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PJ.05-W2-DTT

DIGITAL TECHNOLOGIES FOR TOWER

This Contextual Note is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874470 under European Union's Horizon 2020 research and innovation programme.

Abstract

The Remote Tower concept is changing the provision of Air Traffic Services (ATS) in a way that it is more service tailored, dynamically positioned and available when needed.

Remotely Provided Air Traffic Service for Multiple Aerodromes and development of the Remote Tower Centre are part of this development, this with a flexible allocation of the aerodromes between the Multiple Remote Tower Modules in the same Remote Tower Centre (RTC)

The main driver for the Remote Tower Centre concept development, in SESAR PJ.05-W2-35, is increased cost efficiency by an increase of ATCO (controller) productivity, achieved by a flexible allocation of aerodromes between the MRTMs. Kept Safety levels with support from Human Machine Interface, with a capability to keep capacity at each of the targeted aerodromes, will in fact reduce cost. Kept capacity at each of the targeted aerodromes is, in this solution, possible through a flexible allocation of aerodromes between the controllers in the modules.

The OI step addressed in this OSED document is:

- **SDM-0210: Highly Flexible Allocation of Aerodromes to Remote Tower Modules**
  'The provision of remote ATS service to the remote aerodromes can be dynamically assigned (over time) to any other Remote Tower Module (RTM) within a Remote Tower Centre (RTC). RTC planning tools supporting the RTC supervisor enable an efficient usage of all RTMs and staff in an RTC.'

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1 Purpose

This contextual note provides to any interested reader (external and internal to the SESAR programme) an introduction to the SESAR Solution in terms of scope, main operational and performance benefits, relevant system impacts.

When Solution is at V3 level it contains as well additional activities to be conducted during the industrialization phase or as part of deployment.

It introduces the technical data pack comprising the SESAR JU deliverables (for V3, they are proposed to support industrialization/deployment).

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2 Improvements in Air Traffic Management (ATM)

2.1 Description

The objective of PJ.05-W2-35 is to increase ATCO productivity (i.e. reduce the number of ATCOs required to control multiple aerodromes simultaneously) by balancing the workload between different Multiple Remote Tower Module´s, MRTM´s, accommodated within a Remote Tower Centre, RTC. The flexible allocation of aerodromes will enable a proper balance between controllers within the centre in each module. This compared with several Single Remote Towers in a Remote Tower Centre or the more fixed allocation of aerodromes to dedicated modules within a centre.

This allocation can imply that a particular aerodrome, which is subject of flexible allocation between the modules, can take different positions in the same module, prior transfer to another module and after receiving it back. It is expected that this flexibility adds a complexity, and might be more difficult to maintain situational awareness.

Technical aspects, such as network quality of service, SWIM infrastructure and other resilience/redundancy related issues that are of key importance to the regulatory authorities are in place for the baseline Single Remote Tower.

PJ.05-W2-35 addresses technical development compared to the baseline of Single Remote Tower.

Enablers supporting this flexibility and situational awareness are:

- ATC-84, Multiple Remote Tower allowing dynamic allocation of aerodromes. This enabler support handover of aerodromes between modules to ensure that the controller can maintain situational awareness through a handover process.
- ATC-85, Provide the MRTM with automation functionalities to reduce controller workload. This optional enabler can support the controller with next actions for arriving and departing traffic.
- SVC-072, Aerodrome Transfer service. This enabler present features supporting the controllers in the transfer process of aerodromes between modules.

In order to avoid all uncertainties that could affect the ATCO's (Air Traffic Controller) ability to provide simultaneous Air Traffic Control (ATC) in a safe and efficient manner, the following possibilities is to be considered:

- The traffic load kept at a certain amount defined in the scope of PJ.05-W2-35, by taking into account traffic complexity and required controller workload for providing simultaneous Air Traffic Services. Aerodrome complexity regarding layout or traffic patterns, e.g. backtracking vs. use of parallel taxiways, or ILS for just one RWY, are example of factors which impact ATCO workload.
- Possibility for controllers in charge to self-decide the positioning of the aerodromes within the particular module.
- Additional automation support could support the controller in workload balance.

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A supervisor role (SUP) might be required depending on local operational needs. The SUP will take charge of the flexible allocation of grouped aerodromes to dedicated MRTMs. The supervisor can be aided by a support tool that incorporates data like traffic volume/complexity, planned maintenance and other activities, weather conditions at the different airports, as well as ATCO endorsements and availability. The planning tool might include a what-if functionality to allow the RTC supervisor to compare different parameters.

Note: One of the ATCOs available in the RTC can carry out the RTC Supervisor role can.

Enablers supporting the supervisor role are:

- ATC-83, Multiple Remote Tower planning tools for Supervisor. This enabler describe functionality for the supervisor including the "what if" functionality for aerodromes distribution.
- HUM-066, Supervisor Role. This enabler describe the supervisor role within the centre.

An assumption for the solution is that an ATCO can hold endorsements for four aerodromes. Nevertheless, having four endorsements is not a requirement to implement the concept, but local considerations within each RTC is depending on aspects such as harmonised procedures, airspace class, and type of traffic. Allocation of these four aerodromes grouped together can be flexible to the MRTMs.

Results address a setup with MRTMs, each providing the capability to allocate 3 aerodromes at a time. Each cluster consider a group of 4 aerodromes, with a total of 15 aerodromes within the centre.

The flexible allocation of airports and ATCOs within an RTC adds a need for a RTC Supervisor or a similar role with planning tools to enable an efficient run of an RTC.

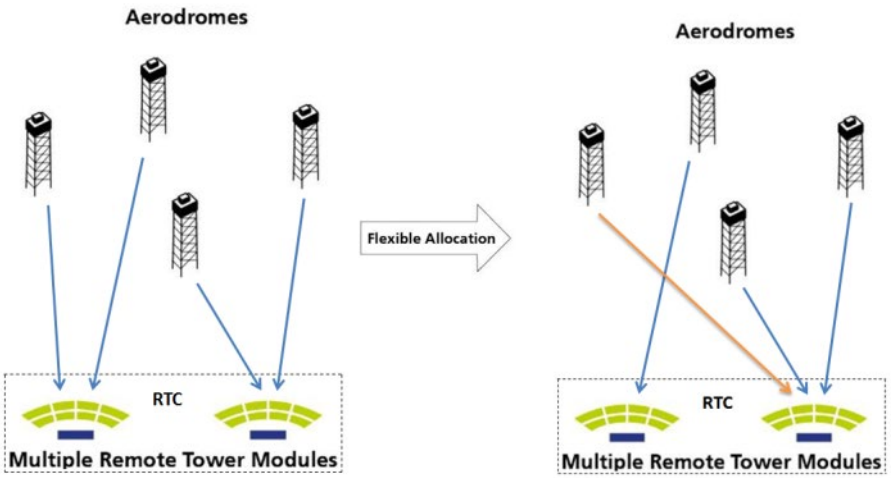

Figure 1: Flexible allocation of aerodromes between MRTMs

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2.1.1 Operating environment

PJ.05-W2-35 addresses any combination of Small Operating Environment aerodromes (between 15K and 40K annual IFR movements) and Other Operating Environment (less than 15K annual IFR movements), according to EATMA aerodrome classification.

Environments at the targeted aerodromes can be composed of:

- Different levels of airport complexity (runways, taxiways, etc.).
- Traffic volumes and their distribution over the controlled aerodromes.
- Various conditions at the different aerodromes (weather, daylight, geographical difference).
- Variable traffic mixes (VFR-IFR-mix, rotor-fixed wing, special).

2.1.2 Example airports

Example airports for deployment are for 2 Small airport environment; ESMS, Malmö-Sturup, ESSV-Visby, EDDR-Saarbrücken, EDDC-Dresden, EHTW-Twente, EICK-Cork.

Example airports for deployment are for 3 Other environment airports; ESNQ-Kiruna, ENHD-Haugesund, ENBO-Bodö, LHDC-Debrecen.

3 Operational Improvement Steps (OIs) & Enablers

The table below provides allocated enablers related to PJ.05-W2-35 covering OI step SDM-0210:

SESAR Solution ID	SESAR Solution Title	OI Steps ID	OI Steps Title	Enabler ID	Enabler Title
PJ05-W2-35	Multiple Remote Tower and Remote Tower Center	SDM-0210	Highly Flexible Allocation of Aerodromes to Remote Tower Modules	Aerodromes ATC - 83	Multiple Remote Tower planning tools for Supervisor
				Aerodromes ATC - 84	Multiple Remote Tower allowing dynamic allocation of aerodromes
				Aerodromes ATC - 85	Provide the MRTM with automation functionalities to reduce controller workload
				SVC-072	Aerodrome Transfer service
				CTE – S10	Multiple Remote Tower Control - Surveillance
				REG-0537	EPAS – 7.11 RMT.0624 Technical and operational requirements for remote tower operation
				HUM-066	RTC Supervisor Role
				STD-162	ED-240A MASPS for Remote Tower Optical Systems Ch. 1

Table 1: OI-steps

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4 Background and validation process

Validation of PJ.05 solutions PJ.05.03 have been validated up to V2, leading to the further validation of PJ.05-W2-35 up to V3, as described in this CN.

Real Time simulations together with one shadow mode trial was used to validate PJ.05-W2-35. This on different validation platforms focusing on the two different airport environments. Validations focused on Small environment airports and Other environment airports (according to EATMA definition).

All validations focused on the same high level objectives related to Human Performance and Safety Objectives.

A consolidated workshop for HP and Safety allowed to review the results of the validation EXEs and concluded that there are no significant gaps in terms of HP and safety despite the fact that some validation objectives were considered by the project team as partially OK. Be aware however that the VALR does not fully reflect these conclusions from the workshop.

- Real Time Simulations for three other environment airports in multiple mode:
  - DLR validation developing a Multiple Remote Tower Module and Remote Tower Centre functionality.
    - Small environment airports
  - INDRA, delivering results on visual reproduction environment for control of 3 aerodromes simultaneously and technical support systems for the ATCOs in a MRTM including approach for all airports.
    - Small and Other environment airports
  - COOPANS, validation platform delivering results on visual reproduction and HMI for control of 3 airports simultaneously with a mix of IFR and VFR traffic. Development of handover functionality for a flexible allocation of aerodromes.
    - Small environment airports
  - ENAV, validation platform delivering results on mixed weather at the airports in a Multiple Remote Tower Module.
    - Small environment airports
  - DFS, validation of a Multiple Remote Tower Module for 3 airports simultaneously.
    - Small environment airports
- Shadow mode trial for three other environment airports in multiple mode:
  - INDRA, delivering results on visual reproduction environment for control of 3 aerodromes simultaneously and technical support systems for the ATCOs in a MRTM including approach for all airports.
    - Small environments airports

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5 Results and performance achievements

The traffic load can be kept at a certain amount defined in the scope of PJ.05-W2-35, by taking into account traffic complexity and required controller workload for providing simultaneous ATC services.

It should be highlighted that already validations on preceding Remote Tower OIs revealed that workload can consist of other tasks than simultaneous movements which will impact amount of traffic a single ATCO can handle. The same findings apply to PJ.05-W2-35. Examples for these tasks are:

- Monitor weather changes
- Possible communication with meteorologist
- Locating technical problems and assessing consequences
- Possible communication with technical supervisor
- Coordination with airport e.g. snow sweeping, electrical service etc.
- Coordination with other Air Traffic Control units
- Monitor changes in traffic load
- Replying to general phone calls e.g. pilots calling to file a flight plan

Following possibilities are important to ensure the controllers ability to provide simultaneous Air Traffic Control (ATC) in a safe and efficient manner:

- Possibility for ATCOs in charge to self-decide the positioning of the aerodromes within the particular MRTM.
- The ATCO workload was balanced to an appropriate level by additional automation/technical support.

PJ.05-W2-35 goal is to maintain the same level of service for airspace users and airport owners. The capacity is kept with a flexible allocation of aerodromes.

Following benefits have been identified:

- Cost efficiency is met through a lower cost for Air Traffic Management
- Controllers feedback present positive results in satisfactory
- Safety levels and Human Performance levels are kept

Providing ATS to more than one airport by one ATCO, when it is safe and practical, will add benefits to airport providers, ANSPs (Air Navigation Service Provider), airlines and eventually the flying customers through a cut in costs and/or the provision of ATC to airports earlier not served with ATC.

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6 Recommendations and Additional activities

The platforms used for the validations included systems needed at V3 level. A refinement of layout and manoeuvring of systems is needed at a local deployment related to systems used. Specific details for system failure and back up as well as local procedures and harmonisation need to be considered:

Operational activities during deployment are:

- Local procedures at the different aerodromes should be harmonized as much as possible
- Coordination needs with other sectors depending on APP(Approach)/ACC(AreaControlCentre) sectors and airport coordination should be reduced as far as possible by using system support
- Alerts and alarms should be harmonised. The same alerts and alarms should be available at the aerodromes that are controlled by one ATCO. The alerts and alarms should be displayed to the ATCO in the same way. The same interaction with the alerts and alarms should be provided to the ATCO for the alarms and alerts of the different aerodromes

Technical activities during industrialisation are:

- Refinement of HMI pending on chosen layout for a module with presentation of multiple aerodromes such as, aerodromes presented on top of each other, side by side or a combination of both.
- Local deployment strategy to enable a joint connectivity of all airport systems manoeuvred or monitored from each single remote tower module in a multiple remote tower module together with a harmonised interaction HMI to enable the flexible allocation.
- Fine-tune the ATCO planning tool to adapt it to local constraints and operational environment.

Depending on chosen technical system and layout, the deployment needs a Safety Assessment on the system for deployment. This to find proper mitigations for degradation where a split in to Single Remote Tower has the lowest impact on airport capacity and termination of service has the highest cost reduction in staffing.
Procedures for degraded modes along with the minimum system performance should be considered as they impact traffic levels and required mitigations.

6.1 Training

ATCO licensing and endorsements can be kept with the aspect that an ATCO need a local endorsement for each aerodrome which the ATCO will work with in a flexible RTC.
Future deployment can find similarities between airports within a cluster to enable a common endorsement for all aerodromes within such a cluster.

Each deployment need a training plan for the functionalities available in the flexible allocation of aerodromes within the MRTM.

The objective of PJ.05-W2-35 is to increase the scope of the Multiple Remote Tower solutions within an RTC and including traffic volumes and airports simultaneously controlled by one ATCO.

7 Actors impacted by the SESAR Solution

Tower Controllers (ATCOs).

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8 Impact on Aircraft System

N/A

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9 Impact on Ground Systems

Single Remote Tower is the baseline and is therefore for PJ.05-W2-35 already in place so there is no impact on the Remote Tower Systems already in place.

It can be possible to convert existing modules (RTMs or MRTMs) in the RTC building to fit this solution. This with new software, and if needed hardware according to requirements.

New functionality for the solution compared to single remote tower or multiple remote tower in a fixed set up are:

- Remote Tower Centre planning tool for the supervisor role
- Remote Tower Module with capability to present up to three different aerodromes in a flexible way with maintained situational awareness for the connected aerodromes (e.g. colour coding of the panoramic view)
- Handover functionality which allows controllers in different modules to flexibly transfer aerodromes between each other with kept situational awareness.

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10 Regulatory Framework Considerations

EASA (European Aviation Safety Agency) and EUROCAE (The European Organisation for Civil Aviation Equipment) have developed the following Guidance Material for regulatory, operational and technical issues for Remote Tower solutions:

- EASA Guidance Material on remote aerodrome air traffic services, Decision 2019/004/R, Issue 2 still valid, Issue3 published as NPA.
- ED-240A, MINIMUM AVIATION SYSTEM PERFORMANCE STANDARD FOR REMOTE TOWER OPTICAL SYSTEMS, ED-240B in preparation.

Conclusions and recommendations from PJ.05-W2-35 to be considered by those initiatives.

Regulatory enabler, REG-0537, cover technical and operational requirements for this solution.

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11 Standardization Framework Considerations

Regulatory support and guidance is available to facilitate safe implementation of multiple remote tower control and to provide a basis for its further development and industrialisation. This regulatory activity is captured in:

- EASA Guidance Material on remote aerodrome air traffic services, Decision 2019/004/R, Issue 2 still valid, Issue3 published as NPA
- ED-240A, MINIMUM AVIATION SYSTEM PERFORMANCE STANDARD FOR REMOTE TOWER OPTICAL SYSTEMS, ED-240B in preparation

The above NPA recognised, at the time of publication, there was two SESAR solution published related to multiple mode of operation, SDM-0205 Two low density aerodromes, together with, SDM-0207-Multiple Remote Tower Module, where both focus on fixed location for multiple remote tower.

Validation of PJ.05 solutions PJ.05.03 have been validated up to V2, leading to the further validation of PJ.05-W2-35 up to V3, as described in this CN. EASA can, with these results, further update its regulatory material to soften some recommended limitations as well as mitigation measures for how to handle related risks, in multiple mode of operation, taking into account the increased level of maturity.
A new STD-162 enabler, linked to SDM-0210, capture this standardization activity.

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12 Solution Data pack

The Data pack for this Solution includes the following documents:

- D2.1.020 PJ05-W2-35-V3 SPR-INTEROP-OSED - Part I (ED 00.02.00-30/11/2022)
- D2.1.020 PJ05-W2-35-V3 SPR-INTEROP-OSED - Part II – SAR (ED 01.00.00-02/03/2023)
- D2.1.020 PJ05-W2-35-V3 SPR-INTEROP-OSED - Part IV – HPAR (ED 00.02.00-14/02/2023)
- D2.1.020 PJ05-W2-35-V3 SPR-INTEROP-OSED - Part V – PAR (ED 00.01.00-29/11-2022)
- D2.1.040 PJ05-W2-35-V3 TS (ED 00.02.01-05/12/2022)
- D2.1.050 PJ05-W2-35-V3 CBA (ED 02.02.02-14/11/2022)
- D2.1.060 PJ05-W2-35-V3 VALR (ED 00.01.01-15/08/2022)

Supporting document is:

- PJ.14-W2-84b TS/IRS describing optional EN CTE-S10