D35 OSED for Remote Provision of ATS to Aerodromes

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Abstract

This document is the Operational Services and Environment Description (OSED) relating to the Remote and Virtual Towers (RVT) element of the SESAR operational concept. It also takes the role of a Safety and Performance Requirements Document (SPR) for OFA06.03.01.

This document covers the remote provision of Air Traffic Services (ATS):

- To single aerodromes - in a one to one relationship of one airport to one remote tower module;
- To multiple aerodromes in parallel - in a one to many relationship of more than one airport to one remote tower module;
- As a Contingency solution when the local Tower is not available, the ATCO cannot be located at the local Tower and the service is temporarily relocated to a remote tower module.

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			[redacted]	EUROCAE WG-100 work. */Section 6* Updated references. /Section 7
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Executive summary

This document is the Operational Services and Environment Description (OSED) for the Operational Focus Area (OFA) 06.03.01 “Remote Tower”. It also takes the role of a Safety and Performance Requirements Document (SPR) for OFA06.03.01, as no SPR is being produced within P06.09.03 / OFA06.03.01.

It defines the operational services, environments, scenarios, use cases and requirements for the remote provision of ATS to aerodromes. This OSED is a top-down refinement of the SESAR Airports DOD produced by P06.02. It also contains additional information which should be consolidated back into the higher level SESAR concepts using a “bottom up” approach.

The main change to current operations proposed by the Remote Tower concept is that the ATCO or AFISO will no longer be located at the aerodrome. They will be temporarily or permanently re-located to a Remote Tower Module (RTM), which itself may be housed in a centralised facility known as a Remote Tower Centre (RTC). The aerodrome view(s) will be captured and presented in the RTM. The visual presentation of the aerodrome view(s) can be overlaid with information from additional sources and enhanced through technology for use in all visibility conditions.

The full range of ATS as defined in ICAO Documents 4444, 9426 and EUROCONTROL’s Manual for AFIS will be provided remotely by an ATCO, (for some aerodromes a single ATCO fulfilling both TWR and APP) or by an AFISO (not applicable for the contingency). The airspace users should be provided with the same level of services as if the ATS were provided locally.

For the purpose of this document, OFA06.03.01 Remote Tower is categorised into three primary modes of operation:

- **Remotely Provided Air Traffic Services for a Single Aerodrome;**
- **Remotely Provided Air Traffic Services for Multiple Aerodromes;**
- **Remotely Provided Air Traffic Services for Contingency Situations at Aerodromes.**

The three currently defined OI steps covered under the Remote Tower OFA, and therefore most clearly defined in this OSED are:

SDM-0201 – Remotely Provided Air Traffic Services for a Single Aerodrome;

SDM-0204 - Remotely Provided Air Traffic Service (TWR) for Contingency Situations at Small to Medium Aerodromes (with a Single Main Runway);

SDM-0205 - Remotely Provided Air Traffic Services (TWR & AFIS) for two low density Aerodromes;

In the future it is proposed that new OI steps (yet to be given denotations and official OI classification) will be created in order to cover the wider scope of the Remote Tower OFA. These are likely to refer to the concept’s application in denser and more complex environments.

Remotely Provided Air Traffic Services for a Single Aerodrome, “Single Remote Tower” describes the concept of providing aerodrome control service or flight information service to a single aerodrome from a remote location (i.e. a location other than the control tower local to the aerodrome). SDM-0201 is the only OI referring to single aerodromes and covers its deployment in all environments.

The aspects of this mode of operations covered to date by P06.09.03 and P06.08.04 focus on the provision of a service by one ATCO to one small (third or fourth level node) airport with a single runway and low capacity utilisation. When providing a remote ATS to such aerodromes it may bring about cost benefits due to the ability to centralise the service in a larger facility. It also may allow ATS to be provided in isolated or dangerous areas, on a temporary or permanent basis and provide an alternative to upgrading or building a new local tower building. It is likely that further project activities will be conducted in larger and more complex environments, as such covering the full scope of SDM-0201.

The first implementation of the remote provision of ATS for a single aerodrome has been given an operational approval by the Swedish Regulator and commenced a live operational service in April 2015 (providing a remote ATS to Örnsköldsvik Airport, ESNO, from RTC Sundsvall).

Remotely Provided Air Traffic Services for Multiple Aerodromes "Multiple Remote Tower" is the provision of ATS by one operator to more than one aerodrome in a 1:n ratio. SDM-0205 partially covers this mode of operations, focusing on the provision of ATS in a 1:2 ratio. The scope of SDM-0205 is the simplest application of the mode. It focuses on one ATCO/AFISO providing a service to two aerodromes where both have a low capacity utilisation and the frequencies of simultaneous movements is minimal. When providing a service to such environments the cost benefits (compared to Single Remote Tower) are higher due to the sharing of facilities and resources. It can also improve the uniformity of service provision at low density and remote aerodromes and increase the availability of the service (for example allowing ATS to be provided at an aerodrome which previously was unable to financially support a service).

It is expected that the initial technical and operational capability of remote provision of ATS for a multiple aerodrome will be available from late 2016.

Remotely Provided Air Traffic Services for Contingency Situations at Aerodromes, "Contingency Tower", proposes that a Remote Contingency Tower (RCT) is used to provide remote ATS during contingency situations. The RCT is a facility which includes a camera based visual presentation of the aerodrome and its vicinity, providing operators with a view of their area of responsibility. This aims to increase capacity to as close to 100% of the capacity from the local aerodrome as possible (or other pre-set level defined by the ANSP or airport operator as required). In turn, cost benefits are envisaged through improved resilience by increasing traffic retention through the use of the RCT compared to existing solutions. Retaining traffic minimises economic losses such as losses of revenues. The provision of a visual presentation of the aerodrome and its vicinity also aims to improve the flexibility with which contingency ATS can be provided. It also will improve the transition in working methods from local to contingency operations. These benefits should be achieved whilst at least maintaining safety and ATCO human performance to the same level as achieved in standard local tower operations.

OI step SDM-0204 is described as *"Aerodrome Control Service is provided by a remote/secondary facility at small to medium airports (with a single main runway) in a contingency situation where the primary ATC Tower is not useable."* The scope of SDM-0204 is one of the simplest applications of the mode, considering that very small aerodromes are unlikely to implement Remote Contingency Tower as the business case for doing so may not be as robust. The rationale is to provide an alternative facility where ATS can be continued to be provided with a high level of retained capacity. The solution is a cost effective alternative which could be implemented both at aerodromes where no ground surveillance radar exist, as well as at aerodromes equipped with ground surveillance radar, adding further benefits compared to a contingency solution based on ground surveillance only. This is possible as the solution does not necessarily require the use of ground surveillance radar. It is expected that the initial technical and operational capability of remote provision of ATS for contingency operations will be available from late 2015.

1 Introduction

1.1 Purpose of the document

The Operational Service and Environment Definition (OSED) describes the operational concept defined in the Detailed Operational Description (DOD) within the scope of its Operational Focus Area (OFA).

It defines the operational services, their environments, scenarios and use cases and requirements.

The OSED is used as the basis for assessing and establishing operational, safety, performance and functional requirements for the related systems. The OSED identifies the operational services supported by several entities within the Air Traffic Management (ATM) community and includes the operational expectations of the related systems.

This OSED is a top-down refinement of the Single European Sky ATM Research Programme (SESAR) Airports DOD Step 1 [7] and Step 2 [8] produced by the federating OPS P06.02 project. It also contains additional information which should be consolidated back into the higher level SESAR concepts using a "bottom up" approach.

The figure below presents the location of the OSED within the hierarchy of SESAR concept documents, together with the SESAR Work Package or Project responsible for their maintenance.

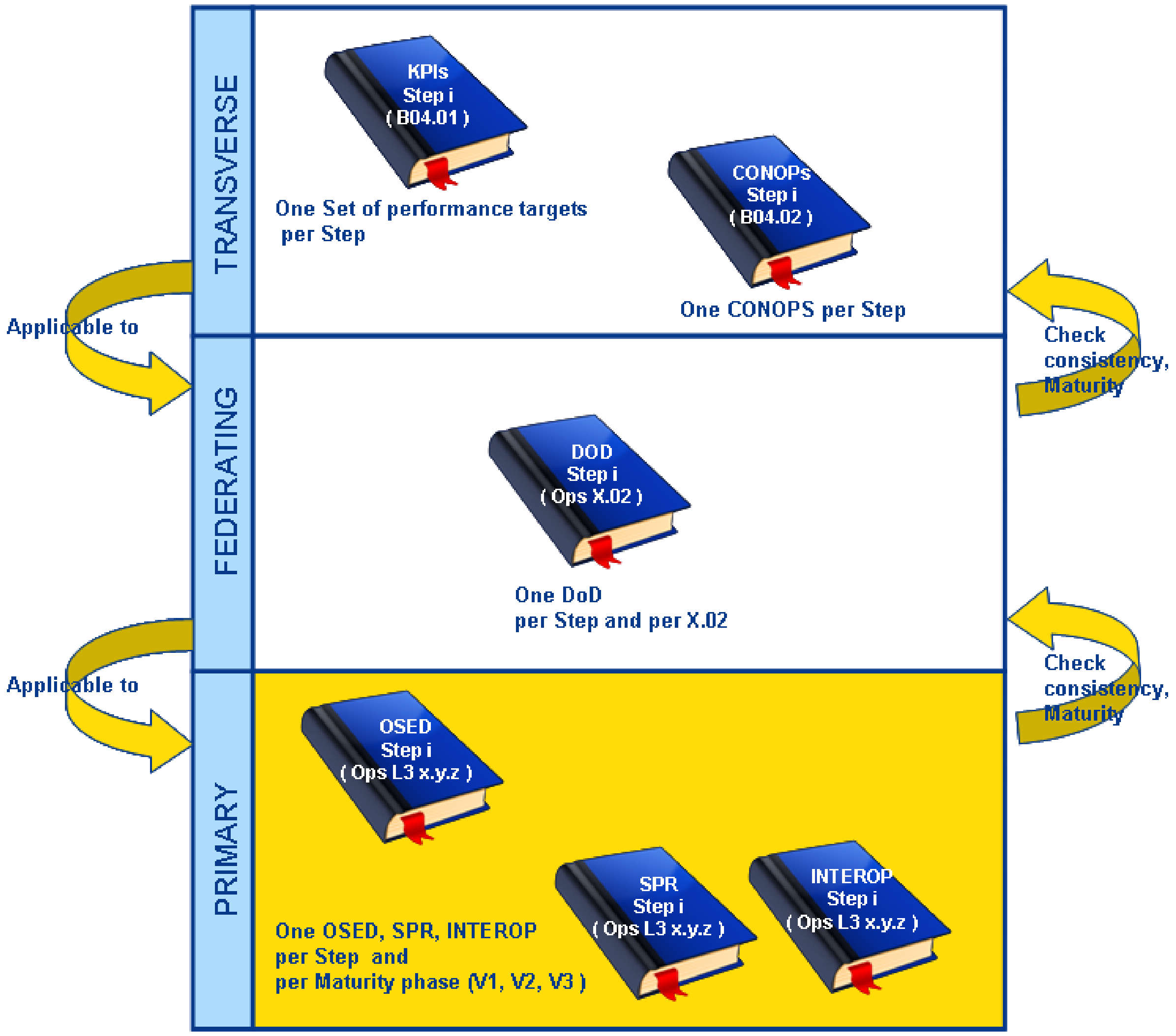


Figure 1 – OSED document with regards to other SESAR deliverables

1.2 Scope

This document is the OSED relating to the OFA 06.03.01 Remote Tower. It will be a top down refinement of the Concept of Operations (ConOps) produced by SESAR PB.04.02 and the Airports Detailed Operational Description (DOD) produced by P06.02. It will also contain new information which should be consolidated back into the higher level SESAR concepts using a "bottom up" approach.

The OFA06.03.01 *Remote Tower* is categorised as shown in Figure 2. At the top level is the general concept and from that three modes of operation can be identified.

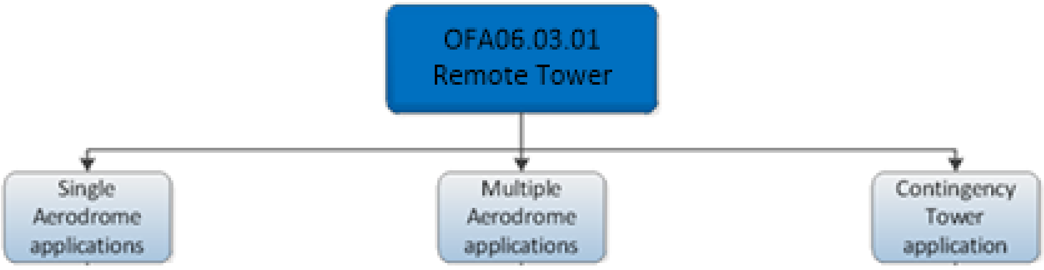


Figure 2 – OSED scope showing concept and modes of operation

1.3 Intended readership

The intended audience for this document are other P06.09.03 and P06.08.04 team members and those in the corresponding technical projects of P12.04.06, P12.04.07 and P12.04.08. Those working on P16.06.0X, P06.09.02 and P12.04.09 may also have an interest.

At a higher project level, P06.02 and WP B are expected to have an interest in this document. External to the SESAR project, other stakeholders are to be found among:

- Appropriate National Safety Authorities (NSA);
- Affected employee unions;
- Air Navigation Service Providers (ANSP);
- Airport owners;
- Airspace users.

1.4 Structure of the document

The structure of the document is as follows:

- §1 (this section) introduces the document;
- §2 scopes the concept and puts it in the context of the overall SESAR concept;
- §3 provides a description of the ATM services offered by the Remote and Virtual Tower concept for single aerodromes, multiple aerodromes and the contingency case;
- §4 characterises the operational environments in which the Remote and Virtual Tower concept implementation is foreseen for single aerodromes, multiple aerodromes and the contingency case;
- §5 outlines some key use cases;
- §6 lists the operational and functional requirements for the Remote and Virtual Tower concept for single aerodromes, multiple aerodromes and the contingency case;
- §7 lists the reference documents used in the production of this OSED.

1.5 Background

A preliminary operational concept was defined in the Remotely Operated Tower (ROT) project, led by LFV and Saab. This was further enhanced by developments made during the Advanced Remote Tower (ART) project led also by LFV and Saab. Both projects investigated the feasibility of an initial concept and a set of technical enablers for remotely provided Air Traffic Service (ATS) to a single aerodrome.

Remote and Virtual Tower was first proposed for development and assessment in SESAR P06.09.03, alongside system projects P12.04.06, 12.04.07, 12.04.08 and 12.04.09. The aim of P06.09.03 was to define and then mature the Remote Provision of ATS against the three identified modes (Single, Multiple, Contingency). At the time, the project was largely focused on the north European environment where the main driver was cost efficiency for low complexity, low traffic aerodromes.

After some initial development, P06.08.04 (led by DFS) became involved to look at the concept both in terms of busier environments, and in terms of controller support tools.

As P06.09.03 nears completion and many aspects of the concept have been matured through learning and validation, it has become clear that the original definition of the concept and classification according to simple modes of operation was not sufficient. The projects have therefore requested that the scope of the originally proposed Operational Improvements (OI) is modified, with reclassification and creation of additional OI. All these OI still fall within the Remote Tower OFA 06.03.01 and are covered by this OSED. However, the projects acknowledge that there is still much to learn on the subject and this will require development and assessment in future projects.

1.6 Glossary of terms

The document uses the following important top level naming conventions:

Where reference is made to the actual Control Tower building, the full word "**Tower**" is used e.g. the local Tower is 87 metres tall.

Aerodrome Control Service (**TWR**) is the air traffic control (ATC) service provided by the Air Traffic Control Officer (**ATCO**) for an aerodrome.

AFIS is the Aerodrome Flight Information Service provided by an **AFISO** (Aerodrome Flight Information Service Officer).

APP (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).

ATS (Air Traffic Service) is a generic term for the three services Flight Information Service (FIS), Alerting Service (ALRS) and Air Traffic Control Service (ATC). ATC is then subdivided into the three services of TWR, APP and ACC (Area Control Service). In this document, when the term ATS is used, it is usually referring to TWR or AFIS in the context of Single & Multiple applications, however referring to TWR only in the context of Contingency applications.

Advanced Visual Features (AVF) refers to the additional features envisaged for potential inclusion in an RTM. The AVFs are optional features that enhance vision and operator situational awareness, including during low visibility conditions. AVFs are likely to include an Infra-Red (IR) Camera, information overlays, Hot-Spot cameras and Visual Tracking Labels.

Technical Enablers refer to additional features and functions within an RTM that enable the provision of ATS using the concept. These technical features will assist in the areas of visualisation, operational performance, safety of operations or reliability. Some technical enablers are considered mandatory (such as binocular functionality), whilst some, including AVFs (which are a subset of Technical Enablers) are considered optional. Further information on the requirement status of the Technical Enablers is given within this document.

CWP (Controller Working Position) is the operator (ATCO / AFISO) work station including necessary ATS systems.

Remote Tower is where ATS are remotely provided through the use of direct visual capture and visual presentation e.g. through the use of cameras.

Remote Tower Module (RTM) is the term for the complete module including both the CWP(s) and the Visual Presentation display screens. An RTM is defined as a work station for an operator. The RTM will enable the remote tower operator to maintain a view over the aerodrome including the manoeuvring area and surfaces as stipulated in regulation. The RTM may be located on the aerodrome site or at a location remote to the aerodrome. Independent of the exact location of the RTM a specialist facility/building is not required to house the RTM and location of the facility is flexible. The RTM is independent of the concept of operations being applied within and hence may be used to provide an ATS to single or multiple aerodromes or during contingency.

A **Remote Tower Centre** (RTC) is a centralised facility housing one or more RTMs where the provision of a remote ATS may be provided to one or more aerodromes.

Remote Tower Centre Supervisor (RTC SUP) The role of an RTC supervisor may be established in order to provide an efficient set up at all times and guarantee a flexible system by means of; maintaining overall supervision of all aerodromes within the RTC; managing the allocation of staff and RTM; performing planning, administration, allocation of tasks and supervision of technical systems.

A **Remote Contingency Tower** (RCT) facility is a facility used to provide remote ATS, including a visual presentation, to an aerodrome in contingency situations.

Remote and Virtual Tower (RVT) refers to either the RVT Project (this project, P06.09.03 of SESAR) or the RVT Concept. The RVT Concept consists briefly of the system elements as laid out by Figure 3 below (***Please note:*** The system picture below is only an example of an RTC set up, the number and configuration of airports/RTMs/CWPs will/can differ with every implementation).

Traditional Operations refers to the current operational practices used within air traffic control and applied within the time frame of the compilation and publication of this document. With specific reference to the current standards and regulations applied to the provision of a TWR service provided by the ATCO and AFIS provided by the AFISO for an aerodrome.

Virtual Tower is where ATS are remotely provided through the use of computer generated images of the aerodrome, aircraft and vehicles and/or surveillance e.g. through the use of terrain mapping and computer modelling of aerodromes.

Visual Presentation is the term for the collected aerodrome sensor data (from cameras and/or other sensors) and presented to the ATCO/AFISO in order to provide situational awareness of the aerodrome and its vicinity. Note that other terms such as Visual Reproduction and Visual Representation have been applied throughout the lifetime of the projects. The definition of the terms should be taken as identical to the definition provided for visual presentation.

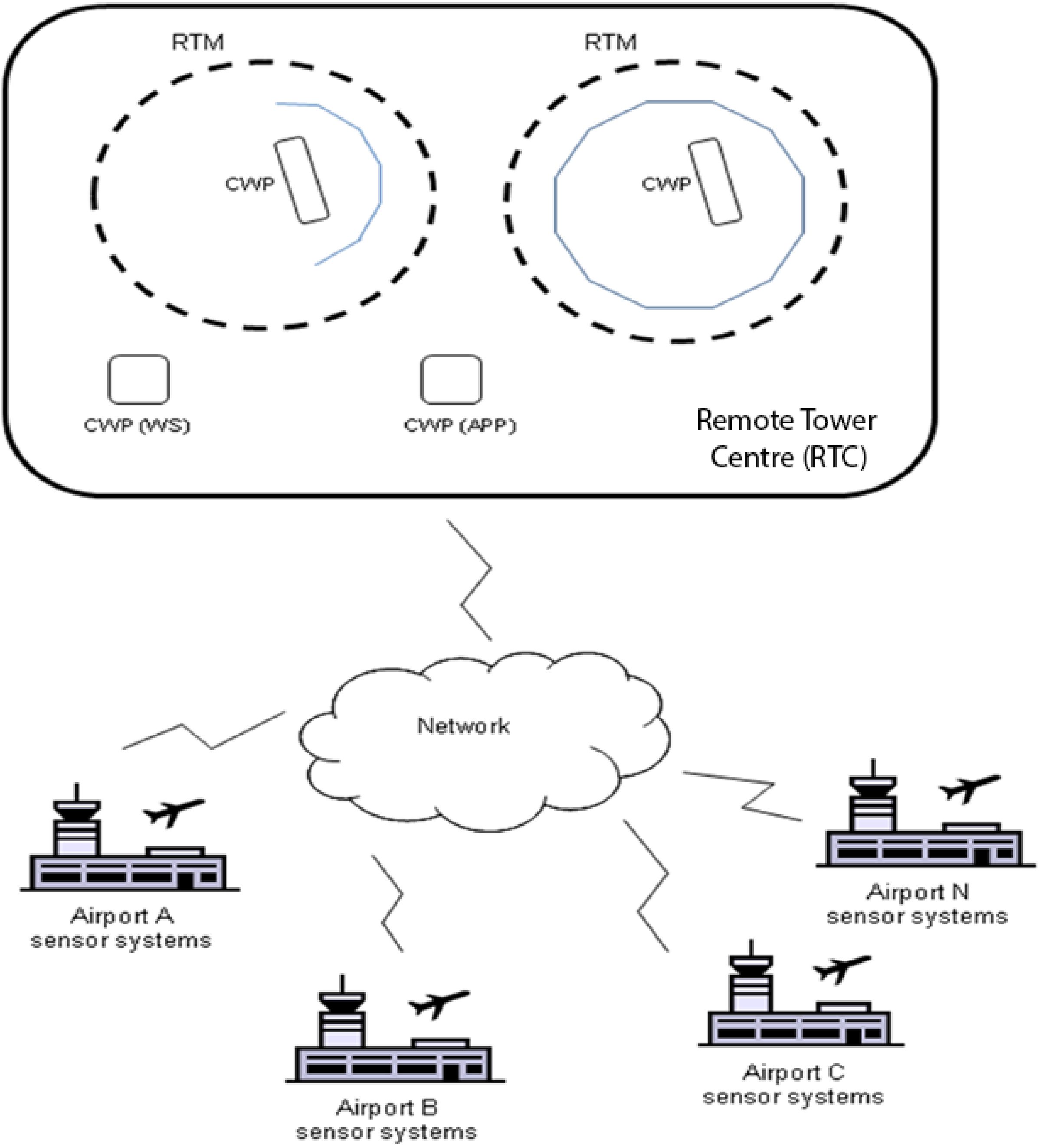


Figure 3 – RVT concept system overview

1.7 Acronyms and Terminology

Term	Definition
ACARS	Aircraft Communications Addressing and Reporting System
ACC	Area Control Centre
ADI	Aerodrome Control Instrument Rating
ADS-B	Automatic Dependent Surveillance-Broadcast
AFIS	Aerodrome Flight Information Service
AFISO	Aerodrome Flight Information Service Officer
AGL	Aerodrome Ground Lighting
AIP	Aeronautical Information Publication
ALRS	Alerting Service
ALT	Altitude
ANSP	Air Navigation Service Provider
APOC	AirPort Operations Centre
APP	Approach Control
APS	Approach Control Surveillance
ART	Advanced Remote Tower
ATC	Air Traffic Control
ATCC	Air Traffic Control Centre
ATCEUC	Air Traffic Controllers European Union's Coordination
ATCO	Air Traffic Control Officer
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATS	Air Traffic Service
ATSEP	Air Traffic Service Electronic Personnel
ATSU	Air Traffic Service Unit
AVF	Advanced Visual Feature
AWOS	Advanced Weather Observation System
CAA	Civil Aviation Authority
CAT	Category
CAVOK	Ceiling and Visibility OK
CEF	Cost Effectiveness
CPDLC	Controller Pilot Data Link Communication
CTR	Control Zone
CWP	Controller Working Position
DCL	Data Communications Link
DEL	Deliverable
DME	Distance Measuring Equipment
DOD	Detailed Operational Description
EAATS	En-route/Approach ATS
EASA	European Aviation Safety Agency
EGLL	ICAO code for London Heathrow Airport UK

Term	Definition
ESMS	ICAO Code for Malmo-Sturup Airport
ESNO	ICAO code for Örnsköldsvik Airport
ETF	European Transport Workers' Federation
EXE	Exercise
FDPS	Flight Data Processing System
FIS	Flight Information Service
FIZ	Flight Information Zone
FPL	Flight Plan
GND	Ground Control
GPS	Global Positioning System
HMI	Human Machine Interface
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organisation
IFATCA	International Federation of Air Traffic Controllers' Associations
IFR	Instrument Flight Rules
ILS	Instrument Landing System
INT	Intermediate Controller
KPA	Key Performance Area
KPI	Key Performance Indicator
LFV	Swedish ANSP
LVO	Low Visibility Operations
LVP	Low Visibility Procedures
MASPS	Minimium Aviation System Performance Specification
MET	Meteorological
METAR	Meteorological Aerodrome Report
METOBS	Meteorological Observations
MLAT	Multi Lateration
MLS	Microwave Landing System
MSL	Mean Sea Level
MSSR	Mono pulse secondary surveillance radar
NATMIG	North European ATM Industry Group
NAV	Navigation
NDB	Non-Directional Beacon
NMOC	Network Manager Operations Centre
NORACON	NORth European and Austrian CONsortium
NOTAM	Notice to Airmen
NPA	Notice of Proposed Amendment
NSA	National Supervisory Authority
OCD	Operational Concept Description
OFA	Operational Focus Area
OPS	Operations

Term	Definition
OSED	Operational Services and Environment Descriptions
OTW	Out-The-Window
PAC	Operational Package
PPR	Prior Permission Required
PSR	Remote Contingency Tower
PTZ	Pan-Tilt-Zoom
QNH	barometric pressure adjusted to mean sea level
RAD	RADAR
RCT	Remote Contingency Tower
RDP	Radar Data Processing
REQ	Requirement
RFFS	rescue and firefighting services
RMT	Rule Making Task
RNAV	Area Navigation
RNP	Required navigation performance
ROT	Remotely Operated Tower (Saab and LFV project)
RTC	Remote Tower Centre
RTM	Remote Tower Module
RTO	Remote Tower Operations
RVR	Runway Visual Range
RVT	Remote and Virtual Tower
RWSL	Runway Status Lights
RWY	Runway
SAR	Search and Rescue
SARP	Standards and Recommended Practices
SCAA	Swedish flight safety authority
SESAR	Single European Sky ATM Research
SFC	Surface
SID	Standard Instrucment Departure
SJU	SESAR Joint Underataking
SMGCS	Surface Movement Guidence and Control System
SMR	Surface Movement Radar
SPC	Operational Sub-Package
SPR	Safety and Performance Requirements
STAR	Standard Terminal Arrival Route
STCA	Short Term Conflict Alert
SUP	Supervisor
SWIM	System Wide Information Management
SWP	Sub Work Package
TIA	Traffic Information Area
TIZ	Traffic Information Zone

Term	Definition
TMA	Terminal Control Area
TMZ	Terminal Manoeuvring Zone
TWR	Aerodrome Control Service
TWY	Taxiway
UHF	Ultra High Frequency
UTC	Coordinated Universal Time
VALR	Validation Report
VCS	Voice Communications System
VFR	Visual Flight Rules
VHF	Very High Frequency (radio spectrum band)
VOR	VHF Omni Directional Radio Range

Table 1 – Acronym Table

2 Summary of Operational Concept from DOD

For the purpose of this document, OFA06.03.01 Remote Tower is categorised into three primary modes of operation (refer to Figure 2 above):

- **Remotely Provided Air Traffic Services for a Single Aerodrome ("Single Remote Tower");**
- **Remotely Provided Air Traffic Services for Multiple Aerodromes ("Multiple Remote Tower");**
- **Remotely Provided Air Traffic Services for Contingency situations at Aerodromes ("Contingency Remote Tower").**

In the early work and ATM Masterplan data sets, one OI represented the full scope of each mode. As the concept developed it became clear that there was a very strong link between operating environment, OI feasibility, acceptance and therefore maturity. Where an OI could be considered mature in a low density, low complexity environment, it could not yet be considered mature for a more complex environment. The projects subsequently made a change request (CR) to reclassify the original OI and add new OI to the dataset.

The scope of the Remotely Provided ATS to a Single Aerodrome OI was least affected since the target operating environment for that OI was quite well defined, namely "small rural airports, which today are struggling with low business margins".

When developing Remotely Provided Air Traffic Services for Contingency Situations two variants emerged, with each again depending on the target environment where aerodrome size and technologies available had a strong link.

Finally, the scope of the Remotely Provided ATS to Multiple Aerodromes was subject to the biggest change. This mode depends very strongly, if not more so that the other two modes, on operational context and as such it is likely that coverage of a wide range of different environments and operating methods will be required.

The three currently defined OI steps covered under the Remote Tower OFA, and therefore most clearly defined in this OSED are:

1. Remote Provision of ATS (TWR & AFIS) to a Single Aerodrome (SDM-0201);
2. Remotely Provided Air Traffic Services (TWR & AFIS) for two low density Aerodromes (SDM-0205);
3. Remotely Provided Air Traffic Service (TWR) for Contingency Situations at Small to Medium Aerodromes (with a Single Main Runway) (SDM-0204);

In the future it is proposed that new OI steps (yet to be given denotations and referred to herein as SDM-020x prior to official OI classification) will be created in order to cover the wider scope of the Remote Tower OFA. These are likely to refer to the concept's application concept in denser and more complex environments.

It should be noted that much of the detail in this OSED document was created prior to the OI steps being changed, hence is covering the concept with reference to the three high level primary modes of operation (i.e. broader/wider scale than limited to the three OI steps as detailed above), but this OSED does try to clearly define what is covered by the OI steps and what lies outside of their scope.

2.1 Remote Provision of ATS to Single and Multiple Aerodromes, SDM-0201 and SDM-0205

This section links this OSED to the Detailed Operational Descriptions (DOD) produced by P06.02 for Step 1 and Step 2. The mapping tables provide information linking SDM-0201 and SDM-0205 to the DOD.

2.1.1 Mapping tables

Table 2 lists the Operational Improvement steps (OIs from the Integrated Roadmap, within the associated Operational Focus Area addressed by the OSED.

Operational Package	Operational Sub-package	Operational Focus Area name / identifier	Relevant OI Steps ref. (coming from the Integrated Roadmap)	Story Board Step	Master or Contributing (M or C)	Contribution to the OIs short description
PAC06 Cooperative Asset Management	SPC06.03 Remotely provided Air Traffic Services for aerodromes	OFA 06.03.01 Remote Tower	SDM-0201 Remotely Provided ATS for Single Aerodromes	1	M	The Remote Provision of ATS to a Single Aerodrome (in a one to one relationship of one airport to one Remote Tower Module (RTM)
			SDM-0205 Remotely Provided Air Traffic Services for two low density Aerodromes	2	M	The Remote Provision of ATS to Multiple Aerodromes in parallel (in a one to two relationship of two airports to one RTM)

Table 2 – List of relevant OIs within the OFA

Table 3 shows the relevant enablers for each OI step mapped within the integrated roadmap. The dataset used reflect dataset 14 the current dataset for the integrated roadmap.

Relevant OI Steps ref. (coming from the Integrated Roadmap)	Relevant Enablers from integrated road map for OI step	Enabler Description
SDM-0201	AERODROME-ATC-52	Provide Remote Tower Controller position with visual presentation of both remote aerodrome views and other sensor data
SDM-0201	AERODROME-ATC-53	Remote Tower controller position enhanced with additional sources for low visibility conditions
SDM-0205	AERODROME-ATC-54	Provide a Remote Tower Centre (RTC) position that enable one ATCO to control multiple remote towers simultaneously or in sequence.
SDM-0201	CTE-C05b	Digital voice/VoIP for ground segment Air-Ground voice
SDM-0201	CTE-C05a	VoIP for ground telephony
SDM-0201	REF-0509	Regulatory Provisions for the

Relevant OI Steps ref. (coming from the Integrated Roadmap)	Relevant Enablers from integrated road map for OI step	Enabler Description
		harmonised deployment of Remote Towers Operations
SDM-0201, SDM-0205	CTE-S02d	Video Surveillance

Table 3 – Relevant enablers from the integrated roadmap

Table 4 identifies the link with the applicable scenarios and use cases of the DOD.

Scenario identification	Use Case Identification	Use Case Description	Reference to DOD section where it is described
Execution Phase	All	-	4.2.5.1 (DOD Step 1 and 2)

Table 4 – List of relevant DOD Scenarios and Use Cases

Table 5 identifies the link with the applicable environments of the DOD.

Operational Environment	Class of environment	Description/Examples	Reference to DOD section where it is described
Network Function	Third Level Node	A regional airport with a limited number of scheduled connections mainly operated by one or two (low fare) carriers. Examples of this class of airport are: Bern, Dortmund, Aarhus, Rotterdam, Girona etc.	Step 1 and Step 2 DOD 3.1.1.1
Network Function	Fourth Level Node	A (regional) airport with only a very few (<10) aircraft movements a day. Examples of this class of airport are: Mora (Sweden), Hof (Germany) etc.	Step 1 and Step 2 DOD 3.1.1.1
Network Function	General / Business Aviation	An Airport dedicated to General / Business Aviation close to important metropolitan areas. Examples for this class of airports are: Paris LBG, Farnborough, Egelsbach, Copenhagen-Roskilde etc.)	Step 1 and Step 2 DOD 3.1.1.1
Layout & Basic Operational Criteria	Single Runway, non-complex surface layout	Examples of this class of Airports might be Rotterdam, Bremen and Stuttgart	Step 1 and Step 2 DOD 3.1.1.2
Capacity Utilisation	Low utilised airports/runways less than 70% load during peak periods	Examples of this class of airports might be Ljubljana, Luxembourg Southampton	Step 1 and Step 2 DOD 3.1.1.3
External Influencing Factors	Moderately Constrained	Constrained by both Geographical/Weather and Political/Community	Step 1 and Step 2 DOD 3.1.1.4

Table 5 – List of relevant DOD Environments

Table 6 identifies the link with the applicable Operational Processes and Services defined in the DOD.

DOD Process	DOD Node - node which is responsible for the activities in the process	Activity - sub-process called to realize a part of the process	Description of the activity	Reference to DOD section where it is described
Prepare and execute off-block	AATS	Provide start-up instruction	Check start-up and provide push-back clearance.	Step 1 DOD 6.2 Ch 5.2.3
	AATS	Provide instruction to exit from the stand	Give instruction to exit from the stand and provide push-back clearance. Start-up may be delayed.	Step 2 DOD 6.2 Ch 5.2.3
Prepare and execute taxi-in routing	EAATS	Provide taxi-in route	Provide a taxi-in route to the aircraft during the approach phase.	Step 1 DOD 6.2 Ch 5.2.4 Step 2 DOD 6.2 Ch 5.2.3
	AATS	Provide taxi-in routing guidance	After vacating the runway, guide the aircraft until it reaches a stand. The taxi route may be revised.	Step 1 DOD 6.2 Ch 5.2.4 Step 2 DOD 6.2 Ch 5.2.3
	AATS	Provide runway crossing		Step 2 DOD 6.2 Ch 5.2.3
Prepare and execute taxi-out routing	AATS	Plan and provide taxi-out route	Plan and provide a taxi-out route to the aircraft during the turn-round phase.	Step 1 DOD 6.2 Ch 5.2.4 Step 2 DOD 6.2 Ch 5.2.3
	AATS	Provide instruction to exit from the stand	Provide instruction for push-back. In some cases, guide aircraft out of an open stand.	Step 1 DOD 6.2 Ch 5.2.4
	AATS	Provide taxi-out routing guidance	Guide the aircraft until it reaches the holding point for take-off. The taxi route may be revised.	Step 1 DOD 6.2 Ch 5.2.4 Step 2 DOD 6.2 Ch 5.2.3

DOD Process	DOD Node - node which is responsible for the activities in the process	Activity - sub-process called to realize a part of the process	Description of the activity	Reference to DOD section where it is described
	AATS	Provide runway crossing	TBC	Step 1 DOD 6.2 Ch 5.2.4 Step 2 DOD 6.2 Ch 5.2.3
Plan and provide routing for a vehicle	AATS	Provide vehicle routing guidance	Guide a ground vehicle (aircraft excluded) on the airport surface.	Step 1 DOD 6.2 Ch 5.2.4 Step 2 DOD 6.2 Ch 5.2.3
	AATS	Provide runway crossing clearance	TBC	Step 1 DOD 6.2 Ch 5.2.4 Step 2 DOD 6.2 Ch 5.2.3
Perform Conformance Monitoring	AATS	Manage Airport Conformance Alert	Do everything which is necessary to cancel a non-conformance alert.	Step 1 DOD 6.2 Ch 5.2.5
Perform RWSL Operations	AATS	Manage RWSL issues	Solve conflicting clearances or any issues with the system.	Step 1 DOD 6.2 Ch 5.2.5

Table 6 – List of the relevant DOD Processes and Services

Table 7 summarizes the requirements including performance (KPA related) requirements relevant to this OSED. This table supports defining the performance objectives in the scope of the addressed OFA. The DOD performance requirements are structured to respond to Key Performance Indicators (PI) targets / decomposed PI's, so this table aids traceability of the performance framework.

DOD Requirement Identification	DOD requirement title	Reference to DOD section where it is described
REQ-06.02-DOD-6200.0057	The Tower Runway and Ground controllers and AFISO shall be provided with the information collected from remote tower sensor systems in order to perform Air Traffic Services from a facility located elsewhere than at the relevant airport.	Step 1 DOD 6.2
REQ-06.02-DOD-CEF1.0631	KPA Cost Effectiveness	Step 1 DOD 6.3.5
REQ-06.02-DOD-CEF2.0631	KPA Cost Effectiveness	Step 2 DOD 6.2.4
REQ-06.02-DOD-SEC1.0001	KPA Security	Step 1 DOD 6.3.3
REQ-06.02-DOD-SEC2.0001	KPA Security	Step 2 DOD 6.2.2
REQ-06.02-DOD-ENV1.0001	KPA Environment	Step 1 DOD 6.3.4

DOD Requirement Identification	DOD requirement title	Reference to DOD section where it is described
REQ-06.02-DOD-ENV2.0001	KPA Environment	Step 2 DOD 6.2.3
REQ-06.02-DOD-FLX1.0001	KPA Flexibility	Step 1 DOD 6.3.8
REQ-06.02-DOD-FLX2.0001	KPA Flexibility	Step 2 DOD 6.2.7
REQ-06.02-DOD-ANE1.0001	KPA Access and Equity	Step 1 DOD 6.3.10
REQ-06.02-DOD-ANE1.0002	KPA Access and Equity	Step 1 DOD 6.3.10
REQ-06.02-DOD-ANE1.0003	KPA Access and Equity	Step 1 DOD 6.3.10
REQ-06.02-DOD-ANE1.0004	KPA Access and Equity	Step 1 DOD 6.3.10
REQ-06.02-DOD-ANE2.0001	KPA Access and Equity	Step 2 DOD 6.2.9
REQ-06.02-DOD-ANE2.0002	KPA Access and Equity	Step 2 DOD 6.2.9
REQ-06.02-DOD-ANE2.0003	KPA Access and Equity	Step 2 DOD 6.2.9
REQ-06.02-DOD-ANE2.0004	KPA Access and Equity	Step 2 DOD 6.2.9
REQ-06.02-DOD-PRT1.0001	KPA Participation	Step 1 DOD 6.3.11
REQ-06.02-DOD-PRT1.0002	KPA Participation	Step 1 DOD 6.3.11
REQ-06.02-DOD-PRT2.0001	KPA Participation	Step 2 DOD 6.2.10
REQ-06.02-DOD-PRT2.0002	KPA Participation	Step 2 DOD 6.2.10
REQ-06.02-DOD-INT1.0001	KPA Interoperability	Step 1 DOD 6.3.12
REQ-06.02-DOD-INT2.0001	KPA Interoperability	Step 2 DOD 6.2.11
REQ-06.02-DOD-6200.0260	The Tower Runway and Ground controllers and AFISO shall be provided with the information collected from remote tower sensor systems located on several aerodromes in order to perform Air Traffic Services from a facility located elsewhere than at the concerned airports	Step 2 DOD 6.1

Table 7 – List of the relevant DOD Requirements

2.1.2 Operational Concept Description

Remotely Provided Air Traffic Services for a Single Aerodrome, “Single Remote Tower” describes the concept of providing aerodrome control service or flight information service to a single aerodrome from a remote location (i.e. a location other than the control tower local to the aerodrome). SDM-0201 is the only OI referring to single aerodromes and covers its deployment in all environments.

The aspects of this OI covered to date by the projects P06.09.03 and P06.08.04 focus on the provision of a service by one ATCO to one small (third or fourth level node) airport with a single runway and low capacity utilisation. These are the environments targeted by the rationale for SDM-0201 and are the ones which are included in the mapping tables in 2.1.1 above. When providing a remote ATS to such aerodromes it may bring about cost benefits due to the ability to centralise the service in a larger facility. It also may allow ATS to be provided to aerodromes situated in isolated or dangerous areas, on a temporary or permanent basis and provide an alternative to upgrading or building a new local tower building. It is likely that further project activities will be conducted in larger and more complex environments, as such covering the full scope of SDM-0201.

Remotely Provided Air Traffic Services for Multiple Aerodromes “Multiple Remote Tower” is the provision of ATS by one operator to more than one aerodrome in a 1:n ratio. SDM-0205 partially covers this mode of operations, focusing on the provision of ATS in a 1:2 ratio. The scope of SDM-0205 focuses on one ATCO/AFISO providing a service to two aerodromes where both have a low capacity utilisation and the frequencies of simultaneous movements are limited. When providing a service to such environments the cost benefits (compared to Single Remote Tower) are higher due to the sharing of facilities and resources. It can also improve the uniformity of service provision at low density and remote aerodromes and increase the availability of the service (for example allowing ATS to be provided at an aerodrome which previously was unable to financially support a service).

2.2 Remote Provision of ATS for Contingency Situations at Aerodromes, SDM-0204

This section links this OSED to the Detailed Operational Descriptions (DOD) produced by P06.02 for Step 1 and Step 2. The mapping tables provide information linking SDM-0204 to the DOD.

2.2.1 Mapping Tables

Table 8 lists the Operational Improvement steps (OIs) from the Integrated Roadmap, within the associated Operational Focus Area addressed by the OSED.

Operational Package	Operational Sub-package	Operational Focus Area name / identifier	Relevant OI Steps ref. (coming from the Integrated Roadmap)	Story Board Step	Master or Contributing (M or C)	Contribution to the OIs short description
PAC06 Cooperative Asset Management	SPC06.03 Remotely provided Air Traffic Services for aerodromes	OFA06.03.01 Remote Tower	SDM-0204 Remotely Provided Air Traffic Service for Contingency Situations at Small to Medium Aerodromes (with a Single Main Runway).	2	M	The Remote Provision of ATS to an Aerodrome during Contingency Situations. This provides a Contingency solution when the local Tower is not available, the ATCO cannot be located at the local Tower and the service is relocated to a Remote Contingency Facility.

Table 8 – List of relevant OIs within the OFA

Table 9 shows the relevant enablers for each OI step mapped within the integrated road map. The dataset used reflect dataset 14 the current dataset for the integrated roadmap.

Relevant OI Steps ref. (coming from the Integrated Roadmap)	Relevant Enablers from integrated road map for OI step	Enabler Description
SDM-0204	AERODROME-ATC-51	RTC position that in contingency situation hosts ATCO that will no longer be located at the local Tower.

Table 9 – Relevant enablers from the integrated roadmap

Scenario identification	Use Case Identification	Use Case Description	Reference to DOD section where it is described
Execution Phase	All	-	4.2.5.1 (DOD Step 1 and 2)

Table 10 – List of relevant DOD Scenarios and Use Cases

Table 11 identifies the link with the applicable environments of the DOD. Some of these environments are not applicable to SDM-0204, however they are target environments for the wider concept of the remote provision of ATS during contingency situations and may be the subject of future OI steps under this OFA investigating contingency remote tower.

Operational Environment	Class of environment	Description/Examples	Reference to DOD section where it is described
Network Function	Primary node	Medium sized airport with a limited hub function and intercontinental P2P connections. Examples of this class of airport are: London-STN, Lyon-Saint Exupéry, Budapest, Warsaw, Athens etc.	Step 2 DOD 3.1.1.1
Network Function	Secondary Node	An airport with limited or no intercontinental traffic, mainly scheduled connections to the large intercontinental (class 1) or European (class 2) hubs, a significant size of charter/leisure operations and acting as a major base for one or more low fare carriers. Examples of this type of airport are:, London-LTN, Nuremberg, Gothenburg, Leeds Bradford, Milan-BGY, Rome –CIA, Valencia etc.	Step 2 DOD 3.1.1.1
Capacity Utilisation	Normally utilised airports/runways. 70 – 90% load during 1 or 2 peak periods a day	Examples of this class of airports might be Düsseldorf, Manchester and Hamburg	Step 2 DOD 3.1.1.3
External Influencing Factors	Moderately Constrained (both Geographical / Weather and Political / Community)	Example of this class of airports might be Cologne	Step 2 DOD 3.1.1.4
External Influencing Factors	Lightly or Unconstrained	No major weather, topographical, political or community issues.	Step 2 DOD 3.1.1.4

Table 11 – List of relevant DOD Environments

Table 12 identifies the link with the applicable Operational Processes and Services defined in the DOD.

DOD Process / Service Title	Process/ Service identification	Process/ Service short description	Reference to DOD section where it is described
Review of and preparation for the response to extraordinary and emergency situations	ATS, APO, NM	Define/update response to emergency Publish response to emergency	Step 2 DOD A.1.1

Table 12 – List of the relevant DOD Processes and Services

Table 13 summarises the requirements including performance (KPA related) requirements relevant to the OSED. This table supports defining the performance objectives in the scope of the addressed OFA. The DOD performance requirements are structured to respond to Key Performance Indicators (KPI) targets / decomposed PIs, so this table will support traceability to the performance framework.

DOD Requirement Identification	DOD requirement title	Reference to DOD section where it is described
REQ-06.02-DOD-6200.0260	The Tower Runway and Ground controllers shall be provided with the information collected from remote tower sensor systems located on several aerodromes in order to perform Air Traffic Services from a facility located elsewhere than at the concerned airports.	Step 2 DOD 6.1.2

Table 13 – List of the relevant DOD Requirements

2.2.2 Operational Concept Description

Current contingency solutions are neither common nor standardised. At some larger aerodromes (with a single main runway)" a secondary local tower/control room is used in case of an emergency, with either a limited view of the aerodrome and its vicinity or with no out-the-window (OTW) view altogether, using a ground based solution instead.

The "Contingency Tower" solution proposes that a Remote Contingency Tower (RCT) is used in order to provide remote ATS to an aerodrome during contingency situations. The RCT is a facility which includes a camera based visual presentation of the aerodrome and its vicinity, providing operators with a view of their area of responsibility. This aims to increase capacity to as close to 100% of the capacity from the local aerodrome as possible (or other pre-set level defined by the ANSP or airport operator as required). In turn, cost benefits are envisaged through improved resilience by increasing traffic retention through the use of the RCT compared to existing solutions. Retaining traffic minimises economic losses such as losses of revenues. The provision of a visual presentation of the aerodrome and its vicinity also aims to improve the flexibility with which contingency ATS can be provided. It also will improve the transition in working methods from local to contingency operations. These benefits should be achieved whilst at least maintaining safety and ATCO human performance to the same level as achieved in standard local tower operations.

OI step SDM-0204 is described as *"Aerodrome Control Service is provided by a remote/secondary facility at small to medium airports (with a single main runway) in a contingency situation where the primary ATC Tower is not useable."* The scope of SDM-0204 starts by examining small to medium density airports, considering that very small aerodromes are unlikely to implement Remote Contingency Tower as the business case for doing so may not be as robust. The rationale is to provide an alternative facility where ATS can be continued to be provided with the high possible level of retained capacity. The solution is cost effective and does not necessarily require the use of ground surveillance radar.

3 Detailed Operating Method

The main objective of the RVT concept is to provide an ATS, as in traditional operations from local aerodrome control towers, from a remote location. The ATS itself should remain unchanged, with only the way in which it is delivered changing. The overall RVT concept includes the following modes:

- Remotely Provided Air Traffic Services (TWR & AFIS) for a Single Aerodrome;
- Remotely Provided Air Traffic Services (TWR & AFIS) for Multiple Aerodromes;
- Remotely Provided Air Traffic Services (TWR) for Contingency situations at Aerodromes.

3.1 Remote Provision of Air Traffic Services for a Single Aerodrome

3.1.1 Scope and Objective

The objective of remote provision for a single aerodrome is to provide the air traffic services (ATS) defined in ICAO Documents 44 [10], 9426 [13] and EUROCONTROL's Manual for AFIS [12] for one aerodrome from a remote location i.e. not from a control tower local to the aerodrome. The full range of ATS should be offered in such a way that the airspace users are not negatively impacted (and possibly benefit) compared to local provision of ATS. (Note that this will be dependent on factors such as the coverage of the visual presentation (e.g. if a full 360° or lesser view is provided) and the distribution of the traffic pattern and will ultimately be dependent on the needs of individual aerodromes and local implementations.) The overall ATS will remain classified into either of the two main service subsets of TWR or AFIS.

One typical operating environment for remote tower services are airports below third level node, with a single runway, non-complex runway layout and low capacity utilisation (SDM-0201). But remote tower services are not limited to those environments.

The remote provision of ATS for a single aerodrome (Single Remote Tower) is expected to be applied to low density aerodromes (where low density traffic is determined as being mostly single operations, rarely exceeding two simultaneous movements) as well as to some medium traffic density aerodromes (where more than two simultaneous movements can be expected). In the long-term the concept may also be applied for larger airports or small airports with occasionally more traffic density (for example tourist airports/remote airports during a particular event etc.). These environments support the business case often applied to Remote Tower Services, which is to provide improved cost efficiencies.

Further to these environments larger multiple runway aerodromes may use an extension of Single Remote Tower to negate the need for more than one conventional tower as the airport expands. The concept of Remote and Virtual tower is very dynamic and flexible, hence it is expected that elements of the concept will be applied in a variety of ways in a wide variety of operating environments. The impacted performance areas <u>may</u> also include safety, particularly when Remote Tower specific technical enablers are introduced. Such operations may be covered by future OI steps.

The remote provision of ATS for a single aerodrome is defined in such a way that is appropriate and operable for a single aerodrome, but can ultimately be expanded and scaled to apply to more than one aerodrome under the multiple aerodromes concept (SDM-0205).

This section, and the sections that follow, describe the key parts of the remote provision of ATS under OI step SDM-0201. Many elements and functions of the ATS provision will be the same when provided remotely as if they had been provided locally and so these may not be repeated in detail in this OSED.

3.1.2 Current Operating Method

3.1.2.1 Principles

In traditional operations, remotely operated TWR / AFIS does not exist. The range of ATS defined in ICAO Documents 4444 [10], 9426 [13] and EUROCONTROL's Manual for AFIS [12] are provided by local ATCOs or AFISOs from local tower building facilities. In some aerodromes, a single ATCO fulfils both TWR and APP services.

The TWR ATCO is responsible for assuring safe operations and provision of air traffic control services for the aerodrome manoeuvring area and the vicinity of the aerodrome. This includes responsibility for clearance delivery, ground control, management of inbound and outbound flow and flight data processing. The AFISO is responsible for the provision of the AFIS.

With a local, physical presence at the aerodrome, the ATCO or AFISO has the ability to perform local tasks such as direct runway inspections, checking local weather stations or basic maintenance if required. However at numerous aerodromes the ATCO/AFISO in principal is mandated with the provision of ATS, thus the ATCO/AFISO determines the necessity for other tasks and delegates these to other local officers (such as airport operator, technicians, firefighters etc.). Staffing is usually provided by operators living within a reasonable range of the aerodrome itself.

ICAO Doc. 9426 (Part III) [13] states that an aerodrome control tower is required to fulfil two main operational requirements:

a) the tower must permit the controller to visually survey those portions of the aerodrome and its vicinity over which he exercises control;

b) The tower must be equipped so as to permit the controller rapid and reliable communications with aircraft with which he is concerned.

The requirements within Doc 9426 [13] also state that the controller must be able to distinguish between aircraft and between aircraft and vehicles while they are on the same or different runways and/or taxiways. The most significant factors contributing to adequate visual observation are the siting of the tower and the height of the control tower cab. The optimum tower site will normally be as close as possible to the centre of the manoeuvring part of the aerodrome, provided that at the intended height of the tower structure does not become an obstruction or hazard to flight.

The ATCO or AFISO uses several means and systems to provide the ATS, however a principal information source is the visual "out-the-window" (OTW) view. The OTW view is from a single viewpoint, typically high above the ground from the centre of the aerodrome. Airport sound (e.g. engine noise, birdsong, wind noises) is obtained directly if the control tower is not sound insulated. Other functions/systems that are required for the provision of an ATS include:

- Voice communications systems;
- Flight Data Processing Systems and ATS message handling ability;
- Manoeuvring of Aerodrome Ground Lighting (AGL), navigation aids, Instrument Landing Systems (ILS), alarms and other airport systems;
- Binoculars and a signal light gun;
- Additional sensors (e.g. radar information) can be used to facilitate surveillance, subject to coverage.

3.1.2.2 Considerations in Low Visibility Conditions

ATC operators shall apply Low Visibility Procedures (LVP) when all or part of the manoeuvring area cannot be visually monitored from the aerodrome tower. During LVP stricter rules are applied regarding the number and position of aircraft and vehicles on the manoeuvring area and the separation to be applied between movements. The appropriate ATS authority is responsible for establishing the procedures that shall be applicable when implementing LVP operations. These are applied during CAT II / III operations and departure operations when the Runway Visual Range (RVR) is less than 550m, e.g. it could be stated in local regulations that implementation of LVP will start at visibility 2000m and will become stricter as RVR decreases, finally allowing only one movement at a time on the manoeuvring area.

LVP guidelines are defined in various documents and regulations such as ICAO Annex 11 [9], Doc 4444 [10] and EUR Doc 13 [11] and mainly concern restrictions on operations, traffic movement and clearances. They include procedures such as:

a) *persons and vehicles operating on the manoeuvring area of an aerodrome shall be restricted to the essential minimum and particular regard shall be given to the requirements to protect the Instrument Landing System/Microwave Landing System (ILS/MLS) sensitive area(s) when Category II or Category III precision instrument operations are in progress;*

b) *... the minimum separation between vehicles and taxiing aircraft shall be as prescribed by the appropriate ATS authority taking into account the aids available;*

The application of procedures such as the above typically results in a reduction in airport capacity and restriction on arrival and departing traffic flows. The movement rate that the aerodrome wishes to sustain is determined according to the aerodrome licence holders in consultation with local ATS staff and fully supported by the LVPs developed.

3.1.2.3 Issues under Current Operating Methods

The focus of the concept is set on reducing the cost of providing ATS without reducing the level of safety. The reason for this primary objective is in response to a need to reduce the cost of ATS provision generally but with a particular focus on less financially secure aerodromes.

In the aviation industry the provision of a transparent cost-regime makes it possible for the customer to see the costs passed on to them. The current costs associated with the provision of ATS are high and need to be reduced, particularly at low to medium density airports. The high costs are then passed onto the customer through increased aerodrome/landing fees, which in turn result in higher airfares and lowers the propensity of customers to remain users of aerodromes. It is necessary to maintain commercial air traffic services at small/medium density airports, as many of these routes act as public service routes for isolated communities. If the ATS costs are not lowered and reasonable business margins cannot be made, many low and medium density airports will find it hard to financially survive without subsidies.

A large proportion of the ATS costs are associated with the building, maintenance and upkeep of the physical ATS facilities and the costs of personnel to provide the ATS.

The maintenance and upkeep of older tower facilities can be inefficient and expensive, aging equipment and infrastructure to maintain. Unique competences are required for maintenance and components can be difficult and expensive to repair when they fail. Construction of a new aerodrome control tower would be very expensive and disruptive to operations and hence is not a viable option for less financially secure aerodromes ATS systems, equipment, specific operating methods and procedures currently vary according to aerodrome. This lack of standardisation has an impact on cost efficiency for Air Navigation Service Providers (ANSPs) and airport operators who own groups of aerodromes. Cost inefficiencies relate to equipment and systems as well as to the training of controllers (methods, equipment and procedures).

The Control Working Position (CWP) provided in many local towers, particularly at smaller less financially stable aerodromes is often deficient in space and in consideration for human performance features/elements that should be incorporated into modern day CWPs and the set-up of required equipment. The variability and subsequent controller training issues (in combination with geographical considerations) mean that many controllers will only be valid / rated for their local aerodrome. This reduces flexibility for ANSPs and increases costs further.

Local facilities sometimes are required to remain open and staffed all day despite perhaps having only a sparse number of scheduled Instrument Flight Rules (IFR) flights. This again contributes to rising costs and efficiencies for the aerodromes, aerodrome operators and ANSPs.

3.1.3 New SESAR Operating Method

3.1.3.1 Principles

The full range of ATS defined in ICAO Documents 4444 [10], 9426 [13] and EUROCONTROL's Manual for AFIS [12] will still be provided remotely by an ATCO (for some aerodromes a single ATCO fulfilling both TWR and APP) or by an AFISO. The airspace users should be provided with the same level of services as if the ATS were provided locally. (Note that this will be dependent on factors such as the coverage of the visual presentation (e.g. if a full 360° or lesser view is provided) and the distribution of the traffic pattern and will ultimately be dependent on the needs of individual aerodromes and local implementations.)

The main change to operating methods between the current and proposed concept is that the ATCO or AFISO will no longer provide ATS from a local aerodrome control tower and will not necessarily be located at the aerodrome.

The remote location of the provision of ATS will necessitate a visual presentation of the aerodrome to be provided at the remote location. In order to facilitate the visual presentation cameras or other sensors will be placed at the local aerodrome in order to provide the remote operators with a view of the aerodrome consistent with regulation. Various sensors will also be required in order to provide the remote operator with all the information they would normal have access to if providing ATS locally under current operating methods.

The visual observation will be provided by visual information capture via cameras and/or other sensors. This will provide operators with a view of their area of responsibility in line with regulatory requirements. The visual presentation can be overlaid with information from additional sources where available. For example; surface movement radar, surveillance radar, ADS-B, multilateration or other positioning and surveillance implementations providing the positions of moving objects within the airport movement area and vicinity. The collected data, either from a single source or combined, is reproduced for the ATCO / AFISO on data/monitor screens, projectors or similar technical solutions.

The use of technologies to enhance the visual presentation may be introduced to assist working methods and situational awareness. The exact type and number of technical enablers will vary with the requirements of individual ANSPs, airport operators and aerodromes.

Through the use of enhanced technology and digital information a wider range of information will be available and possible to share with other stakeholders, airport users and other ANSPs. This may enhance existing airport operations centres. The concept will also introduce the ability to record visual information, this may create unique opportunities to support aerodrome incident/accident investigators.

Ideally an integrated and modular technical solution shall be developed to facilitate the concept. Consequently changes to digital information would automatically be forwarded to all relevant areas of the system, making the exchange and use of information more collaborative. Additionally, in the case of a malfunction of a part of the system the specific part may be exchanged and easily embedded into the overall system again, minimising disruption and making upgrades easier to apply.

Individual implementations will require certification, this will include ensuring the visual presentation meets the minimum specifications and standards (under development by EASA [16]). The decision on whether reduced separation minima, often referred to as "visual separation", between successive flights can be applied always depends on the visibility conditions. Just as in traditional operations where the direct view from the tower underlies different conditions, the ATCO in the Remote Tower Module will take a decision based on what information the visual representation provides in each case. Hence the operational methods for separating the traffic will remain the same; however the extent to which "visual separation" can be applied may potentially be reduced. Depending on the certification of each implementation. Reduced ability to apply "visual separation" could e.g. potentially have a negative effect on the flexibility in separating VFR traffic from IFR traffic in class C airspace. However, if a high quality visual presentation is used it is deemed that there will be no negative impact on VFR traffic. For the AFIS application and environment the impact on both IFR and VFR traffic is foreseen to be minimal or non-existent compared with traditional operations.

The new concept must aim at enhancing operations already in place and hence should integrate any precautionary measures deemed necessary. While reduction in costs are welcomed in order to secure some level of ATC services in small airports, airspace users of small airports want to see operations and services enhanced. Small airports usually have airspace classes ranging from G to E. Improvement should be expected in particular in unmanaged airspaces (AFIS operation).

If the control facility is located away from the aerodrome site then the ATCO / AFISO will not have the ability to perform tasks external to the control facility, however this will not impact upon direct ATS tasks. Also secondary non ATS tasks such as METOBS (metrological observations which are currently performed by ATCOs/ANSPs in a few countries as an additional task) can still be performed (depending on the quality of the visual presentation), but there may be other secondary non ATS tasks that a provider (for administrative reasons, e.g. telephone calls local to the aerodrome but not related to ATS) wants to be transferred to and performed by non ATS personnel local to the aerodrome. At some ANSPs this distinction of responsibilities is clearly defined, yet at some, primarily small remote airports, the role of the ATCO / AFISO may change.

Also, if the control facility is located away from the aerodrome, it will be important to ensure that the ATCO/AFISO(s) can still gain the local knowledge needed being able to provide a good service to airspace users. Naturally such local airport knowledge, e.g. local geography and weather conditions as well as familiarity with airport personnel, is gained simply by being present at the aerodrome. When being placed remote this can be compensated by e.g. regular study visits to the aerodrome and regular meetings with airport personnel/operators and by putting extra emphasise on local airport knowledge as part of training and endorsements.

Where Single Remote Tower is implemented as a replacement for the local tower it will be possible to remove the existing local control tower as it will no longer be used for the provision of air traffic services. The infrastructure (service, maintenance etc.) that goes along with maintaining such a building will also become dispensable. Instead, a local installation consisting of systems/sensors will be maintained by central maintenance teams. The remote facility will also require maintenance, but it is expected that a more 'traditional' building using common systems and components will lead to a reduction in overall maintenance costs. When replacing exiting infrastructure a more optimal location may be found for the placement of aerodrome cameras, or the existing location used as a basis. If single aerodromes share a remote location with other aerodromes then overall building costs will also reduce as they become shared.

3.1.3.2 Single Remote Tower Module (RTM)

In relation to SDM-0201 each RTM would be remotely connected to a single aerodrome, with one ATCO / AFISO providing the ATS. The operator would be able to perform all ATS tasks, as normally provided from the local aerodrome tower, from the RTM.

This would be primarily achieved via the visual presentation screens included within the RTM. A typical RTM used to provide ATS to a single aerodrome will have its own dedicated set of visual presentation screens displaying the aerodrome and its vicinity to the operator. A 360° visual presentation of the aerodrome may be provided however this will be dependent on the traffic pattern and needs of individual aerodromes.

RTMs to be used to provide ATS to single aerodromes may have more than one position for a second operator or supervisor. This will be largely dependent on the traffic levels being experienced.

3.1.3.3 Example Operating Scenarios

The following examples illustrate some operating scenarios based on how ATS may be provided to an aerodrome. In each scenario a single ATCO/AFISO provides ATS to only one aerodrome at a time.

The examples are presented with some key summary information and a table showing how the RTM and ATCO/AFISO may be deployed and how configuration of the CWP may change as the traffic situation becomes more complex.

3.1.3.3.1 Example 1 – Basic Single RTM

Aerodromes	RTM required	ATCO/AFISO required	ATS provided to aerodromes in parallel	RTC supervisor	Traffic Coordination
1	1	1	No	No	No

# Aerodromes with aircraft movements	ATS for Aerodrome: A	Resource Pool: ATCO1	RTM: RTM1
0	ATCO1	Airport A	Airport A
1	ATCO1	Airport A	Airport A

Table 14 – Example 1 – Single Remote Tower Module

This is the simplest operating scenario where a single remote ATCO/AFISO provides ATS from a dedicated facility to a single aerodrome. A single RTM is configured to provide ATS to a single nominated aerodrome. No other aerodromes are provided with ATS from that RTM.

The RTM may be located anywhere (i.e. on or off aerodrome site). However, to capitalise on shared infrastructure and economies of scope, the RTM may be located in a Remote Tower Centre (RTC).

3.1.3.3.2 Example 2 – ATS to single aerodrome with traffic coordination

Aerodromes	RTM required	ATCO/AFISO required	ATS provided to aerodromes in parallel	RTC supervisor	Traffic Coordination
3	Max 2	Max 2	No	No	Yes

# Aerodromes with aircraft movements	ATS for Aerodrome			Resource Pool		RTM	
	A	B	C	ATCO1	ATCO2	RTM1	RTM2
1	ATCO1			Airport A	Available	Airport A	Spare
1		ATCO1		Airport B	Available	Airport B	Spare
2	ATCO1		ATCO2	Airport A	Airport C	Airport A	Airport C
2	ATCO1	ATCO2		Airport A	Airport B	Airport A	Airport B

Table 15 – Example 2 – ATS to Single Aerodromes with Traffic Coordination

In this example the task of providing ATS service to 3 aerodromes is shared among 2 ATCOs/AFISOs. The RTM are configurable to any of the aerodromes. When there is traffic at a third aerodrome simultaneously, the aerodrome may still be open but ATS is not provided.

At any given time the ATCO/AFISO can switch from one aerodrome to another. The ATCO/AFISO can therefore provide ATS service to any of the three aerodromes. The use of collaborative planning and/or traffic coordination would increase the ability of a single ATCO/AFISO to provide ATS service to multiple aerodromes in sequence.

Airspace and ATS at a specific aerodrome will normally be established in conjunction with an IFR departure or arrival, allowing the Remote ATCO/AFISO to then *sequentially* handle traffic from/to more than one airport.

ACC will at all times be able to inform pilots about the status of airspace. All relevant information about operating hours will be stated in national AIP/NOTAM etc.

This example could be scaled up to facilitate a large number of aerodromes by implementing an increased number of RTMs and ATCOs/AFISOs since it is still a 1-to-1 relationship.

As with Example 2, cost efficiency gains could be achieved through reduction in back up staff numbers.

Anyhow this operating scenario is primarily useful at aerodromes with relatively low traffic numbers.

3.1.4 Differences between new and previous Operating Methods

The primary high level differences between the RVT concept and traditional operations include:

- Removal of ATCO/AFISO from the local aerodrome control tower;
- Replacement of direct OTW aerodrome view with relayed visual presentations.

The aim of the RVT concept is to provide the same set of services that are provided from conventional towers. The ATS being provided is not subject to change, only the manner in which the service is provided. Due to the use of a remote location some controller support tools (in addition to the visual presentation) may be required. These included the use of cameras in replacement for tower binoculars. The use of a visual presentation as opposed to local tower windows provides the opportunity to integrate information from other sensors/sources into the visual field. This may lead to additional working methods. Procedures for how operators may use new and integrated surveillance data may also be required.

3.1.4.1 Visual Observation and ICAO Doc 4444

A profound difference between traditional and remote/virtual tower operations lies in the treatment of visual information. According to ICAO Doc 4444 (Ed 15; 7.1.1.2) [10], the aerodrome controllers

> "*shall keep 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 in low visibility conditions by an ATS surveillance system when available*".

On the one hand the above statement underlines that the foundation of aerodrome control service provision rests on the ability of the controller to see the manoeuvring area including aircraft, vehicles and personnel on it. On the other hand it also implies that visual observation is a sufficient means of observation during normal visibility conditions, i.e. the limitations of human vision are inherently 'built into' the concept, thus in a sense relieving the ATCO of the responsibility for maintaining watch on things that are not visually observable. However, the same ICAO document (Ed 15, 7.12) also defines procedures for low visibility operations that apply "*whenever conditions are such that all or part of the manoeuvring area cannot be visually monitored from the control tower*".

The above statements are of fundamental interest in the application of the remote and virtual tower solutions, since they show that current regulations imply that a component of visual observation must exist, but also that if visibility is impaired, for whatever reason, mitigation by procedure and/or augmentation by ATS surveillance systems is possible. (Note also that the use of ATS surveillance systems is treated in Chapter 8 of ICAO Doc 4444 [10]).

Additionally, ICAO Doc 4444 (Ed 15; 7.1.1.1e) [10] states that one objective of the aerodrome control service is to *"prevent collision(s) between aircraft on the manoeuvring area and obstructions on that area"*. Although not explicitly stated, the use of visual observation is an implicit component in the accomplishment of the objective. Another example of the use of visual information can be found in the prerequisites for reduction of separation minima in the vicinity of aerodromes, where ICAO Doc 4444 (Ed 15; 6.1) states that separation minima "*may be reduced in the vicinity of aerodromes if:*

a) adequate separation can be provided by the aerodrome controller when each aircraft is continuously visible to this controller; or

b) each aircraft is continuously visible to flight crews of the other aircraft concerned and the pilots thereof report that they can maintain their own separation; or

c) in the case of one aircraft following another, the flight crew of the succeeding aircraft reports that the other aircraft is in sight and separation can be maintained."

If the aircraft are not visible to the ATCO, for whatever reason, then the separation might be delegated to the flight crews; or otherwise the reduction in separation minima cannot be obtained. Instead normal separation minima would have to be applied and the means of separating aircraft would be based on applicable procedures or supported by ATS surveillance systems (such as radar). It is reasonable to assume the same methods or principles will apply regardless of whether insufficient visibility is caused by meteorological factors or by a visual presentation that is for some reason degraded.

3.1.4.2 Visual Presentation

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 takes the sensor data collected from the aerodrome and its vicinity and transmit to a display in the RTM. This visual information should be to the ATCO/AFISO in a way that provides the situational awareness required for conducting ATS and provide the ability to visually survey their area of responsibility in line with regulation. This technical solution will be termed the *Visual Presentation*.

For an accurate situational awareness to be achieved, it is important that sensor data of adequate completeness and quality is available. It is equally important that the visual presentation presents the data in a logical and comprehensible way. This will lead to considerations on continuity, scale orientation and positioning of the presented data that will generate requirements and recommendations for the design of the technical system, see requirements in Section 6.

By using visual presentation technology some benefits can be achieved compared to the standard OTW view. For example sensor data from multiple, sometimes non-optical, sensors (ground based and aircraft based) may be fused, analysed and presented together on the visual presentation in a way that further enhances situational awareness and thus the capability of the ATCO/AFISO to perform the service. On the other hand the replacement of the OTW view with a visual presentation might potentially lead to limitations in the way the service can be performed if the quality of the ATCO's perception is changed (typically depth perception and limited possibilities to apply visual separations). However different types of technical aids such as automatic tracking of objects could support the Remote ATCO in making judgements, thus compensating for such circumstances.

3.1.4.3 Meteorological Observation

In current operations in some conventional towers, the ATCO/AFISO performs meteorological observation and reporting tasks. This is not strictly an ATS task and is outside the scope of this project. Such tasks can be performed by automatic means (Automated Weather Observing System (AWOS), Auto-Meteorological Aviation Report (METAR) or similar systems). However the approved RTC implementation providing remote ATS to Örnsköldsvik airport in Sweden (ESNO) allows the provision of remote MET observation.

Independent of how MET observations are made within each remote implementation it is still of value for the ATCO/AFISO to be able to observe changing weather situations that are of operational significance (compare with ICAO Annex 11, Chapter 2.20) [10] and also to be able to judge if an automatically generated Meteorological (MET) report seems to be reasonable.

3.1.4.4 Runway Checks

Runway checks and related procedures that are not ATS tasks by definition but happen to require a person to be physically present at the aerodrome will be performed by ground staff and reported to the remote ATCO/AFISO. Today this is already common practice at a large number of aerodromes.

3.1.4.5 Capacity & Capability

Before being approved for operation with any service provider, a system must go through a certification process. In this process, the achieved ATCO/AFISO situational awareness provided by the system will be measured in relation to the requirements imposed by the operational environment. Although the OSED outlines typical environments for both ATC and AFIS, the actual implementation environment could potentially differ from this e.g. in terms of the needed airport capacity. A particular implementation will need to be certified for operations with a particular service provider in a particular operational environment to ensure safety is not compromised.

When Service providers will need to choose between the various Remote Tower solutions available in order to find the solution that is best tailored to match the required capability at their aerodrome of interest and its associated cost benefit case. In this process it will be taken into consideration that the actual traffic capacity threshold for a particular system may differ from airport to airport depending on local conditions. As such each technical implementation will need to be provided with local certification as opposed to universal certification.

3.1.4.6 Reliability

For any remote tower implementation, there will be a requirement to define reliability and availability of technical equipment such as sensors, transmission and presentation equipment. However it should be noted that such analysis must not focus on technical systems alone, but rather study the functional system of humans, methods and technology together when determining the criticality of events and thus the requirements on reliability of technical equipment, which is only one of the means that can be used to achieve safe operations.

3.2 Conceptual and Technical Foundations for the Remote Provision of Air Traffic Services to Aerodromes

The Remote Provision of ATS features some elements that are communal, the following sections introduce these elements as foundations for the overall concept, independently of the precise operating method.

The operating methods accompanying each concept are detailed in the subsequent sections (3.1– *Single Remote Tower*; 3.3 – *Multiple Remote Tower*; and 3.4 – *Contingency Remote Tower*).

3.2.1 Technical Enablers

The Remote Provision of ATS is based on technical concept elements. A wide variety of technical enablers can be chosen depending on the specific local needs. In the chapters below some examples are given (the list is not intended to be exhaustive).

The level of support provided by the system through additional technical enablers is expected to have an impact on the ATCO's /AFISO's capacity in terms of the number of traffic movements that can remotely be controlled.

It should be noted that European Aviation Safety Agency (EASA) are undertaking an ongoing Rule Making Task (RMT) RMT.0624 to define technical requirements for remote tower operations [16]. Alongside ongoing work within EUROCAE Working Group (WG) 100. Both European bodies are using input from this OSED document, however the details below are subject to change as rules, standards or guidance governing Remote Tower Technical requirements are put in place.

3.2.1.1.1 Controller Working Position

As a basis the ATCO/AFISO will be provided with a Controller Working Position (CWP) enabling the provision of an ATS from a remote location. Hence all the systems and tools required for the operator to fulfil the required ATS tasks shall be provided at the CWP. The introduction of new technical systems coupled with a large modernisation of the CWP shall feature in the Remote Provision of ATS. However the underlying principals shall remain familiar to the ATCO/AFISO and in line with those used in traditional operations.

The ATS systems currently used in the tower environment will to be connected to the remote CWP. The list below shows some examples:

- Presentation and updating of flight plan and control data;

- Radio Telephony Communications (ground and air);
- Functionality for manoeuvring and controlling:
  - Airport lights;
  - Signal Light Gun;
  - Navigation aids;
  - ILS;
  - Alarms and;
  - Other airport systems.

Refer to the general service requirements contained in section 6.

3.2.1.1.2 Visual Presentation

A visual presentation is the core of the Remote Provision of ATS and replaces the OTW view from the local aerodrome control tower building.

The visual presentation can take one of several forms and in order to remain applicable to many technical interpretations, the operational and functional requirements in this document will not specify exactly what form the visual presentation should take.

The visual presentation could therefore be:

- A camera based solution, where cameras capture the image at the local aerodrome and these are relayed to the ATCO/AFISO;
- A synthetic, computer generated "virtual" solution where a range of sensors capture information at the local aerodrome and these are relayed to the ATCO/AFISO;
- An A-SMGCS based solution;
- A combination of the above.

Minimum Aviation System Performance Specifications for visual surveillance in Remote Towers are being developed by EUROCAE under WG 100 for remote tower visual surveillance. These MASPS should be referred to in line with European regulation under development by EASA [16].

3.2.1.1.3 Binocular Function

In order to align with existing regulation a binocular functionality shall replace the manually operated binocular which is currently used in the local aerodrome tower. To conform to regulation a function which gives the possibility to zoom/enlarge specific areas and objects in the visual presentation is a mandatory requirement.

In addition to the overall visual presentation the ATCO / AFISO may use the binocular function to facilitate their view when they need to look at certain items of interest more closely (e.g. engine on fire, landing gear extended RWY condition / objects on RWY etc.). For this purpose a binocular function will provide the ATCO / AFISO with the option to angle the view and zoom into objects as required. An easy to use interface is an essential requirement on this functionality, alongside the necessity for a sufficient image quality to support ATS tasks.

Moreover certain aerodrome "hotspots" may be configured enabling the ATCO / AFISO to quickly jump to frequently recurring areas of interest (e.g. waypoints, thresholds, RWY sweep etc.) utilising predefined positions and automatic scans set for the binocular function.

The automatic visual tracking of objects may increase the ATCO's / AFISO's ability to spot and follow relevant objects. This feature of a binocular function would be especially pertinent during non-nominal or distress situations where quick reactions are required. The automatic tracking may provide close-up images of the relevant objects (on a binocular function screen) or highlight the relevant objects in the overall context (visual presentation screen).

3.2.1.1.4 Advanced Visual Features

3.2.1.1.4.1 Overlay Information

The visual presentation may be overlaid with additional information pertinent to the general area of interest or area of responsibility, in order to increase ATCO/AFISO situation awareness. The fundamental classes of information that may be incorporated into visual presentation overlays includes: geographic, meteorological, operations and service and visual reminder information.

The ATCO / AFISO may be provided with additional information regarding aircraft under their control (e.g. Flight Plan Data) via the main visual presentation. Such information can range from an aircraft label through to additional information like distance from the aerodrome, height, intentions etc. In this way situational awareness may be increased as well as reducing head-down times.

Relevant MET information (i.e. actual wind, gusts, QNH, ATIS identifier) may be displayed within the visual presentation as this information is frequently used by the ATCO / AFISO.

Other examples are the tracking of objects (e.g. by highlighting moving objects like aircraft or flocks of birds) and outlining of the runway and taxiways at night.

3.2.1.1.5 Additional Viewpoints

3.2.1.1.5.1 Enhancement of traditional OTW viewpoint

The provision of ATS from a local tower building (as in traditional operations) has some constraints at certain airports due to the single operational viewpoint from a central, high up perspective and subject to prevailing viewing conditions at the time (e.g. clear, foggy). This can create some minor limitations in capability which are accepted in 'traditional' air traffic control. The use of visual presentations can reduce or eliminated the limitations which exist in current operations.

Operational viewpoints may be provided, based on information captured from a range of different positions and sensors, not necessarily limited to the original tower position. This may provide an enhanced situational awareness and/or a progressive operational viewpoint. (Note: Replicating the operational viewpoint obtained from a traditional tower view may ease the transition from traditional operations to remote operations and also provide some common reference points. Yet original towers may not exist, for example at aerodromes that previous has no ATS provision or newly built aerodromes, and hence no comparison will exist).

Moreover the use of additional viewpoints may solve problems related to the obscuring of views over time. Obscuring can occur naturally due to things like tree growth, or from development of the aerodrome and newly built runways, taxiways, gate positions etc. For such circumstances additional viewpoints may provide potential solutions. It has been known for local aerodrome towers to include camera solutions to provide a view of obscured areas. These camera solutions are however unstandardised and could only be used to provide guidance.

The visual presentation may source information from a variety of sensors including visual range cameras, infrared cameras or other sensors. Additionally the primary form of visual surveillance may be enhanced with information received from secondary sensors (again in the visual and non-visual ranges), these secondary sensors may be used in order to provide enhanced information to operators on secondary or integrated visual presentations or as overlays. This could include computer based virtual information for use in virtual tower installations.

In all cases, the visual presentation shall enable visual observation of the airport surface and surrounding area. Operators shall be able to visually observe their area of responsibility.

3.2.1.1.5.2 View during Low Visibility Operations

Low Visibility Operations will still require specific LVP when operating remotely. However, the visual enhancements may lower the limit of visibility value when LVP have to be implemented (above the minimum limit of RVR 550m set by ICAO) and the point of visibility after which only single movements are allowed on the manoeuvring area. These enhancements will need to be considered as part of an updated Pre-LVP.

In case of the visual presentation becoming temporarily unavailable or degraded, it is foreseen that procedures similar to LVP will be implemented. Considerations for the procedures applied during LVP induced by technical degradation of the visual presentation should include:

- In the case of degraded mode operations care must be taken to ensure all actors involved are aware of what each other can see;
- Technical degradation may cause sudden visual failure, this does not occur in conditions of meteorological low visibility;
- Technical degradation may not impact the entire visual presentation (all screens), procedures may consider which part of the visual presentation has degraded. With procedures for operationally critical areas of the visual presentation differing to those if less critical areas experience degradation.

3.2.1.1.5.3 Views during Darkness

The provision of ATS during darkness may continue as in traditional operations. However the addition of infra-red functions or other visual enhancements such as overlay information, may assist the ATCO / AFISO in visual observation tasks during darkness.

3.2.1.1.6 Aerodrome Sound

To further improve ATCO/AFISO situational awareness the aerodrome's background sounds may be captured and relayed. This is likely to be dependent on the size of the aerodrome, as in current operations the local towers of large aerodromes are often sound insulated due to the amount of background noise. In smaller towers however aerodrome sound may aid situational awareness and even detection of occurrences.

The benefit of a remote tower implementation is that aerodrome sound may be volume controlled and switched on or off as required.

3.2.1.1.7 Air Situation Display

Depending on the local needs the CWP might be equipped with an air situation display (radar or ADS-B information).

3.2.1.1.8 Ground Situation Display

Depending on the local needs the CWP might be equipped with a ground situation display. The information presented in the ground situation display can be based on different sensors like a ground radar, ADS-B or MLAT. A multi sensor fusion might be applied where necessary.

3.2.1.2 Information Sharing

This concept may include visual information sharing and enhanced local operations. Critical visual information on the traffic situation may be collected and provided (internally to the system) to other remote tower centres for increased situational awareness. That information and technology might prove useful for other airport stakeholders as well as personnel in ordinary control towers.

External sharing with airport rescue and firefighting services (RFFS) units could positively impact upon response times and enable improved detection and localisation of emergences, especially beneficial during low visibility. This information sharing would also reduce the RFFS dependence on information gained solely and directly through ATS personnel. Airfield security and ground handling could be alerted of unauthorized infringements on the manoeuvring area, debris on the runway and other safety and/or security related issues. AirPort Operations Centre (APOC) could utilise the visual presentation for situation assessment and short term planning.

3.2.2 Remote Tower Module (RTM)

The Remote Provision of ATS is to be provided from a CWP and visual presentation which together are known as a Remote Tower Module (RTM). Figure 4 overleaf shows some potential configurations of an RTM, independent of the number of aerodromes and the level of detail depicted on the visual presentation. With reference to Figure 4:

- **RTM 1:** Consists of one CWP having its own dedicated set of screens for visual presentation (CWP 1);
- **RTM 2:** Consists of one CWP featuring two positions (CWP 2) sharing the same visual presentation. This provides the option of placing an additional role in the RTM (for example a supervisory position or a second operational controlling position).
- **RTM 3:** Consists of two CWPs (CWP 3 and 4) adding flexibility in the use of the RTM. The most common use of this set up would be a shared service provision to one aerodrome (similar to the method of operating RTM 2 when two positions are utilised, however in RTM 3 each position has its own dedicated screens for visual presentation and hence the two CWPs may have the same or differing views). Further to this CWP 3 and 4 could also be used to provide an ATS to two individual aerodromes, with each CWP being independent and utilising half of the RTM;
- **CWP 5:** A position featuring no screens for visual presentation (CWP5). This CWP would be used for roles where visual is not required e.g. Approach or supervisor, but other surveillance equipment would then be required.

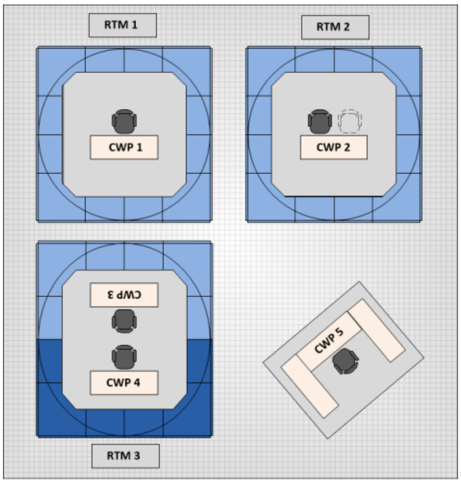


Figure 4 – Potential configurations of the RTM

Further to the above, RTMs may exist as part of a local aerodrome tower, to provide blind spot coverage or additional view points for working positions. This could be implemented as a smaller CWP in various configurations.

Each Implementation of an RTM may be configured differently, to meet local requirements and will differ based on the technical solutions applied. Yet in order to maximise benefits on a wider scale the use of unified and standardised RTMs would be preferred, integrating all concerned systems into a comprehensive solution and taking all Human Machine Interface (HMI) aspects into consideration. In current local tower environments the CWP and HMI from one tower to another can be very different. The use of a standardised RTM solution will eliminate the many different HMI interfaces seen in operation currently. Interaction technology options may also be deployed on the user interfaces for more efficient and optimal user interaction.

3.2.3 ATCO/AFISO Ratings, Endorsements and Licensing

It is not within the remit of SESAR to make decisions on matters relating to ratings, endorsements and licensing. A potential suggestion for the way forward regarding the licensing of remote tower ATCOs is that they shall hold an ADI rating with appropriate endorsements (i.e. radar, etc.) and additionally hold an RTC unit endorsement, complemented with specific local endorsements for the appropriate aerodromes that the skills will be applied to. It is however suggested, as part of safety assessments performed, that endorsement training shall be complemented by (or put extra emphasis on) local airport knowledge and conditions (such as local geography, local weather conditions, typical traffic type and mix etc) in order to compensate for being placed remote. Note: the different aerodromes in an RTC should be treated similarly to the sectors in an ACC, from a licensing point of view. AFISO shall hold an AFIS licence, complemented with a specific local licence for the appropriate aerodrome(s).

Cross licensing enables ATCOs / AFISOs to provide ATS to various aerodromes. Hence flexible staffing may be achieved and thusly costs may be reduced as ATCOs / AFISOs are not bound to one aerodrome. It is envisaged that the collocation of aerodromes to an RTC will reduce the need for different local regulations, working methods and procedures at different aerodromes and will as well bring a standardised HMI (all "towers" within an RTC will more or less have the same design in terms of CWP/HMI and the same systems installed) for all CWP:s/aerodromes, thus simplifying ATCO/AFISO cross licensing for several aerodromes.

The above should be valid for the Single Remote TWR as well as for Multiple Remote TWR applications.

Reference should be made to the ongoing work of the EASA Rule Making Task (RMT) RMT.0624, under Note of proposed amendment (NPA) 2015-04 [16].

3.3 Remote Provision of Air Traffic Services for Multiple Aerodromes

3.3.1 Scope and Objective

The objective of remote tower control for multiple aerodromes is to provide the ATS defined in ICAO Annex 11 [9], Documents 4444 [10], 9426 [13]and EUROCONTROL's Manual for AFIS [12] for more than one aerodrome simultaneously. The full range of ATS should be offered in such a way that the airspace users are not negatively impacted compared to local provision of ATS. (Note that this will be dependent on factors such as the coverage of the visual presentation (e.g. if a full 360° or lesser view is provided) and the distribution of the traffic pattern and will ultimately be dependent on the needs of individual aerodromes and local implementations.) The overall ATS will remain classified into either of the two main service subsets of TWR or AFIS.

This section covers the primary concept application "Multiple Remote Tower" as described in the above paragraph.

The OI step SDM-0205 focuses on the provision of ATS to two low density aerodromes (where low density is determined as being mostly single movement operations, rarely exceeding two simultaneous movements) by a single ATCO/AFISO and implemented from a remote location i.e. not from individual local control towers.

The concept may also be feasible to apply to medium density aerodromes where simultaneous movements at all aerodromes can be expected. It is not expected that the concept be applied to larger aerodromes with multiple simultaneous movements. These applications of Multiple Remote Tower will be covered by future OI steps. As such the focus of this section is the scope of SDM-0205.

3.3.2 Current Operating Method

ATS are not currently provided to multiple aerodromes by a single ATCO/AFISO. Currently a single local ATCO/AFISO provides ATS for a single aerodrome as described in Section 3.1.2.

The baseline for Multiple Remote Towers will be the Single Remote Tower described in section 3.1.3.

3.3.3 New SESAR Operating Method

3.3.3.1 General

The remote provision of ATS to multiple aerodromes can be operated in a number of ways depending on several factors. The following section lays out the principles of the remote provision of ATS to multiple aerodromes.

The general operating principle is that at least two aerodromes will be provided with ATS from one RTM by one ATCO / AFISO, hence the ratio of operators to aerodromes would be a minimum of 1:2. In this case the then the operational principle is as described by SDM-0205. Further to this the operator: aerodrome ratio could be 1:3 or 1:n (future OI coverage). The number of aerodromes which can be provided with ATS will be dependent upon a number of factors, primarily relating to the peak hour traffic level and how the traffic schedule at each aerodrome intersects with the others. Other factors, such as technical configuration of the RTM will also have an influence.

If located as part of a wider RTC facility it is likely that the aerodromes applied to a Multiple RTM will be flexible. Allowing different aerodromes to be provided with a service from the RTM. This would also enable operators to be able to reduce the number of aerodromes if required.

3.3.3.2 Multiple Remote Tower Module (RTM)

When providing ATS to multiple aerodromes from an RTM 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.) may 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.

3.3.3.3 Visual Layouts in the Multiple RTM

The screen layout options available within the multiple RTM will enable the provision of ATS to multiple aerodromes simultaneously. The primary methods to achieve this will depend on the number of aerodromes being controlled. As with Single Remote Tower, the visual presentations of each aerodrome will provide the operator with a view of their area of responsibility in accordance with regulation.

The distribution of screens may be switchable and hence fluid, allowing the RTM operator to change the number of screens each aerodrome is displayed on or the view provided of each aerodrome. When providing a visual presentation of multiple aerodromes one or more of the displays may be subject to a degree of compression (where the visual image is compressed to fit in a small area, without reducing the viewing angle covered by cameras/sensors).

There may also be the option to completely hide the visual display of an aerodrome, provided reactivation is guaranteed when needed or required by the ATCO / AFISO.

The visual presentation provided from a Multiple RTM would be expected to meet the same minimum technical requirements of a Single RTM visual presentation. Additional specifications for the presentation of multiple aerodromes and displaying compressed or “altered” visual images may be required.

3.3.3.4 Operating Methods and Roles

It is expected that the controller’s ability to increase the number of aerodromes to which he is providing ATS will depend largely on the number of parallel aircraft (and vehicle) movements as well as the number of movements per time frame (e.g. per hour) at those aerodromes.

In the exemplary illustration shown in Figure 5, the left hand column represents 5 aerodromes, each with only ground vehicle movements and/or overflights. It is expected that a single ATCO/AFISO will be able to provide ATS to a number of these aerodromes in parallel. The right hand column represents the same 5 aerodromes, this time each with a current arriving/departing aircraft movement. It is expected that a single ATCO/AFISO would not be able to provide ATS to all 5 aerodromes in parallel. The same is true once the number of movements per hour exceeds a certain value. This value is of course also dependant on the number of aerodromes the ATCO/AFISO is having responsibility for. As a consequence different solutions would be possible:

1. The traffic is sequenced in such a way that aircraft / vehicles are handled one at a time;
2. Traffic is generally reduced during preplanning;
3. The number of ATCOs/AFISOs is increased;
4. Tasks are outsourced (e.g. ground control is executed by a dedicated additional Controller) in order to provide the ATCO/AFISO load relief.

The concept aims to allow the ATCO/AFISO to provide ATS to multiple aerodromes in parallel in various ways, all allowing for the continuous visual watch of all of the aerodromes being provided with an ATS.

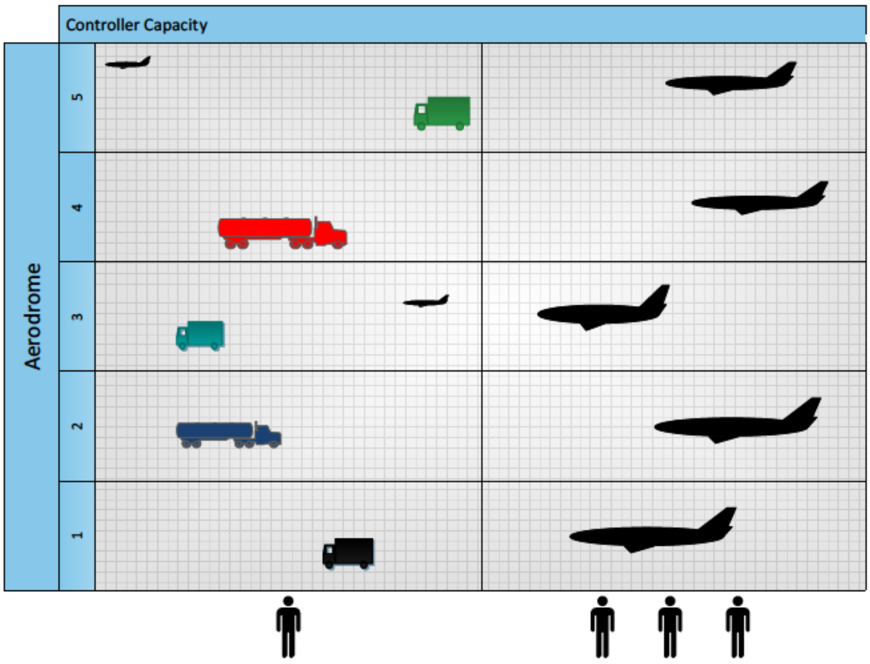


Figure 5 – Controller Capacity

The ATCO/AFISO could provide ATS to multiple aerodromes in one of the following ways, as illustrated in Figure 6(with detailed descriptions provided overleaf):

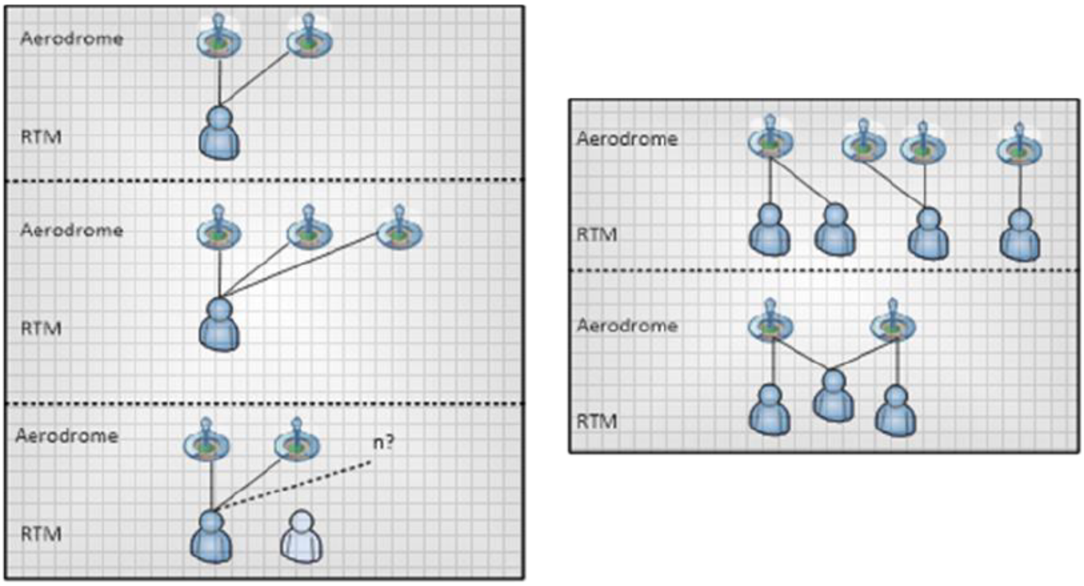


Figure 6 – RTC to aerodrome mapping

Two aerodromes (thus a 1:2 relationship between RTM and aerodrome):

The traffic demand at certain aerodromes might be of such composition that the ATCO/AFISO is restricted to the control of two aerodromes and is capable of managing both aerodromes simultaneously. Thus several movements at both aerodromes might be executed in parallel.

As is the operational procedure being assessed under SDM-0205

Three aerodromes (thus a 1:3 relationship between RTM and aerodrome):

When there are imminent or current aircraft movements at an aerodrome, the ATCO/AFISO would provide ATS to that aerodrome and require all inputs from the actual aerodrome. This aerodrome would be the primary aerodrome and hence would be displayed on the visual presentation. The remaining aerodromes would either be visualised on a visual presentation equal in size to that of the live aerodrome or on a reduced number, on periphery screens.

A supervisor role may be necessary in order to provide additional support due to workload.

Several aerodromes (thus a 1: *n*/many relationship between RTM and aerodrome):

Utilising the same methods of operation as detailed in the 1:3 principle but with additional visual presentations and control devices for the control and monitoring of additional aerodromes.

Due to the potential for higher traffic numbers there would be the optional to split the RTM so that control is provided in a 2-to-many (2:n) principle and would likely to be provided by a supervisor. This would ease pressure and the requirement to co-ordinate between many aerodromes with potentially overlapping peaks.

Providing a service without the use of a visual presentation

An alternative option within an RTM is to provide an advisory service to aerodromes where a visual presentation may not necessarily be required. This could be used when small aerodromes are experiencing long periods of zero scheduled traffic. [*Note: If no IFR traffic is expected for a longer period of time (1-2 hours or more) ATS could be closed and no CTR/Traffic Information Zone (TIZ) is established. The actual aerodrome could still be open e.g. for VFR traffic.*]

The ATCO/AFISO would listen to the radio frequencies (and any other type of communication means as applicable, such as Controller Pilot Data Link Communications (CPDLC), monitor for upcoming aircraft movements and issue clearances for vehicles to enter the manoeuvring area or to aircraft movements (over flights) within the Terminal Manoeuvring Area/Control Zone (TMA/CTR). This could be done via Radio Telephone (R/T) and surveillance aids.

The primary use cases for the provision of an advisory service with no visual presentation include:

1) In a 1:*n* set-up, as the redundant screens could be used to give a wider visual of the remaining aerodromes.
2) It would also be used at the wider RTC level to merge RTMs. Quiet aerodromes could hence be merged into existing RTMs at certain periods of the day. The RTM increasing from a 1:3 to a 1:4 relationship RTM.

It is predicted this form of operating would only be used at certain times and would not be the preferred method of operating. It would be more acceptable to use for aerodromes that previously (prior to their introduction to the RTC) only had an advisory service, hence the service downgrade only reflects a return to normal pre RTC operations.

Multiple operators (thus a 2:*n* relationship)

It is likely that a supervisor would be required to provide additional support and/or co-ordination when many aerodromes are being provided with ATS from one RTM (1:3 or 1:n). Supervisors/additional operators may also be required during non-nominal situations or extremely busy periods (although it is forecast that overlapping traffic peaks at aerodromes will not pose a probably as the target aerodromes for the concept are small to medium traffic aerodromes).

3.3.3.5 Controller Tool Support

In addition to the controller tool support introduced in chapter 3.2.1, supplementary support tools may be introduced in the context of Multiple Remote Tower Operations (RTO). However the controller support tools presented in the context of Single RTO may of course be applicable for Multiple RTO as well. Examples for controller support tools in the context of Multiple RTO are:

- Integrated flight data processing systems FDPS

The configuration of the ATCO/AFISO working desk could consist of consolidating the flight data information of all relevant aerodromes into one FDPS. Thus all flight strips are merged into one system and for example distinguished through colour coding.

- Indication from which aerodrome a radio transmission is received

  On the CWP (e.g. visual presentation screen) an indication could be made highlighting where a radio transmission is coming from. Thus the ATCO/AFISO may easily bring together a station calling and its origin – situational awareness may be increased.

- Route planning

  A function could be provided calculating the most appropriate route for both aircraft and vehicles on ground as well as for aircraft in the air (within the area of responsibility). Such a route planning function could be based on known traffic as well as SIDs / STARs and anticipated VFR routes (waypoints, traffic pattern, typical sightseeing areas etc.). Based on such forecast routes conformance monitoring and conflict detection could be executed.

- Conformance monitoring

  A conformance monitoring function could be implemented in order to check that the forecast route from the route planning function is complied with by the pilot / vehicle driver. If a deviation was detected the controller could be provided with a warning allowing him to transmit a corrective instruction. Conformance monitoring may rest upon buffers around certain areas, e.g. expected flight paths or taxi routes, restricted areas, RWYs etc.

- Conflict detection

  In line with the route planning function and conformance monitoring function a conflict detection function could be implemented alerting the controller in case specified conflicts arise. Hence RWY incursions, interfering routes or airspace violations could be detected and corresponding warnings could be given.

- Voice recognition

  Voice recognition could be implemented in two senses:

  1. Voice recognition (ATCO)

  Instructions / clearances given by the controller are recognized by the system and following activities / functions may be triggered (e.g. FDPS status update).

  2. Voice recognition (pilot / vehicle driver)

  The system recognizes the information stated by the pilot / vehicle driver. Consequently requests can be derived and read backs can be verified.

- Text to speech

  The controller may be supported by a text to speech function. Consequently certain phrases may be installed in the Remote Tower function which are either triggered manually by the controller or automatically if certain preconditions are met. Thus the controller is relieved from communication tasks giving additional time for other tasks.

- Voice recording

  Read backs or requests from the pilot / vehicle driver could be recorded so that the controller can retrieve the transmission at a later point in time. Consequently, if the controller is busy transmitting / receiving a transmission at one aerodrome a pilot could anyhow transmit on another aerodrome at the same time. The controller would then listen to the recorded transmission and provide feedback to the second pilot.

3.3.3.6 Air Traffic Management

Scheduled IFR traffic is planned well in advance. Other IFR operations are also obliged to follow the flight planning procedures, which means they are normally predicted at least a few hours in advance.

VFR traffic can operate on a flight plan and also without one, which can create much less advanced warning to ATS prior to its appearance. VFR traffic may file IFR in flight due to bad weather and become an IFR flight at short notice.

To provide the most optimal balance between ATS staff required and daily traffic demand while providing ATS to multiple aerodromes, traffic coordination may be necessary. Coordination may have to be done between aerodrome operators ,ANSPs and central flow management units/network operations, to ensure that planned scheduled IFR-traffic at the involved aerodromes are not all scheduled at the same time. For scheduled flights this could be done when schedule timetables are being created and approved. For non-scheduled IFR flights arrival/departure times could be granted or a slot time could be set on a daily “tactical” basis by the RTC supervisor in the RTC. The same procedures could take place in the case of revised arrival/departure times (most common cause of delays).

As an interim level of traffic coordination, the existing Prior Permission Required (PPR) function could be utilised for flights which are not scheduled. PPR (e.g. on 30 minutes’ notice to the aerodrome) can prevent ATS receiving sudden traffic or service requests. As the case may be ANSPs might want to provide Transponder Mandatory Zones (TMZ) in order to allow enhanced classification of traffic. This especially applies to aerodromes with a high amount of traffic or to aerodromes with a lot of additional noise (e.g. neighbouring CTR, frequent overflights etc.).

Even with PPR and/or traffic coordination it may not be possible to predict totally accurate times for actual aircraft arrival and departures. Instead they are more likely to be used to give higher level estimates of predicted activity at an aerodrome within a certain timeframe e.g. within the next 30 to 60 minutes. This should be sufficient to allow medium term (resource allocation, staffing) and short term (“tactical”) planning within the RTC. In case of an aircraft declaring emergency, it will be given priority and if necessary other aircraft will have to be delayed or diverted.

In instances where PPR, traffic allocation and coordination do not allow full prior warning of aircraft movements, or where they are not used at all, service could still be provided to multiple aerodromes by a single ATCO/AFISO. This may lead to occasions when the RTC reaches “capacity” and cannot accommodate any more movements or unexpected requests. Aircraft who have not sought PPR or who have not been coordinated and who still wish to arrive/depart during such times may be instructed to hold in the air or on the ground until they can be accommodated by the RTC.

3.3.3.7 Approach Control

At some aerodromes APP service is provided by the Tower controller. In this case APP service can be provided for one or more aerodromes. The allocation of APP service to CWP would depend on workload and the possibility to use ATS surveillance equipment. APP service could be provided from a common/shared CWP or it may be provided from a dedicated ATS Surveillance CWP used for APP service only, using different equipment and simplified set up compared to the Tower ATC/AFIS CWP. Some examples of configurations are shown below:

A. At low traffic load, the Remote ATCO can provide combined TWR and APP for more than one airport simultaneously.

B. In this configuration the APP and TWR roles are split. One Remote ATCO performs the APP role for two or more aerodromes whilst another Remote TWR ATCO provides ATS to two or more aerodromes. (As assessed in SDM-0205 yet with a sole focus on the Remote TWR ATCO position and **not** the APP position)

C. This configuration is similar to Configuration B (above) except that APP for the aerodromes is performed from a separate ATS surveillance CWP, dedicated for APP only. Remote TWR for both aerodromes is provided from another CWP.

D. In this example configuration the ATS for the aerodromes is performed on a one-to-one basis, with a separate TWR ATCO for each aerodrome provided from separate CWP. The APP role is combined, with APP for both aerodromes performed from an ATS surveillance CWP, dedicated for APP only.

Example	RTM 1	RTM 2	Dedicated APP Surveillance CWP
A	APP/TWR Airport A & B	x	x
B	TWR Airport A & B	APP Airport A & B	x
C	TWR Airport A & B	x	APP Airport A & B
D	TWR Airport A	TWR Airport B	APP Airport A & B

Table 16 – Approach Control Configurations

3.3.4 Example Operating Scenarios

The following examples illustrate some operating scenarios based on how an RTC might operate according to some of the principles above. Three main types of scenarios are presented:

- ATS to two aerodromes (1-to-Two);
- ATS to single aerodromes in conjunction with ATS to multiple aerodromes (1-to1 in combination with 1-to-Many);
- ATS to multiple aerodromes (1-to-Many).

3.3.4.1 Example 1 - ATS to Two Aerodromes by a single ATCO/AFISO (SDM-0205)

Aerodromes	RTM required	ATCO/AFISO required	ATS provided to aerodromes in parallel	Traffic Coordination
2	1	1	Yes	Optional

# Aerodromes with aircraft movements	ATS for Aerodrome A	ATS for Aerodrome B
0	ATCO1	
1	ATCO1	
2	ATCO1	

Resource Pool: ATCO 1
Airport A, B
Airport A, B
Airport A, B

RTM: RTM 1
Airport A, B
Airport A, B
Airport A, B

Table 17 – Example 1 - 1-to-2; No RTC supervisor

In this example, the ATCO / AFISO provides ATS to both aerodromes at the same time. There is not necessarily a second controller on standby available.

Consequently several movements (eventually at both aerodromes concurrently) might be controlled at the same time. When there are movements at airport A, the ATCO may be required to view the airport with movements on a primary (enlarged) screen. The ATCO may be required to quickly switch between the two airports on the primary screen. The secondary screen will still enable the ATCO to maintain a constant visual watch on airport B. Alternatively a solution where the visual presentation of both airports is continuously available in 'full size' may be implemented, reducing operator workload for switching the aerodrome views.

In order for the ATCO / AFISO to properly provide ATS at both aerodromes it is essential that all relevant FPL data is provided simultaneously, possibly within one single FDPS. Furthermore it has to be assured that the ATCO / AFISO is supplied with the present situation at both aerodromes at all times (i.e. visual presentation, FDPS information, actual weather information etc.) in order to be able to react on all events.

The frequencies of the aerodromes used for communication with the pilots need to be merged to one frequency. Traffic at both airports may need to be coordinated in order to avoid excessive traffic peaks. This may be performed at network level or by individual ATCOs/AFISOs controlling the traffic as they see fit in order to manage and prioritise their own workload and ensure safe operations.

Note to date this operational scenarios has only been considered assuming that the aerodrome characteristics are as detailed in section 4.1.2, Table 27.

3.3.4.2 Example 2 - ATS to more than two Aerodromes by a single ATCO/AFISO

Aerodromes	RTM required	ATCO/AFISO required	ATS provided to aerodromes in parallel	Traffic Coordination
3	1	1	Yes	Optional

# Aerodromes with aircraft movements	ATS for Aerodrome			Resource Pool	RTM
	A	B	C	ATCO 1	RTM 1
0	ATCO1			Airport A, B, C	Airport A, B, C
1	ATCO1			Airport A, B, C	Airport A, B, C
2	ATCO1			Airport A, B, C	Airport A, B, C

Table 18 – Example 2 - 1-to-3

This operational scenario is the same as detailed in section 3.3.4.1 above, but with the presence of a third aerodrome. Due to the increased number of aerodromes it is likely that more consideration will need to be given to the traffic characteristics, controller support tolls and working methods. There may also be an increased need for traffic coordination.

3.3.4.3 Deployment and Transition

It is very likely that the Remote Provision of ATS for multiple aerodromes will be deployed as part of an extension to a pre-existing Single Remote Tower implementation. This may facilitate the transition from a 1-to-1 operating method to a 1-to-many operating method. However this is not a prerequisite for deployment. If an RTC is already established and is operating Single and Multiple RTMs, it may be a very smooth transition to facilitate a new aerodrome into a pre-existing operation.

The concept is likely to suit an incremental approach to the environments in which it is deployed. With validation and research and development activities commencing in low traffic reduced complexity environments with a sole focus on TWR services (not APP) and on the provision of ATS on a 1 –to-2 basis (as assessed in SDM-0205). This would then be expanded to wider use cases and deployment environments, considering the adaptations required to facilitate the new environments.

3.3.5 Differences between new and previous operating method

The difference between the new and previous operating method, in addition to the differences already described for Single Tower, is mainly concerned with the ATCOs / AFISOs ability to provide ATS to more than one aerodrome in parallel. In traditional operations this is not possible.

3.4 Remote Provision of Air Traffic Services from a Centralised Facility - Remote Tower Centre (RTC)

3.4.1 Overview of an RTC

In order to maximise the benefits proposed by the concept it is likely that in many instances the provision of a remote ATS from an RTM will be from a centralised facility to be known as a Remote Tower Centre (RTC). The centralisation of many RTMs in one RTC will bring about increased cost effectiveness due to economies of scale brought about through increased sharing. It is likely that an RTC would contain several RTMs, similar to sector positions in an Area Control Centre (ACC / ATCC).

The principle of an RTC is independent of the primary concept application being applied. Single, Multiple and Contingency applications can be operated from a centralised facility. The only consideration is that for Remote Contingency Tower applications the ATS would not be permanently provided from the RTC. (More information regarding the Remote Contingency Tower application can be found in section 4.2 below).

An RTC could be laid out as shown in Figure 7 below, with multiple RTMs and one or more supervisor positions (depending on the size and requirements of the RTC). As detailed above a unified and standardised RTM would be required to provide the most efficient setup, facilitating sharing and thus economies of scope.

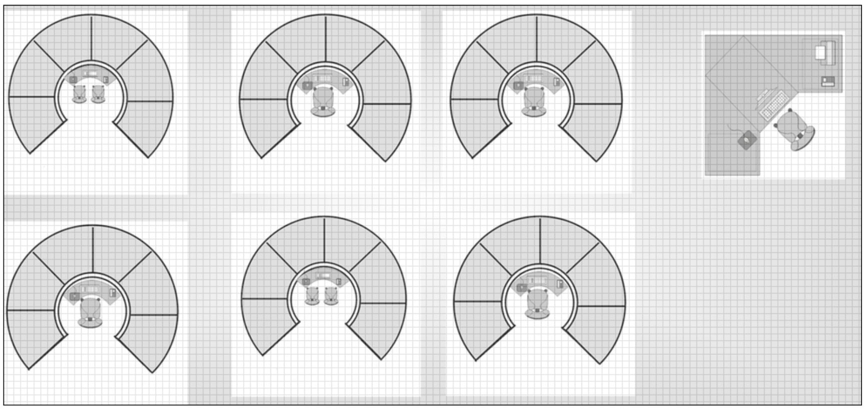


Figure 7 – Illustration of an RTC layout

Depending primarily on the traffic density, it can be decided to open, close or merge the number of aerodromes handled by a single ATCO / AFISO in an RTM. The ability to merge will be reliant on many factors such as ATCO license, traffic density of the aerodromes and technical ability to add aerodromes.

The number of available RTMs in an RTC depends of the following factors:

- The number of aerodromes that are to be connected to the RTC;
- The maximum number of parallel movements possible per each ATCO / AFISO / RTM;
- Another number, depending on ability to combine RTM and aerodromes;
- Additional/Spare RTMs to be considered based on the RTCs requirements for contingency.

ATCOs / AFISOs would need to be licensed for every aerodrome they are to provide and ATS (as is the case in current operations). In order to maximise the utility and flexibility of an RTC it would be beneficial for ATCOs operating from one RTC to hold a license for many of the aerodromes being provide with an ATS from the RTC (depending on the size of the RTC).

3.4.2 Operating methods and Roles within the RTC

The configuration of the RTC and operating methods applied within shall be non-prescriptive, with RTCs being fully flexible and configurable to many applications under the Remote Provision of ATS concept.

It is expected that there will be up to three different primary roles in an RTC (not necessarily all at once, in the same RTC or to the same aerodrome):

- ATCO;
- AFISO;
- RTC supervisor.

The ATCOs / AFISOs main responsibility will be regarding the provision of ATS. The (optional) RTC supervisor role is seen as similar to that of a watch supervisor in an ACC, the main responsibilities will be with regard to staff/RTM allocation. The requirement for an RTC supervisor will be dependent on the size of the RTC.

At RTC level it is expected that management would conduct a study to determine the optimal number of staff according to their own configurations. A more efficient shift pattern with reduced overall staffing is envisaged. This would be especially efficient in large RTCs if ATCOs / AFISOs held licenses for many aerodromes being provided with an ATS from that RTC. If the RTC ATCOs / AFISOs only held licenses for specific aerodromes RTC resource management would be limited in the combination of aerodromes to operators they could provide.

During a shift, an RTC supervisor role can be used to manage the allocation of staff and RTM at any one time during the shift in order to provide an efficient set up at and guarantee a flexible system. The RTC supervisor role can be performed by a dedicated person or can be handled by one of the shift staff in addition to their ATCO/AFISO role.

The RTC will have a predefined number of ATCO / AFISO resources available during a shift period. Shift configuration and resource pool size should consider:

- Expected traffic load and peaks;
- The number of RTMs;
- The ability to combine aerodromes to be controlled using one RTM;
- ATCO licenses;
- Relief staff requirements.

Below is an example of some operating methods that may be applied to an RTC, in addition to those detailed in section 3.3.3.4 above:

Bandboxed/merged operations

In RTCs the supervisor may choose to merge aerodromes in different RTM configurations dependant on traffic and conditions. This may result in an RTM of three aerodromes being reduced to two aerodromes (if experiencing heavy traffic), with a separate RTM taking control of the removed aerodrome. In certain cases an aerodrome may be removed and placed in a single remote tower set-up.

Multiple small and quiet aerodromes may be band boxed into one RTM during quiet periods, thus a 1:n/many relationship prevails until the traffic situation increases.

Other operating methods:

In addition to the above working principles it may be an option to implement an additional controller for clearance delivery, coordination tasks and approach and/or ground control tasks. Hence instead of cutting down traffic in order to reduce the ATCO/AFISO workload, those tasks are delegated to a discrete controller. In doing so the ATCOs / AFISOs is able to accept all upcoming traffic whilst maintaining the efficient use of staff. For example compositions like 3:4 might be accomplished where two ATCO/AFISO each provide ATS to two aerodromes and the additional controller provides ground related tasks at all four aerodromes.

In order to maintain the overall traffic picture required for the staff/RTM allocation, an RTC supervisor may be deployed and either:

- Be a separate and extra role with overall responsibility for the management of the RTC. The RTC supervisor maintains overall supervision of all aerodromes within the RTC at all times in addition to the ATCO/AFISO providing ATS. This role could be performed from a dedicated RTC supervisor CWP. The RTC supervisor would be expected to perform the planning, administration, staff management and allocation tasks and supervision of technical systems, allowing the ATCO/AFISO to concentrate solely on the provision of ATS. Since this is an "extra" role, it is expected that this type of role would only be required for the larger or more complex RTC. (Technical issues may have to be resolved by designated engineers and technicians responsible for the calibration, maintenance and flight testing employed by ANSPs such as Air Traffic Electronic Personnel (ATSEP);
- Perform the role in combination with the duties of a regular ATCO/AFISO and therefore not be a separate role.

3.4.3 Aerodrome Clustering within an RTC

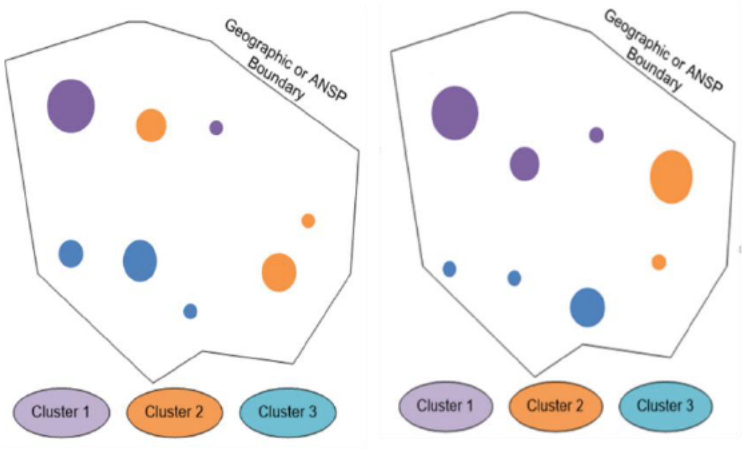
When operating from an RTC some of the RTMs within the centre are likely to be used to provide ATS in a Multiple Tower configuration. This will further maximise the benefits of sharing one facility and will enable more aerodromes to be provided with a service from that facility.

In order to manage the provision of ATS to multiple aerodromes from an RTC it is likely that the aerodromes will be categorised into clusters or sub-sets. This will enable RTC supervisors to define which aerodromes can be clustered together in one RTM.

Aerodromes could be clustered according to:

- **Aerodrome location** where aerodromes in the same geographic area or which share the same TMA/APP are grouped;
- **Aerodrome size,** where large aerodromes are in smaller clusters and small aerodromes are more often grouped together in large clusters. It is also likely that larger aerodromes are clustered with much smaller aerodromes so that total traffic is more balanced;
- **Traffic peaks**, where aerodromes with overlapping traffic peaks are not clustered together in order to better manage controller workload;
- **Aerodrome runway characteristics**, where aerodromes with the differing runway numbers/direction are clustered together to minimise error making or the potential for confusion.

Clusters or groups of aerodromes may also be based upon a mixture of the above. Figure 8 below provides an illustrative example of some aerodrome clusters that could be controlled from one RTM.



Cluster by complimenting size   Cluster by complimenting size and Location

Figure 8 – Examples of aerodrome clusters

3.4.4 Example Operating Scenarios

3.4.4.1 Example 1 - Single Remote Tower - Co-located Single Remote Tower Modules

Aerodromes	RTM required	ATCO/AFISO required	ATS provided to aerodromes in parallel	RTC supervisor	Traffic Coordination
2	2	2	No	No	No

# Aerodromes with aircraft movements	ATS for Aerodrome		Resource Pool		RTM	
	A	B	ATCO1	ATCO2	RTM1	RTM2
0	ATCO1	ATCO2	Airport A	Airport B	Airport A	Airport B
1	ATCO1	ATCO2	Airport A	Airport B	Airport A	Airport B
2	ATCO1	ATCO2	Airport A	Airport B	Airport A	Airport B

Table 19 – Example 1 – Co-located Single ATS (RTC)

This configuration is an application of the single tower service, but for two aerodromes and from the same co-located facility (RTC). One RTM and one ATCO is required for each aerodrome and they will be located in the same RTC or an additional RTM could be placed in a local facility. The RTM could be permanently configured to a specific aerodrome.

If a remote facility and a local facility are co-located (e.g. ATS for Aerodrome B is provided from the Tower of Aerodrome A), RTM1 would provide service to the local facility using a direct OTW view (and therefore no relayed visual presentation). RTM2 would provide ATS to the Aerodrome B using a visual presentation.

In this example, because it is an extension of the single tower service, ATS is provided to the aerodromes by a dedicated ATCO/AFISO regardless of the traffic situation. Therefore the staffing levels remain constant regardless of the number of movements at either aerodrome.

In other words one ATCO/AFISO will be in charge for one aerodrome at all times. However just one back-up ATCO/AFISO is needed for both aerodromes instead of one back-up ATCO/AFISO for each aerodrome (subject to the support personnel holding the sufficient licensing).

Already, for this example there are cost efficiency gains since it would be sufficient to operate the two aerodromes with one back-up ATCO/AFISO, as opposed to one back up staff member at each aerodrome, as is the case with today's local operations.

3.4.4.2 Example 2 - Single Remote Tower in conjunction with Multiple Remote Tower example operating scenarios

The example operating scenarios detailed in the sections below illustrate how a combination of the existing OI may be applied. .

Note when providing ATS to more than 3 aerodrome simultaneously the applicable aerodrome operating environment and required technical configuration of the solution may differ from that detailed in section 4.1 below.

It is not known if the below scenarios will apply to aerodromes outside of those detailed in the aerodrome characteristics described in section 4- Detailed Operational Environment.

3.4.4.2.1 Example 2.1 –- 1-to-1 in conjunction with 1-to-Many; No RTC supervisor

Aerodromes	RTM required	ATCO/AFISO required	ATS provided to aerodromes in parallel	RTC supervisor	Traffic Coordination
4	1 to 4	1 to 4	Yes	No	No

# Aerodromes with aircraft movements	ATS for Aerodrome			
	A	B	C	D
0	ATCO1			
1	ATCO1	ATCO2		
2	ATCO1	ATCO2	ATCO3	
3	ATCO1	ATCO2	ATCO3	ATCO4
4	ATCO1	ATCO2	ATCO3	ATCO4

# Aerodromes with aircraft movements	Resource Pool			
	ATCO1	ATCO2	ATCO3	ATCO4
0	Airport A, B, C, D	Available	Not on shift	Not on shift
1	Airport A	Airport B, C, D	Available	Not on shift
2	Airport A	Airport B	Airport C, D	Available
3	Airport A	Airport B	Airport C	Airport D
4	Airport A	Airport B	Airport C	Airport D

# Aerodromes with aircraft movements	RTM			
	RTM1	RTM2	RTM3	RTM4
0	Airport A, B, C, D	Spare	Spare	Spare
1	Airport A	Airport B, C, D	Spare	Spare
2	Airport A	Airport B	Airport C, D	Spare
3	Airport A	Airport B	Airport C	Airport D
4	Airport A	Airport B	Airport C	Airport D

Table 20 – Example 2.1 – 1-to-1 in conjunction with 1-to-Many; No RTC supervisor

In this example, ATS is provided to four aerodromes on a flexible basis, using a minimum of one ATCO / AFISO from a minimum of one RTM.

The key element of this example is that an ATCO can provide ATS to more than one aerodrome in parallel.

The planned shift starts with two ATCO / AFISO and more staff will then attend (and subsequently leave), according to the staff schedule.

When there are no aircraft movements at any of the aerodromes ATCO1 provides ATS to all four aerodromes from RTM1. When they are made aware of an upcoming aircraft movement at the first aerodrome (either by frequency, coordination, schedule, flight plan or PPR) they will call for ATCO2, who was on standby at the RTC, to provide ATS to Aerodromes B, C and D. ATCO1 will then provide ATS only to Aerodrome 1 (SDM-0201). ATCO3 will come onto shift at (or be called into) the RTC.

When ATCO2 is providing ATS on RTM2, if the second aerodrome has an aircraft movement, ATCO2 will decide to call for ATCO3 to provide ATS to Aerodrome C and D, while ATCO2 focuses on Aerodrome B (providing ATS to a single aerodrome).

Using this method, the ATCO/AFISO will always have had a period of time providing ATS to multiple aerodromes in low (or zero) traffic before providing ATS when there are aircraft movements, meaning they will have built up some sort of traffic picture already. All aerodromes have ATS provided and airspace established at all times. When 3 aerodromes have arriving/departing traffic movements and a 4th ATCO/AFISO is required, ATCO4 provide ATS for Aerodrome D even if it has no current aircraft movements. Since each ATCO is providing ATS for one aerodrome, this scenario would fall under ATS to a single aerodrome (not multiple).

For VFR unplanned traffic requests, a short delay may be necessary in order for the single ATCO/AFISO to brief the ATCO/AFISO taking over, ensuring that he/she is completely aware of the traffic situation.

3.4.4.2.2 Example 2.2 - 1-to-1 in conjunction with 1-to-Many; RTC supervisor

Aerodromes	RTM required	ATCO/AFISO required	ATS provided to aerodromes in parallel	RTC supervisor	Traffic Coordination
4	1 to 5	1 to 5	Yes	Yes	No

# Aerodromes with aircraft movements	ATS for Aerodrome			
	A	B	C	D
0	RTC supervisor (ATCO1)			
1	ATCO2	RTC supervisor (ATCO1)		
2	ATCO2	ATCO3	RTC supervisor (ATCO1)	
3	ATCO2	ATCO3	ATCO4	RTC supervisor (ATCO1)
4	ATCO2	ATCO3	ATCO4	ATCO5

# Aerodromes with aircraft movements	Resource Pool				
	ATCO1	ATCO2	ATCO3	ATCO4	ATCO5
0	Airport A, B, C, D	Available	Not on shift	Not on shift	Not on shift
1	Airport B, C, D	Airport A	Available	Not on shift	Not on shift
2	Airport C, D	Airport A	Airport B	Available	Not on shift
3	Airport D	Airport A	Airport B	Airport C	Available
4	Available	Airport A	Airport B	Airport C	Airport D

# Aerodromes with aircraft movements	RTM				
	RTM1	RTM2	RTM3	RTM4	RTM5
0	Airport A, B, C, D	Spare	Spare	Spare	Spare
1	Airport B, C, D	Airport A	Spare	Spare	Spare
2	Airport C, D	Airport A	Airport B	Spare	Spare
3	Airport D	Airport A	Airport B	Airport C	Spare
4	Spare	Airport A	Airport B	Airport C	Airport D

Table 21 – Example 2.2 – 1-to-1 in conjunction with 1-to-Many; RTC supervisor

This example is an extension of Example 2.1, with the main difference being the introduction of an RTC supervisor who is acting in the combined RTC supervisor-ATCO/AFISO role. The role of the RTC supervisor here is to provide ATS to the 4 aerodromes when there are no aircraft movements and coordinate the deployment of the other ATCOs/AFISOs when dedicated ATS is required. The RTC supervisor can be a dedicated role or an ATCO/AFISO as ATCO1 in this example.

When there are no aircraft movements at any of the aerodromes the RTC supervisor (ATCO1) is the only member of staff required and provides ATS to all 4 aerodromes from RTM1. When made aware of an upcoming aircraft movement at the first aerodrome (either by frequency, coordination, schedule, flight plan or PPR) they will bring in ATCO2 to provide dedicated (single) ATS for that aerodrome. ATCO1 will continue to provide ATS to the other 3 aerodromes.

When the RTC supervisor is made aware of an upcoming movement at the second aerodrome they will bring in ATCO3, to provide dedicated ATS for that aerodrome on RTM3 (as is the operating principle under SDM-0201) and so on.

When there are 4 aerodromes with aircraft movements with ATS provided by 4 ATCOs and the RTC supervisor then this scenario would fall under ATS for single aerodromes (SDM-0201).

3.4.4.3 Example 3 - Multiple Remote Tower example operational scenarios

3.4.4.3.1 Example 3.1 - 1-to-Many; No RTC Supervisor

Aerodromes	RTM required	ATCO/AFISO required	ATS provided to aerodromes in parallel	RTC supervisor	Traffic Coordination
4	1 to 3	1 to 3	Yes	No	No

# Aerodromes with aircraft movements	ATS for Aerodrome			
	A	B	C	D
0	ATCO1			
1	ATCO1			
2	ATCO1	ATCO2	ATCO1	
3	ATCO1	ATCO2		ATCO1
4	ATCO1	ATCO2		ATCO3

# Aerodromes with aircraft movements	Resource Pool		
	ATCO1	ATCO2	ATCO3
0	Airport A, B, C, D	Available	Not on shift

1	Airport A, B, C, D	Available	Not on shift
2	Airport A, C, D	Airport B	Available
3	Airport A, D	Airport B, C	Available
4	Airport A	Airport B, C	Airport D

# Aerodromes with aircraft movements	RTM		
	RTM 1	RTM 2	RTM 3
0	Airport A, B, C, D	Spare	Spare
1	Airport A, B, C, D	Spare	Spare
2	Airport A, C, D	Airport B	Spare
3	Airport A, D	Airport B, C	Spare
4	Airport A	Airport B, C	Airport D

Table 22 – Example 3.1 – 1-to-Many; No RTC supervisor

In this example, the ATCO/AFISO can continue to provide ATS to aerodromes with no movements while also providing ATS to an aerodrome(s) with traffic movements. This combination of service provision extends the period when only 1 ATCO/AFISO is needed.

When there are no movements, ATCO1 provides ATS to all 4 aerodromes on RTM1. When they are made aware of an upcoming aircraft movement at Aerodrome A, they will provide ATS to the aircraft at Aerodrome A, while also providing ATS for Aerodromes B, C and D. (This operating method is also known as “switch”)

When ATCO1 is made aware of an upcoming aircraft movement at the second aerodrome, he/she will decide if they can provide ATS to that aerodrome/aircraft in parallel with the other aerodromes. If they cannot, they will bring in ATCO2 to provide ATS to Aerodrome B. ATCO2 will provide ATS from RTM2 (ATS to a single aerodrome – SDM-0201)). ATCO1 will continue to provide ATS for Aerodrome A, C and D on RTM1.

When ATCO1 is made aware of an upcoming aircraft movement at the third aerodrome, they can ask ATCO2 to provide ATS to Aerodrome C in parallel with their ATS to Aerodrome B on RTM2 (SDM-0205). ATCO1 will continue to provide ATS for Aerodrome A and Aerodrome D on RTM1 (SDM-0205).

Finally, when ATCO1 is made aware of an upcoming aircraft movement at aerodrome D, they will bring in ATCO3 to provide ATS for Aerodrome D since, in this example, ATCO1 is not able to provide ATS to both Aerodrome A and Aerodrome D in parallel when both have current aircraft movements. ATCO3 will provide ATS from RTM3 ATCO1 is now only providing ATS to Aerodrome A. (ATCO1 and ATCO3 would be providing ATS to a single aerodrome SDM-0201 whilst ATCO2 would be providing ATS to multiple aerodromes SDM-0205).

3.4.4.3.2 Example 3.2 - 1-to-Many; RTC supervisor

Aerodromes	RTM required	ATCO/AFISO required	ATS provided to aerodromes in parallel	RTC supervisor	Traffic Coordination
4	1 to 4	1 to 3	Yes	Yes	No

<table>
<tr><th rowspan="2"># Aerodromes with aircraft movements</th><th colspan="4">ATS for Aerodrome</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>D</th></tr>
<tr><td rowspan="2">0</td><td colspan="4">RTC supervisor</td></tr>
<tr><td colspan="4">ATCO1</td></tr>
<tr><td rowspan="2">1</td><td colspan="4">RTC supervisor</td></tr>
<tr><td>ATCO1</td><td colspan="3">ATCO2</td></tr>
</table>

2	RTC supervisor		
	ATCO1	ATCO2	
3	RTC supervisor		
	ATCO1	ATCO2	
4	RTC supervisor		
	ATCO1	ATCO2	ATCO3

	Resource Pool			
# Aerodromes with aircraft movements	RTC supervisor	ATCO1	ATCO2	ATCO3
0	RTC supervisor	Airport A, B, C, D	Available	Not on shift
1	RTC supervisor	Airport A	Airport B, C, D	Available
2	RTC supervisor	Airport A, B	Airport C, D	Available
3	RTC supervisor	Airport A, B	Airport C, D	Available
4	RTC supervisor	Airport A, B	Airport C	Airport D

	RTM			
# Aerodromes with aircraft movements	RTC supervisor RTM/CWP	RTM1	RTM2	RTM3
0	All Airports	Airport A, B, C, D	Spare	Spare
1	All Airports	Airport A	Airport B, C, D	Spare
2	All Airports	Airport A, B	Airport C, D	Spare
3	All Airports	Airport A, B	Airport C, D	Spare
4	All Airports	Airport A, B	Airport C	Airport D

Table 23 – Example 3.2 - 1-to-Many; RTC supervisor

In this example the ATCO/AFISO are permitted to provide ATS to more than one aerodrome in parallel.

An RTC supervisor maintains responsibility for staff management and RTM allocation for all 4 aerodromes at all times. In this example, the RTC supervisor is a dedicated role and does not take on any ATS provision tasks. Using this method, there is always one person with overall continuous awareness of all aerodromes and with sole responsibility for staff deployment. Additionally, the ATCO/AFISO does not have to perform any staff coordination tasks in addition to their ATS provision tasks.

ATCO1 initially provides ATS to all 4 aerodromes from RTM1. When the RTC supervisor and/or ATCO1 are made aware of an upcoming movement at Aerodrome A, the RTC supervisor brings in ATCO2 on RTM2 to provide ATS for Aerodromes B, C and D while ATCO1 provides dedicated ATS for Aerodrome A (SDM-0201).

When the RTC supervisor and/or ATCO2 are made aware of an upcoming aircraft movement at Aerodrome B, the RTC supervisor will check with ATCO1 to ensure they are able provide ATS to Aerodrome B in parallel with Aerodrome A. If ATCO1 confirms this, they will then provide service to Aerodrome B, also on RTM1. The RTM must be able to display a visual presentation for both aerodrome A and B simultaneously (SDM-0205).

The RTM must be designed in such a way as to avoid any mistakes such as mixing up the aerodromes and equipment controls (e.g. runway lighting and radio transmitters/ receivers). Since the RTM will have to be configured for Aerodrome B whilst being used for Aerodrome A, it is critical that the configuration is not disruptive and can be done quickly (SDM-0205).

When the RTC supervisor and/or ATCO2 are made aware of an upcoming aircraft movement at Aerodrome C, the RTC supervisor will instruct ATCO2 to maintain ATS provision for Aerodrome C on RTM2 since (in this example) ATCO1 cannot provide ATS to more than 2 aerodromes with movements in parallel. Meanwhile the RTC supervisor will bring in ATCO3 to provide ATS for Aerodrome D on RTM3 (SDM-0201).

When the RTC supervisor and/or ATCO3 are made aware of an upcoming aircraft movement at Aerodrome D, ATCO3 will continue to provide ATS to Aerodrome D (SDM-0201).

3.4.4.3.3 Example 3.3 - Flexible role application

The final example describes the flexible application of roles. Thus additional roles may be introduced during overload situations in order to distribute workload and to assure reasonable load share.

An exemplary position could be the Ground ATCO which is deployed in situations where the primary ATCO needs load reduction. In such case the primary ATCO/AFISO may just concentrate on airborne traffic (incl. traffic on the RWY) while all remaining traffic and duties are outsourced to the discrete Ground ATCO.

For this purpose an RTM is provided from which the Ground ATCO/AFISO will be provided with all relevant information. He may not need a panorama view, he might just need a surface radar and all relevant flight plan data.

Such a Ground ATCO may particularly be introduced at aerodromes with high traffic load where the ATCO/AFISO is responsible for a lot of movements. As the case may be the Ground ATCO is capable of providing his duties to several aerodromes wherefore he might relieve ATCOs / AFISOs responsible for other aerodromes as well. Consequently this procedure does not contradict to the idea of ATCOs / AFISOs still providing ATS to multiple aerodromes. Accordingly, looking at the exemplary table below a Ground ATCO will take over responsibility for certain tasks at all four aerodromes. For the core ATC services at aerodrome A and B one ATCO each will be in charge (SDM-0201) and as aerodrome C and D might consist of fewer movement numbers ATCO 3 will take care of the ATC service provision at these two aerodromes together (SDM-0205).

Aerodromes	CWP required	ATCO/AFISO required	ATS provided to aerodromes in parallel	RTC supervisor	Traffic Coordination
4	4	4	Yes	No	No

# Aerodromes with aircraft movements	ATS for Aerodrome			
	A	B	C	D
4	GND ATCO			
4	ATCO1	ATCO2	ATCO3	

# Aerodromes with aircraft movements	Resource Pool			
	GND ATCO	ATCO1	ATCO2	ATCO3
4	Airport A, B, C, D	Airport A	Airport B	Airport C, D

# Aerodromes with aircraft movements	RTM			
	CWP/RTM1	RTM2	RTM3	RTM4
4	Airport A, B, C, D	Airport A	Airport B	Airport C, D

Table 24 – Example 3.3 – Flexible role application

3.5 Remote Provision of Air Traffic Services for Contingency Situations at Aerodromes

3.5.1 Scope and Objective

The objective of remotely provided ATS for contingency situations at aerodromes is to provide the ATS defined in ICAO Documents 4444 [10] and 9426 [13] from a remote location i.e. not from the local control tower, to the aerodrome. ATS would be provided using a camera based visual presentation of the aerodrome and its vicinity. In that sense it is similar to Single Remote Tower modes of operations.

ATS contingency plans fall under the jurisdiction of the aerodrome emergency plan, which in turn is a standards and recommended practice (SARP) for aerodromes under ICAO Annex 11, Chapter 9. Contingency plans are "*developed and implemented in the event of a disruption or potential disruption, of air traffic services and relating supporting services in the airspace for which they are responsible for the provision of such services…an aerodrome emergency plan shall be established at an aerodrome, commensurate with the aircraft operations and other activities conducted at the aerodrome".[9]*

ATS contingency is intended to provide alternate facilities and services to "local procedures" when those facilities/services are not available (for planned reasons such as maintenance or unplanned reasons such as emergency outages). Therefore they are temporary in nature.

The driving factors behind contingency planning are safety, security, continuity, resilience and adaptability. The benefits including minimising the losses and costs that would be occurred by airport operators and ANSPs in the event of a major outage if no mitigating measures are adopted. Loss would include economic losses (airport revenues) and capacity losses. Providing contingency ATS would minimise these losses following an ATS outage, aiming to maintain as close to normal operational capacity as feasible and minimise disruption to airspace and airport users. However importantly the ATS being provided must be acceptable and safe. As such for the majority of aerodromes around the world the contingency plan is to cease the provision of ATS and hence close the aerodrome.

The exact type of contingency solution that an aerodrome can implement based on Remote Provision of ATS will depend on a number of factors and is subject to constraints such as safety levels and capacity targets. The effectiveness of the solution as proposed by this project will be highly dependent on external factors. These factors include the type and speed of ATS outage, technical setup of the solution, ATCO proficiency and other mandatory safety or procedural constraints.

SDM-0204 focuses on Remotely Provided Air Traffic Service (TWR) for Contingency Situations at Small to Medium Aerodromes (with a Single Main Runway). This section will address all elements of the primary operational mode Contingency Remote Tower but will specifically focus on SDM-0204, which is currently the sole OI currently covering the mode of operations.

3.5.1.1 Required Performance

3.5.1.1.1 Safety

When describing the use of Remote Tower for Contingency Situations, safety of ATS provision is of primary importance. It is recognised that during contingency situations safety levels could fluctuate according to the circumstances or events. However, it is vital that safety levels during contingency situations are always acceptable and that operations personnel are able to identify any points where the level of safety becomes unacceptable. During a contingency event which impacts the traditional tower it may be necessary for short term "closures" of airspace or aerodrome to take effect, in order to ensure safety and cope with the immediate effects of a developing situation.

3.5.1.1.2 Cost Effectiveness

Important considerations for the contingency solution as described in this document are desired capacity during contingency situations and the cost of the required solution. Smaller aerodromes are unlikely to make a large investment in a contingency facility if it is more cost effective to close the airport and divert the traffic involved to a neighbouring aerodrome.

The hypothesis in this document is that the greater the investment into the contingency plan and contingency facility (equipment, staffing etc.) the higher the contingency capacity of the airport as illustrated in Figure 9 (overleaf). This is due to the increased technical capability that may be added to the contingency facility with additional funding. Added expenditure would importantly allow for additional ATCO training, which ultimately would increase ATCO familiarity with the contingency facility and improve the level of service that could be provided from a contingency facility. It is expected that the cost per % of capacity will increase as the target tends towards 100% of local service capacity. The cost of enabling the ability to provide the final few percentages of capacity may be high and the return on investment in terms of cost versus capacity will tail off.

There is likely to be an optimum contingency level of service which balances the capacity at the aerodrome against the cost outlay required for the contingency facility. This will be the most cost effective point and would vary from airport to airport depending on a range of factors such as size and facilities available.

Each implementation would require a cost benefit analysis in order to derive the cost benefit of providing a remote contingency tower solution. This would take into consideration the financial implications of the airport operator losing an airline partner due to a long term airport closer (airlines may be forced to change their long term plans for scheduled and charter flights). It would also have to considered the required expenditure (technical investment, ATCO training, recurrent training etc.) required to meet varying levels of capacity.

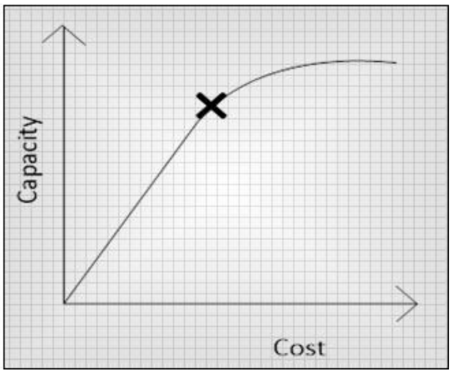


Figure 9 – Cost Effectiveness of Contingency Operations

Once an aerodrome is able to maintain 100% (or close to 100%) operations from a contingency facility it will be, a logical business case to use the contingency facility full time, or at least operate under the Single Remote Tower concept (SDM-0201) in parallel with traditional tower operations. In this way the airport/ANSP is able to benefit to the full extent from remote tower technologies.

3.5.2 Current Operating Method

3.5.2.1 Principles

Contingency solutions, although not very widespread, are available at some airports. Often solutions will either have a limited view of the aerodrome and its vicinity or completely lack an out-the window view. Commonly existing solutions are non-standardised and have a variety of limitations.

The main contingency plans applied at aerodromes globally are presented below:

1. The aerodrome control tower is closed and the ATS ceased:

For this contingency plan the solution is to close the control tower and cease providing an ATS to the aerodrome. The arriving traffic is initially instructed by approach control to hold at nearby waypoints and then transferred to the neighbouring aerodrome approach control and diverted to other aerodromes and all departures will be held on the ground. This is the most common contingency plan applied in current operations when all airports (of all sizes) are considered.

2. **A surface movement radar coverage and/or multi-lateration technology based solution, provided from a location other than the local ATS tower:**

   The one standardised solution includes the use of ground surveillance radar, which provides situational awareness of ground movements. Currently only one[1] such solution is used in live operations within Europe, which uses advanced surface movement guidance and control systems (A-SMGCS), providing a contingency solution for London Heathrow Airport (EGLL) in the United Kingdom. The Remote Tower solution and A-SMGCS solution target the same operational environments.

3. **Basic level of ATS from a location other than the local ATS tower:**

   Globally some aerodromes do facilitate a basic ATS contingency plan. This contingency solution is unstandarised and hence can vary from airport to airport considerably. Where these solutions do exist they offer a very basic level of service to be provided. In this basic solution facilities may or may not provide controllers with a limited view of the aerodrome and its vicinity. One such example of a basic solution is found at Malmo-Sturup Airport (ESMS) in Sweden. This example consists of a windowed container centrally placed alongside one RWY. It is equipped with the most basic ATS systems. An example of one of the simplest versions of this solution may be an office room equipped with only an emergency radio to enable the decommissioning of traffic. The common feature with these types of basic solutions is that limitations are imposed on the ATS provision, enabling only a limited aerodrome capacity with restrictions. However due to the lack of standardisation in this solution it is not possible to fully define it.

Many aerodromes (mainly smaller aerodromes) find contingency facilities or secondary Tower facilities not cost effective. Yet at larger aerodromes a contingency facility can have a large cost benefit. These aerodromes are often economically and socially important on a national or international level. This would most likely include international hub aerodromes with the capability (to cover capital costs) and need to facilitate running a contingency solution for the benefit of cost and airport stakeholders (Airport operator, ANSPs, airlines, passengers, the wider regional, national and international economies).

3.5.2.2 Issues under Current Operating Methods

There are many limitations of the current contingency plans.

If an aerodrome ceases ATS and closes the aerodrome, aircraft are forced to divert to nearby aerodromes. This presents a situations where the risk of safety degradation increases due to the increased number of aircraft (many low on fuel) having to divert to secondary aerodromes or other large primary airports that are usually experiencing their own capacity problems. As such the chance of an aircraft on divert experiencing an emergency situation are increased.

When an aerodrome closes and issues diverts this results in aircraft being displaced from their intended destination. This may cause problems for passengers and also airlines (who will have an aircraft out of place, which has a knock-on effect for the airlines route network). Crew shifts and location can also be affected due to the extra time taken to locate from one aerodrome to the next. It can take several hours or even days to re-align the aircraft locations with the schedule. As a result delays during that period can be high with more cancellations than usual. In extreme circumstances the aerodrome may decide to close completely leading to lost revenue and further inconvenience for passengers.

When using a secondary visual control facility, there is often little or no view of the runway. Secondary visual control facilities also may not have the full equipment package which is found in the Tower.

[1] To the knowledge of the projects at the time of writing

Capacity may therefore be reduced leading to increases in delay. Further to this these solutions are unstandarised, which can lead to varying levels of safety and a reduced ability to operate long term.

When using a surface movement radar coverage and/or multi-lateration technology based solution, provided from a location other than the local ATS tower, there is no OTW view of the aerodrome and its vicinity. The SMR only solution provides a lower operational flexibility and sometimes also lower capacity than local tower operations. Without an OTW view the aerodrome may need to use procedures similar to those used in low visibility operations, meaning that restrictions have to be put in place, spacing has to be increased, capacity may decreases and delays may increase. The impact on capacity and delay will vary depending on if the airport is already capacity constrained, if so then increased aircraft spacing due to procedural control is likely to have a large impact on capacity.

If an airport is forced to close due to a lack of ATS provision or if capacity is reduced compared to normal operations this will have cost implications.

3.5.3 New SESAR Operating Method

3.5.3.1 Principles

The new solution proposes that the Remote Tower concept be applied as a contingency solution at aerodromes, in a facility known as a Remote Contingency Tower (RCT). These RCT solutions would utilise a camera based visual presentation of the aerodrome and its vicinity with the aim is of achieving increased flexibility and maintaining a capacity which is as close as possible to 100%. The solution would include technical enablers as required, this could include SMR technologies such as A-SMGCS. However the provision of ground surveillance radar is not a prerequisite for the concept.

The Contingency Remote Tower solution differs from the existing contingency solutions in that it would provide a camera based visual presentation of the aerodrome and its vicinity which acts as a substitute for the local tower OTW view. The visual presentation in the RCT can provide the primary means of visual surveillance, where no other systems are available. Further to this technical enablers used within the Remote Tower concept could be used to support an existing contingency solution, adding valuable benefits.

The presence of an aerodrome OTW view aims at increasing the resilience of the aerodrome by improving the ATCOs ability to retain traffic in line with normal operating procedure but during contingency. The concept proposes that flexibility would be improved during contingency operations due to the presence of an OTW view, this having particular benefits in airports with more complexities in terms of surface layout or operational methods. Further to this if it is possible to visually observe the manoeuvring area and the vicinity of the aerodrome, safety may increase since phenomena can be seen that would not otherwise be seen, e.g. engine fire and obstructions / foreign objects on the runway. A visual presentation would allow for quicker ATCO feedback in case of go-arounds etc. However it is acknowledged that these benefits (higher flexibility and increased safety) are hard to quantify. Safety and Human performance should at all times be acceptable for the level of ATS being provided, this should align with the standards achieved in normal operations from a local tower.

The improved resilience above would provide cost benefits in the event of a major outage compared to if no mitigating measures would have been adopted (e.g. the contingency solution is closing the aerodrome), due to customer retention and reduced economic loss during contingency events.

The concept of “Remote Provision of ATS to Aerodromes in Contingency Situations” can be divided into the two following target environments (however the concept is not limited to a specific target environment):

- <u>Primary target airports:</u>
  Medium sized airports without ground surveillance radar. Airports that are generally considered as being too small to bear the investment of ground surveillance radar technologies such as an A-SMGCS system. (European example airports are: Stockholm/Nyköping Skavsta, Stockholm Bromma, Bergen, Tampere, Oulu, Bilbao and Valencia.);

- Secondary target airports:
  Medium to large airports equipped with a ground surveillance system. Airports that could either implement:
  - A solution without a visual presentation, but which use components from the Remote Tower Concept & technology;
  - A solution which would couple a visual presentation with the ground surveillance system.

Overall it is envisaged that the target environment for the majority of RCTs will be medium to large density aerodromes that are economically and socially important on a national or international level. This would most likely include international hub aerodromes with the capability (to cover capital costs) and need to facilitate running a contingency solution. It may also be applied at aerodromes from nations wishing to provide widespread aerodrome contingency plans, regardless of aerodrome status or size or for application to aerodromes vital for public service routes.

3.5.3.2 Remote Contingency Tower (RCT)

The contingency facility is referred to as a Remote Contingency Tower (RCT). This would be similar to a standard Remote Tower Module (RTM) (see section 3.2.2 above) and provide all the controls and support tools required to provide ATS.

3.5.3.3 Contingency Lifecycle

The Contingency *Lifecycle* as defined within “EUROCONTROL Guidelines for Contingency Services” will be referred to. Actions and procedures will be described from the outage until recovery to normal local operations. The Contingency lifecycle below is adapted from the guidelines [15] and shows the phase “service continuity”. This is referred to herein as “transition into contingency” and “transition out of contingency”.

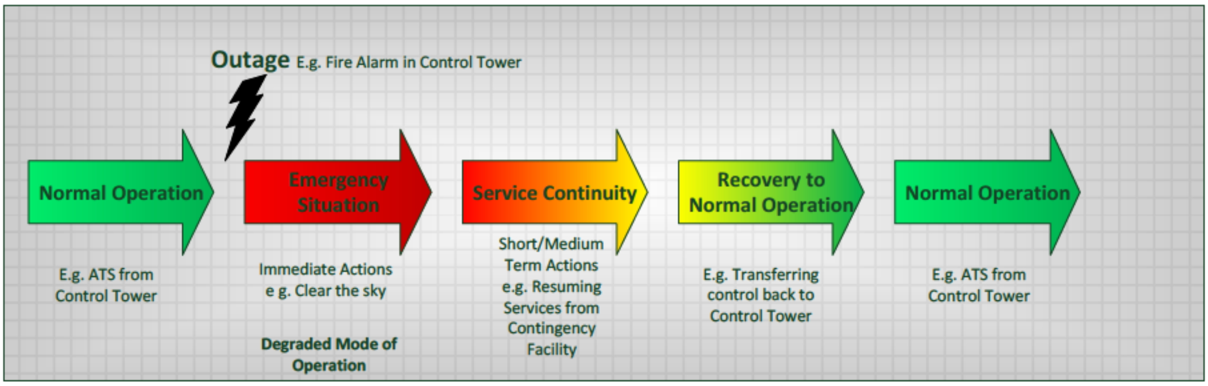


Figure 10 – Contingency Lifecycle

The progression of the various stages of the contingency lifecycle will be impacted by a variety of factors, to be discussed herein. These factors all impact ability to maintain operational performance during contingency situations. The operational and technical considerations that impact the ability to maintain operations from an RTC are summarised below.

- The Operational Feasibility to regain operations, influenced by:
  - Nature of outage;
  - Airport characteristics;
  - Time of outage;
  - Visibility and weather conditions.
- The Technical Capability to regain operations, influenced by:
  - Technical configuration;
  - CWP configuration;

- ATCO technical ability;
- Provision of technical enablers.

These points are expanded upon in the following sections.

3.5.3.3.1 Location of RCT

An RCT may be located on or off of the aerodrome site. For larger aerodromes (who are able to financially support their own RCT implementation) a dedicated RCT facility may be provided on aerodrome site. When located at the aerodrome the RCT will be required to be placed away from the local tower, to prevent the contingency event affecting the local tower also impacting the RCT facility. One possible location to base the RCT may be in co-location with the RFFS site or the terminal building.

An RCT may also be located as part of a larger remote tower centre (also serving RTMs operating under the Single and Multiple Remote Tower modes) or be a single RCT facility. In these cases the location of the facility and the layout, technical equipage and HMI of the CWP will need to be considered.

In the case of an RCT being located as part of a larger remote tower centre a likely operating method would be that a spare RTM would be maintained for use during contingency events. The RTMs are likely to be generic and unified enabling them to be applied to many aerodromes. In this case the remote tower centre would need to provide licensed ATCOs that could take over control (if local tower ATCOs were not transferred to the facility). In addition, it may be that the existing RTC facilities would not be suitable for the larger aerodromes being targeted under this concept. The primary benefit of operating from a shared RCT would be the facilitation of shared operating and capital costs.

Many airports may share a contingency facility, this may include those located a considerable distance away, as shown in Figure 11. It is likely that an RCT would be located closer to the largest aerodrome, as this would enable that aerodrome to establish ATS more quickly following an outage and conduct recurrent training in a more efficient and robust manner.

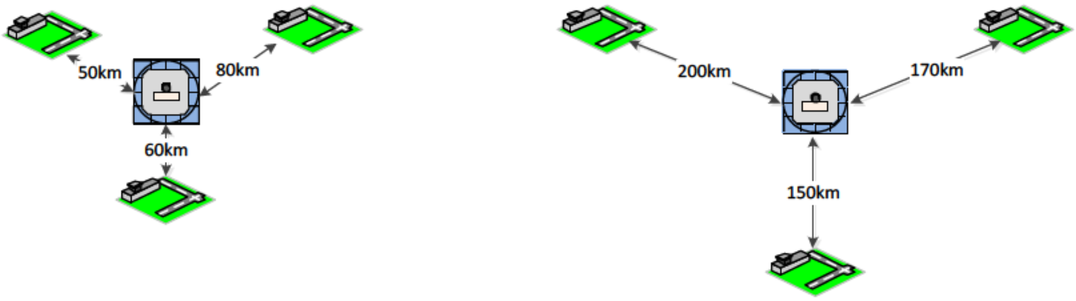


Figure 11 – Location of RCT facility for Multiple Aerodromes

If locating the RCT off aerodrome site it should be considered that staff in the local Tower would have to be transferred to the remote site and this turnaround time could cause operations to temporarily stop. The further away the remote site is away from the local Tower, the longer it would take to transfer the controllers and the more the level of service would be affected. Yet it is considered that for unplanned contingency events some degree of airspace closure is likely and the aim of an RCT is not to enable ATS to be re-established as quickly as possible, but to enable operations to be re-established (eventually) at full operationally capacity.

3.5.3.3.2 Nature and Speed of Outage

If the contingency event is *planned*, such as building or maintenance work which leads to closure of the Tower, then the RCT facility can be set up prior to the event starting. ATS are simply transferred from the local to RCT. Staffing and flight schedules can be optimised as to minimise the disruption to the service.

If the contingency event is *unplanned* and *sudden*, staff will have had no time to transfer to the RCT facility (if there are not permanent staff on site) or set up/turn on the equipment and be given a brief on the current situation. Therefore, after the outage, the level of operations will be very low or even non-existent until the RCT facility is operationally ready. In the meantime, traffic will be transferred to neighbouring ATSU and NMOC (network manager operations centre) will be informed.

During the reinstatement of services back to the local Tower after the contingency event, the level of operations will not be affected as much since the transition can be planned and the transfer of services will not be fully implemented until the local Tower is completely ready. Again, there could be a need for double manning while the transfer takes place.

If the contingency event is *unplanned* but *gradual*, the staff may be given some prior warning that the control room will have to be evacuated (such as forecast excessively strong winds). In these cases then the level of service may be affected, but not as much as during a sudden outage. This principle is illustrated in Figure 12 below.

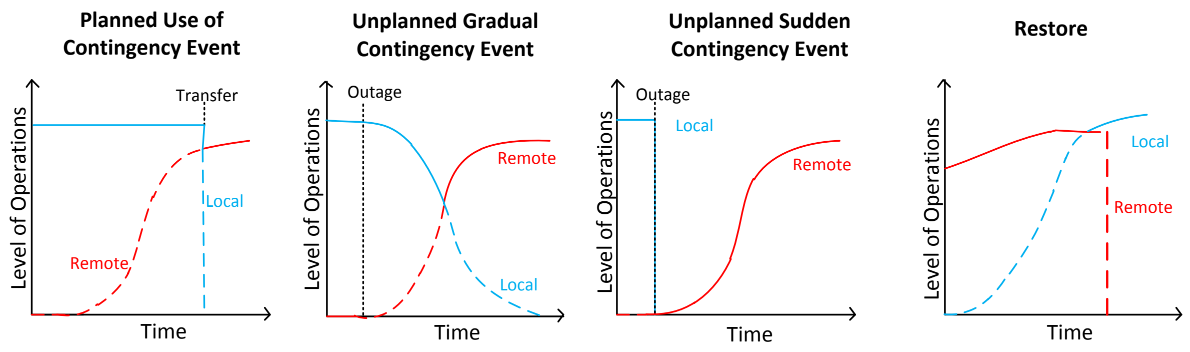


Figure 12 – Level of Operations for Different Types of Contingency Event

The capacity capability in the RCT is seen to develop in steps, for both planned and unplanned events. These steps in capacity would likely be linked to external factors such as the human performance of ATCOs. The steps represent a manipulated progression in capacity.

In order to aid in re-establishing operations in an RCT, to full capacity or other pre-set level, following a contingency event proficiency checklists will be required. These checklists are likely to require development at a local ANSP level and would require integration into and alignment with ANSP contingency plans and local operating procedures. The role of an RCT supervisor is also a requirement, to oversee the return to normal operations and the transition into contingency. Note the role may not be discrete from the role of ATCO (where only one ATCO is providing ATS at the time of the outage).

The nature of the checklists, including the time to re-establish the require capacity level would be a factor of ATCO performance and the nature of the outage.

3.5.3.3.3 Transition Times

The transition time is the time between outage and the re-establishment of full operations (to 100% capacity or another pre-set level). The transition period reflects the fact that when switching from providing ATS from a local tower to using an RCT the ATCOs will require a period of adjustment. Operations will likely need to be reduced to some extent and a period of familiarisation taken. This will also apply to when transitioning from the RCT back to the local tower. Although it is foreseen that the transition out of contingency operations will be much smoother or a lesser impact on operations.

The transition time into contingency and out of contingency will be a factor of the nature of the contingency event, the reason for the contingency and the time of the event. Dependant on the nature of the outage this phase may require the aerodrome to close for long periods. For all unplanned emergencies the transitions phase is likely to result in zero capacity for some period of time. During planned events capacity may not reduce to zero, however staged capacity increases (in line with proficiency checklists) will still be required to manage the re-establishment of operations.

The “transition out of contingency” phase will always be planned and hence the return to normal operations should not result in much service disruption/reduction in capacity if there are no restrictions put on staffing levels etc.

3.5.3.3.4 Length of Outage use case

The length of outage is the period that service continuity is required from the RCT and is a factor of the nature of the contingency event. The RCT is considered as a short to long term solution, allowing fully flexible ATS provision over varying lengths of time.

RCT equipage and length of outage are linked, with the RCT equipage often playing a role in determining the various length of outage use cases that can be applied.

In cases where fully operational capacity can be retained from an RCT it is not unfeasible than permanent operations could be maintained from a facility originally designed for contingency service (i.e. transitioning operating modes from Contingency Remote Tower to Single Remote Tower).

The equipage of the RCT will likely determine how long it can acceptably be used to provide ATS. The definition of acceptable will be based on many stakeholders. If the airport owner and ANSP equip the RCT with a lower functionality than the local tower it is unlikely that full operational capacity will be maintained from the RCT. Using such an RCT configuration for long term outage will be unacceptable to the airport operator as they will face a longer term reduction in operational capacity.

A further example is that ATCOs may prefer to use an RCT which is a replica of the local tower for short term closures, as it takes a period of time to adjust to a new CWP. Steps can be taken to minimise this (i.e. recurrent training or frequent use during off peak periods such as night time operations). However if the RCT includes new technical enablers which are unfamiliar to the ATCO it is likely that a period of familiarisation training will be required. It may not be worth providing this training if the RCT is to be used for very short periods of time and as such the ANSP may prefer to exclude such technical enablers when the RCT is to be used during short term outages.

The various use cases for the RCT should be considered for each implementation, where it should be considered what equipage is provided, if a flexible equipage is provided and how this would impact on the use case to which the RCT can be applied.

3.5.3.3.5 Time of Outage

The time when the outage occurs can greatly affect the level of operations. For example, if the contingency event happens during peak hours then the traffic volume will be high so a greater number of aircraft could potentially be affected. However, there may be more personnel available in order to deal with the problem and/or move to the remote facility.

Conversely, if the incident takes place during off peak hours, for example in the middle of the night, there could be no/very low traffic so less aircraft would theoretically be affected but there would also be fewer staff to handle the situation and to manage the re-establishment of operations from the RCT.

Procedures which take into consideration the various staffing schedules should be included ANSP contingency plans and local operating procedures.

3.5.3.3.6 CWP configuration

The CWP can be generic or tailored to specific airports. Yet overall it should be equipped to the same standard and with the same support tools as supplied in the local aerodrome control tower, if operations are to be maintained to the same level as local operations.

It is advisable for individual RCT implementations (to be used by only one airport) that the RCT CWP be made to be as similar to the local tower CWP as possible. A replication of the layout and features as found in the tower would provide ATCOs with a reduced familiarisation time. This in turn should result in a reduced time in the transition phase and a quicker return to full operations (depending on the influence of outside factors such as the type of outage). CWP replication would also ease the potential stress induced by a contingency event (and may hence reduce the potential for error) as well as reducing the requirement for frequent RCT training sessions.

If CWP replication is provided then ANSPs must consider their use of remote tower technical enablers in the RCT which may not be possible to replicate in the local tower. For further information regarding this see section 3.5.3.3.9 below.

If the contingency facility is to be shared then the implications of CWP replication will need to be considered as it is not possible to provide a replica of the CWP at all aerodromes, unless each of the local towers also has a common CWP layout, equipage and HMI. Standardisation of the RCT CWP would reduce the overall cost of producing and operating the facility as costs could be shared between many airports.

By introducing increased training schedules it may be possible to use a standardised CWP and also reduce ATCO familiarisation times. This would be best suited when the RCT is located at part of a wider facility used for “full time” remote tower operations under the Single and Multiple Remote Tower concept applications. The contingency aerodrome could use Remote Tower Centre ATCOs to provide the contingency service. These ATCOs would be required to hold a valid license for the contingency aerodrome, however they would be fully familiar with the CWP.

In summation:

- Replica CWP between RCT and Local Tower = large cost for the CWP which could not be shared with other airports, less cost for training.
- Standardised CWP in the RCT = less cost for the CWP which could be shared with other airports, more cost for training.

Split of infrastructure also needs to be considered. Depending of the desired robustness of the contingency system, considerations regarding reduction of the number of common cause failures needs to be taken. An appropriate level, depending on a local assessment, needs to be found.

3.5.3.3.7 Camera Tower Placement

Placement of the camera towers feeding the RCT facility will also need careful consideration as it will not be advisable to place these on the existing local tower as there purpose is to be used during an event which may have impacted the structure of the local aerodrome tower building.

If adequate recurrent training is provided in the contingency facility and ATCOs are given adequate time to adjust to the new viewpoint when transitioning into contingency operations, it is feasible that the RCT aerodrome view does not mirror the local tower aerodrome view. One suggestion is for the camera housing to be placed on the opposite side of the runway to the local tower, despite this providing a view which has been switched 180° compared to the local aerodrome tower view.

If possible it is beneficial to maximise the similarities in view to the local tower in order to minimise the need for recurrent training and reduce the time it takes to transition into contingency operations after an outage occurs. These aspects should be considered for each implementation.

3.5.3.3.8 Airport Characteristics

The airport characteristics themselves will influence the capacity of operations during contingency. Very large density aerodromes will have a high movement rate and therefore may find it harder to achieve, in percentage terms, near normal service levels in contingency situations. Medium to large aerodromes with fewer movements and natural gaps in traffic may be able to maintain service levels closer to normal capacity.

Traffic type and traffic mix will ultimately have an influence on the ability to maintain full operations from the RCT. If an airport has mostly homogenous traffic, as is the case in most large international aerodromes in “class A” airspace, traffic will consist of purely IFR arrivals and departures. This operational setting could be easier to deal with in contingency situations than airports with heterogeneous traffic including helicopters and helipads, general aviation traffic, ambulance and military traffic. The use of multiple runways and different arrival and departure procedures would likely reduce the operational feasibility of the RCT to maintain service, compared to a single runway operation with uniform procedures.

In contrast to the above, heterogeneous traffic mixes including VFR traffic do benefit from having a visual presentation which offers a more dynamic way to monitor aircraft, potentially enhancing safety.

3.5.3.3.9 Controller Support Tools

The controller support tools provided during contingency will depend on two primary factors:

1) The equipage of the local aerodrome control tower;
2) The required level of ATS to be provided during contingency (and hence level of operations/maintained capacity).

In relation to point 1) above it is recommended that the controller support tools provided in the local aerodrome control tower be reflected in the RCT. CWP replication can provide benefits especially during the transition into contingency phase, although standardising the RCT CWP also has benefits. Regardless of the replication or standardisation of the RCT CWP if full capacity is to be achieved then the RCT should be equipped with the same support tools as provided to controllers in the local tower. This would include any surveillance systems such as A-SMGCS.

If a full equipage is not provided then operations may be negatively impacted. It may be that the ANSP and airport operators agree in their business case to provide a reduced capacity/level of operations during contingency in order to have a more cost efficient RCT implementation. In these cases the RCT may not include some of the more sophisticated surveillance systems (such as A-SMGCS and M-LAT) for example.

The visual presentation should cover the aerodrome traffic pattern in order to maintain a high capacity compared to normal local tower operations. VFR traffic and irregular traffic may have to be restricted in some implementations depending on the extent of the visual presentation coverage.

If CWP replication is provided then ANSPs must consider their use of remote tower technical enablers in the RCT. If technology such as visual presentation overlays and tracking solutions are provided in the RCT it may not be possible to replicate these in the local tower. In which case the RCT CWP and local tower CWP will not be a true replica of one another. In cases like this it may be favourable to start operations with an exact replica, introducing remote tower technical enablers (which do not feature in the local tower) at a suitable point as determined by conducting proficiency checklists.

3.5.3.4 Operating Methods during Contingency Operations

During the contingency situation, the operating methods will be based upon the operating methods for Remote provision of ATS to a Single Aerodrome as described in Section 3.1.3 and summarised below.

The full range of ATS defined in ICAO Documents 4444 and 9426 will still be provided remotely by an ATCO. The airspace users should be provided with the same level of services as if the ATS were provided locally. The main change is that the ATCO will no longer be located at the local Tower; they will be re-located to the RCT facility.

The RCT facility will consist of one or more RTMs and the ATCO will be able to perform all ATS tasks from this RTM. The RTM can be generic or tailored to the individual aerodrome.

The visual observation will be provided by a visual presentation of the aerodrome and its vicinity, provided via camera based visual information and/or other sensors. The visual presentation can be overlaid with information from additional sources if available, for example, surface movement radar, surveillance radar, multilateration or other positioning and surveillance implementations providing the positions of moving object within the airport movement area and vicinity. The collected data, either from a single source or combined, is reproduced for the ATCO on data/monitor screens, projectors or similar technical solutions.

The visual presentation may replicate the operational viewpoint obtained from the local tower OTW view as this may allow for more familiar view during contingency. Additional operational viewpoints may be provided based on information captured from a range of different positions, not necessarily limited to the original Tower position. This may provide an enhanced situational awareness and/or a progressive operational viewpoint..

To further improve the situational awareness, the airport audible background sounds can be captured and relayed in the RCT facility. Although it is noted that many large aerodromes have sound insulted local aerodrome towers and as such it may be advisable to maintain the same conditions in the RCT.

In order to aid in re-establishing operations in an RCT, to full capacity or other pre-set level, following a contingency event checklists will be required. These checklists are likely to require development at a local ANSP level and would require integration into and alignment with ANSP contingency plans and local operating procedures.

The role of an RCT supervisor may be applied to oversee the return to normal operations and the transition into contingency. Note the role may not be discrete from the role of ATCO (where only one ATCO is providing ATS at the time of the outage).

3.5.3.5 Differences between operating methods for Provision of ATS to Single Aerodrome and Provision of ATS for Contingency Situations at Aerodromes

The primary difference between the operating modes Single Remote Tower and Contingency Remote Tower is that in the latter the local aerodrome control tower is still the primary means of ATS provision during normal operations. In essence the key considerations for a remote contingency tower solution all relate to the fact a remote tower solution will exists in parallel with a local tower and be used only on a temporary basis This is not the main use case for Single Remote Tower operations, where the local aerodrome control tower would not be used, or may be non-existent.

As such the remote provision of ATS during contingency situations has to consider the local aerodrome control tower. This would include factors such as:

- Continuity of working methods between the remote and local towers;
- Transition from the local tower to the remote tower;
- Placement of the remote tower camera housing in relation to the local tower:
    - Continuity of aerodrome view;
    - Continuity of reference points;
    - Differences in blind spots;
- The use of technical enablers not present in the local tower:
    - Changes in working methods;
    - Changes in view and the operators ability to see;
    - Changes in the operators ability to provide a service/view the aerodrome and its vicinity in LVP or darkness;
- Recurrent training needs.

Additionally this concept application must consider that an outage has occurred which has caused the local aerodrome tower to become non-usable. This could be due to a major event and as such the placement of the camera tower is unlikely to be able to exactly mirror the viewing angles and position of the local aerodrome control tower. In Single Remote Tower applications, the camera house can be placed on top of the disused local tower or in its place.

Once established in the RCT the operating methods between “Single Remote Tower” and “Remote Contingency Tower” are the same. Any differences will be due to differences in the implementation environment.

3.5.4 Differences between new and previous operating methods

The main difference between current operating methods and the proposed new operating methods are highlighted in Table 25 below. This primarily includes the introduction of a contingency service that will facilitate near full or full service continuity following an aerodrome control tower contingency outage. The operating methods during contingency can hence continue in a manner similar to normal operations from the local tower. The RCT solution also provides a standardised manner in which these services can be provided, which should benefit the quality and safety of operations during contingency.

Previous Operating Method	New Operating Method
Close/divert	• Not all traffic may have to be diverted; • The aerodrome will provide some level of service continuity.
Basic level of ATS from a location other than the local ATS tower	• Remote provision of ATS; • The OTW view is replaced with relayed visual presentations. • Possibility to relay/replay camera images onto other stakeholders (rescue, safety, air crew); • At least maintain safety and human performance in line with current operations; • Increased resilience and capacity retention.
A surface movement radar coverage and/or multi-lateration technology based solution, provided from a location other than the local ATS tower	• Visual presentation; • The OTW view is replaced with relayed visual presentation, that should give a more complete awareness of vehicle and aircraft movements; • Increased resilience and capacity retention; • Possibility to relay/replay camera images onto other stakeholders (rescue, safety, air crew; • Continuity of working methods.

Table 25 – Differences between new and previous operating methods

4 Detailed Operational Environment

4.1 Remote Provision of ATS to Single and Multiple Aerodromes

The environment for the remote provision of ATS can be viewed from two aspects, the actual aerodrome operating environment and the remote facility operating environment.

The services are envisaged in two different aerodrome operational environments, depending on whether the aerodrome is a controlled aerodrome or an AFIS aerodrome. The operational characteristics, roles and responsibilities and aerodrome (infrastructure) technical characteristics are different for each environment. The remote facility technical and performance characteristics will be common to both types of aerodrome operational environment.

The environments covered relate only to SDM-0201 and SDM-0205 as these are the applications where detailed operating environments can be stated at present. In the future the operational environments will be expanded, it is forecast that these will include more complex and larger operating environments in which the concept can be applied.

4.1.1 Aerodrome Operational Characteristics – SDM-0201

Guideline operational characteristics of the two candidate environments when applying the concept as detailed in SDM-0201 are outlined in Table 26 below. They should be interpreted as common characteristics across all candidate countries and ANSP and are not restrictive i.e. they represent a baseline operating environment that may be slightly different in each individual country or ANSP. They should however not be interpreted as universal operational characteristics for future OI steps covering the remote provision of ATS to a single aerodrome, as the aerodrome characteristics for wider concept applications may differ.

		Environment 1 - AFIS	Environment 2 - ATC
Services	AFIS	Yes	-
	TWR	No	Yes (Including Clearance delivery / Ground Control / Tower Control / TWR Apron Control)
	APP	-	Optional
	Opening Hours	Up to 24H (including night)	Up to 24H (including night)
Staffing	Number of ATS staff	At most 1, rarely 2.	1 ATCO but sometimes up to 3.
	Ratings	AFIS	ADI, APP, possibly APS/RAD
Airspace	Airspace Classification	Class F, G (G+)	Class C and/or D
	CTR	-	10- 15 NM radius/rectangular, Vertical extension up to 3000 ft MSL
	TMA	-	Optional (dependant on regional regulations/procedures)
	TIA/TIZ	Typically around 15 NM radius, from surface to 5,000ft or FL095.	-
	Procedures	Specific IFR routes & approach procedures	Specific IFR routes & approach procedures

		Established VFR routes	Established VFR routes
Aerodrome	Number of RWY	Typically 1	One or more runways
	Taxiway and runway entries	Typically 1	Typically one major taxiway parallel with the RWY, number of RWY intersections/entries varying typically between 1 and 3
	Aprons	Typically 1	1 to 4
Traffic	Number of movements	The typical operating environments for remote tower services are airports below third level node, with a single runway, non-complex runway layout and low capacity utilization. But remote tower services are not limited to those environments.	
	Number of simultaneous movements		
	Traffic Type	Mainly Scheduled and School flights. Also charter, taxi, ambulance, offshore helicopter and General Aviation (GA) and Business Aviation (BA).	VFR and IFR Mainly scheduled, charter and GA (School) flights and Business Aviation (BA).
	Aircraft Fleet mix	Some medium jets (B737, A320, MD80), Mainly medium Turbo Props (SB20, FK50, AT72) GA light aircraft (C172, P28A, PA31) BA and HOSP. medium/light jets and turboprops (Dassualt Falcons, Cessna Citations, BE20) Helicopters	All types of aircraft.

Table 26 – Environment Operational Characteristics for Single Remote Tower SDM-0201

4.1.2 Aerodrome Operational Characteristics – SDM-0205

Guideline operational characteristics of the two candidate environments when applying the concept as detailed in SDM-0201 are outlined in Table 27 below. They should be interpreted as common characteristics across all candidate countries and ANSP and are not restrictive i.e. they represent a baseline operating environment that may be slightly different in each individual country or ANSP. They should however not be interpreted as universal operational characteristics for future OI steps covering the remote provision of ATS to a single aerodrome, as the aerodrome characteristics for wider concept applications may differ.

		Environment 1 - AFIS	**Environment 2 - ATC**
Services	AFIS	Yes	-
	TWR	-	Yes (Including Clearance delivery / Ground Control / Tower Control / TWR Apron Control)
	APP	-	Optional
	Opening Hours	Up to 24H (including night)	

Staffing	Number of ATS staff	Single AFISO (expansions of the concept could include more than one AFISO providing AFIS to multiple aerodromes)	Single ATCO (expansions of the concept could include more than one ATCO providing ATC to multiple aerodromes)
	Ratings	AFIS	ADI, APP, possibly APS/RAD
Airspace	Airspace Classification	Class F, G (G+)	Class C and/or D
	CTR	-	10- 15 NM radius/rectangular, Vertical extension up to 3000 ft MSL
	TMA	-	Optional (dependant on regional regulations/procedures)
	TIA/TIZ	Typically around 15 NM radius, from surface to 5,000ft or FL095.	-
	Procedures	Specific IFR routes & approach procedures Established VFR routes	
Aerodrome	Number of RWY	One runway	
	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	
Traffic	Number of movements	The typical operating environments for remote tower services to multiple aerodromes are airports below third level node, with a single runway, non-complex runway layout and low capacity utilisation. But remote tower services to multiple aerodromes are not limited to those environments.	
	Number of simultaneous movements		
	Traffic Type	VFR and IFR Mainly scheduled, charter and GA (School) flights and Business Aviation (BA). Also charter, taxi, ambulance, offshore helicopter and General Aviation (GA) and Business Aviation (BA).	
	Aircraft Fleet mix	All types of aircraft. Primarily those common at smaller aerodromes.	

Table 27 – Environment Operational Characteristics for Multiple Remote Tower SDM-0205

4.1.3 Aerodrome Technical Characteristics

Guideline technical characteristics of the two candidate aerodrome environments when applying the concept as detailed in SDM-0201 and SDM-0205 are outlined in Table 28 below. The technical characteristics of the actual aerodromes will not necessarily change as a result of providing the ATS remotely.

	Environment 1 - AFIS	Environment 2 - TWR
Visual observation	• Visual information for the aerodrome via the Out The Window (OTW) View	

Surveillance	• Radar surveillance (optional -informational use above given altitude, typically 4000-7000ft.) • Ground Radar • Visual information (OTW view) • Binoculars	
Communication	• ATC Voice Communications • VHF and UHF-transmitters/receivers, Ground Radio System, Autonomous VHF-radio, SAR radio. • Ambient Sound • Presentation and updating of flight plan and control data	
Navigation	• Navigation specifications including ILS, RNAV, NDB, DME.	
Safety Nets	• Typically none.	• Stop Bars • Runway Guard Lights • Optional: Short Term Conflict Alert (STCA) for APP.

Table 28 – Environment Aerodrome Technical Characteristics

4.1.4 Remote Tower Module Characteristics

In addition to the technical characteristics of the aerodrome environments, the Remote Tower Module environment will also have certain technical characteristics to be consider when applying the concept as detailed in SDM-0204. These will likely be common to both aerodrome operating environments. Table 29 below details the characteristics of an RTM suitable for the provision of a service in relation to SDM-0201 and SDM-0205.

	Remote Tower Module
Visual Features	The OTW view(s) of the aerodrome(s) will be reproduced in the Remote Tower Module. The visual features aim at increasing situational awareness through: • Image enhancements • Standard/traditional tower view and/or multiple viewpoints (achieved through camera tower placement); • Overlay of information in the visual view; • User acceptance is aimed to be increased by a uniform, smooth and high quality visual view (not necessarily 360° viewing angle). • Cameras/Sensors to enlarge and zoom into areas of significance e.g. PTZ camera; • Infra-red and other non-visual sensors Optional overlaid information includes: • Position information (e.g. Radar, Multilateration, ADS-B and Video Tracking); • Automatic identification and tracking of aircraft; • Flight data processing system information and weather information
Communication	The corresponding communication systems will be installed into the RTM. Considerations: Where necessary, short range transmitters/receivers will be replaced with longer range technical solutions.
Audio Features	Airport (ambient) audio such as engine noise, wind noise etc. may be relayed into the remote facility via speaker if necessary.

Information Management	The remote facility could include systems to support and integrate system wide engineering (SWIM). This will be used to share existing information and updates: - to be exchanged between different isolated ATS systems; - to be exchanged with other airports and ATS units; - and to other airport users such as, rescue dept., snow removal, bird strike, fuel, passenger service, airlines, etc.
RTM	The RTM should reflect an integrated comprehensive solution.
Other systems	The remote facility shall include all other technical functions and systems, currently found in local facilities and necessary to provide the services e.g.: - Flight plan system; - Manoeuvring of ground lighting, navigation aids, alarms, etc.; - Signal light gun; - Surveillance – optional or alternative solutions

Table 29 – Remote Facility Environment Technical Characteristics

4.1.5 Roles and Responsibilities

The airspace users are receivers of the ATS service. However, as previously stated, neither their role nor their responsibility should change as a result of introducing the remote aerodrome ATS.

The primary actors impacted by a remotely provided ATS are the ATCO/AFISO and the local airport officers. The overall roles and responsibilities of the ATCO/AFISO will not change, in so far as they will remain responsible for the provision of the required services. The main changes will be in relation to the tasks external to the tower currently done by ATCO/AFISO (whether or not these form part of documented ATS) or ATS tasks done by local officers and potentially an extra layer of responsibility due to the reliance on technical equipment.

In some current operational environments the ATCO/AFISO will be required to perform some tasks that actually are not a part of the ATS Service, e.g. physical runway inspections, gathering MET data, answering public telephone calls directed to tower just by tradition. Using the remotely provided ATS services, these tasks will require automation or delegation to a local agent (e.g. airport/rescue crew) or a remote technical solution will have to be implemented.

In some AFIS environments, some or all of the ATS services are not provided by a dedicated AFISO, but by suitably qualified local agents such as rescue crew or airport operators. When the ATS provision is removed from the aerodrome, it will be performed by a dedicated AFISO leading to potential task redundancy for local agents. This will require changes to staffing procedures and may impact overall cost effectiveness of service provision.

In traditional operations the ATCO/AFISO is responsible for providing the ATS and the airport authority / air traffic service provider is responsible for making sure that the equipment required to provide the service is in an acceptable working order. This extends to the local tower infrastructure itself e.g. visibility through tower windows. In the Remote Tower, there is a greater reliance on equipment in order to be able to provide the ATS. It will still be the responsibility of the airport authority / service provider to ensure that the equipment is properly maintained and kept in acceptable condition. The ATCO/AFISO will not be responsible for faults or failures due to lack of maintenance or design issues. These issues will be addressed by qualified engineers and technicians responsible for the calibration, maintenance and flight testing such as Air Traffic Services Electronic Personnel (ATSEP).

A new role for consideration when providing ATS remotely, especially from an RTC, is the RTC supervisor. In the same way that an ACC/Approach Supervisor is responsible for the general management of all activities in the Operations Room, an RTC supervisor is responsible for the general management of all activities in the RTC. This role may be filled by an ATCO or alternatively may be a distinct position.

4.1.6 Hours of Provision for ATS

ATS is mainly provided at smaller aerodromes to protect scheduled commercial IFR-traffic and utility IFR-traffic (ambulance/rescue flights etc.).

ATS for a specific aerodrome will normally be provided at published times (opening hours published in AIP or via Notice To Airmen (NOTAM)). Specific requests/agreements may be made in advance to provide ATS outside the normal opening hours. Extended opening hours will improve the availability of the aerodrome to business as well as ambulance/ rescue flights. Extended opening hours could be a political issue, setting environmental restrictions on flights (e.g. reducing night flights due to noise impacts). If no specific requests are made, ATS will not be provided outside normal opening hours, although the aerodrome may still choose to be open without ATS.

All traffic (IFR or VFR) as well as ground traffic/vehicles will be provided with ATS during opening hours.

4.1.7 Airspace status

The status of the Control Zone (CTR) can vary, either being Established or Not Established.

The CTR is established according to the ATS opening hours and Not Established outside this. An air traffic information zone/ flight information zone (TIZ/ FIZ) is established around airports where AFIS is provided (i.e. not part of controlled airspace). TIZs and FIZs can also vary in status in the same way.

4.1.8 Constraints

The key constraint is that the full range of operating environments has not been covered and hence it is not possible to confidently state the applicable operating environments for the Single and Multiple primary concept applications.

This does restrain concept development as the operational environments in which the concept is applied has been shown to have a large influence on application, feasibility and requirements.

The technical solution should be flexible. This particularly applies to the application of the Multiple Remote Tower concept.

Technical constraints would include the ability to provide a visual presentation of sufficient technical specification to allow the operator to meet current regulatory requirements for the provision of an ATS.

When operating the Multiple Remote Tower concept application the technical solution should provide a continuous visual surveillance of all aerodromes being provided with a service. If this is not possible then the service being provided to the aerodrome without visual surveillance should cease.

4.2 Remote Provision of ATS in Contingency Situations

The concept of “Remote Provision of ATS to Aerodromes in Contingency Situations” can be divided into the two following target environments, aerodromes with or without A-SMGCS (however the concept is not limited to a specific target environment and this is not the only way of dividing the aerodromes).

Characteristics detailed in the following sections are detailed based upon the target application covered by SDM-0204. In the future more complex environments above will likely be added as the concept develops under new OI steps.

4.2.1 Aerodrome Operational Characteristics – SDM-0204

Guideline operational characteristics of the two candidate environments when applying the concept as detailed in SDM-0204 are outlined in Table 30 below. They should be interpreted as common characteristics across all candidate countries and ANSP and are not restrictive i.e. they represent a baseline operating environment that may be slightly different in each individual country or ANSP.

		Primary Target Environment – Non A-SMGCS	Secondary target Environment – A-SMGCS
Services	TWR	Yes	Yes
	APP	Sometimes combined with TWR	Yes. Off Site.
	Opening Hours	24 H	
Staffing	Number of ATS staff	1-2 in TWR	Up to 6 in TWR
Airspace	Airspace Classification	Class C, D	Class A, C
	CTR	10-15NM radius, 2500FT Altitude (ALT)/Surface (SFC)	
	TMA	In some cases FL95-, during low traffic periods mainly during night time	
	Procedures	Specific IFR routes & approach procedures Established VFR routes	
Aerodrome	Number of RWY	1-2	2-3
	Taxiway and runway entries	1-2 taxiways, 5 runway entry points	3 taxiways, 4-6 runway intersection points
	Aprons	3-4	8-12
Traffic	Number of movements	The typical operating environment for a contingency tower will include a range of aerodrome environments from intercontinental hubs to secondary node aerodromes. Typically aerodromes will portray one or more of the following complexities: multiple runways, runway independencies, a complex layout or a high capacity utilisation. The provision of this service is not limited to these environments.	
	Number of simultaneous movements		
	Traffic Type	Scheduled, Business, Charter, Some Military, Some GA.	Scheduled, Business, Charter
	Aircraft Fleet mix	All types of aircraft	

Table 30 – Environmental Operational Characteristics

4.2.2 Aerodrome Technical Characteristics

Guideline technical characteristics of the two candidate aerodrome environments when applying the concept as detailed in SDM-0204 are outlined in

	Primary Target Environment – Non A-SMGCS	Secondary Target Environment – A-SGMCS
Visual observation	• Visual information for the aerodrome via the Out The Window (OTW) View	
Surveillance	• Primary surveillance radar • MSSR • A-SMGCS • SMR	
Communication	• ATC Voice Communications • VHF and UHF-transmitters/receivers, Ground Radio System, Autonomous VHF-radio, SAR radio.	

	• Presentation and updating of flight plan and control data
Navigation	• Navigation specifications including ILS, RNAV, P-NAV, RNP, NDB, DME.
Safety Nets	• Stop Bars • Runway Guard Lights • Short Term Conflict Alert (STCA) for APP • A-SMGCS Level 2 (automated monitoring and alerting functions)

Table 31 below. The technical characteristics of the actual aerodromes will not necessarily change as a result of providing the ATS remotely.

	Primary Target Environment – Non A-SMGCS	Secondary Target Environment – A-SGMCS
Visual observation	• Visual information for the aerodrome via the Out The Window (OTW) View	
Surveillance	• Primary surveillance radar • MSSR • A-SMGCS • SMR	
Communication	• ATC Voice Communications • VHF and UHF-transmitters/receivers, Ground Radio System, Autonomous VHF-radio, SAR radio. • Presentation and updating of flight plan and control data	
Navigation	• Navigation specifications including ILS, RNAV, P-NAV, RNP, NDB, DME.	
Safety Nets	• Stop Bars • Runway Guard Lights • Short Term Conflict Alert (STCA) for APP • A-SMGCS Level 2 (automated monitoring and alerting functions)	

Table 31 – Environment Aerodrome Technical Characteristics

4.2.3 Roles and Responsibilities

The primary actors impacted by a remotely provided ATS are the ATCO and the local airport officers. 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. The role of an RTC supervisor is likely to benefit operations, however this role may not be discrete from the role of ATCO. The RTC supervisor role would lead the transition into RCT operations and oversee the re-establishment of operations to full/or other pre-defined capacity.

Airspace users should positively benefit from the application of the concept, with an increased availability of ATS during contingency operations at aerodromes.

4.2.4 Constraints

The key constraint is that the full range of operating environments has not be covered and hence it is not possible to confidently state the applicable operating environments for the Contingency Tower primary concept applications.

This does restrain concept development as the operational environments in which the concept is applied has been shown to have a large influence on application, feasibility and requirements.

5 Use Cases

The selected use cases are based on certain criteria:

- Normal Operations to give coverage against ICAO Doc 4444 [10], ICAO Doc 9426 [13] and the Eurocontrol Manual for AFIS [12];
- To generate specific requirements for non-normal cases;
- As a means to provide examples and clarifications of how the Remote Tower concept may function in operational scenarios;

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.

5.1 Remote Provision of ATS to Single and Multiple Aerodromes

Nine operational scenarios are considered in this OSED, in addition to the service descriptions given in Sections 3.1, 3.3, 3.4 and 3.5. The scenarios presented below are all written from a Remote TWR ATCO point of view. However, the scenarios would also apply for Remote AFISO.

The scenarios relating to a single aerodrome are also all applicable to the environment of a remote tower being used to provide ATS to multiple aerodromes. The technical, operational and procedural elements remain unchanged. The primary difference being the multiple remote tower ATCO can provide a service to one of many aerodromes, may have a more compressed visual presentation of each aerodrome and has (in some cases) duplicated features in the CWP.

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.

5.1.1 Arriving aircraft handled by remotely provided ATS

5.1.1.1 General Conditions

GC1 - The Remote TWR ATCO is located in an RTM, located away from the aerodrome and/or local Tower.

GC2 - The Remote TWR ATCO is situated at an RTM where they are presented with a visual presentation of the aerodrome view.

GC3 - The Remote TWR ATCO is providing ATS to a single Aerodrome.

5.1.1.2 Pre-Conditions

PreC1 - An inbound estimate is delivered from ACC

5.1.1.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for arrival aircraft, with the same or better levels of service as if the ATS had been provided locally

5.1.1.4 Operating Method, Nominal Flow

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
1.	Establishes contact (R/T) with the inbound IFR flight crew when the aircraft is established on final approach.	Acknowledges contact.	Remote TWR ATCO may also relay potential updates of the actual MET Report, displayed on the RTM and other relevant information e.g. regarding runway conditions to the Flight Crew (if no ATIS is available).	Final Approach
2.	Verifies that the runway is free of obstacles for the landing of the aircraft and issues the landing clearance to the Flight Crew using R/T.	Acknowledges the landing clearance.	Remote TWR ATCO runway check is performed by visual reference gained from the relayed visual surveillance of the aerodrome and aerodrome ground personnel.	Final Approach
3.	Monitors the aircraft's final approach and landing to ensure safety and intervenes if required.	Proceeds with the approach and lands the aircraft.	Remote TWR ATCO monitors aircraft on relayed visual presentation/visual surveillance. Technical enablers and AVFs may assist the Remote TWR ATCO in identifying and monitoring the aircraft on final approach e.g. additional viewpoints or enhanced views, MET and aerodrome status overlays (showing wind measurements, runway visual range values, runway lights status).	Final Approach and landing
4.	Issue a clearance where to exit the runway. Verifies that the aircraft has vacated the runway via the planned exit. Issues a taxi clearance via appropriate taxiway(s) to the allocated stand on apron.	Executes the clearance and vacates runway Acknowledges the taxi clearance.	Remote TWR ATCO monitors aircraft on relayed visual presentation/visual surveillance The Remote TWR ATCO may use an alternative viewpoint at the taxiway (where provided) in order to be able to get an enhanced view and aid in establishing that the aircraft has left the RWY.	Landing / Runway

5.	Monitors the traffic situation for the detection of potential hazards and hazardous situations (e.g. converging airport traffic, temporary obstructions, debris). If the Taxi Clearance Limit is an active runway, the Remote TWR ATCO verifies that the runway is clear, confirms the aircraft can cross and issues a taxi route clearance(s) to the stand.	Acknowledges and accepts the route clearance, updating the aircraft system. Manoeuvre the aircraft assisted by the routing displayed on-board the aircraft and/or using visual navigation aids (e.g. taxiway markings and lighting).	Remote TWR ATCO monitors aircraft on relayed visual presentation/visual surveillance with the aid of technical enablers (where relevant) and any AVFs (that may feature).	Taxi

Table 32 – Operating Method Nominal Flow - Arriving aircraft handled by remotely provided ATS

5.1.1.4b Operating Method, Alternative Flow 1, Large Animal on Manoeuvring Area

Flow continues from #2 in Table 32, section 5.1.1.4 above.

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
3.	Is made aware of a large animal moving on the manoeuvring area towards the RWY and immediately instructs the aircraft to go-around following the go-around procedure.	Acknowledges and immediately initiates the go-around procedure.	The Remote TWR ATCO may be made aware of the presence of the large animal or obstacle by various means including: The visual presentation, communication with ground personnel or the binocular function. Further to this additional features such as an IR camera tool or “hot-spot” cameras may provide assistance.	Final Approach
4.	Instructs ground personnel (Using a communications link between the Remote Tower module and the aerodrome) to immediately to go to the given position of the animal and commence methods to remove or scare off the animal.		The Remote TWR ATCO will monitor the aircraft on the visual presentation. On the same display, the Remote TWR ATCO may bring up a different viewpoint to allow simultaneous monitoring of the area in which the animal is present. The Remote TWR ATCO will continue to monitor both aircraft and animal until the animal has been removed or scared off.	

5.	Updates Flight Crew on on-going situation and approximate time frame for being given a new approach and landing clearance	The flight crew will consider this in their planning for alternative aerodromes to land if necessary.		Approach
6.	Receives confirmation from ground personnel (via communications link) that the animal is no longer in the vicinity.		The confirmation form ground personnel verified by visual monitoring via the RTM.	Approach
7.	Remote TWR ATCO has confirmed that runway is clear and issues a clear to land again instruction to the aircraft.	Acknowledges the landing clearance.	Remote TWR ATCO runway check is performed by visual reference gained from the relayed visual presentation of the aerodrome.	Final Approach
8.	Flow continues from 3 in 5.1.1.4 (Table 32 above).			

Table 33 – Operating Method, Alternative Flow 1, Large Animal on Manoeuvring Area

5.1.1.4c Operating Method, Alternative Flow 2, Landing Gear not Down

Flow continues from #2 in Table 32, section 5.1.1.4 above.

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
3.		Flight Crew observes an indication in the cockpit that the landing gear is not down and request to make a low pass above the aerodrome. The Flight Crew request the Remote Tower ATCO to observe if the landing gear seems to be down		Final Approach
4.	Informs the Flight Crew of the position of the landing gear using a binocular functionality to focus on the aircraft.	Acknowledges response and decide to land	If such a function is not available due to malfunction or other reasons, the Remote TWR ATCO may request, via communications link, that local airport personnel to perform a visual check of	Final Approach

			the aircraft and report back.	
5.	Remote ATCO verifies landing gear failure, informs emergency unit and initiates emergency procedures to be followed.			Final Approach
6.	Monitors the aircraft's final approach and landing to ensure safety and intervenes if required.	Proceeds with the approach and lands the aircraft.	When the Flight Crew make a new approach to land, the Remote TWR ATCO again uses a binocular functionaility to observe the aircraft and reports any deviations to the Flight Crew and rescue units.	Final Approach and landing.
7.	Co- ordinates suitable spacing due to emergency		Co-ordinates emergency if APP performed by different ATCO	
8.	Flow continues from 4 in 5.1.4			

Table 34 – Operating Method, Alternative Flow 2, Landing Gear not Down

5.1.2 VFR flight in the traffic circuit is conflicting with an arriving IFR flight

5.1.2.1 General Conditions

GC1 - The Remote TWR ATCO is located in an RTM, located away from the aerodrome and/or local Tower.

GC2 - The Remote TWR ATCO is situated at an RTM where they are presented with a visual presentation of the aerodrome view.

GC3 - The Remote TWR ATCO is providing ATS to a single Aerodrome.

5.1.2.2 Pre-Conditions

PreC1 -The VFR flight in the traffic circuit is conflicting with an arriving IFR flight.

PreC2 – Airspace class C.

PreC3 –The ATCO does not have both aircraft in sight.

5.1.2.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for the arrival aircraft, with the same or better levels of service as if the ATS had been provided locally.

5.1.2.4 Operating Method

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
1	Contact VFR Flight (R/T) and clears the VFR flight to a published VFR holding point or any suited location.	VFR Flight crew acknowledges clearance and proceeds to VFR holding point or any suited location.	The VFR flight will stay in the VFR hold until one of the following occurs: The IFR flight has landed; The Remote TWR ATCO has both aircraft in sight on the visual presentation and could maintain visual separation; The pilot in the VFR flight reports to have the IFR in sight and can maintain own visual separation.	Approach

Table 35 – Operating Method - VFR flight in the traffic circuit is conflicting with an arriving IFR flight

5.1.3 Two departing IFR flights during Low Visibility

5.1.3.1 General Conditions

GC1 - The Remote TWR ATCO is located in a RTM, located away from the aerodrome and/or local Tower.

GC2 - The Remote TWR ATCO is situated at an RTM where they are presented with a visual presentation of the aerodrome view.

GC3 - The Remote TWR ATCO is providing ATS to a single Aerodrome.

5.1.3.2 Pre-Conditions

PreC1 - In this scenario there are two departing IFR flights.

PreC2 - Visibility is poor and LVP are in place.

PreC3 - En-route clearance is issued by the ATCO before start-up upon Flight Crew request, by use of R/T or Datalink.

5.1.3.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for the departing aircraft, with the same or better levels of service as if the ATS had been provided locally. The Advanced Visual Features enable simultaneous movements during LVP.

5.1.3.4 Operating Method

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
1	Initiates LVP locally at the airport and informs the airport authority and departing aircraft.	Acknowledges LVP in operation		Start up
2	Clears departing aircraft No.1 for engine start-up when ready	Departing aircraft No.1 confirms engine start-up		Start up
3	Verifies that the runway (and manoeuvring areas if applicable) is free of obstructions and approves departing aircraft No.1 to push back.	Aircraft No.1 executes push back.	Technical enablers such as the binocular functionality may be used to assist the Remote TWR ATCO in identifying possible obstacles on the runway and key areas. AVFs may also assist where provided.	
4	Clears aircraft No.1 to taxi to the holding point of the runway-in-use and when approaching the holding clears departing aircraft No.1 to line up on the runway.	Acknowledges taxi and runway clearances		Taxi and Line-up
5	Clears departing aircraft No.2 for engine start-up when ready	Departing aircraft No.2 confirms engine start-up	Technical enablers and AVFs may be used to assist the Remote TWR ATCO in identifying any obstacles on runway	Start up

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
			and key areas. Enhancements may be used to highlight key areas along the taxiways, such as the holding points.	
6	Verifies that the runway (and manoeuvring areas if applicable) is free of obstructions and approve departing aircraft No.2 to push back.	Aircraft No.2 execute push back	Technical enablers and AVFs may be used to assist the Remote TWR ATCO in identifying any obstacles on runway and key areas.	Push Back
7	Verifies that the runway (and manoeuvring areas if applicable) is free of obstructions Clears No.1 for take-off	No.1 acknowledges clearance and departs on runway-in-use	No. 2 for departure will be monitored and tracked using the visual presentation or other sensors such as a binocular functionality or optional AVF enhancements in order to avoid a runway incursion or other deviation from issued clearance. Use of stop bars if available to avoid runway incursion.	Take Off
8	Clears the second departing aircraft (No.2 for departure) to taxi to the holding point of the runway-in-use.	Departing aircraft No.2 acknowledges taxi clearance	This is performed after Aircraft No. 1 has been cleared for take-off and is airborne.	Taxi
9	Clears the second departing aircraft (No.2 for departure) to line up on the runway.	Acknowledges clearance		Line Up
10	Verifies that the runway is free of obstructions Clears departing aircraft No.2 for take-off	Departing aircraft No.2 acknowledges clearance and departs on runway-in-use		Take Off

Table 36 – Operating Method - Two departing IFR flights during Low Visibility

5.1.4 Arrival aircraft with combined Remote TWR/APP

5.1.4.1 General Conditions

GC1 - The Remote TWR ATCO is located in a RTM, located away from the aerodrome and/or local Tower.

GC2 - The Remote TWR ATCO is situated at an RTM where they are presented with a visual presentation of the aerodrome view.

GC3 - The Remote TWR ATCO is providing ATS to a single Aerodrome.

5.1.4.2 Pre-Conditions

PreC1 - A combined Remote APP/TWR ATCO is responsible for ATS in the CTR around a remotely serviced aerodrome and TMA FL95 and below.

PreC2 - Arriving aircraft are given inbound clearances direct to the Initial Approach Fix (IAF) for the runway-in-use.

PreC3 - No ATS surveillance service is provided by TWR/APP ATCO.

PreC4 - Two IFR flights are arriving at approximately the same time into the aerodrome.

5.1.4.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for the arrival aircraft, with the same or better levels of service as if the ATS had been provided locally.

5.1.4.4 Operating Method

Step	Remote APP/TWR ATCO	Flight Crew	Notes	Phase
1	Issues an approach clearance to Aircraft No. 1 full procedure (VOR)/ILS on VHF omnidirectional radio.	Arriving aircraft No.1 acknowledges clearance	The ACC ATCO has decided the approach sequence and arranges the traffic. The aircraft are vertically separated when transferred from the ACC ATCO to the Remote APP/TWR ATCO.	Approach
2	Issues a clearance for Aircraft No. 2 to a published holding point, with vertical separation to Aircraft No. 1 and with expected approach time given.	Arrival aircraft No.2 acknowledges clearance.	Vertical separation is applied by use of step descend or by use of rate-of-descend. Aircraft No. 1 could continue with an instrument approach (full procedure) or at a certain point report field in sight and be cleared to make a visual approach.	Approach

Step	Remote APP/TWR ATCO	Flight Crew	Notes	Phase
3a	Verifies that the runway is free of obstacles for the landing of aircraft No.1 and clears the aircraft for a visual approach.	Aircraft No.1 acknowledges the approach clearance and report runway in sight.	Remote TWR ATCO runway check is performed by visual reference gained from the relayed visual presentation of the aerodrome.	Approach
3b	Issues a landing clearance to aircraft No.1	Aircraft No.1 acknowledges the landing clearance and continues its VFR approach for landing.		Final Approach
4	Issues arrival aircraft No.2 with an approach clearance	Aircraft No.2 acknowledges the approach clearance and starts its approach.	Conditional that the Remote APP/TWR ATCO has Aircraft No. 1 in sight on visual reproduced view and reasonable assurance exists that a normal landing can be accomplished.	Approach
5	Monitors aircraft No.1's final approach and landing to ensure safety and intervenes if required.	Aircraft No.1 proceeds with the final approach and lands the aircraft.	Remote TWR ATCO monitors aircraft on relayed visual presentation. Technical enablers may assist in the monitoring of the aircraft. AVFs may overlay additional information onto the visual presentation to assist the Remote TWR ATCO in identifying and monitoring the aircraft on final approach e.g. wind measurements, runway visual range values, runway lights status.	Final Approach and landing.
6	Issues a taxi clearance to aircraft No.1 via appropriate taxiway(s) to the allocated stand on apron. Verifies that the aircraft has vacated the runway via the planned exit.	Aircraft No.1 acknowledges the taxi clearance. Executes the clearance and vacates runway.	Remote TWR ATCO monitors aircraft on relayed visual presentation. Remote TWR ATCO verifies by visual reference gained from the visual presentation and optionally enhanced by AVFs, that the aircraft has vacated the runway via the planned exit.	Landing / Runway.
7	Clears No.2 for landing and monitors aircraft No.2's final approach and landing to ensure safety and intervenes if required.	Aircraft No. 2 acknowledges the landing clearance and proceeds with its final approach and then lands the aircraft.	Remote TWR ATCO monitors aircraft on relayed visual presentation. Technical enablers may assist in the monitoring of the aircraft. AVFs may overlay additional information onto the visual presentation to assist the Remote TWR ATCO in identifying and monitoring the aircraft on final approach e.g.	Final Approach and landing.

Step	Remote APP/TWR ATCO	Flight Crew	Notes	Phase
			wind measurements, runway visual range values, runway lights status.	
8	The visual presentation will then be used to monitor and control both aircraft.			

Table 37 – Operating Method - Arrival aircraft with combined Remote TWR/APP

5.1.5 Transition of ATS provision from local TWR to Remote TWR

5.1.5.1 General Conditions

GC1 - The ATS is provided locally during some hours of the day and remotely during others.

GC2 - The Remote TWR ATCO is located in an RTM, located away from the aerodrome and/or local Tower.

GC3 - The Remote TWR ATCO is situated at an RTM where they are presented with a visual presentation of the aerodrome view.

GC4 - The Remote TWR ATCO is providing ATS to a single Aerodrome.

5.1.5.2 Pre-Conditions

PreC1 - The local TWR ATCO is ready to hand over to the Remote TWR ATCO.

5.1.5.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for the arrival aircraft, with the same or better levels of service as if the ATS had been provided locally.

5.1.5.4 Operating Method

Step	Remote TWR ATCO	Local TWR ATCO	Notes	Phase
1	Prior to the nominated time of transfer, the Remote TWR ATCO coordinates with the Local TWR ATCO to see if conditions are sufficient to begin	The Local TWR ATCO has the final decision.	The following items are taken into account: Division of responsibility between Remote TWR ATCO and Local TWR ATCO at any given moment;	-

Step	Remote TWR ATCO	Local TWR ATCO	Notes	Phase
	remote provision of ATS.		Received Flight plans; Requested flight permissions (PPR); Actual (known) traffic; Meteorological conditions; Possibility to actually observe traffic from the remote facility. Before and during transition, the Local TWR ATCO and the Remote TWR ATCO shall communicate and judge how the visual view in TWR and remote facility is experienced; Planned maintenance work.	
2	Once satisfied that a transfer can take place, the Remote TWR ATCO performs various checks in the remote facility		RTM handover procedure checks will include, but is not limited to the following: Check MET briefing in remote facility; Check ground to air and ground to ground radio; Check relayed visual view from camera tower; Check that the various technical enablers and AVFs are functioning correctly; In coordination with Local TWR ATCO, check ILS mode, HMI and navigation aids; Check settings for systems such as airport lights and air situational display; Check connection by telephone to surrounding ATS units and inform of impending transfer to remote provision of ATS.	-
3	Once all checks have been complete to the satisfaction of the Remote TWR ATCO, the Remote TWR ATCO takes control of the relevant equipment from the Local TWR ATCO. The Remote TWR ATCO informs the Local TWR ATCO that they are ready	This is confirmed by the Local TWR ATCO	The Remote TWR ATCO then calls the Local TWR ATCO by telephone to transfer information on: General information including deviations from normal procedures; Work in Progress on or close to manoeuvring area that could have an influence;	-

Step	Remote TWR ATCO	Local TWR ATCO	Notes	Phase
	to begin remote provision of ATS services.		AWOS – Check date and "letter" for current Met. Info; Traffic situation – actual air traffic, vehicles on manoeuvring area, issued clearances; If available air situational display settings – range, centre settings, additional maps; Any other pertinent information.	
4	After transfer of relevant information, transfer of control is performed with the Remote TWR ATCO taking control. The Remote TWR ATCO performs final essential checks on radio and telephone functions and volume by conducting final transmissions to the Local TWR ATCO and ACC.			-
5	The Remote TWR ATCO then requests control by using the RTC supervisor telephone and initiating "Remote Provision of ATS". The Remote TWR ATCO accepts and states "Remote facility takes control".	The Local TWR ATCO then states "You have control" and acknowledges the initiation.		-
6		The Local TWR ATCO informs the airport agents, officers and ACC that the remote facility is now providing ATS		-

Table 38 – Operating Methods - Transition of ATS provision from local TWR to Remote TWR

5.1.6 Aircraft Arriving to an Aerodrome with no Present Visual Presentation

5.1.6.1 General Conditions

GC1 - The Remote TWR ATCO is located in an RTM, located away from the aerodrome(s) and/or local Tower(s).

GC2 - The Remote TWR ATCO is providing ATS to two Aerodromes sequentially.

GC3 - The Remote TWR ATCO is situated at an RTM where they are presented with a visual presentation of only one aerodrome at a time but switching between the two aerodromes is possible.

5.1.6.2 Pre-Conditions

PreC1 - Remote ATCO is providing ATS for aerodrome A and B sequentially. At the start of this use case ATS is being provided to aerodrome A and hence this is the only aerodrome being viewed on the visual presentation.

5.1.6.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for the arrival aircraft, with the same or better levels of service as if the ATS had been provided locally.

5.1.6.4 Operating Method

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
1.	Remote ATCO is providing ATS to aerodrome A.	A pilot in a single engine aircraft flying according to VFR, is calling Remote ATCO, declaring emergency and request to land at aerodrome B, time to landing is 10 minutes.	Reference to section which describes the use of traffic co-ordination in the concept . This form of traffic co-ordination would have been in place prior to the establishment of an emergency at the aerodrome not currently being provided with an ATS (i.e. aerodrome B).	En-route
2	The Remote TWR ATCO switches the visual presentation and all primary controls (e.g. e-strip) from aerodrome A to aerodrome B. The provision of ATS to aerodrome A from this RTM shall cease due to the switch of the service to aerodrome B.		ATS of aerodrome A may be handed to another Remote TWR ATCO if using an RTC or ATS may be halted at aerodrome A, however the aerodrome will remain open.	Approach

3	Issues a clearance to the aircraft landing at aerodrome B, informs rescue unit and ground staff.	The pilot approaches the aerodrome and passes all relevant information to remote ATCO.	Visual surveillance of the aerodrome shall be used to issues clearance. Technical enablers, AVFs and ground staff may be used to assist.	Approach
4	Verifies that the runway is free of obstacles for the landing of the aircraft and issues the landing clearance to the Flight Crew using R/T.	Acknowledge landing clearance. Proceeds with the approach and lands the aircraft.	Remote TWR ATCO runway check is performed by visual reference gained from the relayed visual presentation of the aerodrome. AVFs may also be useful and or required to allow for a closer inspection. Ground personnel may also be required to perform the physical check or remove FOD.	Landing/ Runway
5			The Remote TWR ATCO can now switch the visual presentation and controls to aerodrome A in order to recommence the provision of an ATS. When using the switch mode to operate multiple aerodromes there is likely to be advanced traffic coordination to negate the requirement for excessive switching.	Taxi

Table 39 – Operating Methods Aircraft Arriving with no Present Visual Presentation

5.1.7 Two arriving aircraft to two different aerodromes

5.1.7.1 General Conditions

GC1 - The Remote TWR ATCO is located in an RTM, located away from the aerodrome(s) and/or local Tower(s).

GC2 - The Remote TWR ATCO is providing ATS to 2 Aerodromes simultaneously.

GC3 - The Remote TWR ATCO is situated at an RTM where they are presented with a visual presentation of both aerodromes (Aerodrome A and B).

5.1.7.2 Pre-Conditions

PreC1 - Two aircraft are approaching two different airports in a TMA, both aircraft are supposed to follow a Standard Terminal Arrival Route (STAR) to their destination.

PreC2 - Runway inspection by ground staff / inspection vehicle is recently performed and completed for aerodrome A, but still in progress for aerodrome B at the start of this Use Case.

5.1.7.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for the arrival aircraft, with the same or better levels of service as if the ATS had been provided locally.

5.1.7.4 Operating Method, Nominal Flow

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
1.	Monitors the progress of the vehicle performing the runway inspection at aerodrome B		Not later than 10 min before landing ground staff from each aerodrome respectively will inform the Remote TWR/APP ATCO that the runway is inspected and allowed to be used for aircraft landings and departures. (Later on this inspection could be allowed to be done with the use of cameras only) At the start of this Use Case a runway inspection has recently been performed by a runway inspection vehicle for aerodrome A, but is still is still progress for aerodrome B.	Approach
2.	When landing aircraft no.1 is on final to aerodrome A, Remote TWR ATCO will use a binocular tool to inspect the runway of aerodrome A and assure it is free from obstacles, where after they issues a landing clearance.	Flight Crew of acft no. 1 acknowledge landing clearance.	The RTM will feature a visual presentation of both aerodromes being provided with a remote ATS. All equipment and technical features that require duplication shall be provided for each aerodrome in an separate or combined manner. The Remote TWR ATCO shall be able to easily distinguish between aerodromes and all duplicated features. With intuitive and swift switching of controls where required. Touch and control panels for each aerodrome are placed (and may be colour coded) to eliminate the risk of manoeuvring the wrong equipment and confusion.	Final Approach
3	Verifies that the vehicle have vacated the runway and removes the vehicle strip from the runway bay for aerodrome B in the Flight Progress Board (FPB) / e-strip.	The driver of the runway inspection vehicle vacates the runway at aerodrome B and reports “runway vacated and runway inspection completed”.	Remote TWR ATCO uses the relayed visual presentation to quickly confirm that the vehicle has vacated the runway. Technical enablers may assist the Remote TWR ATCO in the monitoring of the vehicle. E.g. sensors at the	Vehicle movement

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
			runway exits could trigger a sound alert in the RTM when the vehicle crosses a runway exit line. AVFs may overlay additional information onto the visual presentation, e.g. highlighting that the runway is blocked in the visual presentation as long as there is a vehicle strip inserted in the runway bay of the e-strip system.	
4.	Monitors aircraft no.1 on final approach and landing to ensure safety and intervenes if required.	Flight Crew of acft no. 1 proceeds with the approach and lands the aircraft.	Remote TWR ATCO monitors aircraft on relayed visual presentation. Technical enablers may assist in the monitoring of the aircraft. AVFs may overlay additional information onto the visual presentation to assist the Remote TWR ATCO in identifying and monitoring the aircraft on final approach e.g. wind measurements, runway visual range values, runway lights status.	Final Approach and landing.
5.	Issues a taxi clearance to aircraft 1 via back track and appropriate taxiway(s) to the allocated stand on apron. Verifies that aircraft no. 1 starts taxiing via back track.	Flight Crew of acft no. 1 acknowledges the taxi clearance and commence taxiing via back track on the runway.	Remote TWR ATCO monitors aircraft on relayed visual presentation. The ATCO may use an alternative viewpoint if available to view the taxiway to enhance the view and monitor more closely that the aircraft has left the RWY.	Landing / Runway.
6.	When landing aircraft no.2 is on final to aerodrome B, Remote TWR ATCO will use a binocular tool to inspect the runway of aerodrome B and assure that the runway is free, where after he/ she issues a landing clearance.	Flight Crew of acft no. 2 acknowledge landing clearance.	The RTM will feature a visual presentation of both aerodromes being provided with a remote ATS. All equipment and technical features that require duplication shall be provided for each aerodrome in an separate or combined manner. The Remote TWR ATCO shall be able to easily distinguish between aerodromes and all duplicated features. With intuitive and swift switching of controls where required. Touch and control panels for each aerodrome are placed (and may be colour coded) to eliminate the risk of manoeuvring the wrong equipment and confusing.	Final Approach

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
7.	Monitors the progress of the taxiing aircraft no 1 and the traffic situation for the detection of potential hazardous situations at aerodrome A (e.g. converging airport traffic, temporary obstructions, debris). Verifies that aircraft no. 1 has vacated the runway via the planned exit. (If the Taxi Clearance Limit is an active runway, the Remote TWR ATCO verifies that the runway is clear and the aircraft can cross and issues taxi route clearance(s) to the stand.)	Flight Crew of acft no. 1 continue taxing while manoeuvring the aircraft assisted by the routing displayed on board the aircraft and/or using visual navigation aids (e.g. taxiway markings and lighting). When reaching the first runway exit taxiway, they turn the aircraft to vacate the runway. (Acknowledges and accepts the route clearance, updating the aircraft system.)	Remote TWR ATCO monitors the taxiing aircraft no. 1 at aerodrome A simultaneously as monitoring the landing aircraft no. 2 on final for aerodrome B by sweeping/searching the relayed visual presentation of both aerodromes. As following up on the approach of aircraft no.2, e.g. being able to assess the aircraft "angel of attack" via the information gained from the visual presentation, the TWR ATCO can quickly mentally prepare to take correct actions if the landing aircraft would e.g. need to do a "go around". If required the TWR ATCO uses technical enablers such as a binocular functionality or any available AVFs. E.g., if available, the TWR ATCO could use the automatic tracking functionality to "lock" the PTZ/binocular functionality on the landing aircraft no. 2 on final, thus being supported to quickly switch view/focus between the taxing aircraft no. 1 at aerodrome A and the landing aircraft no. 2 at aerodrome B.	Taxi
8.	Monitors aircraft no.2 final approach and landing to ensure safety and intervenes if required.	Flight Crew of acft no. 2 proceeds with the approach and lands the aircraft.	Remote TWR ATCO monitors aircraft on relayed visual presentation. Technical enablers may assist in the monitoring of the aircraft. AVFs may overlay additional information onto the visual presentation to assist the Remote TWR ATCO in identifying and monitoring the aircraft on final approach e.g. wind measurements, runway visual range values, runway lights status.	Final Approach and landing.
9.	Issues a taxi clearance to aircraft no.2 via appropriate taxiway(s) to the allocated stand on apron. Verifies that aircraft no.2 has vacated the runway via the planned exit.	Flight Crew of acft no. 2 acknowledges the taxi clearance. Flight Crew of acft no. 2 executes the clearance and vacates runway.	Remote TWR ATCO monitors aircraft on relayed visual presentation. The ATCO may use an alternative viewpoint if available to view the taxiway to enhance the view and monitor more closely that the aircraft has left the RWY.	Landing / Runway.

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
10.	Monitors the traffic situation for the detection of potential hazardous situations at aerodrome B (e.g. converging airport traffic, temporary obstructions, debris). (If the Taxi Clearance Limit is an active runway, the Remote TWR ATCO verifies that the runway is clear and the aircraft can cross and issues taxi route clearance(s) to the stand.)	Flight Crew of acft no. 2 manoeuvre the aircraft assisted by the routing displayed onboard the aircraft and/or using visual navigation aids (e.g. taxiway markings and lighting). (Acknowledges and accepts the route clearance, updating the aircraft system.)	Remote TWR ATCO monitors aircraft on relayed visual presentation and if required using technical enablers such as a binocular functionality or any available AVFs.	Taxi

Table 40 – Operating Methods, Two arriving aircraft to two different aerodromes

5.1.7.5 Operating Method, Alternative Flow 1, Failure conditions for Multiple Remote Tower

In case of a failure or degradation to system/functions of the Multiple RTM which have an impact on the controller workload or affects the capability of the controller to continue providing a safe service to all airports under his/her responsibility, the controller shall, in order to be able to manage the degraded mode consider one of the following as acceptable means of operation:

- Stop the provision of the remote service for some or all airports;
- Transfer the provision of the remote service for some or all airports to another RTM where service is being provided from an RCT;
- Be provided with additional operational support in provide ATS to the aerodromes under control

Note: Supervisor in the RTC may support the controller to apply these procedures.

The above operating scenarios are taken directly from the safety report for Multiple Remote Tower [28] and act as a placeholder for further refinement. The precise operating method to be applied will be dependent on the local implementation and the conditions of each degraded mode scenario. As such it is for local operating procedures to develop operating methods suitable for their RTM configuration and operating environment. As a minimum to maintain safety during failure modes of operation the ATS provision shall be ceased, in line with current operational procedures (aircraft to divert to alternate aerodrome for landing).

5.1.8 Arriving and departing aircraft at two different aerodromes

5.1.8.1 General Conditions

GC1 - The Remote TWR ATCO is located in an RTM, located away from the aerodrome(s) and/or local Tower(s).

GC2 - The Remote TWR ATCO is providing ATS to 2 Aerodromes simultaneously.

GC3 - The Remote TWR ATCO is situated at an RTM where they are presented with a visual presentation of both aerodromes (Aerodrome A and B).

5.1.8.2 Pre-Conditions

PreC1 - One IFR aircraft is approaching an airport and one IFR aircraft is departing at another airport. The arriving aircraft no. 1 at aerodrome A has already called up on the aerodrome frequency and established contact with the Remote TWR ATCO. The departing aircraft no. 2 at aerodrome B has already received start up clearance from the Remote TWR ATCO.

5.1.8.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for both the arrival and departure aircraft, with the same or better levels of service as if the ATS had been provided locally.

5.1.8.4 Operating Method, Nominal Flow

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
1.	Issues a taxi clearance to RWY holding point for acft no. 2 at aerodrome B, via appropriate taxiways. Confirms on the visual presentation that aircraft no. 2 commence taxi and survey that the aircraft is taking the correct taxiway according to clearance.	Flight Crew of acft no. 2 at aerodrome B request taxi clearance.	The RTM will feature a visual presentation of both aerodromes being provided with a remote ATS. All equipment and technical features that require duplication shall be provided for each aerodrome in a separate or combined manner. The Remote TWR ATCO shall be able to easily distinguish between aerodromes and all duplicated features. With intuitive and swift switching of controls where required. Touch and control panels for each aerodrome are placed (and may be colour coded) to eliminate the risk of manoeuvring the wrong equipment and confusion.	Taxi out
2.	When landing aircraft no.1 is on final to aerodrome A, Remote TWR ATCO will use a binocular tool to inspect the runway of aerodrome A and assure it is free from any obstacles. After assuring that the RWY is free and the	Flight Crew of acft no. 1 acknowledge landing clearance and continue the approach.	Remote TWR ATCO uses the visual presentation to	Final Approach

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
	aircraft is on approximately 4NM final the TWR ATCO issues a landing clearance.		survey the aircraft on final, to see that everything looks normal in the aircraft configuration and approach.	
3	Makes a final visual confirmation in both the Flight Progress Board / e-strip system and the visual presentation that the RWY is free, then issues a take-off clearance to aircraft no. 2 at aerodrome B Monitors the acft during take-off roll and makes a note of the take-off time in the strip when the aircraft starts roll.	Aircraft no. 2 at aerodrome B approaches the RWY holding point and reports ready for take-off. Flight crew of acft no. 2 acknowledge the take-off clearance, lines up the aircraft and pulls the throttle for take-off.	Remote TWR ATCO monitors both aircraft on relayed visual presentation, by sweeping focus/eyes over the visual presentation of both aerodromes. Technical enablers may assist in the monitoring of both aircraft. AVFs may overlay additional information onto the visual presentation to assist the Remote TWR ATCO in identifying and monitoring both aircraft at the two aerodromes, on final approach and on runway for take-off respectively, e.g. wind measurements, runway visual range values, runway lights status.	Taxi out and Take Off
4.	Switches focus to aerodrome A and the landing aircraft no. 1 which now is on 1NM final. Monitors the landing to ensure safety and intervenes if required. When the aircraft has landed and is still under rollout after touch-down, the TWR ATCO issues a taxi clearance to aircraft no, 1 to the apron via the appropriate taxiway(s).	Flight Crew of acft no. 1 proceeds with the approach and lands the aircraft. Flight Crew of acft no. 1 proceeds acknowledges the taxi clearance.	Remote TWR ATCO monitors both aircraft on relayed visual presentation, by sweeping focus/eyes over the visual presentation of both aerodromes. Technical enablers may assist in the monitoring of both aircraft. AVFs may overlay additional information onto the visual presentation to assist the Remote TWR ATCO in identifying and monitoring both aircraft at the two aerodromes, on final approach and on runway for take-off respectively, e.g. wind measurements, runway visual range values, runway lights status.	Final Approach and Landing.
5.	Call aircraft no. 2 on aerodrome B frequency to report/relay take off time and to tell the flight crew to contact the APP/TMA sector on the appropriate frequency. Removes the strip from the Flight Progress Board / e-strip for aerodrome B as the aircraft is no longer under TWR responsibility.	Flight Crew of acft no. 2 acknowledge and reads back the APP/TMA frequency and says good bye.	Remote TWR ATCO monitors both aircraft on relayed visual presentation, by sweeping focus/eyes over the visual presentation of both aerodromes.	Climb out after Take Off

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
6.	Monitors aircraft no. 1 and verifies on the visual presentation when vacating the runway via the planned exit. Moves the strip from the runway bay to the taxi bay (and subsequently from the taxi bay to the apron bay when the aircraft have entered the apron.	Flight Crew of acft no. 1 continue taxing.	The ATCO may use an alternative viewpoint if available to view the taxiway to enhance the view and monitor more closely that the aircraft has left the RWY.	Taxi in

Table 41 – Operating Methods, Arriving and departing aircraft at two different aerodromes

5.1.9 Transition of Visual Presentation from Aerodrome A to Aerodrome B

5.1.9.1 General Conditions

GC1 - The Remote TWR ATCO is located in an RTM, located away from the aerodrome(s) and/or local Tower(s).

GC2 - The Remote TWR ATCO is providing ATS to two Aerodromes sequentially.

GC3 - The Remote TWR ATCO is situated at an RTM where they are presented with a visual presentation of only one aerodrome at a time but switching between the two aerodromes is possible.

5.1.9.2 Pre-Conditions

PreC1 - Remote ATCO is providing ATS for aerodrome A and B. At the start of this use case ATS is being provided to aerodrome A and hence this is the only aerodrome being viewed on the visual presentation.

5.1.9.3 Post-Conditions

PostC1 -Safe and efficient provision of ATS for the arrival aircraft, with the same or better levels of service as if the ATS had been provided locally

5.1.9.4 Operating Method, Nominal Flow

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
1	Remote TWR ATCO switches the visual presentation and all primary controls (e.g. e-strip) from aerodrome A to aerodrome B. It will clearly be indicated on the visual presentation that it now shows aerodrome B.	According to FPL, an aircraft shall request taxi for departure in 10 minutes at aerodrome B. At the present and within 20 minutes there are no aircraft moments expected at aerodrome A. Flight crew request taxi for departure at aerodrome B, according to FPL at least 10 minutes prior to departure.	Remote TWR ATCO will follow a checklist, to assure that the switch to aerodrome B is correctly done. Reference to section 3.4.4 which describes the use of traffic co-ordination in the concept. ATS of aerodrome A may be handed to another Remote TWR ATCO if using an RTC or ATS may be halted at aerodrome A. however the aerodrome will remain open.	On apron
2	Runway inspection performed at aerodrome B. Remote TWR ATCO approves start-up of the aircraft.	The flight crew request start up and when approved start the engines.	Runway inspection performed by visual presentation, technical enablers, AVFs and/or ground personnel.	On apron
3	Issue a clearance for the departing aircraft to taxi to the holding point of the runway-in-use.	The flight crew request taxi clearance to RWY in use.	The Remote TWR ATCO shall use visual surveillance and any technical enablers or AVFs to assist in monitoring the departure during the whole taxi procedure, to be sure that there will be no deviation from issued clearances. Enhancements may be used to highlight key areas along the taxiways, such as the holding points.	Taxi
4	Clears the aircraft for take-off	Flight crew acknowledges clearance and departs on runway-in-use		Take Off

Step	Remote TWR ATCO	Flight Crew	Notes	Phase
5.	At an operationally appropriate time after departure Remote TWR ATCO will transfer the aircraft to APP or ACC	Flight crew switch to APP(ACC) frequency		Take Off
6.	After a predefined time Remote TWR ATCO can, if requested, change to visual presentation of aerodrome A, following procedures as in 1 and 2.		When using the switch mode to operate multiple aerodromes there is likely to be advanced traffic coordination to negate the requirement for excessive switching.	

Table 42 – Operating Methods, Transition of Visual Presentation from Aerodrome A to B

5.1.10 Runway Inspection at Multiple Aerodromes during Night

5.1.10.1 General Conditions

GC1 - The Remote TWR ATCO is located in a remote tower module, located away from the aerodrome(s) and/or local Tower(s).

GC2 - The Remote TWR ATCO is providing ATS to multiple Aerodromes (in this case 3 aerodromes).

GC3 - The Remote TWR ATCO is situated at a RTM where they are presented with simultaneous visual presentations of all 3 aerodromes (Aerodrome A, B and C).

5.1.10.2 Pre-Conditions

PreC1 - The ATCO is providing ATS to three aerodromes simultaneously, the ATCO is operating during darkness at all three aerodromes.

5.1.10.3 Post-Conditions

PostC1 -Safe and efficient provision of ATS for the arrival aircraft, with the same or better levels of service as if the ATS had been provided locally.

5.1.10.4 Operating Method, Nominal Flow

Step	Remote TWR ATCO	Local Ground Staff	Notes	Phase
1.	A visual presentation of all aerodromes is provided simultaneously. As in local operations aerodrome lighting enables the ATCO to maintain visual. The ATCO surveys all aerodromes.	Local ground staffs are on hand at the aerodromes to provide any technical assistance; this includes clearing obstructions from onsite cameras etc. Ground staff should also be available to assist the ATCO in performing runway checks, runway clearing and bird scaring duties etc.	The display of aerodromes on visual presentation screens is determined by the RTM configuration. Aerodromes may be displayed on an equal number of screens or the ATCO may choose to have one aerodrome displayed on a larger number of screens for a clearer view (minimising the remaining aerodromes to be displayed on a reduced number of screens). However all aerodromes shall be provided with a visual presentation continuously.	N/A
2.	The ATCO inspects the runway of a specific aerodrome. The ATCOs finds an obstacle on the manoeuvring area. Contact is made with the local aerodrome ground staff via phone. The situation is monitored from the remote tower, the ATCO remains in contact with ground personnel to advise on the location of the obstacle.	Clearance of the obstacle is performed. Remote TWR ATCOs are contacted.	To inspect a specific runway in greater detail during night time the ATCO may use technical enablers or AVFs such as the binocular functionality or (if provided) an IR camera to enhance the visual presentation. The aerodrome should (in most cases, if possible) be displayed using a larger number of screens/uncompressed view. To enhance ATCO visibility of the aerodrome	
			The above steps 2-3 are repeated for each aerodrome. Contact with multiple aerodromes can be made via individual radio communications. If on performing runway checks etc. at Aerodrome A an aircraft makes contact at Aerodrome B full priority should be given to aerodromes with live traffic, however the ATCO remains responsible for all aerodromes and is continuously providing ATS to all.	

Table 43 – Operating Methods. Runway Inspection at Multiple Aerodromes during Night

5.1.11 Control of Vehicles in the Manoeuvring Area

5.1.11.1 General Conditions

GC1 - The Remote TWR ATCO is located in a remote tower module, located away from the aerodrome and/or local Tower.

GC2 - The Remote TWR ATCO is situated at an RTM where they are presented with a visual presentation of the aerodrome view.

GC3 - The Remote TWR ATCO is providing ATS to a single Aerodrome.

5.1.11.2 Pre-Conditions

PreC1 - Ground vehicle requests to proceed for movement within the manoeuvring area

5.1.11.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for the manoeuvring vehicle, with the same or better levels of service as if the ATS had been provided locally

5.1.11.4 Operating Method, Nominal Flow

Step	Remote TWR ATCO	Ground Crew	Notes	Phase
1.	Establishes contact (R/T) with the airside vehicle requesting movement within the manoeuvring area.	Call TWR on R/T and establish contact.		N/A
2.	Verifies that the manoeuvring area is free of obstacles and aircraft for drive of the vehicle and issues the "proceed to" clearance to the Ground Crew using R/T.	Acknowledges the clearance on R/T.	Remote TWR ATCO manoeuvring area check is performed by visual reference gained from the relayed visual presentation of the aerodrome.	N/A
3.	Monitors the vehicle's driving to ensure safety and intervenes if required.	Proceeds to requested destination within the manoeuvring area.	Remote TWR ATCO monitors vehicle on relayed visual presentation with the aid of technical enablers and where available AVFs.	N/A

4.	Acknowledge on R/T that the vehicle has reached its final destination.	Report on R/T that vehicle has reached final destination on the manoeuvring area.	Remote TWR ATCO monitors vehicle on relayed visual presentation with the aid of technical enablers and where available AVFs.	N/A

Table 44 – Operating Methods. Control of Vehicles in the Manoeuvring Area

5.2 Remote Provision of ATS in Contingency Situations

The below operational scenarios correspond to events surrounding a contingency situation impacting the local tower. The three scenarios below are related to the speed and type of event, namely sudden or gradual speed of outage and planned or unplanned events. The target environment is that of a large aerodrome and the contingency tower solution is not considered as a permanent tower replacement.

5.2.1 Unplanned Sudden Event (e.g. Fire, Bomb)

5.2.1.1 General Conditions

GC1 - The TWR ATCO is initially located in the local aerodrome tower.

GC2 - The TWR ATCO is providing ATS to a single aerodrome.

GC3 - The RCT is not initially in use, but is available at a location outside the local tower.

5.2.1.2 Pre-Conditions

PreC1 –Local Tower ATCO´s are responsible for providing ATS at manoeuvring area and CTR.

5.2.1.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for departing and arriving aircraft, with level of service and capacity as stated by airport authorities and ATS.

5.2.1.4 Operating Method, Nominal Flow

Step	Remote TWR ATCO	Flight Crew	Notes	Phase	Mode
1.			Emergency event occurs. No warning is possible.		Emergency Situation

Step	Remote TWR ATCO	Flight Crew	Notes	Phase	Mode
2.	Tower Evacuation is triggered according to local operating procedures. Temporary restrictions will be set and aircraft diverted as the aerodrome is immediately closed.	Flights approaching the aerodrome will be told to divert to an alternative aerodrome.	The aerodrome will be required to immediately close in accordance with local procedures for emergencies.	Approach Final Approach Landing	Service Continuity Degraded Mode of Operations
3.	ATCOs moved to a safe location (this may or may not be the RCT) and attended to. Once deemed acceptable ATCOs move to the RCT.		A Technician on watch has been alerted and sets up the RCT facility. If deemed necessary a new supporting team of ATCOs is contacted to take over the shift.		Service Continuity Degraded Mode of Operations
4.	ATCO shift enters RCT and checklists are performed. Procedures for starting up the RCT are followed.		ATCOs may require increased transition time, depending on their familiarity with the RCT.		Service Continuity Degraded Mode of Operations
5.	RCT facility takes over the responsibility of providing ATS. The RCT capacity is capped and slowly builds. The development of capacity is set according to proficiency checklists.		The aerodrome is reopened but movements remained restricted. RTC Supervisor informs NMOC (network manager) about present capacity.	Approach Final Approach Landing	Service Continuity Degraded Mode of Operations
6.	The transition into contingency phase is complete and contingency operations are established. *(Capacity has increased in gradual steps in line with proficiency checklists. The aim being to reach the maximum capacity conditions without safety detriment.)*				
7.	Establishes contact (R/T) with the inbound IFR flight crew when the aircraft is established on final approach.	Acknowledges contact.	RCT ATCO may also relay potential updates of the actual MET Report, displayed on the RTM and other relevant information e.g. regarding runway conditions to the Flight Crew (if no ATIS is available).	Final Approach	
8.	Verifies that the runway is free of obstacles for the landing of the aircraft and issues the landing clearance to the Flight Crew using	Acknowledges the landing clearance.	RCT ATCO runway check is performed by visual reference gained from the relayed visual presentation of the aerodrome.	Final Approach	

Step	Remote TWR ATCO	Flight Crew	Notes	Phase	Mode
	R/T.				
9.	Monitors the aircraft's final approach and landing to ensure safety and intervenes if required.	Proceeds with the approach and lands the aircraft.	Remote TWR ATCO monitors aircraft on relayed visual presentation. Technical enablers may assist in the monitoring of the aircraft. AVFs may overlay additional information onto the visual presentation to assist the Remote TWR ATCO in identifying and monitoring the aircraft on final approach e.g. wind measurements, runway visual range values, runway lights status.	Final Approach and landing.	
10.	Issue a clearance where to exit the runway. Verifies that the aircraft has vacated the runway via the planned exit. Issues a taxi clearance via appropriate taxiway(s) to the allocated stand on apron.	Executes the clearance and vacates runway Acknowledges the taxi clearance.	Remote TWR ATCO monitors aircraft on relayed visual presentation. The ATCO may use an alternative viewpoint if available to view the taxiway to enhance the view and monitor more closely that the aircraft has left the RWY.	Landing / Runway.	
11.	Monitors the traffic situation for the detection of potential hazardous situations (e.g. converging airport traffic, temporary obstructions, debris). If the Taxi Clearance Limit is an active runway, the RCT ATCO verifies that the runway is clear and the aircraft can cross and issues taxi route clearance(s) to the stand.	Acknowledges and accepts the route clearance, updating the aircraft system. Manoeuvre the aircraft assisted by the routing displayed on-board the aircraft and/or using visual navigation aids (e.g. taxiway markings and lighting).	RCT ATCO monitors aircraft on relayed visual presentation and/or technical enablers or AVF.	Taxi	

Table 45 – Operating Method. Contingency Situations

5.2.2 Unplanned Gradual Event (e.g. excessive wind warning)

5.2.2.1 General Conditions

GC1 - The TWR ATCO is initially located in the local aerodrome tower.

GC2 - The TWR ATCO is providing ATS to a single aerodrome.

GC3 - The Remote Contingency Facility is not initially in use, but is available at a location outside the local tower.

5.2.2.2 Pre-Conditions

PreC1 - Local Tower ATCO´s are responsible for providing ATS at manoeuvring area and CTR.

5.2.2.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for departing and arriving aircraft, with level of service and capacity as stated by airport authorities and ATS

5.2.2.4 Operating Method, Nominal Flow

Step	Local Tower ATCO	RCT facility ATCO	Notes	Phase	Mode
1.			Forecast foresees wind speed above maximum allowed to keep local Tower manned.		Emergency Situation
2.	Tower Supervisor plans move to RCT facility. Part of local Tower ATCO´s move to RCT facility. Neighbouring ATS will be informed. NMOC (network manager) will be informed and temporary restrictions will be set.			Approach Final Approach Landing	Service Continuity Degraded Mode of Operations

3.		ATCO´s that have resettled from local Tower prepare to take over the responsibility of ATS at the aerodrome.	A Technician on watch has been alerted and sets up the RCT facility.		Service Continuity Degraded Mode of Operations
4.	Local Tower ATCO´s transfer, step by step, the responsibility of ATS to RCT facility ATCO´s,	RCT facility takes over the responsibility of providing ATS.		Approach Final Approach Landing	Service Continuity Degraded Mode of Operations
5.	Remaining local Tower personnel relocate to RCT facility.		RTC supervisor informs NMOC (network manager) about present capacity.	Approach Final Approach Landing	Service Continuity Degraded Mode of Operations
6.	The transition into contingency phase is complete and contingency operations are established. (capacity capped until proficiency checks have been fulfilled, return to normal operating capacity should there after only been impacted by external conditions)				

Table 46 – Operating Method, Unplanned Gradual Event

5.2.3 Planned Use of Contingency Facility (e.g. scheduled maintenance)

5.2.3.1 General Conditions

GC1 - The TWR ATCO is initially located in the local aerodrome tower.

GC2 - The TWR ATCO is providing ATS to a single aerodrome.

GC3 - The Remote Contingency Facility is not initially in use, but is available at a location outside the local tower.

5.2.3.2 Pre-Conditions

PreC1 - The local Tower ATCO´s are ready to handover responsibility of ATS to Contingency Tower ATCO´s.

5.2.3.3 Post-Conditions

PostC1 - Safe and efficient provision of ATS for departing and arriving aircraft, with level of service and capacity as stated by airport authorities and ATS.

5.2.3.4 Operating Method, Nominal Flow

Step	Local Tower ATCO	RCT facility ATCO	Notes	Phase	Mode
1.			An example of a planned contingency event would be that the local Tower is to be closed due to maintenance. The move to contingency Tower is planned well in advance and all authorities and companies are informed. A capacity rate is set during the period when the RCT is used for providing ATS. NMOC (network manager) is informed of the rate.		Outage
2.		Contingency Tower is manned and ready to take responsibility of ATS at the aerodrome and CTR.	To be done during a low traffic density period. All checks of equipment are performed and the RCT is fully up and running.	All	Service Continuity
3.	Local Tower ATCO´s gradually and according to plan are transferring the responsibility of ATS to Contingency ATCO´s.	Contingency Tower ATCO´s gradually and according to plan are to take over responsibility of ATC		All	Service Continuity
4.	Local Tower ATCO´s are closing Tower, after a period of shadow mode.	Contingency Tower ATCO´s are now responsible for ATS at the aerodrome and CTR.	Capacity at the aerodrome shall be as predefined at step 1.	All	Service Continuity
5.			When local Tower is ready to be used again, step 2-4 will occur in reverse order.		Recovery to Normal Operations

Table 47 – Operating Method, Planned Use of Contingency Facility

6 Requirements

Requirements presented in this section include conceptual, regulatory, operational, functional, performance, human performance, safety and security level requirements for OFA06.03.01. These requirements form a direct input to P12.04.07 and will be further developed and detailed, where applicable, within the Technical Specification produced by P12.04.07.

The set of requirements have been amended during the course of the project as a result of the validation activities performed within P06.09.03 & P06.08.04, as well as the Safety and Human Performance assessments performed within P06.09.03. This final OSED edition from P06.09.03 includes;

- A set of conceptual, regulatory, operational, functional and performance requirements for the Single aerodrome application (as defined by OI step SDM-0201), based on validation results from; EXE-06.09.03-VP-056, EXE-06.09.03-VP-057 and EXE-06.09.03-VP-058, as well as EXE-06.08.04-VP-638.
- A set of conceptual, regulatory, operational, functional and performance requirements for the Multiple aerodrome application (as defined by OI step SDM-0205), based on the validation exercises performed; EXE-06.09.03-VP-060, EXE-06.09.03-VP-061 and EXE-06.09.03-VP-063 as well as EXE-06.08.04-VP-641.
- A set of conceptual requirements for the Contingency application (as defined by OI step SDM-0204), based on conceptual findings but also incorporating validation results from EXE-06.09.03-VP-059 and EXE-06.09.03-VP-062.
- Security requirements, based on the Security Risk Assessment Report produced by WP16.06.02 ("06.03.01 Remote and Virtual Tower Security Risk Assessment", Edition 00.00.02, 09/12/2013). The one security requirement is tagged with the <Security> attribute in the Category field of the requirement table.
- Safety and Human Performance requirements, based on their respective assessment reports produced within P06.09.03. Safety requirements are tagged with the <Safety> attribute in the Category field of the requirement table, whilst references to the applicable safety requirements in the SAR reports are given in the Rationale field. Human Performance requirements are tagged with the <HMI> attribute in the Category field of the requirement table, whilst references to the applicable human performance requirements in the Human Performance Assessment Reports are given the Rationale field. It should be noted that:
  - This OSED takes the role of an Safety and Performance Requirements Document (SPR) for OFA06.03.01 (as no SPR is being produced within P06.09.03);
  - Safety and Human Performance requirements within this document represent the governing higher level requirements on a concept level, whereas the requirements as laid out within the respective Safety and Human Performance Assessment report represent lower level requirements, sometimes applicable on the validation platform level.
- Traceability links to requirements appointed to OFA06.03.01 within the WP6 Airport Detailed Operational Descriptions for Step 1 and Step 2 (produced by P06.02.00), are included for those DOD requirements deemed applicable. These traceability links are to be found under the Concept Requirements section. (See below for a description of the different subsections within this Chapter 6.) (For the DOD requirements appointed to OFA06.03.01 but by P06.09.03 not deemed as being applicable, this has been fed back to P06.02.00 for coordination.)

The requirements are divided in the following subsections:

Section **6.1** contains concept requirements derived for the RVT concept, stating the goals of the concept. Requirements are presented as overall baseline concept requirements, as well as concept requirements specific for the three applications of Single, Multiple and Contingency. All the links to the P06.02 DOD requirements are to be found in this section.

Section **0** contains a review of 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 these requirements are all applicable for the RVT concept.

Section **6.3** lists operational, functional and performance requirements that apply in the Remote environment, explaining how to fulfil the service requirements detailed in Section 0 at the same time as achieving the goals for the concept as detailed in Section 6.1. The requirements are generally valid both for the Single and Multiple aerodrome applications (aside from some specific requirements were for Multiple aerodrome applications the prioritisation / importance has been elevated compared to Single).

Section **6.4** details additional requirements for the Multiple aerodrome application, for those circumstances where the requirements in section 6.3 are not enough when operation in a multiple environment.

Section **6.5** comprises a set of higher level placeholder type requirements, to be used if building an ATS contingency solution based on the RVT concept.

Most of the requirements are applicable to both TWR and AFIS. For those requirements which are not applicable to both services, the Rationale field of the requirement states clearly which of the services ATC (TWR) or AFIS that is targeted.

All requirements are written and prioritised in accordance with the guidelines and instructions as laid out by the “Requirements and VV Guidelines”, Edition 03.01.00 and the “Templates and Toolbox User Manual, Edition 03.01.01.

The following prioritisation / importance level are used:

Essential: indicates that the requirement is mandatory. A failure to meet an Essential requirement implies that the intended concept is of limited value.

Essential requirements are indicated by the word ***shall*** in the requirement text **and** by the text string <Essential> in the Importance field of each requirement table. (The latter only visible when showing “hidden text” of this document).

Important: indicates that the requirement is important. A failure to meet an Important requirement implies that the intended concept scope is reduced.

Important requirements are indicated by the word ***should*** in the requirement text **and** by the text string <Important> in the Importance field of each requirement table. (The latter only visible when showing “hidden text” of this document).

Desirable: indicates that the requirement is optional.

Desirable requirements are indicated by the word ***may*** in the requirement text and by the text string <Desirable> in the Importance field of each requirement table. (The latter only visible when showing “hidden text” of this document).

Each requirement table has a section with “hidden text” for easier reading of the document. To see the full tables, “hidden text” has to be enabled. If not, only the “Identifier” and

"Requirement" fields of each table are visible. "Hidden text" can also be toggled on/off via the ¶ button (if not enabled in "Word Options").

6.1 Concept Requirements

This section presents the concept requirements derived for the RVT concept, stating the overall goals for the concept on its full/wider scope (i.e. not limited to the current scopes of SDM-0201, -0204 and -0205 or the environments which have been assessed). Requirements are presented as overall baseline concept requirements, as well as concept requirements specific for the three applications of Single, Multiple and Contingency. All the traceability links from this OSED and requirements to the P06.02 DOD requirements are to be found among the applicable requirements presented in this section.

Note: Each requirement table has a section with "hidden text" for easier reading of the document. Viewing of "hidden text" can be toggled on/off via the ¶ button.

6.1.1 Baseline Concept Requirements

Identifier	REQ-06.09.03-OSED-BC01.0001
Requirement	ATCO/AFISOs ***shall*** provide aerodrome Air Traffic Services (ATS) from a remote location.

Identifier	REQ-06.09.03-OSED-BC01.0008
Requirement	For each Remote & Virtual Tower application, minimum Security Management levels and applicable minimum security measures ***shall*** be defined, in order to maintain airport operations at or above the current local operations level.

Identifier	REQ-06.09.03-OSED-BC01.0009
Requirement	The Remote & Virtual Tower Concept ***shall*** contribute to the overall cost reduction of the European gate-to-gate ATM, by reducing costs for performing ATS at aerodromes.

Identifier	REQ-06.09.03-OSED-BC01.0010
Requirement	The Remote & Virtual Tower Concept ***shall*** contribute to the overall improvement of uniformity of ATM services.

6.1.2 Concept Requirements Single Aerodrome Applications

Identifier	REQ-06.09.03-OSED-CS03.0001
Requirement	The ATCO/AFISO ***shall*** provide ATS to one aerodrome from a single RTM.

Identifier	REQ-06.09.03-OSED-CS03.0002
Requirement	The ATCO/AFISO ***should*** provide ATS to more than one aerodrome sequentially from a single RTM.

Identifier	REQ-06.09.03-OSED-CS03.0003
Requirement	The Single Aerodrome Application part of the Remote & Virtual Tower Concept ***shall*** contribute to the reduction of direct cost of gate-to-gate ATM (where the target for OFA06.03.01 in SESAR Step 1 (SDM-0201) as defined by WP6.2 DOD [7] is 0,27%).

6.1.3 Concept Requirements Multiple Aerodrome Applications

Identifier	REQ-06.09.03-OSED-CM04.0001
Requirement	The ATCO/AFISO ***shall*** provide ATS for more than one aerodrome simultaneously from a single RTM.

Identifier	REQ-06.09.03-OSED-CM04.0007
Requirement	The Multiple Aerodrome Application part of the Remote & Virtual Tower Concept ***shall*** contribute to the reduction of direct cost of gate-to-gate ATM (where the target for OFA06.03.01 in SESAR Step 2 (SDM-0204 & SDM-0205) as defined by WP6.2 DOD [8] is 0,48%).

6.1.4 Concept Requirements Contingency Applications

Identifier	REQ-06.09.03-OSED-CC05.0001
Requirement	The ATCOs ***shall*** provide ATS for an aerodrome from a Remote Contingency Tower (RCT) in situations where the primary ATC tower is not usable.

Identifier	REQ-06.09.03-OSED-CC05.0002
Requirement	The Contingency Aerodrome Application part of the Remote & Virtual Tower Concept ***shall*** contribute to the reduction of direct cost of gate-to-gate ATM (where the target for OFA06.03.01 in SESAR Step 2 (SDM-0204 & SDM-0205) as defined by WP6.2 DOD [8] is 0,48%).

6.2 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.

Note: Each requirement table has a section with "hidden text" for easier reading of the document. Viewing of "hidden text" can be toggled on/off via the ¶ button.

6.2.1 Communications

Identifier	REQ-06.09.03-OSED-CO02.1001
Requirement	The ATCO/AFISO ***shall*** use aeronautical mobile service (air-ground communications) in the area of responsibility, in accordance with ICAO Annex 11, Chapter 6.1.

Identifier	REQ-06.09.03-OSED-CO02.1002
Requirement	The ATCO/AFISO ***shall*** use aeronautical fixed service (ground-ground communications) in accordance with ICAO Annex 11, Chapter 6.2.

Identifier	REQ-06.09.03-OSED-CO02.1003
Requirement	The ATCO/AFISO ***shall*** 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.

Identifier	REQ-06.09.03-OSED-CO02.1004
Requirement	The ATCO/AFISO ***shall*** be able to communicate via a signalling lamp with the respective aircraft, 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.

Identifier	REQ-06.09.03-OSED-CO02.1005
Requirement	Visual communication from aircraft on and in the vicinity of the aerodrome ***shall*** be used when/as applicable, in accordance with ICAO Doc 4444 Chapter 12.3.4.

6.2.2 MET Functions & Procedures

Identifier	REQ-06.09.03-OSED-MT02.2001
Requirement	The ATCO/AFISO ***shall*** use relevant meteorological information, in accordance with ICAO Annex III, ICAO Annex 11 Chapter 7.1 and national regulations.

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 ***shall*** 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.

Identifier	REQ-06.09.03-OSED-MT02.2003
Requirement	The ATCO/AFISO ***shall*** advise aircraft of significant meteorological conditions in the take-off and climb-out area, except when it its known that the information has already been received by the aircraft, in accordance with ICAO Doc 4444 Chapter 7.4.1.2.2.

6.2.3 Visualisation

Identifier	REQ-06.09.03-OSED-VS02.3001
Requirement	The ATCO ***shall***, from the remote location, apply ICAO Doc 4444, Chapter 7.1.1.2: *"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 in low visibility conditions by an ATS surveillance system when available."*

Identifier	REQ-06.09.03-OSED-VS02.3002
Requirement	The AFISO ***shall***, from the remote location, apply Eurocontrol Manual for AFIS Chapter 3.1.2: *"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."*

Identifier	REQ-06.09.03-OSED-VS02.3003
Requirement	The ATCO/AFISO ***shall*** issue information (TWR & 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) & Chapter 4.5.1.1, Eurocontrol Manual for AFIS, 3.1.1, bullet point e).

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).

6.2.4 NAV Functions

Identifier	REQ-06.09.03-OSED-NV02.4001

Requirement	The ATCO/AFISO ***shall*** 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.

Identifier	REQ-06.09.03-OSED-NV02.4002
Requirement	The ATCO/AFISO ***shall*** monitor and adjust the status of non-visual navigational aids, in accordance with ICAO Annex 11 Chapter 7.3.

6.2.5 Other ATS Systems / Functions / Procedures

Identifier	REQ-06.09.03-OSED-FN02.5001
Requirement	The ATCO/AFISO ***should*** 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.

Identifier	REQ-06.09.03-OSED-FN02.5002
Requirement	The ATCO/AFISO ***shall*** access and handle ATS messages, in accordance with ICAO Doc 4444 Chapter 11.

Identifier	REQ-06.09.03-OSED-FN02.5003
Requirement	The ATCO/AFISO ***shall*** 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.

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

Identifier	REQ-06.09.03-OSED-FN02.5005
Requirement	Correct time, in the format of hours, minutes and seconds in UTC, ***shall*** be continuously presented to the ATCO/AFISO), in accordance with ICAO Doc 4444 Chapter 7.3.1.2.

Identifier	REQ-06.09.03-OSED-FN02.5006
Requirement	The ATCO/AFISO ***shall*** 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.

Identifier	REQ-06.09.03-OSED-FN02.5007
Requirement	The ATCO/AFISO ***shall*** be provided with all relevant operational data (e.g. AIP information, NOTAMs, Manual of operations etc.) required for conducting the ATS tasks.

Identifier	REQ-06.09.03-OSED-FN02.5008
Requirement	The ATCO/AFISO ***shall*** alert the rescue and fire fighting services in accordance with ICAO Doc 4444 Chapter 7.1.2.

Identifier	REQ-06.09.03-OSED-FN02.5009
Requirement	The ATCO/AFISO ***shall*** 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.

6.2.6 Voice and Data Recording

Identifier	REQ-06.09.03-OSED-DR02.6001
Requirement	Necessary communications and data ***shall*** 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.

6.3 Remote Operations Requirements

The requirements that are listed in Section 0 originate from the fact that the aim of the RVT concept is to provide the same set of services as are provided from conventional towers, meaning that the regulatory, operational and functional requirements on a conventional tower should also be applicable to 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 detailed in Section 0 at the same time as achieving the goals for the concept as detailed in Section 6.1.

The requirements in this section are generally valid both for the Single and Multiple aerodrome applications. However some specific requirements have a higher prioritisation / importance level for Multiple aerodrome applications than for Single (and are then detailed (again) in section **Error! Reference source not found.**, alongside all the Multiple Remote Tower Requirements, but with the higher prioritisation/importance level). Those specific requirements, as detailed here in section 6.3, are as such hence only valid for the Single application. For those requirements the Rationale field states “Requirement applicable to the SINGLE aerodrome environment only”.

The requirements are based on the OI steps and environments which have been assessed, i.e. SDM-0201, SDM-0204 and SDM-0205.

Note: Each requirement table has a section with “hidden text” for easier reading of the document. Viewing of “hidden text” can be toggled on/off via the ¶ button.

6.3.1 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 ***should*** 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).

Identifier	REQ-06.09.03-OSED-RTC3.0005
Requirement	All RTMs in a RTC ***should*** be unified in terms of HMI and equipment (in order to contribute to the overall improvement of uniformity of ATM services).

Identifier	REQ-06.09.03-OSED-RTC3.0006
Requirement	RTC ***should*** enable transfer of responsibility of ATS for aerodromes between RTMs within an RTC.

Identifier	REQ-06.09.03-OSED-RTC3.0007
Requirement	If compliant with REQ-06.09.03-OSED-RTC3.0006, RTC ***shall*** enable the service provision to be uninterrupted during transfer of responsibility between RTMs.

6.3.2 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. However an RTC supervisor role is not essential within the scope of SDM-0201 and SDM-0204 (nor in SDM-0205).

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 ***should*** 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).

Identifier	REQ-06.09.03-OSED-SUP3.0010
Requirement	If implemented, the RTC Supervisor role ***shall*** 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.

Identifier	REQ-06.09.03-OSED-SUP3.0011
Requirement	If implemented, the RTC Supervisor role ***shall*** access functions for the monitoring and coordination of responsibilities between different RTMs within the RTC.

Identifier	REQ-06.09.03-OSED-SUP3.0012
Requirement	If implemented, the RTC Supervisor role ***should*** access functions for the monitoring of airport systems status for all aerodromes and all RTC systems.

Identifier	REQ-06.09.03-OSED-SUP3.0013
Requirement	If implemented, the RTC Supervisor role ***shall*** access functions for the monitoring of weather conditions for all aerodromes.

Identifier	REQ-06.09.03-OSED-SUP3.0014
Requirement	If implemented, the RTC Supervisor role ***shall*** access functions for communicating the status of RTC and aerodromes and coordinating maintenance (to be carried out by a qualified engineer/technician).

6.3.3 Procedures Related to Remote Operations

Requirements in this section detail specific (operational) procedures that have been identified as being needed when operating remote.

Identifier	REQ-06.09.03-OSED-RTC3.0008
Requirement	The ATCO/AFISO/RTC Supervisor (if implemented) ***shall*** 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.

Identifier	REQ-06.09.03-OSED-RTC3.0015
Requirement	Airspace users ***should*** be informed about the remote provision of ATS, e.g. through AIP or NOTAMs.

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 ***shall*** be developed and agreed.

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 ***shall*** take place between the local tower and the RTM prior to transfer of ATS provision from one to the other.

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 ***shall*** be developed.

Identifier	REQ-06.09.03-OSED-RTC3.0019
Requirement	Degraded mode procedures for all systems, including new system elements (such as the visual presentation) ***shall*** be developed for every local implementation.

Identifier	REQ-06.09.03-OSED-RTC3.0020
Requirement	ATCO/AFISOs ***shall*** 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.

6.3.4 Visualisation

6.3.4.1 Visualisation – General

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), ***shall*** be provided.

Identifier	REQ-06.09.03-OSED-VG03.1002
Requirement	The visual presentation ***should*** incorporate enhancements that improve the visual range and resolution compared to unaided viewing, to provide the ATCO/AFISO a greater level of situational awareness.

Identifier	REQ-06.09.03-OSED-VG03.1004

Requirement	The visual presentation ***should*** incorporate additional sensors that improve the visual range and resolution 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.

Identifier	REQ-06.09.03-OSED-VG03.1003
Requirement	The visual presentation ***may*** be augmented with additional (digital) information, to provide the ATCO/AFISO a greater level of situational awareness and to minimise ATCO/AFISO heads down time.

6.3.4.2 Visualisation – Characteristics

Identifier	REQ-06.09.03-OSED-VC03.1101
Requirement	The visual presentation ***shall*** be designed to avoid unnecessary discontinuities or non-uniformities of the presented view.

Identifier	REQ-06.09.03-OSED-VC03.1104
Requirement	The visual presentation, including any additional sensors and the binocular functionality, ***shall*** provide a smooth and regular impression of moving objects to the human eye.

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 ***shall*** not negatively affect the ability to perform the ATS service.

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 ***shall*** 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.

6.3.4.3 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
  - 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 ***shall*** be able to visually detect an aircraft of type A320, ATR72 or similar size on 4NM final, by using the visual presentation (excluding the binocular functionality).

Identifier	REQ-06.09.03-OSED-VQ03.1207
Requirement	During daylight CAVOK conditions, the ATCO/AFISO ***shall*** be able to visually recognise an aircraft of type A320, ATR72 or similar size on 4NM final, by using the visual presentation in combination with the binocular functionality.

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 ***should*** 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.

Identifier	REQ-06.09.03-OSED-VQ03.1203
Requirement	During daylight CAVOK conditions, the ATCO/AFISO ***should*** 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.

Identifier	REQ-06.09.03-OSED-VQ03.1208
Requirement	During CAVOK conditions, the ATCO/AFISO ***shall*** be able to visually detect all flight operations and vehicles on the manoeuvring area, by using the visual presentation (excluding the binocular functionality).

Identifier	REQ-06.09.03-OSED-VQ03.1209
Requirement	During CAVOK conditions, the ATCO/AFISO ***shall*** be able to visually recognise all flight operations and vehicles on the manoeuvring area, by using the visual presentation in combination with the binocular functionality.

Identifier	REQ-06.09.03-OSED-VQ03.1205
Requirement	During daylight CAVOK conditions, the ATCO/AFISO ***should*** be able to visually detect obstructions on the manoeuvring area, by using the visual presentation in combination with the binocular functionality.

Identifier	REQ-06.09.03-OSED-VQ03.1210
Requirement	During daylight CAVOK conditions, the ATCO/AFISO ***shall*** be able to visually recognise personnel on the manoeuvring area, by using the visual presentation in combination with the binocular functionality.

Identifier	REQ-06.09.03-OSED-VQ03.1206
Requirement	Depending on visibility and daylight/darkness conditions, the ATCO/AFISO ***may*** 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.

Identifier	REQ-06.09.03-OSED-VQ03.1211
Requirement	The ATCO/AFISO ***may*** 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.: - aircraft flashing or showing landing lights (in darkness). - moving ailerons (or rudder). (in daylight) - aircraft repeatedly changing its bank angle - "rocking wings" (in daylight).

6.3.4.4 Visualisation – Augmentation

Identifier	REQ-06.09.03-OSED-VA03.1401
Requirement	The visual presentation ***may*** incorporate overlaid information associated with a specific element or target in the visual field, aiding or facilitating detection, recognition, identification and ranging of objects relevant for the service provision - in order to minimise ATCO/AFISO heads down time.

Identifier	REQ-06.09.03-OSED-VA03.1402
Requirement	The visual presentation ***may*** incorporate overlaid information to indicate / high light specific parts of the aerodrome, such as runways, taxiways, in order to enhance the ATCO/AFISO situational awareness, specifically in darkness and low visibility conditions.

Identifier	REQ-06.09.03-OSED-VA03.1403
Requirement	The visual presentation ***may*** incorporate overlaid information pertinent to the general area of interest or area of responsibility, in order to assist, enhance situational awareness and minimise ATCO/AFISO head down time.

Identifier	REQ-06.09.03-OSED-VA03.1404
Requirement	If any overlaid information - as defined in REQ-06.09.03-OSED-VA03.1401, REQ-06.09.03-OSED-VA03.1402 or REQ-06.09.03-OSED-VA03.1403 - is implemented in the visual presentation, such overlaid information ***shall*** be possible to toggle on/off as well as to adjust in light intensity by the operator.

6.3.4.5 Visualisation – Binocular Functionality

Identifier	REQ-06.09.03-OSED-BF03.1501
Requirement	The binocular functionality ***shall*** be simple, quick and easy to use.

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

Identifier	REQ-06.09.03-OSED-BF03.1503
Requirement	The binocular functionality ***shall*** include a moveable zoom feature with a visual indication of the direction of bore sight.

Identifier	REQ-06.09.03-OSED-BF03.1504
Requirement	The binocular functionality ***should*** include predefined and user-definable positions (where a position is based on automatic (predefined / user-definable) zoom, pan-tilt and focus).

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

Identifier	REQ-06.09.03-OSED-BF03.1506
Requirement	The binocular functionality ***should*** include automatic tracking of moving aircraft, vehicles or obstructions (e.g. personnel or large animals).

Identifier	REQ-06.09.03-OSED-BF03.1507
Requirement	The means of directing the signalling lamp towards the applicable aircraft ***may*** be combined with the binocular functionality.

6.3.5 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 ***may*** access the actual outdoor sound from the remote airport.

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 ***shall*** be adjustable and possible to be turned off by the operator.

6.3.6 Other ATS Systems / Functions

Identifier	REQ-06.09.03-OSED-FN03.3001

Requirement	The ATCO/AFISO ***should*** access an electronic system for the presentation and updating of flight plan and control data (in accordance with ICAO Doc 4444 Chapter 4.13).

Identifier	REQ-06.09.03-OSED-FN03.3002
Requirement	When RTC enables transfer of responsibility of ATS for aerodromes between RTMs within the RTC, the ATCO/AFISO ***shall*** access an electronic system for the presentation and updating of flight plan and control data (in accordance with ICAO Doc 4444 Chapter 4.13).

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 ***should*** use pre-set functions for the most common actions, e.g. creating a new strip for a pop up VFR flight.

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 ***may*** be done automatically (as in not being performed by manual coordination by the ATCO/AFISO).

Identifier	REQ-06.09.03-OSED-FN03.3005
Requirement	In low visibility conditions, the ATCO/AFISO ***may*** be notified about an aircraft or vehicle entering or vacating the runway. Note: Such notifications can be particularly helpful in low visibility conditions.

Identifier	REQ-06.09.03-OSED-FN03.3006
Requirement	The ATCO/AFISO ***may*** be warned about an aircraft or vehicle entering the runway without clearance.

Identifier	REQ-06.09.03-OSED-FN03.3007
Requirement	The ATCO/AFISO ***may*** be warned about an aircraft or vehicle entering the manoeuvring area without clearance.

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 ***shall*** be extended to include systems and/or data that are specific to remote tower operations, such as detecting corrupt/delayed/frozen visual presentation.

6.3.7 Voice and Data Recording

Identifier	REQ-06.09.03-OSED-DR03.4001
Requirement	Recording of necessary communications and data ***shall*** 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).

6.3.8 Work Environment

Identifier	REQ-06.09.03-OSED-WE03.5001
Requirement	Working Environment ***should*** permit day light conditions equal to ordinary office establishments.

Identifier	REQ-06.09.03-OSED-WE03.5002
Requirement	Working Environment (noise, temperature etc) ***shall*** be according national regulations for normal office establishments.

Identifier	REQ-06.09.03-OSED-WE03.5003
Requirement	Working Environment ***shall*** enable the ATCO/AFISO to adjust the lighting conditions in the RTM in order to adapt to the conditions at the remote airport(s).

Identifier	REQ-06.09.03-OSED-WE03.5004
Requirement	If several RTMs are collocated in a RTC, the ATCO/AFISO ***should*** be able to control the lights individually for each RTM in a RTC.

Identifier	REQ-06.09.03-OSED-WE03.50053677
Requirement	Working Environment ***shall*** enable sufficient writing space in the CWP for the ATCO/AFISO to make manual notes.

Identifier	REQ-06.09.03-OSED-WE03.5006
Requirement	The CWP ***should*** be designed according to good ergonomical design principles and allow for a degree of flexibility for user adaption.

6.3.9 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 ***shall*** be operationally acceptable as per local implementation and as per applicable regulations.

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, ***shall*** be defined on local implementation level in order to be operationally acceptable.

6.4 Additional Multiple Aerodrome Requirements

This section presents additional requirements applicable for the Multiple Aerodrome application, adding on to the requirements already detailed in section 6.2 and 6.3. The requirements are based on the OI step and environments which have been assessed, i.e. simultaneous ATS of two low density aerodromes (SDM-0205). The requirements can largely also be assumed to be valid for other operational contexts - such as larger aerodromes and more than two simultaneous airports - but as such some requirements may be elevated to mandatory and new requirements may need to be added, for other such use cases.

Note: Each requirement table has a section with "hidden text" for easier reading of the document. Viewing of "hidden text" can be toggled on/off via the ¶ button.

6.4.1 Multiple handling

Identifier	REQ-06.09.03-OSED-MH04.1001
Requirement	For each RTM, the ATCO/AFISO ***shall*** provide service for all aerodromes under the responsibility of that RTM, at any one time.

Identifier	REQ-06.09.03-OSED-MH04.1002
Requirement	For each RTM, it ***shall*** be clearly indicated to the ATCO/AFISO which aerodromes that ATS are under the responsibility of that RTM, allowing for a distinct and easy identification of each aerodrome.

Identifier	REQ-06.09.03-OSED-MH04.1003
Requirement	For each RTM, the design ***shall*** ensure that there is no ambiguity for the ATCO/AFISO as to which aerodrome's systems are manoeuvred.

Identifier	REQ-06.09.03-OSED-MH04.1007
Requirement	The ATCO/AFISO ***shall*** be provided with all systems and data required to perform the ATS for all aerodromes under his/her responsibility.

6.4.2 Procedures Related to Multiple Remote Operations

Identifier	REQ-06.09.03-OSED-MP04.0001

Requirement	In case of an unexpected event, 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/AFISO ***shall,*** in order to be able to manage the abnormal situation, perform one of the following actions: • Temporarily stop traffic at the other airport(s), • Transfer the provision of ATS - for either the airport experiencing the unexpected event, or the other airport(s) - to another RTM in the RCT, • Request another ATCO/AFISO in the RTC to support her/him, in order to be able continue the provision of ATS for all aerodromes under responsibility, from the same RTM. Note: The RTC Supervisor, if implemented, may support the controller to apply these procedures.

Identifier	REQ-06.09.03-OSED-MP04.0002
Requirement	When combining airports for Multiple ATS provision from an RTM, considerations of which airports that are suitable to combine ***shall*** be done, in terms of traffic levels & complexity and other aspects such as geographical location, RWY orientation, etc.

6.4.3 Communication

Identifier	REQ-06.09.03-OSED-MC04.2001
Requirement	When ATS is performed to more than one aerodrome simultaneously from one RTM, the ATCO/AFISO ***shall*** be able to listen to all aeronautical mobile service (air-ground communications) communication channels for all aerodromes being served.

Identifier	REQ-06.09.03-OSED-MC04.2002
Requirement	When ATS is performed to more than one aerodrome simultaneously from one RTM, the ATCO/AFISO ***shall*** for the aeronautical mobile service (air-ground communications), be able to transmit either to “all aerodromes” being served or to an “individual aerodrome”.

Identifier	REQ-06.09.03-OSED-MC04.2003
Requirement	When ATS is performed to more than one aerodrome simultaneously from one RTM, aeronautical mobile service (air-ground communications) ***should*** be (possible to be) retransmitted / relayed between all aerodromes (often referred to as frequency coupling) being served from the RTM.

Identifier	REQ-06.09.03-OSED-MC04.2004
Requirement	When ATS is performed to more than one aerodrome simultaneously from one RTM, the ATCO/AFISO ***shall*** use aeronautical fixed service (ground-ground communications) extended to cover communications with all units relevant for all aerodromes being served.

Identifier	REQ-06.09.03-OSED-MC04.2005

Requirement	When ATS is performed to more than one aerodrome simultaneously from one RTM, the ATCO/AFISO ***shall*** be able to listen to all surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes) communication channels for all aerodromes being served.

Identifier	REQ-06.09.03-OSED-MC04.2006
Requirement	When ATS is performed to more than one aerodrome simultaneously from one RTM, the ATCO/AFISO ***shall*** for the surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes), be able to transmit to individual aerodromes.

Identifier	REQ-06.09.03-OSED-MC04.2007
Requirement	When ATS is performed to more than one aerodrome simultaneously from one RTM and when there is a possibility of confusion due airports having the same or similar RWY designators (and if transmissions are not performed to individual aerodromes) - the inclusion of airport names in clearances / radio transmissions ***shall*** be considered as a standard procedure.

6.4.4 Visualisation

6.4.4.1 Visualisation – General

Identifier	REQ-06.09.03-OSED-MV04.3001
Requirement	The visual presentation ***should*** be augmented with additional (digital) information, to provide the ATCO/AFISO a greater level of situational awareness and to minimise ATCO/AFISO heads down time.

6.4.4.2 Visualisation – Augmentation

Identifier	REQ-06.09.03-OSED-MA04.3101
Requirement	The visual presentation ***should*** incorporate overlaid information associated with a specific element or target in the visual field, aiding or facilitating detection, recognition, identification and ranging of objects relevant for the service provision - in order to minimise ATCO/AFISO heads down time.

Identifier	REQ-06.09.03-OSED-MA04.3102
Requirement	The visual presentation ***should*** incorporate overlaid information to indicate / high light specific parts of the aerodrome, such as runways, taxiways, in order to enhance the ATCO/AFISO situational awareness, specifically in darkness and low visibility conditions.

Identifier	REQ-06.09.03-OSED-MA04.3103
Requirement	The visual presentation ***should*** incorporate overlaid information pertinent to the general area of interest or area of responsibility, in order to assist, enhance situational awareness and minimise ATCO/AFISO head down time.

Identifier	REQ-06.09.03-OSED-MA04.3104
Requirement	If any overlaid information - as defined in REQ-06.09.03-OSED-MA04.3101, REQ-06.09.03-OSED-MA04.3102 or REQ-06.09.03-OSED-MA04.3103 - is implemented in the visual presentation, such overlaid information ***shall*** be possible to be toggled on/off as well as to adjust in light intensity by the operator.

6.4.5 Airport sound

Identifier	REQ-06.09.03-OSED-MS04.3201
Requirement	In order to increase situational awareness and compensate for being placed remote in a multiple environment, the ATCO/AFISO ***should*** access the actual outdoor sound from the remote airports.

Identifier	REQ-06.09.03-OSED-MS04.3202
Requirement	If a function for actual outdoor sound reproduction is implemented (REQ-06.09.03-OSED-MS04.3201), the volume ***shall*** be adjustable and possible to be turned off by the operator, individually for each airport.

Identifier	REQ-06.09.03-OSED-MS04.3203
Requirement	If a function for actual outdoor sound reproduction is implemented (REQ-06.09.03-OSED-MS04.3201), the sound ***shall*** be linked in a directional manner with the visual presentation of the aerodromes.

6.4.6 Other ATS Systems / Functions

Identifier	REQ-06.09.03-OSED-MF04.4002
Requirement	Updates for flight plan and control data (in accordance with Doc 4444 4.13.2) to other ATS units ***should*** be done automatically (as in not being performed by manual coordination by the ATCO/AFISO).

6.4.7 Work Environment

Identifier	REQ-06.09.03-OSED-MW04.5001
Requirement	The number of input devices to control the same functions for different aerodromes ***shall*** be as few as possible

6.5 Contingency Applications

This section comprises a set of higher level, placeholder type requirements for Contingency applications, if ATS is to be performed with help of the Remote & Virtual Tower Concept/Technology (or parts thereof) in Contingency situations. The requirements are different in nature from those catering to the Single and Multiple Aerodrome ATS provision; the difference and its rationale being discussed below.

6.5.1 Discussion

Both the Remote Provision of ATS to Single Aerodromes and Remote Provision of ATS to Multiple Aerodromes Operational Improvements are new concepts and both rely on the presentation of a visual aerodrome view. As such, defining requirements for the Remote Provision of ATS to Single and Multiple Aerodromes is necessary at a detailed level in this OSED.

In contrast, contingency solutions of varying forms already exist as at some airports. Some of these solutions may not necessarily feature a direct or reproduced visual view.

While the Remote Functional Requirements as defined in this document *may* be applied in contingency situations, the fact that contingency solutions can exist independent of those requirements must be acknowledged.

Therefore this document defines higher level, placeholder type requirements for contingency applications intended to guide and standardize the application design process. The process itself would be the responsibility of the service provider and with it, the determination of the cost benefit analysis of the chosen configuration.

If an ANSP or airport owner decides to build up an ATS contingency solution using the Remote Tower Concept, the Remote Requirements from this project and document (as outlined in Section 6.3) can be used as a baseline set of requirements to support the implementation. However, in the context of Contingency Operations they are not mandatory.

6.5.2 Requirements

This section outlines the operational requirements for ATS to Aerodromes in Contingency Situations, if based on the Remote Tower Concept/Technology (or parts thereof).

Note: Each requirement table has a section with "hidden text" for easier reading of the document. Viewing of "hidden text" can be toggled on/off via the ¶ button.

Identifier	REQ-06.09.03-OSED-CF05.1001
Requirement	For each contingency application, minimum requirements on safety, security, reliability, integrity and adaptability ***shall*** be defined.

Identifier	REQ-06.09.03-OSED-CF05.1002
Requirement	For each contingency application, minimum requirements on capacity, duration of service and switchover time ***shall*** be defined.

Identifier	REQ-06.09.03-OSED-CF05.1003
Requirement	For each contingency application, the required level of commonality of HMI ***shall*** be defined with respect to the tower being served by the contingency application.

Identifier	REQ-06.09.03-OSED-CF05.1004

Requirement	For each contingency application the character and form of visual presentation, airport sound reproduction, other ATS systems/functions, (extension of) voice and data recording and working environment ***shall*** be defined.

7 References

7.1 Applicable Documents

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

[1] SESAR B4.2 Initial Service Taxonomy document;

[2] SESAR Requirements and V&V Guidelines, Edition 03.01.00, February 2014;

[3] SESAR Templates and Toolbox User Manual, Edition 03.01.01, February 2014;

[4] SESAR Operational Service and Environmental Definition (OSED) Template, Edition 00.00.00, Version 03.00.00;

[5] SESAR RVT Framework Regulatory Impact Assessment Report, C.03, Edition 00.03.00, April 2013;

[6] SESAR RVT Rules and Regulations Assessment Report, D03, Edition 00.01.01, November 2012;

7.2 Reference Documents

The following documents were used to provide input/guidance/further information/other:

[7] SESAR WP6.2 Airport Detailed Operational Description (DOD)Step 1 Update, Edition 00.01.01, December 2014;

[8] SESAR WP6.2 Airport Detailed Operational Description (DOD) Step 2, 00.01.01, March 2014;

[9] The Convention on International Civil Aviation, Annex 11, Air Traffic Services, Chapter 2.30, amendment 49, November 2013;

[10] ICAO Document 4444 “Procedures For Air Navigation Services - Air Traffic Management”, 15th Edition, 2007 (amendment 4, November 2012);

[11] EUR Doc 13 “European Guidance Material On All Weather Operations at Aerodromes”, 4th Edition, September 2012;

[12] EUROCONTROL “Manual for Aerodrome Flight Information Service (AFIS)”, Edition, 1.0, June 2010;

[13] ICAO Document 9426 “Air Traffic Services Planning Manual”, 1st Edition, December 1992;

[14] CAA Air Navigation: The Order and the Regulations, CAP 393, Fourth Edition, 1 April 2015;

[15] EUROCONTROL Guidelines for Contingency Planning of Air Navigation Services (including service continuity), Edition 2.0, April 2009;

[16] European Aviation Safety Agency, Notice of Proposed Amendment 2015-04, Technical and operational requirements for remote tower operations, RMT.0624, 23/03/2015;

[17] SESAR 06.03.01 Remote and Virtual Tower Security Risk Assessment”, Edition 00.00.02, 09/12/2013;

[18] SESAR DEL-06.09.03-D08-02-VALR (Remotely Provided Air Traffic Service for Single Aerodrome VALR), Edition 00.05.02, 01/05/2014;

[19] SESAR DEL-06.09.03-D08-02-VALR-ANNEX (Remotely Provided Air Traffic Service for Single Aerodrome VALR Annex), Edition 00.05.02, 29/04/2014;

[20] SESAR DEL-06.08.04-D86-VALR Single Remote TWR ph1 V2, Edition 00.01.00, 12/01/2013;

[21] SESAR DEL-06.08.04-D97 VALR V2 Multiple Remote TWR, Edition 00.01.01, 22/08/2014;

[22] SESAR DEL-P06.09.03-D13-VALR Remotely provided ATS for two low density aerodromes Validation Report, VALR, Edition 00.04.00, 31/08/2015;

[23] SESAR DEL-06.09.03-D12-VALR Contingency TWR Trial 1 & 2 Validation Report, Edition 00.03.01, Okt/Nov 2015;

[24] SESAR DEL-06.09.03-D15-HP “PP 6.9.3 HP Assessment Report for Single Remote Tower”, Edition 00.01.02, TBD;

[25]SESAR DEL-06.09.03-D28, P06.09.03 Remotely provided Air Traffic Services for two low density aerodromes Appendix F: HP Assessment Report, Edition 00.01.01, 01/09/2015

[26]SESAR DEL-06.09.03-D27-HP Remotely Provided Air Traffic Service for Contingency Situations at Aerodromes Appendix F: HP Assessment Report, Edition 00.01.00, 29/05/2015;

[27]SESAR DEL-06.09.03-D14-SAR, OFA06.03.01 Remote Tower – Safety Assessment Report for Single Remote Tower, Edition 00.01.02, 12th October 2015;

[28] SESAR DEL-06.09.03-D32-SAR, OFA06.03.01 Remote Tower – Safety Assessment Report for Multiple Remote Tower, Edition 00.01.00, 8th October 2015;

[29]SESAR DEL-06.09.03-D31-SAR, OFA06.03.01 Remote Tower – Safety Assessment Report for Remote Contingency Tower, Edition 00.01.00, 28th September 2015.

Appendix A – Deleted Requirements

The following requirements have been included in previous OSED editions, but have been deleted during the course of P06.09.03 as part of requirement updating and refinement.

Identifier	REQ-06.09.03-OSED-BC01.0002
Requirement	AFISO/AFISOs shall provide Aerodrome Flight Information Service (AFIS) from a remote location.

Identifier	REQ-06.09.03-OSED-CO02.1006
Requirement	The ATCO/AFISO shall observe visual communication from aircraft that are within visual range on the aerodrome manoeuvring area, i.e.: - moving ailerons (or rudder). (in daylight) - flashing or showing landing lights (in darkness)

Identifier	REQ-06.09.03-OSED-DR02.6002
Requirement	Necessary data, according to ICAO Annex 11 Chapter 6, shall be recorded.

Identifier	REQ-06.09.03-OSED-VQ03.1204
Requirement	During daylight CAVOK conditions, the ATCO/AFISO shall visually detect irregularities during landing or take-off of aircraft that requires the ATCO/AFISO to perform alerting service (e.g. engine fire/smoke, collapsing nose-wheel).

-END OF DOCUMENT-