shall be extended to cover communications with all units relevant for all aerodromes being served.
Status	<Validated>
Rationale	<p>The ATCO must be able to communicate with all units relevant for all aerodromes being provided with ATS from the MRTM, in accordance with ICAO Annex 11, Chapter 6.2.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-08, SR-12, SR-13, SR-14.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-MC04.2004</b></p>
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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< ALLOCATED_TO >	<Functional Block>	G/G Communication Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-CO03.0006
Title	Surface Movement Control Service in Multiple
Requirement	When ATS is performed to more than one aerodrome simultaneously from one MRTM, the standard practise for the surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes) should be to transmit to aerodromes/frequencies individually (frequencies not to be cross-coupled).
Status	<Validated>
Rationale	<p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-08, SR-10, SR-11.</p> <p>REQ.05.00_HPdesign_9: Most ATCOs confirm that by having un-coupled frequencies on the ground, the risk of vehicle drivers assuming a wrong clearance (from another aerodrome) will significantly lower. The conclusion is attributed to the fact that vehicle drivers are less experienced with coupled frequencies, as opposed to pilots that have an appropriate training and practice, e.g. en-route).</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-MC04.2005 &amp; REQ-06.09.03-OSED-MC04.2006</b></p>
Category	< Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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Founding Members



<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	G/G Communication Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-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>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	G/G Communication Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

### 4.3.3 Visualisation (Common for S02/S03)

#### 4.3.3.1 General

[REQ]

Identifier	REQ-05.00-SPRINTEROP-VS01.0002
Title	Visual Presentation in Multiple
Requirement	<p>The ATCO shall have access to a visual presentation of all aerodromes under responsibility, covering (at least) the manoeuvring area and the aerodrome vicinity of each aerodrome.</p> <p>The visual presentations might either be placed side-by-side or on top of each other or in a combination of both.</p>
Status	<Validated<
Rationale	<p>In case the ATS unit is also responsible for the provision of apron management services, the visual presentation would also need to cover the respective aprons. Even if the ATS unit is not providing apron management services, there could be an operational need/benefit to access a view of the aprons.</p> <p>For details on what the operator needs to be able to see with help of the visual presentation, see the lower level requirements under section “Visualisation – Quality”.</p> <p>The vicinity of an aerodrome is defined in Doc 4444 as: “aircraft in, entering or leaving an aerodrome traffic circuit”.</p> <p>The manoeuvring area is defined in Doc 4444 as: “that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons”.</p> <p>In order to fulfil the task of keeping watch by visual observation while not being physically present at the aerodrome, a technical solution is needed that presents visual sensor data - collected from the aerodrome and its vicinity and transmitted to the remote tower facility - to the ATCO/AFISO in a way that provides him/her with the situational awareness required for conducting the associated services. This technical solution will be termed the Visual Presentation.</p> <p>This requirement is valid in both daylight and darkness, however dependent on the visibility conditions at the aerodrome and its vicinity. (Note: Personnel /objects without its own light source may be difficult to detect during darkness.)</p>

	<p>This requirement is also valid in all weather conditions (the most common except for the very extreme/unusual weather phenomena) existing at the particular aerodrome.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-VG03.1001</b></p>
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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<ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
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<ALLOCATED_TO >	<Activity>	N/A
<ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC
<ALLOCATED_TO >	<Role>	Tower Runway Controller
<ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-VS02.0008
Title	Possibility to scan/view all parts of the CTR
Requirement	The binocular functionality or the Visual Presentation (the latter by enabling a possibility to turn/pan the view) shall allow the ATCO to scan the remaining part of the CTR (in case not a 360 degree view is provided by default).
Status	<Validated>
Rationale	<p>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.).</p> <p>This REQ originates from REQ.05.00 HPdesign_22 of the [HPAR].</p> <p>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. (REC.05.00_HPdesign16)</p>

	In order to avoid having the ATCO "look" for a location. (Rationale:REC.05.00_HPdesign16)
Category	<Operational>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	Out of the Window
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

### 4.3.3.2 Quality

### 4.3.3.3 Augmentation

[REQ]

Identifier	REQ-05.00-SPRINTEROP-VG01.0002
Title	Overlay: Visual Presentation Digital Overlays in Multiple
Requirement	The visual presentation should include digitally overlaid additional information to provide the ATCO a greater level of situational awareness and minimise head down time (as further detailed in requirements REQ-05.00-SPRINTEROP-VG01.0004, REQ-05.00-SPRINTEROP-VG01.0005, REQ-05.00-SPRINTEROP-VG01.0006, REQ-05.00-SPRINTEROP-VG01.0007 and REQ-05.00-SPRINTEROP-VG01.0009).
Status	<Validated>
Rationale	To facilitate provision of ATS to multiple aerodromes, the importance of this requirement has been raised to a higher level compared to when ATS is provided to a single aerodrome only.  The aim with this requirement is to present additional information directly in the visual presentation (compare with head up displays in aircrafts) in



	<p>order to minimise ATCO/AFISO head down time (as further detailed in requirements REQ-05.00-SPRINTEROP-VG01.0004, REQ-05.00-SPRINTEROP-VG01.0005, REQ-05.00-SPRINTEROP-VG01.0006, REQ-05.00-SPRINTEROP-VG01.0007 and REQ-05.00-SPRINTEROP-VG01.0009).</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-33, SR-35, SR-36, SR-37.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-MV04.3001</b></p>
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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<ALLOCATED_TO >	<Functional Block>	Out of the Window
<ALLOCATED_TO >	<Role>	Tower Runway Controller
<ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-VG01.0004
Title	Overlay: Visual and radar tracking in Multiple
Requirement	The visual presentation should include overlaid symbols/boxes/labels facilitating detection and identification of objects capable of movement and relevant for the service provision.
Status	<Validated>
Rationale	<p>To facilitate provision of ATS to multiple aerodromes, the importance of this requirement has been raised to a higher level compared to when ATS is provided to a single aerodrome only.</p> <p>This requirement targets objects such as aircraft, vehicles, personnel, obstructions, birds etc. on the manoeuvring area and in the vicinity of the aerodrome.</p>

	<p>Objects not relevant for the service provision would include e.g. vehicles outside of the manoeuvring area / outside the aerodrome premises.</p> <p>Such symbols and labels can be based on;</p> <ul style="list-style-type: none"> <li>• surveillance information (from radars, ADS-B etc), targeting cooperative targets (commonly referred to as “radar tracking” or “radar labels”),</li> <li>• visual information (system detection of moving objects in the visual presentation), targeting all moving objects, including also non-cooperative targets in the visual field of view (commonly referred to as “visual tracking” or “box and follow”),</li> <li>• or a combination of the two above.</li> </ul> <p>In order to only present relevant targets for the service provision (i.e. to not present disturbing information), there may be a need to mask some areas in the visual field, e.g. aprons, roads or other areas outside of the aerodrome premises, airspace/sky outside CTR etc.</p> <p>The exact configuration of these overlays is to be determined in the scope of local implementations.</p> <p>The importance of this requirement is dependent on total traffic density and ATCO work load and is likely to be more advantageous in a high density environment.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-36.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-MV04.3101</b></p>
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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<ALLOCATED_TO >	<Functional Block>	Out of the Window
<ALLOCATED_TO >	<Role>	Tower Runway Controller
<ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

Founding Members



[REQ]

Identifier	REQ-05.00-SPRINTEROP-VG01.0005
Title	Overlay: RWY/TWY/apron designators/markings in Multiple
Requirement	The visual presentation should include overlaid information to indicate / high light runways, taxiways and aprons.
Status	<Validated>
Rationale	<p>To facilitate provision of ATS to multiple aerodromes, the importance of this requirement has been raised to a higher level compared to when ATS is provided to a single aerodrome only.</p> <p>This requirement primarily targets runway (in relation to the RWY direction in use or to all RWY directions), taxiway and apron <b>designators</b> to support the ATCO in a multiple environment.</p> <p><b>Framing</b> of runways, taxiways and aprons could be useful during darkness and low visibility conditions (but are not specifically related to Multiple).</p> <p>The exact configuration of these overlays is to be determined in the scope of local implementations.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-MV04.3102</b></p>
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	Out of the Window
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-VG01.0006
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Founding Members



Title	Overlay: Meteorological and other operationally relevant information in Multiple
Requirement	The visual presentation should include meteorological and other operationally relevant overlaid information.
Status	<Validated>
Rationale	<p>To facilitate provision of ATS to multiple aerodromes, the importance of this requirement has been raised to a higher level compared to when ATS is provided to a single aerodrome only.</p> <p>Information types/classes may e.g. include:</p> <ul style="list-style-type: none"> <li>- Meteorological: current wind, QNH and RVR values (in relation to the RWY direction in use or to all RWY directions), met reports.</li> <li>- Operational: UTC clock, airport names/designators, cardinal / compass directions.</li> </ul> <p>During landing or departure the ATCO provide correct wind information (according to doc 4444) to aircrafts. Easy access to wind information support ATCOs in heads up time and enables focus in departure/touch down area.</p> <p>The ATCO must be able to access correct UTC time without a loss of situation awareness while searching for the information.</p> <p>The ATCO must be able to have support information presenting which aerodrome the ATCO has under control at each time. Validation results have shown that that information support ATCOs.</p> <p><b>REC.05.00_HPdesign3:</b> The full airport name should be displayed both in the Visual Presentation (VP) and the radar display in order to easily link OTW view, radar display and EFSS info.</p> <p><b>Rationale: REC.05.00_HPdesign3:</b> To allow the ATCOs to easily associated the display of information to the corresponding aerodrome.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-42.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-MV04.3103</b></p>
Category	< Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
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Founding Members



<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	Out of the Window
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-VG01.0007
Title	Overlay: Digital Intensity and On/Off Status Adjustments
Requirement	It shall be possible for the ATCO to toggle on/off as well as adjust light intensity of any overlaid information in the visual presentation, for each overlay type/category and each aerodrome separately.
Status	<Validated>
Rationale	Based on validation feedback. It is particularly important to be able to dim such overlays during darkness so as not to dazzle the operator  <b>Initially addressed in SESAR1 REQ-06.09.03-OSED-MV04.3001</b>
Category	< Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	Out of the Window
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

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Identifier	REQ-05.00-SPRINTEROP-VG01.0009
Title	Overlay HF design principles.
Requirement	The overlay options shall be embedded on the VP 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.  This REQ originates from REQ.05.00_HPdesign_23 of [HPAR].
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	Out of the Window
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

### 4.3.3.4 Binocular Functionality

[REQ]

Identifier	REQ-05.00-SPRINTEROP-BF01.0001
Title	Binocular Functionality in Multiple
Requirement	A binocular functionality, giving the possibility to zoom/enlarge specific areas and objects in the visual presentation / area of responsibility, shall be provided for each aerodrome under responsibility.
Status	<Validated>

Rationale	<p>ICAO Doc 9426 (Planning manual), Appendix B, (Aerodrome Control Tower Equipment Checklist) states binoculars as equipment.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-41.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-VS02.3004</b></p>
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
<ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
<ALLOCATED_TO >	<Activity>	N/A
<ALLOCATED_TO >	<Functional Block>	Out of the Window
<ALLOCATED_TO >	<Role>	Tower Runway Controller
<ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

### 4.3.4 Other ATS Functions/Systems (Common for S02/03)

#### 4.3.4.1 Surveillance

[REQ]

Identifier	REQ-05.00-SPRINTEROP-FN01.0001
Title	Surveillance Data in Multiple
Requirement	Surveillance data shall be provided to ATCO to support tasks for all aerodromes. Air surveillance data is mandatory while ground surveillance is optional.
Status	<Validated>
Rationale	<p>This requirement originates from SR-31 of [SAR] and is applicable for the environment that was validated within PJ05. Local assessment might confirm that no surveillance data is required.</p> <p>ICAO Doc 4444, Chapter 7.1.1.2</p>

	<p>Eurocontrol Manual for AFIS Chapter 3.1.2</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-FN02.5001</b></p>
Category	< Operational>,<Safety> ,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

### 4.3.4.2 E-strip System

[REQ]

Identifier	REQ-05.00-SPRINTEROP-FN02.0001
Title	Systems - Electronic Flightstrips integration
Requirement	The ATCO should be provided with an integrated presentation of the electronic flight strips for all aerodromes controlled from the MRTM.
Status	<Validated>
Rationale	<p>ICAO Doc 4444 Chapter 4.13</p> <p>E-strip is a supportive tool in the Multiple environment.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-FN03.3001</b></p>
Category	< Operational>

[REQ Trace]

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Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

### 4.3.4.3 ATIS

[REQ]

Identifier	REQ-05.00-SPRINTEROP-FN03.0001
Title	Systems - ATIS
Requirement	The ATCO workload should be reduced by availability of an automated ATIS for all aerodromes being controlled from the MRTM
Status	<Validated>
Rationale	Automated ATIS will support and reduce workload in a Multiple environment.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

Founding Members

### 4.3.5 Technical Supervision (Common for S02/03)

[REQ]

Identifier	REQ-05.00-SPRINTEROP-TS01.0002
Title	Alarms and alerts – HF design principles
Requirement	Alarms and alerts shall be developed in line with HF design principles.
Status	<Validated>
Rationale	To ensure appropriate visibility and user friendliness, without confusions. This REQ originates from REQ.05.00_HPdesign_25 of the [HPAR].
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	Technical Supervision ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-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	<p>The symmetry of information between the aerodromes would help the ATCO easily identify the relevant information.</p> <p>This REQ originates from REQ.05.00_HPdesign_26 of the [HPAR].</p>
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	Technical Supervision ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

### 4.3.6 ATCO Planning Tools

[REQ]

Identifier	REQ-05.00-SPRINTEROP-AP01.0001
Title	ATCO Planning tool
Requirement	<p>The ATCO shall be presented with planning information (e.g. forecasted traffic, forecasted weather, etc.) in order to adjust/plan traffic to any constraints or foresee the need for a split of the merged aerodromes.</p> <p>At the same time the planning information also allows the ATCO to foresee the possibility for a merge of aerodromes in one MRTM.</p>
Status	<Validated>
Rationale	SESAR 1 results delivered a need of a tool to support the ATCO with a forecast of e.g. traffic, weather, airport work that affect the workload in situations when serving more than two low density aerodromes simultaneous.

	<p>The need for this tool is to cover a more complex Multiple Remote Tower environment.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-46.</p>
Category	<Operational>,<Human Performance>,<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

### 4.3.7 Automation Functionalities

[REQ]

Identifier	REQ-05.00-SPRINTEROP-AF01.0001
Title	Search Airport
Requirement	The ATCO should be provided with an indication of a radio transmission related to an aerodrome, e.g. either in the visual presentation or the flight strip system
Status	<Validated>
Rationale	<p>Human Machine Interface design can support ATCO in situational awareness by presenting visual and/or sound to enhance Voice Com transmissions from the aerodromes connected to the MRTM.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-06.</p>

	REQ.05.00_HPdesign_8: As for the visual input, the ATCOs shall be able to easily distinguish the information associated to each of the aerodromes they are controlling.
Category	<Operational>,<Human Performance>,<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.03
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC
< ALLOCATED_TO >	<Functional Block>	A/C Voice Communication
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

## 4.4 Transfer/Merging

### 4.4.1 General (Common for S02/03)

[REQ]

Identifier	REQ-05.00-SPRINTEROP-TM02.0001
Title	Transfer of aerodromes - Split (or close MRTM)
Requirement	The ATCO shall be able to transfer one of the controlled aerodromes to another MRTM.
Status	<Validated>
Rationale	<p>There is a need to split aerodromes in case of high workload due to e.g. increased traffic load, emergency situations.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-20.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-RTC3.0006</b></p>

Category	< Operational>,<Safety>,<Human Performance>
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[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-TM02.0002
Title	Transfer of aerodromes - Merge (or open MRTM)
Requirement	The ATCO shall be able to take over an aerodrome to one MRTM.
Status	<Validated>
Rationale	<p>There is a need to be able to merge aerodromes when work load permit's.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-20.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-RTC3.0006</b></p>
Category	< Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC

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< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.02-SPRINTEROP-TM02.0004
Title	Transfer of aerodrome between MRTMs – duplicated/shared view
Requirement	During Transfer of an aerodrome both ATCOs shall be presented with the same information on the aerodrome being transferred with all available technical systems as replicas until the transfer is performed.
Status	<Validated>
Rationale	<p>There is a need for both ATOs to have a correct overview of aerodromes to be merged or split in order to maintain a correct situational awareness.</p> <p>The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-20.</p> <p><b>Initially addressed in SESAR1 REQ-06.09.03-OSED-RTC3.0007</b></p>
Category	< Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.02-SPRINTEROP-TM02.0005
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Title	Transfer of aerodromes – transfer procedures
Requirement	Transfer procedures (for the transfer of an aerodrome between MRTMs) shall be locally defined with a clear description of the associated roles and responsibilities and corresponding coordination procedures.
Status	<Validated>
Rationale	To ensure all actors involved are aware of their responsibilities and associated tasks.  This REQ originates from [HPAR] REQ.05.00_HPtraining_32.  The following safety requirement(s) of [SAR] comply with this OSED requirement: SR-20.
Category	<Operational>,<Safety>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

[REQ]

Identifier	REQ-05.00-SPRINTEROP-TM02.0006
Title	Dimming/removing inactive aerodromes
Requirement	The ATCO shall be able to visually distinguish which aerodromes are active or inactive (e.g. grey out, removing the inactive one).  NOTE: For PJ05.03 the possibility to grey out information is not an option – only the "removal" from the screen of the inactive aerodrome.
Status	<Validated>



Rationale	The possibility to grey out the inactive aerodrome or to remove it from the display would remove the non-relevant information from the ATCOs visual range, allowing the focus on the active aerodromes.  This REQ originates from REQ.05.00_HPdesign_2 of [HPAR].
Category	<Operational>,<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
< ALLOCATED_TO >	<SESAR Solution>	PJ.05.02
<SATISFIES>	<Information Exchange>	N/A
< ALLOCATED_TO >	<Activity>	N/A
< ALLOCATED_TO >	<Functional Block>	CHMIM Aerodrome ATC
< ALLOCATED_TO >	<Role>	Tower Runway Controller
< ALLOCATED_TO >	<Sub-Operating Environment>	Airport Low Utilisation Simple/Complex Layout

*This section has to be filled in only for V2 and V3 phases, with increased refinement and consolidation.*

*Requirements shall be developed according to the SESAR 2020 Requirements and Validation Guidelines. SE-DMF environment aligns to these Guidelines and will facilitate the capturing of SE data according to the SESAR 2020 Requirements and Validation Guidelines*

# 5 References and Applicable Documents

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## 5.1 Applicable Documents

### Content Integration

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- [1] B.04.01 D138 EATMA Guidance Material
- [2] EATMA Community pages
- [3] SESAR ATM Lexicon

### Content Development

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

### System and Service Development

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- [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

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- [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

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[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

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[25]SESAR 2020 Requirements and Validation Guidelines

#### Safety

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[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

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[30]16.06.05 D 27 HP Reference Material D27

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

#### Environment Assessment

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[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

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[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)

## 5.2 Reference Documents

Founding Members



- [37]ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.<sup>1</sup>
- [38]SESAR 1 P06.08.04-D94-OSED Single Remote TWR Ph2 – Final Update, Edition 00.07.01, Dated 27/07/2016
- [39]SESAR 1 P06.09.03-D32 SAR for Multiple Remote Tower (two low density aerodromes), Edition 00.01.01, Dated 18/11/2015
- [40]SESAR 1 P06.09.03-D28 HP for Multiple Remote Tower (two low density aerodromes), Edition 00.01.01, Dated 01/09/2015
- [41]The Convention on International Civil Aviation, Annex 11, Air Traffic Services, Chapter 2.30 (Amendment 46)
- [42]ICAO Document 4444 “Procedures For Air Navigation Services - Air Traffic Management”, Sixteenth Edition, 2016 (Amendment 8, 08 November 2018)
- [43]ICAO Document 9426 “Air Traffic Services Planning Manual”, 1st Edition, December 1992
- [44] SESAR1 P06.09.03-D35 “OSED for Remote Provision of ATS to Aerodromes”, Edition 00.06.02, Dated 20/11/2015
- [45] LSD.02.03 D03 – RACOON Demonstration Report, Edition 01.01.00, Dated 19/12/2016
- [46] LSD.02.04 D03 – Remote Towers Demonstration Report, Edition 00.02.00, Dated 06/12/2016
- [47] LSD.02.05 D03 – RTO Demonstration Report, Edition 00.02.00, Dated 31/10/2016
- [48] LSD.02.10 D03 – Budapest 2.0 Demonstration Report, Edition 01.00.20, Dated 19/12/2016

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<sup>1</sup> *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).*

## Appendix A Cost and Benefit Mechanisms

### A.1 Stakeholders identification and Expectations

Stakeholder	Involvement	Why it matters to stakeholder
ANS providers	ANSPs will be able to implement the systems	ANSPs expect a reduction of cost for running local air traffic service at aerodromes
Staff union and organisations (ETF/IFATCEA)	ATCOs will be the end user of the system	Staff working in a MRTM and RTC will be affected when working with more than one aerodrome at a time. Their expectations are that the technology will ensure that daily work can be performed safe and controlled.
ATM infrastructure and equipment suppliers	The technology set new demands on a reliable system for Multiple Remote Tower	Industries is affected by new requirements on multiple remote towers and the need for stable systems
Airspace users	Airspace users fly to and from aerodromes with RTC and Multi Remote Tower	Traffic to and from airports expect to continue to traffic aerodromes without impact on scheduled traffic with a kept availability for each of the aerodromes controlled in Multiple mode
Affected NSA	NSA will issue approval for any new ANS systems	NSA expect that any new technology is safe and stable for air traffic service and that methodology is properly adapted to the technology
Airport owners/providers	Airport owners are customers to ANS providers	Airports expect prices for ANS to be lowered with Multiple Remote Tower without a negative impact on their availability for flying customers.

**Table 13: Stakeholder’s expectations First Activities Approach**

### A.2 Benefits mechanisms

Benefit mechanisms are the same for solution 2 and solution 3. The final outcome will increase in solution 3 compared to solution 2 with the introduction of the Remote Tower Centre.

#### A.2.1 Cost Efficiency

The main driver for Remote Provision of ATS for multiple aerodromes is Cost Effectiveness (the blue boxes in Figure 108). However, this is NOT proved through the validation activities. Rather the validation activities are used to validate the assumption in the business case i.e. that it is operationally feasible to provide ATS from a remote location to multiple aerodromes. Maintaining Operational Feasibility depends most on Safety, Human Performance and Capacity and so it is those areas that are further explored.

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Figure below illustrates the above logic for how the project hopes to assess CEF through operational feasibility.

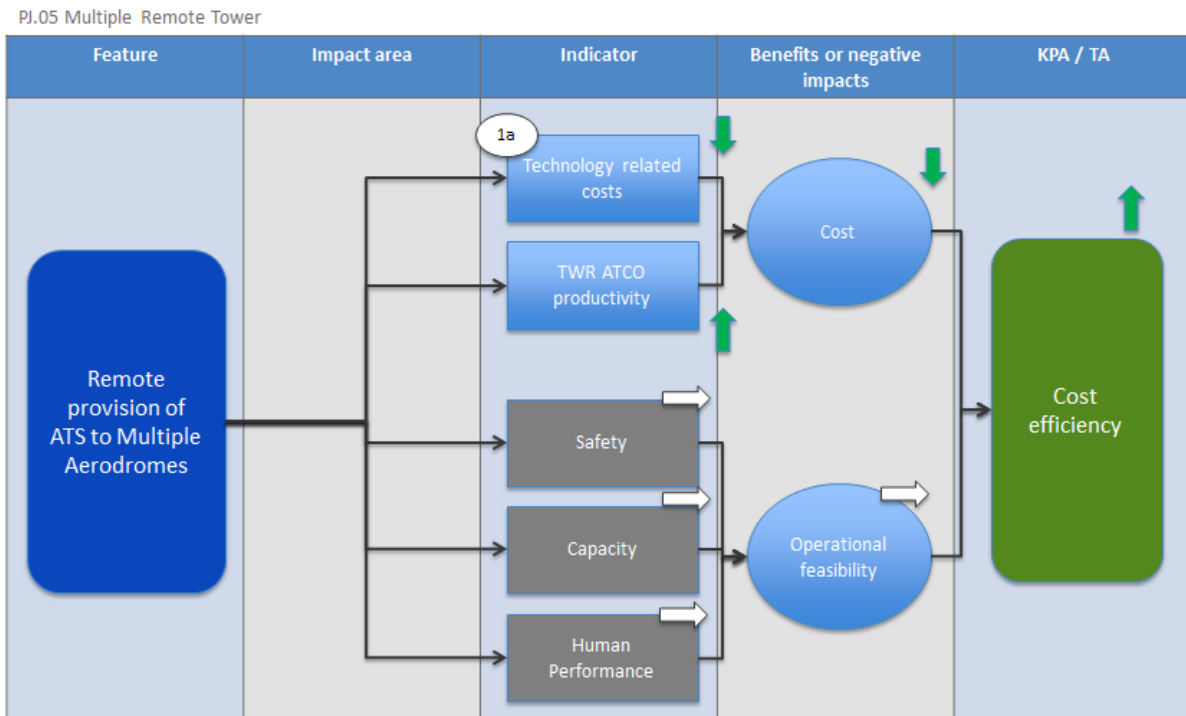


Figure 21: Benefit and Impact Mechanisms for Cost Effectiveness

1a and 1b) Technology related TWR costs comprise of operational engineering staff costs, system-related capital and operating costs. It is envisaged that these costs will decrease due to the centralisation of resources and systems.

2a and 2b) TWR Controller Productivity involves increasing safe throughput for a given level of operational resourcing. The remote provision of ATS for multiple aerodromes involves raising the number of flights that an individual controller can handle safely. The technical enablers within the RTM are designed to help the controller increase their situational awareness and decrease the workload.

3a, 3b, 4a, 4b, 5a, 5c) In order to assess Cost Effectiveness, the Operational Feasibility of the Multiple Remote Tower concept shall be assessed (the grey boxes in Figure 101). In order to prove the concept is operationally feasible the validation activities primarily assess the KPAs safety, human performance and capacity.. The validation activities therefore look at these performance areas rather than cost effectiveness directly. These are detailed in the sections below.

## A.2.2 Safety

Multiple Remote Tower will keep safety levels for local Air Traffic Service. The new tools and features described as visual reproduction and advanced visual features aim to give the controller a level of situational awareness that is needed for service from the MRTM.

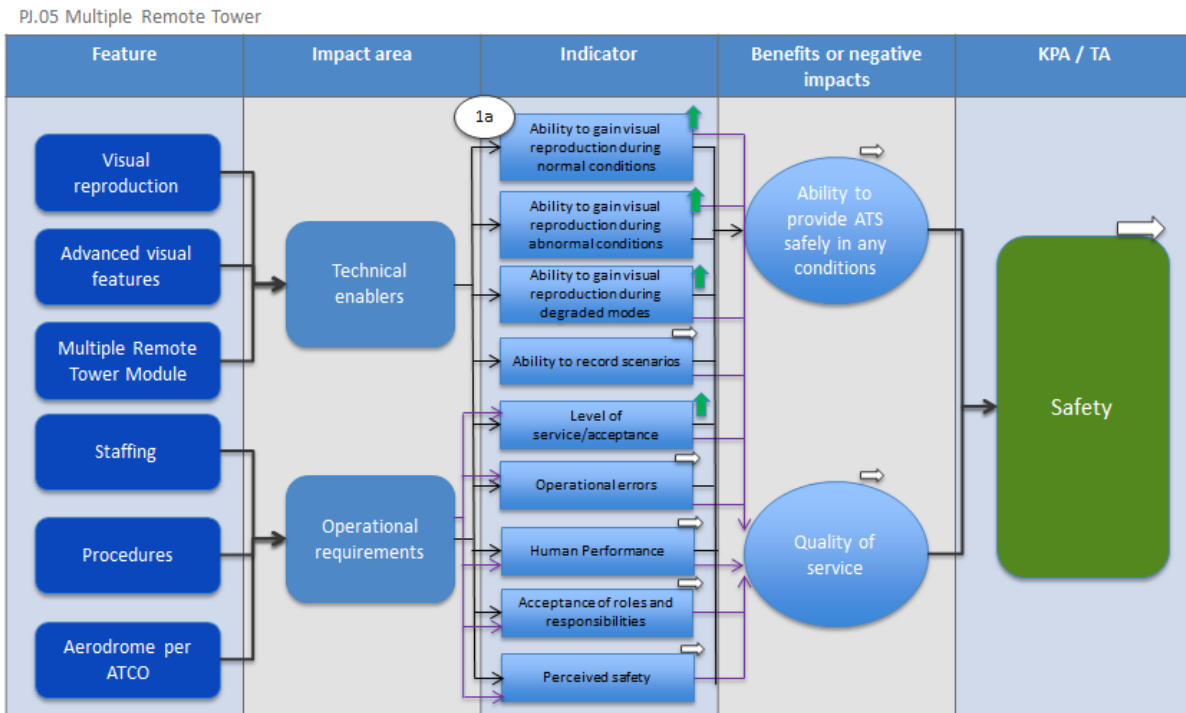


Figure 22: Benefit and Impact Mechanisms for Safety

Safety features already evolved for Single Remote will be baseline for Multiple Remote Towers and are already safe and implemented. A possibility to split aerodromes from MRTM to Single Remote Towers keep Multiple Remote Towers safe.

NOTE: The inclusion of Quality of Service in this Benefit Impact Mechanism is to indicate that in addition to gaining awareness of ability to provide **any** service in various modes a good quality of service can safely be provided e.g. a dramatic reduction in capacity or service quality is not the primary means by which safety is maintained.

1a) Visual reproduction of the local aerodrome is a key part of the solution. A camera mast (or similar visual reproduction) will be placed at the airport relaying the visual reproduction to screen/screens in the MRTM in the RTC.

1b) To enhance the visual reproduction, advanced visual features will be introduced such as; object bounding, radar tracking, IR and PTZ cameras.

1c) Controllers will control from the MRTM which includes the screens for visual reproduction and the CWP with all the necessary ATS systems.

1d) Staffing of the controllers will change with the introduction of the remote provision of ATS for multiple aerodromes. Endorsements will need to be considered as they may require change. The shift pattern and staffing levels may change.

1e) Local procedures might change with the introduction of the remote provision of ATS for multiple aerodromes. New methods of operation during multiple control and detailed training will have to be included into the new procedures for operating all of the features in the MRTM.

1f) The number and size of aerodromes per controller is new. This will largely relate to safety and how many aerodromes the controller can safely handle.

2a) The ATCO must be able to gain sufficient information from the visual reproduction in order to make their decisions and provide their services during normal conditions. The advanced visual features will supplement the visual reproduction and give the controller access to more information.

2b) The ability to provide visual reproduction during normal conditions will affect the ability to provide ATS services in any conditions. The airspace users should be provided with the same level of services as if the ATS were provided from a single RTM. The visual reproduction shall support the recognition task.

2c) The visual reproduction during normal conditions should maintain the level of service provided in single Remote Towers. Alternative methods may be used in order to provide the service but the level of ATS should be the same. For example, the PTZ camera will use a functionality corresponding to (and being at least/equally easy and quick to use) as the binoculars in a conventional Tower, giving the possibility to zoom/enlarge specific areas and objects in the visual presentation.

3a) The ATCO must be able to gain sufficient information from the visual reproduction in order to make their decisions and provide their services during non-nominal conditions. The advanced visual features will supplement the visual reproduction and give the controller access to more information.

3b) The ability to gain visual reproduction during low visibility conditions should increase with the introduction of new AVF such as the IR camera. .

4a) The ATCO must be able to gain sufficient information from the visual reproduction in order to make their decisions and provide their services during degraded modes of operation. New technology such as electronic flight strips or advanced visual features could supplement the visual reproduction and give the controller access to more information.

4b) The ability to gain visual reproduction during degraded modes of operation should increase with the introduction of new AVF such as the IR camera and electronic flight strips. .

5a) The concept will introduce the ability to record visual information; this will create enhanced and unique opportunities to support incident/accident investigators when working at aerodromes.

5b) If better investigations are possible after certain scenarios/incidents then the result will be better safety systems. Controllers and airspace users will be able to learn from incidents/accidents and can put in place working methods to stop them from reoccurring.

6a) The technical enabler system must provide the controller with sufficient information in order to maintain the level of service currently provided by the controller. The technical system must be accepted by the controller.

7a) Any technical enabler system errors including malfunctions, bugs, error messages etc. will have a negative effect on human performance

7b) If there are too many errors (system and human) then this will affect the ATCO capacity and safety.

7c) Errors will also affect the quality of service. If multiple errors are incurred then the quality of service provided will deteriorate.

8a) The usability and utility of the technical enabler system with all the features involved will have an impact on human performance.

8b) ATM is critically dependent on the day-to-day performance of front-line personnel, such as controllers, supervisors and other operational staff. Effective human performance at the front line enables the ATS service to be supplied safely and efficiently.



8c) Human Performance is used to denote the human capability to successfully accomplish tasks and meet job requirements, maintaining/ increasing the quality of service provided in Multiple Remote Towers, as per PJ05.

9a) The controllers will have a perception of the safety of the technical enabler system. This includes how safe they believe each feature is.

9b) The new roles and responsibilities will affect quality of ATS remotely to multiple aerodromes. The acceptance of transitioning between roles must be clearly understood, managed and accepted and will directly impact the quality of service provided.

10a) The operational impacts of the concept including the staffing levels, procedures and the number of aerodromes per controller will affect the user acceptance (pilots and controllers) of the concept and the level of service that the controllers can safely provide. The airspace users should be provided with the same level of service as if the ATS were provided from a Single Remote Tower.

10b) By identifying areas where the service users feel there are risks or lower levels of safety, the quality of the service can be improved. Perceived safety includes safety of the equipment and also safety of the organisational factors such as resources, training, policies and procedures.

11a) The new operating method may cause errors. Technical and operational errors will be recorded.

12a) The number of aerodromes a controller has jurisdiction over will affect the human performance of the controller including the workload, situational awareness and trust in the concept.

There is a limit on the amount of endorsements that an ATCO can maintain due to needed practise at each airport which has to be decided locally.

### A.2.3 Capacity

Aerodrome capacity will not change with Multiple Remote Tower Operations. The same procedures apply for providing aerodrome control service as with operations from a local tower. In general, traffic demand will be below aerodrome capacity at small to medium sized aerodromes.

As aerodromes can be transferred to a different MRTM the required capacity can always be met. The main question is about how many airports can be controlled at a time by one ATCO. That will affect

cost-effectiveness (but not airport capacity).

PJ.05 Multiple Remote Tower

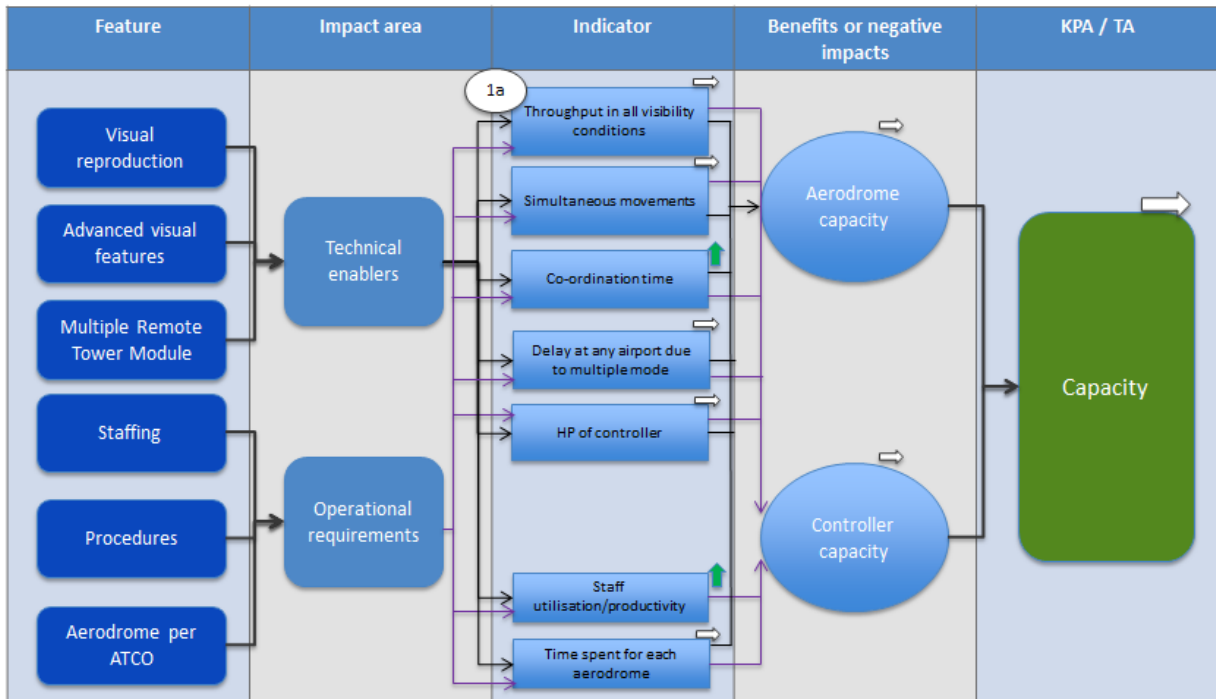


Figure 23: Benefit and Impact Mechanism for Capacity

In current operations, opening and closing ATCO positions at a local tower in order to balance traffic demand and ATCO workload is a standard procedure (which is now only extended to be applied over multiple aerodromes).

Nevertheless, the following aspects should be highlighted:

- Throughput in all weather conditions  
The visual presentation may include infrared images that enhance ATCO situation awareness in low visibility conditions. But as the pilot still has to cope with low visibility conditions, no increase in capacity is to be expected.
- ATCO workload / human performance  
Increasing traffic volumes and other factors can increase ATCO workload while at the same time system design and support tools will increase human performance. ATCO and Supervisor planning tools aim to ensure that airports are transferred in time to a different MRTM if forecasted workload at a certain MRTM is too high.  
The impact will therefore be on cost-effectiveness rather than on capacity.
- Simultaneous runway operations at different airports  
It needs to be validated to what extent simultaneous runway operations (simultaneous landings and take-offs at different airports) are feasible.  
Procedures might be introduced in order to limit simultaneous runway operations (e.g. delay departure) that might impose some delay to certain flights. If there is a forecasted expected impact on capacity, airports can be transferred in time to a different MRTM.  
The impact will therefore be on cost-effectiveness rather than on capacity.

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- Local procedures  
depending on specific local factors, local procedures might need to be adjusted to multiple remote tower operations (e.g. change in use of traffic patterns). Validations will show potential factors that need to be considered. It has already shown that this needs to be evaluated on a case-by-case basis.

ATCO “capacity” is not part of this KPI but addressed in Human Performance

2c) Performance and operational conditions will directly affect what the ATCO in terms of the number of movements they are able to control. Controlling multiple aerodromes may reduce the human performance of the ATCO for one of the airports (comparing single remote tower), however the addition of advanced visual features should improve controller performance. Hence the ATCOs ability to handle a certain number of movements per hour (capacity) should remain unchanged.

3a) The level of support provided by the system through system tools or aids is expected to have an impact on the number of aerodromes or traffic level an ATCO can operate in parallel. Additional functionality such as monitoring aids, advanced controller tools and advanced visual features could all potentially increase the maximum number of aerodromes a single ATCO could operate in parallel.

### A.2.4 Human Performance

Human Performance is a key factor for Multiple Remote Towers and the goal is to keep all indicators on the same level as in single remote towers. Capacity and Safety are closely related to Human Performance affected of the outcome from the indicators.

PJ.05 Multiple Remote Tower

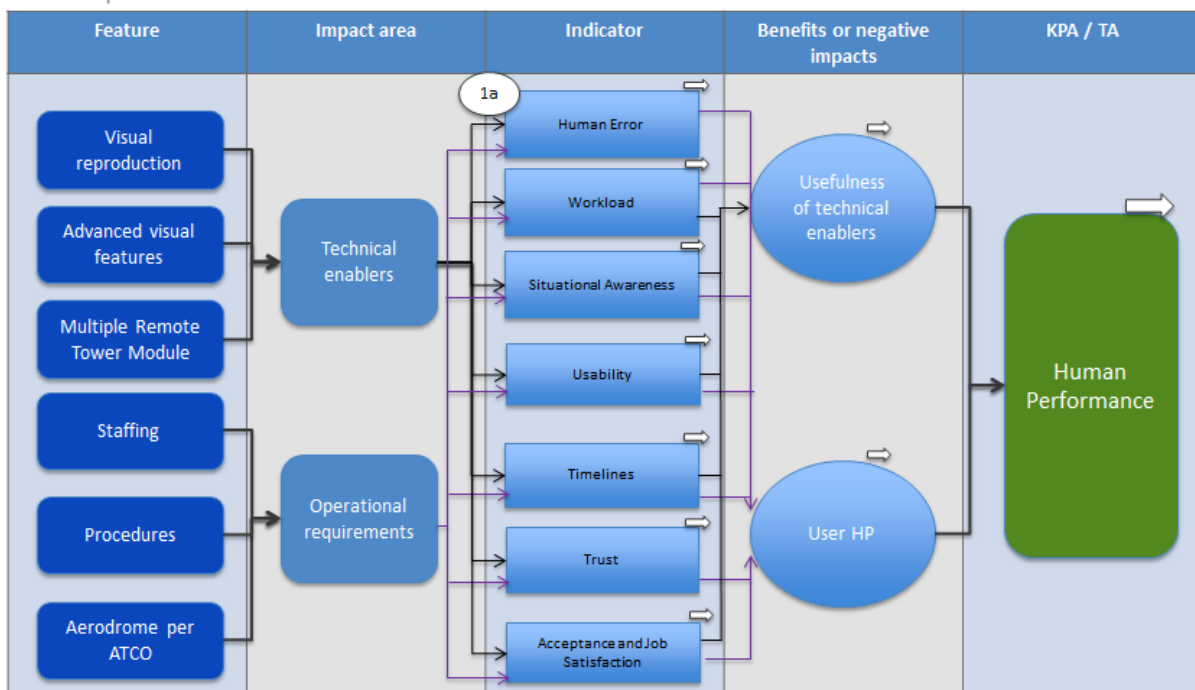


Figure 24: Benefit and Impact Mechanism for Human Performance

1a) Visual reproduction of the local aerodrome is a key part of the solution.

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- 1b) To enhance the visual reproduction, advanced visual features will be introduced such as visual overlays, radar tracking, IR and PTZ cameras.
- 1c) Controllers will control from the MRTM which includes the screens for visual reproduction and the CWP with all the necessary ATS systems.
- 1d) Staffing of the controllers will change with the introduction of the remote provision of ATS for multiple aerodromes. Endorsements for each aerodrome will be needed. The shift pattern and staffing levels might change.
- 1e) Local procedures might change with the introduction of the remote provision of ATS for multiple aerodromes. New local procedures might have to be introduced to cover how the switch is made from one MRTM to another during multiple control and has to be included into the new procedures for operating all of the features in the MRTM.
- 1f) The number of aerodromes per controller is a new aspect. This is directly related to human performance and what the controller can safely handle.
- 2a) The complexity of the technical enabler system will affect the number of errors the controller will make. The more usable and simple (harmonized) the system is, the less likely the controller is to make mistakes.
- 2b) The number of operational errors a controller makes contributes to their human performance. The fewer the errors made, the greater the human performance.
- 3a) The stability of the system will affect the confidence the controllers have that the system is providing them with the correct and accurate information. The controllers will have more confidence in the system if it is reliable and robust.
- 3b) The confidence the controller has in the system depends on the technical capability of the system. The system must work accurately and be robust in difficult situations which will lead to controller confidence.
- 3c) The human actors' level of confidence in the new concept / new procedures must be appropriate, that is, neither too high nor too low.
- 4a) The usability and operability of the Multiple Remote Provision platform must be acceptable, i.e. the system is user friendly.
- 4b) The controller's view on the acceptance of the platform is related to the system's capability.
- 4c) Acceptance and job satisfaction, changes in competence requirements, impact on staff levels and shift organisation, and the need for re-location of the work force will all affect controller's human performance.
- 5a) Technical issues with the system will lower the controller trust. Functional Alarm systems and back-up systems will increase trust which will increase human performance.
- 5b) Trust of the system will depend on how accurate and reliable the output information is. Alarm systems and back-up systems will increase trust which will increase human performance.
- 5c) Trust relates to the level of confidence the human actors have in the new / changed tasks & procedures etc. The human actors' level of confidence in the new concept / new procedures must be appropriate, that is, neither too high nor too low.
- 6a) Stress may be induced due to the complexity of the technical enabler system. A complex system may increase workload which could have negative effects on stress.

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6b) Controller stress depends on how complex and usable the platform is. If the system is robust and provides the controller with all the information he requires (neither too much nor too little), this will lead to less stressful situations brought on by technology.

6c) Stress has a direct relation to human performance. If a controller is excessively stressed this may negatively affect their performance.

7a) The visual reproduction in conjunction with the AVF aim to improve the controller's situational awareness by providing them with enough, if not more, information compared to the conventional tower. The system must be usable so that features do not take a long time to operate and situational awareness remains high.

7b) Situational awareness depends on the system capability and robustness. The layout of the CWP and the usability of the HMI will also affect situational awareness so that the controllers have information readily available. As much "heads up" controlling as possible is necessary for the controller to maintain a solid traffic picture.

7c) Situational awareness is a contributor to the human performance and safety of service the controller provides.

8a) The ease of using the platform and the usability and utility of the technical enablers will directly impact workload.

8b) The workload of the controller will be affected by how usable the system is and how much of the controller workload is removed by the system's AVF.

8c) The workload is directly related to the user human performance. If the workload is excessively high the human performance of the controller may be negatively impacted.

10a) Confidence of the controllers will be impacted by the procedures, new roles and responsibilities and how comfortable they are.

11a) The controllers and pilots must find the new concept acceptable from an operational point of view as this will affect the human performance of the controller. This includes the procedures, staffing, organisation and training.

12a) The operational requirements will affect the trust of the controller. The controller must be able to trust the procedures and policies. If the controller is not content with the operational aspect of the concept, this will affect the human performance.

13a) The operational requirements of the concept will affect the stress levels of the controller. Increasing the number of aerodromes will increase the stress levels of the controller as the workload and situational awareness will have to increase.

14a) The operational requirements of the concept will affect the situational awareness of the controller. The increase in the number of aerodromes being controller by a single ATCO will require an increase in situational awareness.

15a) The operational requirements of the concept will affect the workload of the controller. The more aerodromes a single controller has under his/her control, the higher the workload and larger need of buffer. The efficiency of procedures and the training will also affect controller workload.

## A.3 Costs mechanisms

### Technology related costs

Cost for installation of a Remote Technology Systems is compared to installation of a conventional tower. Maintenance for the remote system is compared to a conventional tower.

### TWR ATCO productivity

Tower ATCO productivity in Multiple Remote Tower is measured in comparison with a single ATCO in a conventional Tower situated at the aerodrome. A remote solution with one ATCO controlling 2 or 3 aerodromes from a Multiple Remote Tower working position has a possibility to reduce costs for staff. Different rostering is possible in an environment where several controllers are controlling several aerodromes.

### Safety

Safety is the most important objective for Multiple Remote Tower. It is closely interlinked with Human Performance. Building a functional Human Machine Interface will therefore impact safety.

### Capacity

Aerodromes in focus for validation need to maintain capacity wherefore measurements are made on the capability for one ATCO to maintain the requested capacity for 2 or 3 aerodromes simultaneously.

*Note: In situations with a higher request than normal, such as peak time or emergency situations, other precautions might be needed, e.g. closing of an aerodrome, split of the multiple service or slot allocation of movements.*

### Human Performance

Human Performance is measured in Human Machine Interface design. ATCO acceptance of tools and features in the Multiple Remote Tower Module will show the results.

### Cost

Cost can be reduced with new technology and a decrease in running cost for the ATM system. Added benefits are a possibility for new aerodromes to get ATS compared to with conventional towers.

### Operational feasibility

Safety and capacity can be kept with focus on Human Performance in design of the MRTM.

## Appendix B Single Remote Tower baseline requirements (from SESAR 1)

This Appendix contains the Single Remote Tower baseline requirements from SESAR 1 - forming the baseline for Multiple Remote Tower. The requirements listed below/herein are fully replicated from the final SESAR 1 OSED (SESAR Solution PJ05.02 SPR-INTEROP/OSED for V3 - Part I – D94 – Edition **Error! Unknown document property name. – 15/07/2016**), **unless specified by red text.**

### B.1 Overall Concept Requirements

Identifier	REQ-06.09.03-OSED-BC01.0008
Requirement	For each Remote & Virtual Tower application, minimum Security Management levels and applicable minimum security measures <b>shall</b> be defined, in order to maintain airport operations at or above the current local operations level.
Title	KPA Security
Status	<Validated>
Rationale	Security Management systems are already a regulatory requirement on ANSPs, however needs to be expanded to cover e.g. for the transmission of remote airport data. Security measures is to be determined in the scope of local implementations, but may include controls such as; <ul style="list-style-type: none"> <li>- Data Input Credibility and Authentication,</li> <li>- Data Encoding / Encryption.</li> <li>- Technical controls against different threats such as viruses, malware, Trojans, electromagnetic interference etc.</li> <li>- Alternate Supply Systems.</li> </ul> A Security Risk Assessment Report have been produced by WP16.06.02, under “06.03.01 Remote and Virtual Tower Security Risk Assessment”, Edition 00.00.02, 09/12/2013.
Category	<Design><Security>
Validation Method	<Expert Group (Judgement Analysis)><Analytical Modelling>
Verification Method	<Analysis>

Identifier	REQ-06.09.03-OSED-BC01.0009
Requirement	The Remote & Virtual Tower Concept <b>shall</b> contribute to the overall cost reduction of the European gate-to-gate ATM, by reducing costs for performing ATS at aerodromes.
Title	OFA06.03.01 KPA Cost Effectiveness, general
Status	<Validated>

Rationale	<p>Through progressive implementation of new systems and procedures the European gate-to-gate ATM costs shall reduce, as stated in the Airport Detailed Operational Descriptions for Step 1 and Step 2, produced by P06.02.00.</p> <p>This requirement is refined in separate cost reduction figures for SESAR Step 1 (SDM-0201) and SESAR Step 2 (SDM-0204 &amp; SDM-0205) respectively, in accordance with the requirements given in WP6.2 DOD Step 1 &amp; Step 2; see the respective Single, Multiple &amp; Contingency Concept Requirements Sections below.</p> <p>Cost Effectiveness has not been assessed directly through the validation exercises, with the cost benefit analysis task being performed externally to P06.09.03 and P06.08.04. (P06.09.03 contributed to an Analysis of Costs and Benefits (ACB) which was used to provide input towards the P16.06.06 full Airport CBA, which in turn gave the figures as detailed in WP6.2 DOD requirements.) Instead the focus of the validation exercises has been to validate the assumption in the business case i.e. that it is operationally feasible to provide ATS from a remote location. Also, a cost benefit analysis will be dependent on the implementation environment and is something where a generic assessment may not prove to be useful. As the concept of Remote aerodrome ATS (within all the three concept applications of Single, Multiple and Contingency) has been proven feasible by P06.09.03, this requirement is considered being validated.</p>
Category	<Design>
Validation Method	<Expert Group (Judgement Analysis)><Analytical Modelling>
Verification Method	<Analysis>

Identifier	REQ-06.09.03-OSED-BC01.0010
Requirement	The Remote & Virtual Tower Concept <b>shall</b> contribute to the overall improvement of uniformity of ATM services.
Title	KPA Interoperability
Status	<Validated>
Rationale	Operate on the basis of uniformity throughout Europe Applying standards and uniform principles, and ensuring the technical and operational interoperability of aircraft and ATM systems.
Category	<Interoperability><Design>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	<Analysis>

## B.2 General Service Requirements

*This section presents applicable regulatory, operational and functional requirements that exist on the service in order to provide ATS for aerodromes, regardless of whether that service is performed locally or remotely, such as requirements originating from current ICAO regulations. Hence all the requirements presented in this section apply for the RVT concept.*

### B.2.1 Communications

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Identifier	REQ-06.09.03-OSED-CO02.1001
Requirement	The ATCO/AFISO <b>shall</b> use aeronautical mobile service (air-ground communications) in the area of responsibility, in accordance with ICAO Annex 11, Chapter 6.1.
Title	Aeronautical Mobile Service
Status	<Validated>
Rationale	ICAO Annex 11, Chapter 6.1  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR07.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-CO02.1002
Requirement	The ATCO/AFISO <b>shall</b> use aeronautical fixed service (ground-ground communications) in accordance with ICAO Annex 11, Chapter 6.2.
Title	Aeronautical Fixed Service
Status	<Validated>
Rationale	ICAO Annex 11, Chapter 6.2  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR06, SR09, SR11, SR12.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-CO02.1003
Requirement	The ATCO/AFISO <b>shall</b> use surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes) for the aerodrome(s) under control, in accordance with ICAO Annex 11, Chapter 6.3.
Title	Surface Movement Control Service
Status	<Validated>
Rationale	ICAO Annex 11, Chapter 6.3  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR08, SR10.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-CO02.1004
Requirement	The ATCO/AFISO <b>shall</b> be able to communicate via a signalling lamp with <del>the respective</del> aircraft <b>and vehicles at each aerodrome under responsibility</b> , in case of radiotelephony or data link communication failure, in accordance with ICAO Annex 14 section 5.1.3 / Eurocontrol Manual for AFIS section 4.2.2.3.2.  <i>Note: Requirement text adjusted compared to its appearance in S1 OSED to be in line with ICAO provisions (including communication with vehicles).</i>
Title	Signalling Light Gun Communication
Status	<Validated>
Rationale	In accordance with ICAO Annex 14 section 5.1.3 / Eurocontrol Manual for AFIS section 4.2.2.3.2.  ICAO Annex 14, Volume 1, chapter 5.1.3 (5.1.3.1 A signalling lamp shall be provided at a controlled aerodrome in the aerodrome control tower.) ICAO Annex 2, Appendix 1, chapter 4.1 (4.1 Light and pyrotechnic signals, Figure 1.1) Eurocontrol Manual for AFIS, 4.2.2.3.2 (4.2.2.3.2 When communications by a system of visual signals is deemed to be adequate, or in the case of radio-communication failure, the signals given hereunder shall have the meaning indicated therein:) Eurocontrol Manual for AFIS, Attachment A, 1.2 (1.2 The equipment in the AFIS unit should be the same as that required for an aerodrome control tower at an aerodrome with low traffic density.)  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR37.
Category	<Operational><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-CO02.1005
Requirement	Visual communication from aircraft on and in the vicinity of the aerodrome <b>shall</b> be used when/as applicable, in accordance with ICAO Doc 4444 Chapter 12.3.4.
Title	Visual Communication
Status	<Validated>
Rationale	The vicinity of an aerodrome is defined in Doc 4444 as: "aircraft in, entering or leaving an aerodrome traffic circuit".  ICAO Doc 4444 12.3.4 "Phraseologies for use on and in the vicinity of the aerodrome" defines; - showing landing lights as a possible means of "Identification of aircraft" (12.3.4.1) - and moving ailerons (or rudder), rocking wings or flashing landing lights as "acknowledgement by visual means (12.4.3.2).
Category	<Operational>

Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

## B.2.2 MET Functions & Procedures

Identifier	REQ-06.09.03-OSED-MT02.2001
Requirement	The ATCO/AFISO <b>shall</b> use relevant meteorological information, in accordance with ICAO Annex III, ICAO Annex 11 Chapter 7.1 and national regulations.
Title	Met Info
Status	<Validated>
Rationale	ICAO Annex III, ICAO Annex 11 Chapter 7.1 and national regulations.  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR23.  The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_001.
Category	<Operational><Safety><HMI>
Validation Method	<Live Trial><Shadow Mode><Expert Group (Judgement Analysis)>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-MT02.2002
Requirement	The current MET report, actual wind information, actual QNH and, if measured for the particular airport(s), RVR values <b>shall</b> continuously be presented to the ATCO/AFISO, in accordance with ICAO Doc 4444 Chapter 7.3.1.2 & ICAO Annex 11 Chapter 7.1.4.
Title	Met Info Presented
Status	<Validated>
Rationale	ICAO Doc 4444 Chapter 7.3.1.2 & ICAO Annex 11 Chapter 7.1.4.  This is essential information used frequently by the ATCOs/AFISOs to inform pilots in real time.  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR 24.  The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_001.
Category	<Operational><Functional><Safety><HMI>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-MT02.2003
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Requirement	The ATCO/AFISO <b>shall</b> advise aircraft of significant meteorological conditions in the take-off and climb-out area, except when it is known that the information has already been received by the aircraft, in accordance with ICAO Doc 4444 Chapter 7.4.1.2.2.
Title	Advising of Significant Met Conditions
Status	<Validated>
Rationale	<p>ICAO Doc 4444 Chapter 7.4.1.2.2 states that prior to take-off aircraft shall be advised of significant meteorological conditions in the take-off and climb-out area, except when it is known that the information has already been received by the aircraft.</p> <p>Significant meteorological conditions in this context are defined in ICAO Doc 4444 Chapter 7.4.1.2.2.</p> <p>Significant meteorological conditions can be either visually observed by the ATCO/AFISO or reported to the same from pilots, met-offices etc.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR 26.</p>
Category	<Operational><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

### B.2.3 Visualisation

Identifier	REQ-06.09.03-OSED-VS02.3001
Requirement	<p>The ATCO <b>shall</b>, from the remote location, apply ICAO Doc 4444, Chapter 7.1.1.2 and 7.1.1.2.1.</p> <p><b>7.1.1.2:</b> "Aerodrome controllers shall maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome as well as vehicles and personnel on the manoeuvring area. Watch shall be maintained by visual observation, augmented <b>when available in low-visibility conditions</b> by an ATS surveillance system <del>when available.</del>"</p> <p><b>7.1.1.2.1:</b> "Visual observation shall be achieved through direct out-of-the-window observation, or through indirect observation utilizing a visual surveillance system which is specifically approved for the purpose by the appropriate ATS authority."</p> <p><b>Note:</b> Requirement text adjusted compared to its appearance in S1 OSED in order to reflect the latest amendments of ICAO Doc 4444 (Amendment 8 to the Sixteenth Edition 2016, applicable as of 08 November 2018).</p>
Title	Visual Observation Doc 4444
Status	<Validated>

Rationale	<p>ICAO Doc 4444, Chapter 7.1.1.2 and 7.1.1.2.1.</p> <p>The vicinity of an aerodrome is defined in Doc 4444 as: “aircraft in, entering or leaving an aerodrome traffic circuit”.</p> <p>The manoeuvring area is defined in Doc 4444 as: “that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons”.</p> <p>Requirement valid for ATC (TWR) only.</p>
Category	<Operational>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VS02.3002
Requirement	<p>The AFISO <b>shall</b>, from the remote location, apply Eurocontrol Manual for AFIS Chapter 3.1.2:</p> <p><i>“AFISOs shall maintain a continuous watch by visual observation and an ATS surveillance system when authorized by and subject to conditions prescribed by the appropriate authority (see Appendix A), on all flight operations on and in the vicinity of an aerodrome as well as vehicles and personnel on the manoeuvring area.”</i></p>
Title	Visual Observation Eurocontrol Manual for AFIS
Status	<Validated>
Rationale	<p>Eurocontrol Manual for AFIS Chapter 3.1.2</p> <p>The vicinity of an aerodrome is defined in Doc 4444 as: “aircraft in, entering or leaving an aerodrome traffic circuit”.</p> <p>The manoeuvring area is defined in Doc 4444 as: “that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons”.</p> <p>Requirement valid for AFIS only.</p>
Category	<Operational>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VS02.3003
Requirement	<p>The ATCO/AFISO <b>shall</b> issue information (TWR &amp; AFIS) and clearances (TWR) with the object of preventing collisions (AFIS: assisting pilots in preventing collisions) between aircraft and obstructions on the manoeuvring area, in accordance with ICAO Doc 4444, Chapter 7.1.1.1, bullet point e) &amp; Chapter 4.5.1.1, Eurocontrol Manual for AFIS, 3.1.1, bullet point e).</p>
Title	Visual Observation Obstructions
Status	<Validated>

Rationale	<p>Doc 4444 – CHAPTER 7 – PROCEDURES FOR AERODROME CONTROL SERVICE</p> <p>Chapter 7.1.1.1: Aerodrome control towers shall issue information and clearances to aircraft under their control to achieve a safe, orderly and expeditious flow of air traffic on and in the vicinity of an aerodrome with the object of preventing collision(s) between: e) aircraft on the manoeuvring area and obstructions on that areas.</p> <p>Doc 4444 - 4.5 AIR TRAFFIC CONTROL CLEARANCES</p> <p>Chapter 4.5.1.1: Clearances are issued solely for expediting and separating air traffic and are based on known traffic conditions which affect safety in aircraft operation. Such traffic conditions include not only aircraft in the air and on the manoeuvring area over which control is being exercised, but also any vehicular traffic or other obstructions not permanently installed on the manoeuvring area in use.</p> <p>EUROCONTROL MANUAL FOR AFIS – CHAPTER 3 – PROCEDURES FOR AFIS</p> <p>Chapter 3.1.1: AFIS units shall issue information to aircraft in its area of responsibility to achieve a safe, orderly and expeditious flow of air traffic on and in the vicinity of an aerodrome with the object of assisting pilots in preventing collision(s) between: e) aircraft on the manoeuvring area and obstructions on that area.</p> <p>The manoeuvring area is defined in Doc 4444 as: "that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons".</p>
Category	<Operational>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VS02.3004
Requirement	A functionality corresponding to the binoculars in a traditional Tower, giving the possibility to zoom/enlarge specific areas and objects in the visual presentation / Area of Responsibility shall be provided, in accordance with ICAO Doc 9426 (Planning manual), Appendix B, (Aerodrome Control Tower Equipment Checklist).
Title	Binocular Functionality
Status	<Validated>
Rationale	<p>ICAO Doc 9426 (Planning manual), Appendix B, (Aerodrome Control Tower Equipment Checklist) states binoculars as equipment.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR19.</p> <p>The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_012.</p>
Category	<Operational><Safety><HMI>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

## B.2.4 NAV Functions

Identifier	REQ-06.09.03-OSED-NV02.4001
Requirement	The ATCO/AFISO <b>shall</b> monitor and adjust intensity and on/off status of visual navigational aids, in accordance with ICAO Annex 11 Chapter 7.3 & ICAO Doc 4444 Chapter 7.15.
Title	Visual Nav Aids
Status	<Validated>
Rationale	Visual navigational aids are; runway and field lighting systems as applicable to the aerodrome, such as approach, PAPI, runway, taxiway, RGL, stopway and obstacle lighting.  ICAO Annex 11 Chapter 7.3 ICAO Doc 4444 Chapter 7.15  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR21.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-NV02.4002
Requirement	The ATCO/AFISO <b>shall</b> monitor and adjust the status of non-visual navigational aids, in accordance with ICAO Annex 11 Chapter 7.3.
Title	Non-Visual Nav Aids
Status	<Validated>
Rationale	Non-visual navigational aids are; aerodrome NAV systems as applicable to the aerodrome, such as ILS LOC/GP, LO NDB, OM/MM/IM, VOR, DME).  ICAO Annex 11 Chapter 7.3  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR22.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

## B.2.5 Other ATS Systems / Functions / Procedures

Identifier	REQ-06.09.03-OSED-FN02.5001
Requirement	The ATCO/AFISO <b>should</b> access surveillance data, such as radar presentation, when available for the particular airport(s), in accordance with ICAO Doc 4444, Chapter 7.1.1.2 / Eurocontrol Manual for AFIS Chapter 3.1.2.

Founding Members



Title	Surveillance Data
Status	<Validated>
Rationale	ICAO Doc 4444, Chapter 7.1.1.2 Eurocontrol Manual for AFIS Chapter 3.1.2  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR13.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN02.5002
Requirement	The ATCO/AFISO <b>shall</b> access and handle ATS messages, in accordance with ICAO Doc 4444 Chapter 11.
Title	ATS Messages
Status	<Validated>
Rationale	ICAO Doc 4444 Chapter 11
Category	<Operational>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN02.5003
Requirement	The ATCO/AFISO <b>shall</b> access and update flight plan and control data for all flights being provided with the ATS service, in accordance with ICAO Doc 4444 Chapter 4.13.
Title	Flight Plan and Control Data
Status	<Validated>
Rationale	ICAO Doc 4444 Chapter 4.13  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR05.  The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: MRT_REQ_DS2.
Category	<Operational><Functional><Safety><HMI>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN02.5004
Requirement	The ATCO/AFISO <b>shall</b> monitor and manage accident, incident and distress alarms as applicable to the aerodrome(s), in accordance with ICAO Doc 4444 Chapter 7.1.2.

Founding Members





Title	Accident, Incident and Distress Alarms
Status	<Validated>
Rationale	ICAO Doc 4444 Chapter 7.1.2 The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR38.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN02.5005
Requirement	Correct time, in the format of hours, minutes and seconds in UTC, <b>shall</b> be continuously presented to the ATCO/AFISO), in accordance with ICAO Doc 4444 Chapter 7.3.1.2.
Title	UTC Time Presentation
Status	<Validated>
Rationale	ICAO Doc 4444 Chapter 7.3.1.2
Category	<Operational><Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN02.5006
Requirement	The ATCO/AFISO <b>shall</b> be notified about any technical status of systems that can affect the safety or efficiency of flight operations and/or the provision of air traffic service, in accordance with ICAO Doc 4444 Chapter 4.14 & Chapter 7.1.3.
Title	Technical Status
Status	<Validated>
Rationale	ICAO Doc 4444, Chapter 4.14 "Failure or irregularity of systems and equipment", states; "ATC units shall immediately report in accordance with local instructions any failure or irregularity of communication, navigation and surveillance systems or any other safety-significant or equipment which could adversely affect the safety or efficiency of flight operations and/or the provision of air traffic control service."  ICAO Doc 4444, Chapter 7.1.3 "Failure or irregularity of aids and equipment", states; "Aerodrome control towers shall immediately report in accordance with local instructions any failure or irregularity of operation in any equipment, light or other device established at an aerodrome for the guidance of aerodrome traffic and flight crews or required for the provision of air traffic control service."  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR46, SR48, SR57.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode><Expert Group (Judgement Analysis)>

Founding Members



Verification Method	<Review of Design><Test>
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Identifier	REQ-06.09.03-OSED-FN02.5007
Requirement	The ATCO/AFISO <b>shall</b> be provided with all relevant operational data (e.g. AIP information, NOTAMs, Manual of operations etc.) required for conducting the ATS tasks.
Title	AIP, NOTAMs and other relevant operational data.
Status	<Validated>
Rationale	The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR01, SR02, SR03.
Category	<Operational><Safety>
Validation Method	<Live Trial><Shadow Mode><Expert Group (Judgement Analysis)>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN02.5008
Requirement	The ATCO/AFISO <b>shall</b> alert the rescue and fire fighting services in accordance with ICAO Doc 4444 Chapter 7.1.2.
Title	Alerting Service
Status	<Validated>
Rationale	ICAO Doc 4444 Chapter 7.1.2.1 states that; Aerodrome control towers are responsible for alerting the rescue and fire fighting services whenever: a) an aircraft accident has occurred on or in the vicinity of the aerodrome; or b) information is received that the safety of an aircraft which is or will come under the jurisdiction of the aerodrome control tower may have or has been impaired; or c) requested by the flight crew; or d) when otherwise deemed necessary or desirable."
Category	<Operational>
Validation Method	<Live Trial><Shadow Mode><Expert Group (Judgement Analysis)>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN02.5009
Requirement	The ATCO/AFISO <b>shall</b> advise aircraft about abnormal configurations or conditions, such as landing gear not extended or only partly extended or unusual smoke emissions from any part of the aircraft, if observed by or reported to the ATCO/AFISO, in accordance with ICAO Doc 4444 Chapter 7.4.1.7.
Title	AIP, NOTAMs and other relevant operational data.
Status	<Validated>

Rationale	ICAO Doc 4444 Chapter 7.4.1.7 states that; "Whenever an abnormal configuration or condition of an aircraft, including conditions such as landing gear not extended or only partly extended, or unusual smoke emissions from any part of the aircraft, is observed by or reported to the aerodrome controller, the aircraft concerned shall be advised without delay."
Category	<Operational>
Validation Method	<Live Trial><Shadow Mode><Expert Group (Judgement Analysis)>
Verification Method	<Review of Design><Test>

## B.2.6 Voice and Data Recording

Identifier	REQ-06.09.03-OSED-DR02.6001
Requirement	Necessary communications and data <b>shall</b> be recorded (in order being available e.g. for accident and incident investigation purposes), to be retained for a period of at least thirty days (or longer if pertinent to accident and incident investigations), in accordance with ICAO Annex 11 Chapter 6.
Title	Voice & Data Recording
Status	<Validated>
Rationale	ICAO Annex 11 Chapter 6 states that; <ul style="list-style-type: none"> <li>- For aeronautical mobile service (air-ground communications), two-way radiotelephony or data link communications used for the provision of air traffic control service, recording facilities shall be provided on all such air-ground communication channels, and such recordings shall be retained for a period of at least thirty days. (6.1.1.3 &amp; 6.1.1.4)</li> <li>- For aeronautical fixed service (ground-ground communications), in all cases where automatic transfer of data to and/or from air traffic services computers is required, suitable facilities for automatic recording shall be provided, and all facilities for direct-speech or data link communications between air traffic service units and between air traffic service units and other units (described under 6.2.2.2.1 and 6.2.2.2.2) shall be provided with automatic recording. Recordings of data and communications described shall be retained for a period of at least thirty days. (6.2.2.3.3, 6.2.2.3.7 &amp; 6.2.2.3.8)</li> <li>- For surface movement control service, when conditions warrant separate channels to be provided for the control of vehicles on the manoeuvring area, automatic recording facilities shall be provided on all such channels, and such recordings shall be retained for a period of at least thirty days. (6.3.1.2 &amp; 6.3.1.3)</li> <li>- For aeronautical radio navigation service, surveillance data (from primary and secondary radar equipment or other systems (e.g. ADS-B, ADS-C)) used as an aid to air traffic services shall be automatically recorded for use in accident and incident investigations, search and rescue, air traffic control and surveillance systems evaluation and training. Such automatic recordings shall be retained for a period of at least thirty days. When the recordings are pertinent to accident and incident investigations, they shall be retained for longer periods until it is evident that they will no longer be required. (6.4.1.1 &amp; 6.4.1.2)</li> </ul>
Category	<Operational><Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

## B.3 Remote Operations Requirements

The requirements that are listed under B.2 “General Service Requirements” above originate from the fact that the aim of the RVT concept is to provide the same set of services as from conventional towers, meaning that the regulatory, operational and functional requirements on a conventional tower also apply for a remote tower.

Stopping there, however, one would fail to answer how these requirements are applicable to the RVT concept and most requirements would end up in the unanswered question of how this requirement should be handled in the “remote” environment.

This section is therefore dedicated to facilitating the advancement of the concept, by providing a set of operational, functional and performance requirements that apply specifically to the remote and virtual component of operations, explaining how to fulfil the service requirements in a “remote” context.

### B.3.1 RTC Level Requirements

Requirements in this section are applicable when operations are performed from an RTC connected to several aerodromes and consisting of several RTMs.

Identifier	REQ-06.09.03-OSED-RTC3.0004
Requirement	The ATCO/AFISO <b>should</b> use unified operating methods and procedures for all airports connected to a RTM/RTC (in order to contribute to the overall improvement of uniformity of ATM services).
Title	KPA Interoperability – RTC Operating Methods and Procedures
Status	<Validated>
Rationale	Operate on the basis of uniformity throughout Europe Applying standards and uniform principles, and ensuring the technical and operational interoperability of aircraft and ATM systems. Operating methods and procedures are today sometimes different in between aerodromes.
Category	<Interoperability><Operational><Design>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	<Analysis>

Identifier	REQ-06.09.03-OSED-RTC3.0005
Requirement	All RTMs in a RTC <b>should</b> be unified in terms of HMI and equipment (in order to contribute to the overall improvement of uniformity of ATM services).
Title	KPA Interoperability – RTC HMI & Equipment
Status	<Validated>

Rationale	Operate on the basis of uniformity throughout Europe Applying standards and uniform principles, and ensuring the technical and operational interoperability of aircraft and ATM systems. In today's operation there is often a lack of standardisation of systems and equipment between different aerodromes. CWP and HMI are often different from one ATS tower to another. This requirement also aims to ensure flexibility within an RTC regarding airport and CWP allocation, as well as to simplify ATCO/AFISO licensing & training issues.
Category	<Functional><Interoperability><Design>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	<Analysis>

Identifier	REQ-06.09.03-OSED-RTC3.0006
Requirement	RTC <b>should</b> enable transfer of responsibility of ATS for aerodromes between RTMs within an RTC.
Title	RTC Transfer of Responsibility
Status	<Validated>
Rationale	To ensure flexibility of staff and CWP/airport allocation.  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-27M02,
Category	<Design><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-RTC3.0007
Requirement	If compliant with REQ-06.09.03-OSED-RTC3.0006, RTC <b>shall</b> enable the service provision to be uninterrupted during transfer of responsibility between RTMs.
Title	RTC Transfer of Responsibility, Uninterrupted Service Provision
Status	<Validated>
Rationale	This includes functional supporting of a handover sequence.  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-27M02.
Category	<Design><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

### B.3.2 RTC Supervisor

*Requirements in this section are applicable when operations are performed from an RTC connected to several aerodromes and consisting of several RTMs. The requirements are specifically targeting the RTC Supervisor Role and its needed functionalities, if such a role is put in place.*

Founding Members



Identifier	REQ-06.09.03-OSED-SUP3.0009
Requirement	When RTC enables transfer of responsibility of ATS for aerodromes between RTMs within the RTC, RTC <b>should</b> enable a RTC Supervisor role for the RTC. Note: The RTC Supervisor role may be performed either from a separate stand-alone working position (where no ATS is performed in combination) or combined from a CWP/RTM (where ATS is performed in combination).
Title	RTC Supervisor Role
Status	<Validated>
Rationale	The role of the RTC Supervisor is defined in the OSED.
Category	<Operational><Design>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-SUP3.0010
Requirement	If implemented, the RTC Supervisor role <b>shall</b> access functions for the planning, coordination and monitoring of the upcoming and present traffic flow, in the purpose of tactical opening and closure of RTMs and allocation of airports to them.
Title	RTC Supervisor Flow Planning Tools
Status	<Validated>
Rationale	As an example, available tools could include e.g. flight plans, slot coordination, communications and surveillance data. The role of the RTC Supervisor is defined in the OSED.  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR34.  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-34M01, SR-35M01.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-SUP3.0011
Requirement	If implemented, the RTC Supervisor role <b>shall</b> access functions for the monitoring and coordination of responsibilities between different RTMs within the RTC.
Title	RTC Supervisor RTM Coordination Tools
Status	<Validated>
Rationale	The role of the RTC Supervisor is defined in the OSED.  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-34M02.

Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-SUP3.0012
Requirement	If implemented, the RTC Supervisor role <b>should</b> access functions for the monitoring of airport systems status for all aerodromes and all RTC systems.
Title	RTC Supervisor Airport System Monitoring Tools
Status	<Validated>
Rationale	The role of the RTC Supervisor is defined in the OSED.  Monitoring of system status could also be allocated to technical staff (who need to inform the RTC Supervisor.)  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-35M01.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-SUP3.0013
Requirement	If implemented, the RTC Supervisor role <b>shall</b> access functions for the monitoring of weather conditions for all aerodromes.
Title	RTC Supervisor Airport Weather Monitoring Tools
Status	<Validated>
Rationale	The role of the RTC Supervisor is defined in the OSED.  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR35.  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-35M01.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-SUP3.0014
Requirement	If implemented, the RTC Supervisor role <b>shall</b> access functions for communicating the status of RTC and aerodromes and coordinating maintenance (to be carried out by a qualified engineer/technician).
Title	RTC Supervisor Maintenance Coordination Tools
Status	<Validated>

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Rationale	The role of the RTC Supervisor is defined in the OSED.
Category	<Operational><Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

### B.3.3 Procedures Related to Remote Operations

Identifier	REQ-06.09.03-OSED-RTC3.0008
Requirement	The ATCO/AFISO/RTC Supervisor (if implemented) <b>shall</b> verify the status of an aerodrome, in terms of traffic, weather etc, and its related systems, before assuming responsibility for providing ATS to the aerodrome.
Title	RTC Verifying Aerodrome Status
Status	<Validated>
Rationale	<p>In order to be sure about the airport and related system status before assuming the responsibility.</p> <p>Note: Indications from validation exercises performed so far indicates that some kind of system support such as a common handover/transfer area might be needed to enable this, when transferring aerodromes between RTMs within an RTC.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR28.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-27M02.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-C3.</p>
Category	<Operational><Safety>
Validation Method	<Live Trial><Shadow Mode><Real Time Simulation>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-RTC3.0015
Requirement	Airspace users <b>should</b> be informed about the remote provision of ATS, e.g. through AIP or NOTAMs.
Title	Information to airspace users about remote operations.
Status	<Validated>
Rationale	The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR04.
Category	<Operational><Safety>
Validation Method	<Live Trial><Shadow Mode><Real Time Simulation>
Verification Method	<Review of Design><Test>



Identifier	REQ-06.09.03-OSED-RTC3.0016
Requirement	A Letter of Agreement for the communication and coordination between the remote ATS unit and the airport <b>shall</b> be developed and agreed.
Title	LoA between the remote ATS unit and the airport.
Status	<Validated>
Rationale	The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR29, SR39.
Category	<Operational><Safety>
Validation Method	<Live Trial><Shadow Mode><Real Time Simulation>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-RTC3.0017
Requirement	If service is provided alternately from the local tower and from the RTM, coordination and transfer of control of operational systems <b>shall</b> take place between the local tower and the RTM prior to transfer of ATS provision from one to the other.
Title	Transfer of ATS between local tower and RTM.
Status	<Validated>
Rationale	This coordination must include transfer of control of operational systems  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR40.  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-C4, SR-C5, SR-C6.
Category	<Operational><Safety>
Validation Method	<Live Trial><Shadow Mode><Real Time Simulation>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-RTC3.0018
Requirement	For (new) system elements (specific to remote tower operations) where existing procedures are not already in place, new operational procedures <b>shall</b> be developed.
Title	Operational procedures for new systems introduced by remoter tower operations.
Status	<Validated>
Rationale	System elements targeted by this requirement can e.g. be tracking and labels, infra-red cameras etc.  The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_PROCEDURE_002.
Category	<Operational><HMI>
Validation Method	<Live Trial><Shadow Mode><Real Time Simulation>
Verification Method	<Review of Design><Test>

Founding Members



Identifier	REQ-06.09.03-OSED-RTC3.0019
Requirement	Degraded mode procedures for all systems, including new system elements (such as the visual presentation) <b>shall</b> be developed for every local implementation.
Title	Operational procedures for new systems introduced by remoter tower operations.
Status	<Validated>
Rationale	<p>Degraded mode procedures needs to cover full as well as partial system failures (e.g. loss of all visual presentation screens, loss of only one screen and loss of more than one but less than all).</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR64, SR67.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-61M01, SR-64M01, SR-67M01.</p> <p>The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_PROCEDURE_003.</p>
Category	<Operational><Safety><HMI>
Validation Method	<Live Trial><Shadow Mode><Real Time Simulation>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-RTC3.0020
Requirement	ATCO/AFISOs <b>shall</b> be provided with a specific training incorporating knowledge about local airport conditions - such as local geography, local weather conditions, traffic type & mix, etc – as part of the endorsement training for the aerodromes to which remote services are to be provided.
Title	ATCO/AFISO local knowledge training
Status	<Validated>
Rationale	<p>To better keep the ‘local’ knowledge of the operational environment even if the service is provided remotely. Such training may include study visits to the concerned aerodrome(s) on a regularly basis.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-69M01.</p>
Category	<Operational><Safety>
Validation Method	<Expert Group (Judgement Analysis)><Analytical Modelling>
Verification Method	<Analysis>

### B.3.4 Visualisation

#### Visualisation – General

Founding Members



Identifier	REQ-06.09.03-OSED-VG03.1001
Requirement	A visual presentation of the aerodrome (SINGLE)/ all aerodromes (MULTIPLE) under responsibility, covering the manoeuvring area(s) and the vicinity of the aerodrome(s), <b>shall</b> be provided.
Title	Visual Presentation
Status	<Validated>
Rationale	<p>For details on what the operator needs to be able to see with help of the visual presentation, see the lower level requirements under section “Visualisation – Quality”.</p> <p>The vicinity of an aerodrome is defined in Doc 4444 as: “aircraft in, entering or leaving an aerodrome traffic circuit”.</p> <p>The manoeuvring area is defined in Doc 4444 as: “that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons”.</p> <p>In order to fulfil the task of keeping watch by visual observation while not being physically present at the aerodrome, a technical solution is needed that presents visual sensor data - collected from the aerodrome and its vicinity and transmitted to the remote tower facility - to the ATCO/AFISO in a way that provides him/her with the situational awareness required for conducting the associated services. This technical solution will be termed the Visual Presentation.</p> <p>This requirement is valid in both daylight and darkness, however dependent on the visibility conditions at the aerodrome and its vicinity. (Note: Personnel /objects without its own light source may be difficult to detect during darkness.)</p> <p>This requirement is also valid in all weather conditions (the most common except for the very extreme/unusual weather phenomena) existing at the particular aerodrome.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR14, SR15, SR16, SR18.</p> <p>The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_005, RT_REQ_DESIGN_014.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-14M01, SR-16M01, SR-68M01.</p>
Category	<Functional><Safety><HMI>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-VG03.1002
Requirement	The visual presentation <b>should</b> incorporate enhancements that improve the visual range compared to unaided viewing, to provide the ATCO/AFISO a greater level of situational awareness.
Title	Visual Presentation Image Processing Enhancements
Status	<Validated>

Founding Members



Rationale	The enhancements considered in this requirement may utilize image processing, high-dynamic-range imaging and other techniques to improve the “raw” picture.  The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_005.
Category	<Functional><HMI>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-VG03.1004
Requirement	The visual presentation <b>should</b> incorporate additional sensors that improve the visual range compared to unaided viewing, to provide the ATCO/AFISO a greater level of situational awareness. Note: Such sensors would be particularly helpful in darkness and low visibility conditions.
Title	Visual Presentation Additional Sensors
Status	<Validated>
Rationale	The sensors considered in this requirement may utilise additional “hot spot cameras” or sensors/cameras other than narrowly light band spectrum, such as UV and IR. The purpose of such sensors would e.g. be to assist the ATCO/AFISO to; <ul style="list-style-type: none"> <li>- monitor aircraft/vehicles entering or vacating the runway, (or to confirm stopping at holding points) during low visibility conditions,</li> <li>- detect obstructions/objects/personnel/animals (without its own light source) during darkness.</li> </ul> The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_005.
Category	<Functional><HMI>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

**Visualisation – Characteristics**

Identifier	REQ-06.09.03-OSED-VC03.1101
Requirement	The visual presentation <b>shall</b> be designed to avoid unnecessary discontinuities or non-uniformities of the presented view.
Title	Visual Presentation Characteristics of Design/Setup
Status	<Validated>

Rationale	<p>Additionally, existing discontinuities and non-uniformities needs to be clearly indicated so as to avoid misleading impressions of the observed area.</p> <p>Validation experiences have showed this to be an essential requirement.</p> <p>Avoid eventual (screen) seams / joints in the visual presentation located at "hot spot" areas, e.g. holding positions, RWY entrance / exits etc as far as possible. If that is not possible, consider to implement mitigations such as hot spot cameras (if the PTZ camera is not sufficient) in order for the ATCO/AFISO to get an undivided/unbroken/unobscured presentation of these "hot spot" areas.</p> <p>The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_011.</p>
Category	<Functional><Performance><HMI>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VC03.1104
Requirement	The visual presentation, including any additional sensors and the binocular functionality, <b>shall</b> provide a smooth and regular impression of moving objects to the human eye.
Title	Visual Presentation Characteristics of Moving Objects
Status	<Validated>
Rationale	<p>Moving objects must not give a "jumping" impression to the operator.</p> <p>This requirement is also related to transient phenomena, e.g. flashing lights such as Runway Guard Lights (RGL) or aircraft strobe lights. It is of high operational importance for an ATCO/AFISO to be able to see/judge if a light is flashing or not, e.g. confirm on/off status of RGL.</p> <p>Validation experiences have showed this to be an essential requirement.</p>
Category	<Functional><Performance>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VC03.1105
Requirement	The time delay between occurrences - at the aerodrome or its vicinity - and their presentation to the ATCO/AFISO <b>shall</b> not negatively affect the ability to perform the ATS service.
Title	Visual Presentation Characteristics Time Delay
Status	<Validated>
Rationale	The ATCO/AFISO must be able to trust the information presented. Time delay must be small enough (negligible) and fairly constant in order to be able to perform the service. Validation results have given a recommended maximum latency of 1 second.
Category	<Functional><Performance>

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Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-VC03.1106
Requirement	If there is a difference in the perception of daylight / darkness conditions between the visual presentation and the reality, the ATCO/AFISO <b>shall</b> have access to information about the current daylight/dusk/darkness/dawn condition at the remote aerodrome as well as the expected time for the transitioning between these phases.
Title	Difference in daylight / darkness perception.
Status	<Validated>
Rationale	Validation experiences have showed that the visual presentation of some technical platforms presents the remote operating environment brighter than the conditions in the real world (prolonging the experience of daylight to some extent), thus allowing the operator to see better than in reality, but with the drawback making it difficult for the operator to judge when darkness has occurred (e.g. not knowing when needed to turn on landing lights). If this is the case for a particular implementation, some kind of mitigation would be needed (which in its simplest form could be a basic table of the sunrise / sunset times, but could also be a technical solution that provide and support the ATCO/AFISO with this kind of information and decision support.)  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR18, SR20.
Category	<Operational><Functional><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

### Visualisation – Quality

*This section intends to set a minimum standard for the quality of the visual presentation, in terms of what the ATCO/AFISO needs to be able to visually observe/see. For this reason a terminology based on the Johnson Criteria model and adapted for use in an ATS context has been introduced. Whenever one of the terms below is used within the following requirements, they should be interpreted as follows:*

**Detect** (Visual Detection): *Something in the image raises the observer’s attention*

- *“There is something!”*

**Recognise** (Visual Recognition): *Classes of objects can be differentiated*

- *Class/category/type of aircraft, to be determined with the help of e.g. one or several of the following parameters;*
  - *aircraft size & fuselage configuration (e.g. fighter/glider/ commercial acft, etc)*
  - *engine configuration (e.g. wing mounted (below / above) or tail mounted, number and type of engines)*
  - *wing configuration (e.g. mid or top mounted wings)*
  - *stabilizer configuration*

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- *landing gear configuration*
- *aircraft painting*
- *Vehicle type/class; e.g. Fire Truck / Car / Snow Sweeping Truck / Luggage Trolley*
- *Personnel and obstructions; e.g. Person / Wildlife of potential hazards, e.g. birds, dears etc // FOD (Foreign Object (Damage))*

Identifier	REQ-06.09.03-OSED-VQ03.1201
Requirement	During CAVOK conditions, the ATCO/AFISO <b>shall</b> be able to visually <b>detect</b> an aircraft of type A320, ATR72 or similar size on 2NM final, by using the visual presentation (excluding the binocular functionality).
Title	Visual Presentation – Quality; traffic on final, visual presentation only
Status	<Validated>
Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation (excluding the binocular functionality).</p> <p>CAVOK stands for Ceiling and visibility OK and shall for the purpose of this requirement have the following meaning: visibility &gt; 10 km, no clouds &lt; 5000 feet, no cumulonimbus or towering cumulus and no significant weather (such as precipitation, thunderstorms, dust storm, shallow fog, low drifting dust, sand or snow) at or in the vicinity of the aerodrome.</p> <p>Detect in this context means that something in the image raises the observers attention: "There is something!"</p> <p>This requirement is valid in daylight and darkness (in darkness only when the aircraft has its own light source).</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p>
Category	<Operational><Performance>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VQ03.1220
Requirement	During CAVOK conditions, the ATCO/AFISO <b>should</b> be able to visually <b>detect</b> an aircraft of type A320, ATR72 or similar size on 4NM final, by using the visual presentation (excluding the binocular functionality).
Title	Visual Presentation – Quality; traffic on final, visual presentation only
Status	<Validated>



Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation (excluding the binocular functionality).</p> <p>CAVOK stands for Ceiling and visibility OK and shall for the purpose of this requirement have the following meaning: visibility &gt; 10 km, no clouds &lt; 5000 feet, no cumulonimbus or towering cumulus and no significant weather (such as precipitation, thunderstorms, dust storm, shallow fog, low drifting dust, sand or snow) at or in the vicinity of the aerodrome.</p> <p>Detect in this context means that something in the image raises the observers attention: "There is something!"</p> <p>This requirement is valid in daylight and darkness (in darkness only when the aircraft has its own light source).</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p>
Category	<Operational><Performance>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VQ03.1207
Requirement	During daylight CAVOK conditions, the ATCO/AFISO <b>shall</b> be able to visually <b>recognise</b> an aircraft of type A320, ATR72 or similar size on 4NM final, by using the visual presentation in combination with the binocular functionality.
Title	Visual Presentation – Quality; traffic on final, visual presentation in combination with binocular functionality
Status	<Validated>
Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation, in combination with the binocular functionality when needed.</p> <p>CAVOK stands for Ceiling and visibility OK and shall for the purpose of this requirement have the following meaning: visibility &gt; 10 km, no clouds &lt; 5000 feet, no cumulonimbus or towering cumulus and no significant weather (such as precipitation, thunderstorms, dust storm, shallow fog, low drifting dust, sand or snow) at or in the vicinity of the aerodrome.</p> <p>The intent with this requirement is not to be able to identify the aircraft but rather to judge/estimate that the aircraft in sight is an aircraft of the same class/category/configuration.</p> <p>This requirement is valid in daylight conditions only.</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation in combination with the binocular functionality, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p>
Category	<Operational><Performance>



Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VQ03.1202
Requirement	During CAVOK conditions and when the topography of the surrounding terrain so permits, the ATCO/AFISO <b>should</b> be able to visually judge the position of a light aircraft (e.g. C172 or P28A) in the traffic circuit, by using the visual presentation, in combination with the binocular functionality.
Title	Visual Presentation – Quality; small acft in traffic circuit
Status	<Validated>
Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation, in combination with the binocular functionality when needed.</p> <p>CAVOK stands for Ceiling and visibility OK and shall for the purpose of this requirement have the following meaning: visibility &gt; 10 km, no clouds &lt; 5000 feet, no cumulonimbus or towering cumulus and no significant weather (such as precipitation, thunderstorms, dust storm, shallow fog, low drifting dust, sand or snow) at or in the vicinity of the aerodrome.</p> <p>Aerodrome traffic circuit is defined in Doc 4444 as: “the specified path to be flown by aircraft operating in the vicinity of an aerodrome”. (The vicinity of an aerodrome is defined in Doc 4444 as: “aircraft in, entering or leaving an aerodrome traffic circuit”.)</p> <p>This requirement is valid in daylight and darkness (in darkness only when the aircraft has its own light source).</p> <p>The intent behind this requirement is to define parameters that enable the use of reduction of separation minima in the vicinity of aerodromes, when two aircraft are continuously visible to the ATCO, according to ICAO Doc 4444 chapter 6.1.</p> <p>Also in today's ordinary towers it is hard to achieve this (judge the position of a light aircraft in the traffic circuit) at all times, e.g. when the traffic circuit is extended or if the light aircraft is in front of low standing sunlight, etc etc. The nature of a traffic circuit is that it can vary a lot in size and distance to aerodrome depending on many various factors, such as the aircraft type and the type of approach. Thus, in order for this requirement to be a "shall", a specific distance to aerodrome would need to be defined at the same time as a lot of other factors would need to be fixed (e.g. no strong sun backlight, contrast values between the aircraft painting and the sky, etc etc). In addition to that, for some airports today the view from the tower can be obscured in a direction for various reasons (e.g. by forests, buildings, mountains). If this requirement would be a "shall", then it would ultimately disqualify some of the existing towers at some airports.</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation in combination with the binocular functionality, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p>
Category	<Operational><Performance>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

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Identifier	REQ-06.09.03-OSED-VQ03.1203
Requirement	During daylight CAVOK conditions, the ATCO/AFISO <b>should</b> be able to visually recognise aircraft abnormal configurations or conditions, such as landing gear not or only partly extended or unusual smoke emissions from any part of the aircraft, by using the visual presentation in combination with the binocular functionality.
Title	Visual Presentation – Quality; aircraft abnormal configurations or conditions.
Status	<Validated>
Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation, in combination with the binocular functionality when needed.</p> <p>The reasoning for having this requirement as a "should (important) requirement" only (and not a "shall (mandatory) requirement") is that this requirement is primarily based on ICAO Doc 4444 Chapter 7.4.1.7 (see REQ-06.09.03-OSED-FN02.5009), which states "is observed by or reported to the aerodrome controller". Hence regulations imply that "abnormal configuration or condition of an aircraft" must not necessarily be observed by the controller at all times, it could likewise be reported to the ATCO/AFISO. In addition to that, "abnormal configuration or condition of an aircraft" can be a vast variety of different things, thus in order for this requirement to be a "shall", a specific situation / occurrence / object size would need to be defined as well as a distance to the same.</p> <p>CAVOK stands for Ceiling and visibility OK and shall for the purpose of this requirement have the following meaning: visibility &gt; 10 km, no clouds &lt; 5000 feet, no cumulonimbus or towering cumulus and no significant weather (such as precipitation, thunderstorms, dust storm, shallow fog, low drifting dust, sand or snow) at or in the vicinity of the aerodrome.</p> <p>This requirement is valid in daylight conditions only.</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation in combination with the binocular functionality, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p>
Category	<Operational><Performance>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VQ03.1208
Requirement	During CAVOK conditions, the ATCO/AFISO <b>shall</b> be able to visually <b>detect</b> all flight operations and vehicles on the manoeuvring area, by using the visual presentation (excluding the binocular functionality).
Title	Visual presentation – Quality; traffic on manoeuvring area, visual presentation only
Status	<Validated>

Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation (excluding the binocular functionality).</p> <p>CAVOK stands for Ceiling and visibility OK and shall for the purpose of this requirement have the following meaning: visibility &gt; 10 km, no clouds &lt; 5000 feet, no cumulonimbus or towering cumulus and no significant weather (such as precipitation, thunderstorms, dust storm, shallow fog, low drifting dust, sand or snow) at or in the vicinity of the aerodrome.</p> <p>The manoeuvring area is defined in Doc 4444 as: "that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons".</p> <p>Detect in this context means that something in the image raises the observers attention: "There is something!"</p> <p>This requirement is valid in daylight and darkness (in darkness only when the aircraft/vehicle has its own light source).</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p>
Category	<Operational><Performance>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VQ03.1209
Requirement	During CAVOK conditions, the ATCO/AFISO <b>shall</b> be able to visually <b>recognise</b> all flight operations and vehicles on the manoeuvring area, by using the visual presentation in combination with the binocular functionality.
Title	Visual presentation – Quality; traffic on manoeuvring area, visual presentation in combination with binocular functionality
Status	<Validated>

Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation, in combination with the binocular functionality when needed.</p> <p>CAVOK stands for Ceiling and visibility OK and shall for the purpose of this requirement have the following meaning: visibility &gt; 10 km, no clouds &lt; 5000 feet, no cumulonimbus or towering cumulus and no significant weather (such as precipitation, thunderstorms, dust storm, shallow fog, low drifting dust, sand or snow) at or in the vicinity of the aerodrome.</p> <p>The manoeuvring area is defined in Doc 4444 as: "that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons".</p> <p>The intent with this requirement is not to be able to identify the aircraft/vehicle but rather to judge/estimate the type/category/configuration/class.</p> <p>This requirement is valid in daylight and darkness (in darkness only when the aircraft/vehicle has its own light source).</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation in combination with the binocular functionality, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p>
Category	<Operational><Performance>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VQ03.1205
Requirement	During daylight CAVOK conditions, the ATCO/AFISO <b>should</b> be able to visually <b>detect</b> obstructions on the manoeuvring area, by using the visual presentation in combination with the binocular functionality.
Title	Visual presentation – Quality; obstructions on manoeuvring area
Status	<Validated>

Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation, in combination with the binocular functionality when needed.</p> <p>CAVOK stands for Ceiling and visibility OK and shall for the purpose of this requirement have the following meaning: visibility &gt; 10 km, no clouds &lt; 5000 feet, no cumulonimbus or towering cumulus and no significant weather (such as precipitation, thunderstorms, dust storm, shallow fog, low drifting dust, sand or snow) at or in the vicinity of the aerodrome.</p> <p>The manoeuvring area is defined in Doc 4444 as: "that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons".</p> <p>Detect in this context means that something in the image raises the observers attention: "There is something!"</p> <p>This requirement is valid in daylight conditions only.</p> <p>The fulfilment of this requirement will be dependent on distance to and size of the obstruction as well as on meteorological conditions - as already implicit in current ICAO regulations.</p> <p>The reasoning for having this requirement as a "should (important) requirement" only (and not a "shall (mandatory) requirement") is that regulations only states that ATCOs shall prevent collisions between aircraft and obstructions (AFISOs to assist pilots for the same) but nowhere states that the ATCO/AFISO needs to visually see/detect the obstruction, hence implying that the existence of an obstruction can likewise be reported to the ATCO/AFISO. In addition to that the size of an obstruction can vary widely from a very small object to a large. Thus, if having this requirement as a "shall (mandatory) requirement" a minimum target size of the obstruction would need to be defined.</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation in combination with the binocular functionality, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p>
Category	<Operational><Performance>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VQ03.1210
Requirement	During daylight CAVOK conditions, the ATCO/AFISO <b>shall</b> be able to visually <b>recognise</b> personnel on the manoeuvring area, by using the visual presentation in combination with the binocular functionality.
Title	Visual presentation – Quality; personnel on manoeuvring area
Status	<Validated>

Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation, in combination with the binocular functionality when needed.</p> <p>CAVOK stands for Ceiling and visibility OK and shall for the purpose of this requirement have the following meaning: visibility &gt; 10 km, no clouds &lt; 5000 feet, no cumulonimbus or towering cumulus and no significant weather (such as precipitation, thunderstorms, dust storm, shallow fog, low drifting dust, sand or snow) at or in the vicinity of the aerodrome.</p> <p>The manoeuvring area is defined in Doc 4444 as: "that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons".</p> <p>Recognise in this context means being able to see/distinguish a person (not just being able to see "there is something").</p> <p>This requirement is valid in daylight conditions only.</p> <p>The fulfilment of this requirement will be dependent on distance to and size of the person as well as on meteorological conditions - as already implicit in current ICAO regulations.</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation in combination with the binocular functionality, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p>
Category	<Operational><Performance>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VQ03.1206
Requirement	Depending on visibility and daylight/darkness conditions, the ATCO/AFISO <b>may</b> be able to visually observe significant meteorological conditions in the take-off and climb-out area, by using the visual presentation in combination with the binocular functionality.
Title	Visual Presentation Quality Significant Met Conditions
Status	<Validated>

Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation, in combination with the binocular functionality when needed.</p> <p>ICAO Doc 4444 Chapter 7.4.1.2.2 states that aircraft shall be advised of significant meteorological conditions in the take-off and climb-out area, except when it is known that the information has already been received by the aircraft.</p> <p>Significant meteorological conditions in this context are defined in ICAO Doc 4444 Chapter 7.4.1.2.2.</p> <p>Significant meteorological conditions can be either visually observed by the ATCO/AFISO or reported to the same from pilots, met-offices etc. In addition, "significant meteorological conditions" can be a variety of different weather phenomena's, many of them impossible to observe visually, some difficult to observe visually. In conclusion this is not a mandatory requirement to be able to observe all significant met conditions at all times even in today's regulations / today's traditional towers.</p> <p>The fulfilment of this requirement will be dependent on the type of and distance to the significant weather, the daylight/darkness conditions as well as the meteorological visibility - as already implicit in current ICAO regulations.</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation in combination with the binocular functionality, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR18.</p>
Category	<Operational><Performance><Safety>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-VQ03.1211
Requirement	<p>The ATCO/AFISO <b>may</b> be able to visually observe visual communication from aircraft that are within the ATCO/AFISO's visual range on and in the vicinity of the aerodrome, by using the visual presentation in combination with the binocular functionality, i.e.:</p> <ul style="list-style-type: none"> <li>- aircraft flashing or showing landing lights (in darkness).</li> <li>- moving ailerons (or rudder). (in daylight)</li> <li>- aircraft repeatedly changing its bank angle - "rocking wings" (in daylight).</li> </ul>
Title	Visual Communication from Aircraft in Aerodrome Vicinity
Status	<Validated>

Rationale	<p>Fulfilment of this requirement is to be achieved by using the visual presentation, in combination with the binocular functionality when needed.</p> <p>The vicinity of an aerodrome is defined in Doc 4444 as: “aircraft in, entering or leaving an aerodrome traffic circuit”.</p> <p>ICAO Doc 4444 12.3.4 “Phraseologies for use on and in the vicinity of the aerodrome” defines;</p> <ul style="list-style-type: none"> <li>- showing landing lights as a possible means of "Identification of aircraft" (12.3.4.1)</li> <li>- and moving ailerons (or rudder), rocking wings or flashing landing lights as "acknowledgement by visual means (12.4.3.2).</li> </ul> <p>Regulations nowhere state this being a mandatory requirement at all times. E.g. an aircraft at the RWY threshold moving its ailerons is difficult to spot even from a conventional tower today.</p> <p>The fulfilment of this requirement will be dependent on distance to aircraft and meteorological conditions - as already implicit in current ICAO regulations.</p> <p>The purpose of this requirement is to define a quantifiable minimum standard for the quality of the visual presentation in combination with the binocular functionality, where a gradual degradation of performance is expected in less favourable conditions. The purpose is not to define operator responsibilities.</p>
Category	<Operational><Performance>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

**Visualisation – Binocular Functionality**

Identifier	REQ-06.09.03-OSED-BF03.1501
Requirement	The binocular functionality <b>shall</b> be simple, quick and easy to use.
Title	Binocular Functionality Ease of Use
Status	<Validated>
Rationale	<p>Compare with traditional binoculars, as used in normal towers.</p> <p>The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_012.</p>
Category	<Operational><Functional><HMI>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-BF03.1502
Requirement	The visual presentation provided by the binocular functionality <b>shall</b> be of sufficient quality (image sharpness, magnification, contrast) to support the related ATCO/AFISO tasks.



Title	Binocular Functionality Performance
Status	<Validated>
Rationale	For details on the required quality/performance in order to support the ATCO/AFISO tasks, see the related requirements under section “Visualisation – Quality” (which details what the operator needs to be able to see with help of the binocular functionality.)  The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_012.
Category	<Functional><HMI>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-BF03.1503
Requirement	The binocular functionality <b>shall</b> include a adjustable zoom feature with a visual indication of the direction of bore sight.
Title	Binocular Functionality Zoom Feature
Status	<Validated>
Rationale	In order for the binocular functionality to be simple, quick and easy to use, this forms an essential feature.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-BF03.1504
Requirement	The binocular functionality <b>should</b> include predefined and user-definable positions (where a position is based on automatic (predefined / user-definable) zoom, pan-tilt and focus).
Title	Binocular Functionality Fixed Positions
Status	<Validated>
Rationale	Assisting the ATCO/AFISO quickly scanning commonly hot spots or areas of particular interest. In order for the binocular functionality to be simple, quick and easy to use, this forms an important feature.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-BF03.1505
Requirement	The binocular functionality <b>should</b> include predefined and user-definable automatic scanning patterns, such as runway sweeps.

Title	Binocular Functionality Automatic Scanning Sweeps
Status	<Validated>
Rationale	Assisting the ATCO/AFISO performing e.g. runway sweeps or sweeps of any of other area of interest within the area of responsibility. In order for the binocular functionality to be simple, quick and easy to use, this forms an important feature.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-BF03.1506
Requirement	The binocular functionality <b>should</b> include automatic tracking of moving aircraft, vehicles or obstructions (e.g. personnel or large animals).
Title	Binocular Functionality Automatic Tracking
Status	<Validated>
Rationale	Assisting the ATCO/AFIS to follow moving targets. In order for the binocular functionality to be simple, quick and easy to use, this forms an important feature.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-BF03.1507
Requirement	The means of directing the signalling lamp towards the applicable aircraft <b>may</b> be combined with the binocular functionality.
Title	Signal Light Gun combined with Binocular Functionality
Status	<Validated>
Rationale	This solution has been tested successfully in validations.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

### B.3.5 Airport Sound

Identifier	REQ-06.09.03-OSED-AS03.2001
Requirement	In order to increase situational awareness and compensate for being placed remote the ATCO/AFISO <b>may</b> access the actual outdoor sound from the remote airport.
Title	Airport Sound Single

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Status	<Validated>
Rationale	Requirement applicable to the SINGLE aerodrome environment only.  Requirement is likely to be more important for small aerodromes (to attract ATCO/AFISOs attention of arising occurrences at the aerodrome) where sound plays an important role in the ATCO/AFISO's job. Requirement can also increase situational awareness in low visibility conditions.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-AS03.2002
Requirement	If a function for actual outdoor sound reproduction is implemented (REQ-06.09.03-OSED-AS03.2001), the volume <b>shall</b> be adjustable and possible to be turned off by the operator.
Title	Airport Sound Adjustments
Status	<Validated>
Rationale	In order to meet individual ATCO/AFISO needs and to be able to minimise disturbing background noise in some circumstances.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

### B.3.6 Other ATS Systems / Functions

Identifier	REQ-06.09.03-OSED-FN03.3001
Requirement	The ATCO/AFISO <b>should</b> access an electronic system for the presentation and updating of flight plan and control data (in accordance with ICAO Doc 4444 Chapter 4.13).
Title	E-Strip System Baseline Requirement
Status	<Validated>
Rationale	ICAO Doc 4444 Chapter 4.13
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN03.3002
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Requirement	When RTC enables transfer of responsibility of ATS for aerodromes between RTMs within the RTC, the ATCO/AFISO <b>shall</b> access an electronic system for the presentation and updating of flight plan and control data (in accordance with ICAO Doc 4444 Chapter 4.13).
Title	E-Strip System for Transfer of Responsibility Between RTMs
Status	<Validated>
Rationale	ICAO Doc 4444 Chapter 4.13  To facilitate the transfer of aerodromes between RTMs within the RTC, the importance of this requirement has been raised to a higher level compared to when ATS is provided to a fixed aerodrome only from a RTM.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN03.3003
Requirement	If the RTM is equipped with an electronic system for the presentation and updating of flight plan and control data, the ATCO/AFISO <b>should</b> use pre-set functions for the most common actions, e.g. creating a new strip for a pop up VFR flight.
Title	E-Strip System Pre Set Functions
Status	<Validated>
Rationale	This requirement is based on validation feedback overall, but particularly from EXE-060.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN03.3004
Requirement	Updates for flight plan and control data (in accordance with Doc 4444 4.13.2) to other ATS units <b>may</b> be done automatically (if not being performed by manual coordination by the ATCO/AFISO).
Title	Automatic Flight Plan and Control Data Updates, Single
Status	<Validated>
Rationale	Requirement applicable to the SINGLE aerodrome environment only  ICAO Doc 4444 Chapter 4.13
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN03.3005
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Requirement	In low visibility conditions, the ATCO/AFISO <b>may</b> be notified about an aircraft or vehicle entering or vacating the runway. Note: Such notifications can be particularly helpful in low visibility conditions.
Title	RWY Entry/Exit Notification
Status	<Validated>
Rationale	Such notifications may be utilized by cameras / laser beams monitoring specific parts of the manoeuvring area, such as runway entry/exits.  To assist ATCO/AFISOs identifying aircraft/vehicle entering/vacating RWY.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN03.3006
Requirement	The ATCO/AFISO <b>may</b> be warned about an aircraft or vehicle entering the runway without clearance.
Title	RWY Entry/Exit Warning
Status	<Validated>
Rationale	To assist in identifying/avoiding RWY incursions.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN03.3007
Requirement	The ATCO/AFISO <b>may</b> be warned about an aircraft or vehicle entering the manoeuvring area without clearance.
Title	Manoeuvring Area Entry/Exit Warning
Status	<Validated>
Rationale	To assist in identifying/avoiding manoeuvring area incursions.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-FN03.3008
Requirement	Notifications about any technical status of systems that can affect the safety or efficiency of flight operations and/or the provision of air traffic service <b>shall</b> be extended to include systems and/or data that are specific to remote tower operations, such as detecting corrupt/delayed/frozen visual presentation.
Title	Technical Status
Status	<Validated>

Rationale	ICAO Doc 4444, Chapter 4.14, ICAO Doc 4444, Chapter 7.1.3  The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR54.  The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_003.
Category	<Functional><Safety><HMI>
Validation Method	<Live Trial><Shadow Mode><Expert Group (Judgement Analysis)>
Verification Method	<Review of Design><Test>

### B.3.7 Voice and Data Recording

Identifier	REQ-06.09.03-OSED-DR03.4001
Requirement	Recording of necessary communications and data <b>may shall</b> be extended to include recording of systems and/or surveillance data that are specific to remote tower operations, such as recording of the visual presentation (or other surveillance data used as an aid for ATS provision).  <b>Note:</b> Note 1 to ICAO Doc 4444 Chapter 7.1.1.2.1 now clarifies that “For the purposes of automatic recording of visual surveillance system data, Annex 11, 6.4.1 applies”. See also the guidance provided in Chapter 5.6 of Annex 1 to EASA ED Decision 2019/004/R.  <b>Note:</b> Requirement text adjusted compared to its appearance in S1 OSED in order to reflect the latest amendments of ICAO Doc 4444 (Amendment 8 to the Sixteenth Edition 2016, applicable as of 08 November 2018).
Title	Voice & Data Recording expanded for remote.
Status	<Validated>
Rationale	ICAO Annex 11 Chapter 6.4.1.1 & 6.4.1.2. <del>The requirement on whether recording of data that are specific to remote tower operations, such as visual presentation, is still under discussion. Whether such data should be considered in the ICAO definition or not needs to be discussed.</del> ICAO Doc 4444 Chapter 7.1.1.2.1. Annex 1 to EASA ED Decision 2019/004/R (‘Guidance Material on remote aerodrome air traffic services’ — Issue 2), Chapter 5.6.
Category	<Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

### B.3.8 Work Environment

Identifier	REQ-06.09.03-OSED-WE03.5001
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Requirement	Working Environment <b>should</b> permit day light conditions equal to ordinary office establishments.
Title	Working Environment General Lighting Conditions
Status	<Validated>
Rationale	ATCOs/AFISOs are used to work in a daylight environment. Compare with modern ACCs, which are also designed to allow for daylight conditions to avoid fatigue etc.
Category	<Design><Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-WE03.5002
Requirement	Working Environment (noise, temperature etc) <b>shall</b> be according national regulations for normal office establishments.
Title	Working Environment Noise & Temperature Conditions
Status	<Validated>
Rationale	In order to ensure good working environment to avoid fatigue etc.
Category	<Design><Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test>

Identifier	REQ-06.09.03-OSED-WE03.5003
Requirement	Working Environment <b>shall</b> enable the ATCO/AFISO to adjust the lighting conditions in the RTM in order to adapt to the conditions at the remote airport(s).
Title	Working Environment Lighting Adaptable to Remote Airport
Status	<Validated>
Rationale	E.g., during darkness at the remote aerodrome, the room/RTM is likely needed to be darker. Based on validation feedback.
Category	<Design><Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test><Review of Design>

Identifier	REQ-06.09.03-OSED-WE03.5004
Requirement	If several RTMs are collocated in a RTC, the ATCO/AFISO <b>should</b> be able to control the lights individually for each RTM in a RTC.
Title	Working Environment Lights Adjustable on RTM Level
Status	<Validated>
Rationale	It can be daylight conditions (at the remote airport) in one RTM, and darkness (at the remote airport) in the RTM next beside.

Category	<Design><Functional>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-WE03.5005
Requirement	Working Environment <b>shall</b> enable sufficient writing space in the CWP for the ATCO/AFISO to make manual notes .
Title	Working Environment Space for Writing
Status	<Validated>
Rationale	Based on validation feedback, particularly from VP-058. The space shall be properly lit as required, minding the difference in daylight/night-time operations.  Taking manual notes are often common practice in small towers due to e.g. lot unplanned traffic. Making manual paper notes is ultimately also the final fall-back procedure if all technical systems would stop functioning. Using paper strips may satisfactory fulfil this need, hence if using paper strips no additional separate space for making notes may be needed.
Category	<Design><Operational>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test><Review of Design>

Identifier	REQ-06.09.03-OSED-WE03.5006
Requirement	The CWP <b>should</b> be designed according to good ergonomical design principles and allow for a degree of flexibility for user adaption.
Title	Working Environment - good ergonomics and user adaptation
Status	<Validated>
Rationale	Adaption for left/right handed persons, height adjustable worktable, number of input and output devices limited to a minimum, etc.  The following human performance requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: RT_REQ_DESIGN_007, RT_REQ_DESIGN_009.
Category	<Design><Functional><HMI>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Test><Review of Design>

### B.3.9 Reliability & Integrity

Identifier	REQ-06.09.03-OSED-RI03.6001
Requirement	The likelihood of failure or degradation of systems not specific to remote tower operations <b>shall</b> be operationally acceptable as per local implementation and as per applicable regulations.

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Title	Reliability & integrity of non-remote tower specific systems.
Status	<Validated>
Rationale	<p>Systems not specific to remote tower operations refers to systems that are used already in today's local operations, e.g. radio communication, radar surveillance etc.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR42, SR43, SR44, SR45, SR47, SR49 SR51, SR56, SR58, SR59, SR60.</p>
Category	<Safety><Reliability><Operational>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>

Identifier	REQ-06.09.03-OSED-RI03.6002
Requirement	The likelihood of failure or degradation of systems that are specific to remote tower operations, such as the visual presentation, <b>shall</b> be defined on local implementation level in order to be operationally acceptable.
Title	Reliability & integrity of remote tower specific systems.
Status	<Validated>
Rationale	<p>These decisions and figures will likely be based on e.g. Regularity, Cost Benefit and Safety analysis for every airport and local implementation.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR52.</p> <p>The following safety requirement(s) of <b>Error! Reference source not found.</b> comply with this OSED requirement: SR-52M01.</p>
Category	<Safety><Reliability><Operational>
Validation Method	<Live Trial><Shadow Mode>
Verification Method	<Review of Design><Test>