Release 5 SESAR Solution #13

Remotely-provided air traffic services for contingency situations at aerodromes

Contextual note – SESAR Solution description form for deployment planning

Purpose:

This contextual note introduces a SESAR Solution (for which maturity has been assessed as sufficient to support a decision for industrialization) with a summary of the results stemming from R&D activities contributing to deliver it. It 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 as well as additional activities to be conducted during the industrialization phase or as part of deployment. This contextual note complements the technical data pack comprising the SESAR deliverables required for further industrialization/deployment.

Improvements in Air Traffic Management (ATM)

The remote provision of Air Traffic Services (ATS) to an aerodrome during contingency situations provides a solution when the local tower is not available and services need to be provided from a back-up location. The Air Traffic Control Officer (ATCO) cannot be located at the local tower and the service is provided from a remote contingency tower.

The Contingency Remote Tower solution differs from the existing contingency solutions (i.e. close aerodrome control tower – provide basic level of ATS from a location other than the local ATS tower without visibility or with only limited visibility of the aerodrome and its vicinity – or provide ATS from a location other than the local ATS tower supported by a ground surveillance system) in that it provides a camera-based visual presentation of the aerodrome and its vicinity which acts as a substitute for the local tower Out of the Window (OTW) view.

The new solution shows that the remote tower concept can be applied as a contingency solution at aerodromes, in a facility known as a Remote Contingency Tower (RCT) with the aim of increasing resilience to as close as possible to 100% of the nominal capacity. The improved resilience provides cost benefits in the event of a major outage compared to where no mitigating measures had been adopted (e.g. the consequence of a serious outage simply to close consists in closing the aerodrome), due to customer retention and reduced economic loss during contingency events.

The RCT facility utilises a Controller Working Position (CWP) complemented with a camera-based visual presentation of the aerodrome and its vicinity (with full or limited visibility of the aerodrome and its surroundings), which acts as a substitute for the local tower OTW view.

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

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

In relation to equipage, it is recommended that the controller support tools provided in the local aerodrome control tower are 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.

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 multilateration) for example.

Safety and human performance were found to be acceptable for the level of ATS being provided, and were aligned with the standards achieved in normal operations from a local tower.

The solution was validated for aerodromes with one single main runway and mainly Instrument Flight Rules (IFR) traffic. Based on a visual presentation with basic functionality Visual Flight Rules (VFR) traffic should be limited to one or two simultaneous movements because of the limitations in the current technology to support distance perception. If more VFR flights need to be controlled simultaneously, it is recommended to complement the visual presentation with advanced features (e.g. object bounding and automatic Pan- Tilt Zoom (PTZ) tracking which were validated for medium size aerodromes but so far not in relation to the solution addressed here). In this case care has to be taken that ATCOs are sufficiently trained in these functionalities. Overall it is envisaged that the target environment for the majority of RCTs will be medium density aerodromes that are economically important. (Note: hub aerodromes could also benefit by implementing the RCT concept but were out of the scope of this study.)).

The visual presentation in the RCT can provide the primary means of surveillance, where no other systems like ground surveillance are available. Two examples for target airports are given below:

- Without ground surveillance:
  Airports without ground surveillance radar that are generally considered as being too small to bear the investment of ground surveillance radar technologies such as an A-SMGCS system.
- Complementing ground surveillance :
  Airports equipped with a ground surveillance system that could implement a solution that would couple a visual presentation with the ground surveillance system in order to further increase resilience.

Operational Improvement Steps (OIs) & Enablers

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The Solution fully covers the OI Step **SDM-0204 Remotely Provided Air Traffic Service for Contingency Situations at Small to Medium Aerodromes (with a Single Main Runway).**

The remote aerodrome ATS concept and the enablers applied (such as the visual enhancement features), can provide alternative facilities for ATC with the highest possible air traffic capacity at a reasonable cost.

The solution was validated for aerodromes with mainly IFR traffic and up to one or two additional VFR movements at a time.

The enablers for this solution are given in the table below

Relevant Enablers from integrated road map for OI step	Enabler Description
AERODROME-ATC-51	RTC position that in contingency situation hosts ATCO that will no longer be located at the local Tower.

The applicable Integrated Roadmap Dataset is DS16.

This solution has a close relation to solution #71 'Remote tower for single airport' and solution #12 'Aerodrome Control Service or Aerodrome Flight Information Service for medium size airport provided from a remote location', both referring to SDM-0201.

Background and validation process

This SESAR Solution has been validated through passive shadow mode trials in Sweden (Gothenburg Airport – ESGG) and in Spain (Girona – Costa Brava Airport - LEGE). Both ANSP providers ran a V2 as well as a V3 validation exercise focussing on safety, human performance assessments and aerodrome capacity.
While one exercise addressed contingency operations at medium traffic density airports with air and ground surveillance and mainly IFR, the other addressed the scenario with controllers not being supported by ground surveillance (air surveillance still being available) and the traffic being composed of VFR and IFR.

During the validations different operating conditions were addressed: Visual Meteorological Conditions (VMC), Instrument Meteorological Conditions (IMC), as well as daylight and darkness conditions. Transfer from conventional tower to the contingency tower was also considered.

Results and performance achievements

The overall conclusion from the trials was that the remote provision of ATS during contingency situations is acceptable to the controllers for the environment and experimental conditions experienced (except for the limitation of VFR traffic as explained before). The visual presentation provided added value in terms of resilience over existing ground-based radar contingency solutions and helped to maintain safety, capacity, and human performance at acceptable levels. Remote contingency significantly increases resiliency in environments with and without ground surveillance. The validation results provide evidence that the operability and technical feasibility has been achieved.
The above conclusion is valid for an environment with mainly IFR traffic. Validations showed that the prototype under test was not mature enough to conclude that more than two simultaneous VFR movements can be controlled. It should be noted that the limitations found in the contingency validation could be mitigated in the single remote tower validation for medium size aerodromes by the use of object bounding and automatic PTZ-tracking.

The acceptance of the primary visual presentation was also rated high with all of the controllers believing the quality to be sufficient to be able to view the aerodrome and its vicinity even though controllers generally preferred a constant 360° view, mostly in aerodromes where VFR traffic can operate at the two circuits at each side of the runway and not only in one of them. In addition to the visual presentation the PTZ was deemed to be very supportive as a replacement for the binocular functionality in RCT. Easy control of the PTZ is essential and needs further improvement as part of the industrialization process.

Despite the controllers rating all the advanced functionalities average in terms of usefulness, none of them were deemed mandatory. Among the advanced functionalities, radar tracking and visual tracking were rated as the most helpful. The auxiliary / hot spot cameras and the IR camera were deemed to be very supportive but need further technical improvement. However, depending on the aerodrome complexity, the absence of particular systems may have a detrimental effect on the degree of resilience provided by the solution.

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 as similar to the local tower CWP as possible. A replication of the layout and features as found in the tower 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 also eases the potential stress induced by a contingency event (and may hence reduce the potential for error) and reduces the requirement for frequent RCT refresher training sessions.

Recommendations and Additional activities

With regards to the concept and associated procedures, the following points should be addressed during industrialisation and deployment:

- Further investigate the effect on resilience for VFR traffic based on more mature prototypes.
- Investigate the impact of CWP replication (between the local tower and RCT) – compared to using a standardized Remote Tower Module (RTM) – on operator acceptance and transition periods (i.e. time to re-establish operations from the RCT after an outage).
- Further investigate working methods when working with two positions on the same RTM for using a shared PTZ camera, switching views and any other aspects that may be impacted by the use of a common visual display (OTW) among more than one operator.
- Develop local procedures to manage degraded modes when operating from an RCT during contingency (e.g. examine the need for “dark screen procedures” for use during technical degradation.)
- Improve the PTZ camera and the tracking label’s technical performance and usability.
- Continue investigating the different 360° view solutions, with specific focus on improving the viewing options when handling non-nominal situations and VFR traffic.
- Assess trade-off on cost-efficiency for:
    - One RCT in each airport compared to one RCT for various airports
    - One CWP in RCT limiting airport resilience or more than one CWP for sustained level of service in contingency.
- The auxiliary / hot-spot cameras and the IR camera were deemed to be very supportive but need further technical improvement.
- The time required for the transition to contingency tower and the other way round out of contingency and returning to normal operation in the local TWR were measured in the validations. Nevertheless these times depend on local factors and the time needs to be determined for each specific location.
- Ensure regular refresher training on the remote tower tools as the ATCOs are not used to using them in their regular working place in the conventional tower.

Actors impacted by the SESAR Solution

Actors involved in operations are the same as for regular operations, i.e Tower Controllers.

Impact on Aircraft System

None

Impact on Ground Systems

The visual reproduction in the Remote Tower replaces the OTW view from the local tower building. The OTW view is obtained by a number of cameras, mounted on top of a suitably located or designed structure, covering the aerodrome manoeuvring area and (partially or totally) the aerodrome vicinity. Those cameras capture the image at the local aerodrome. It is then reproduced over display screens arranged around the controller.

A mixture of basic (which are mandatory) and advanced technical features were identified as enabling the safe provision of contingency ATS:

- Basic features:
    - Visual display (OTW); and
    - PTZ camera (video and/or Infrared).
- Advanced Visual Features (AVF) are optional features that enhance vision and operator situational awareness, including during low visibility conditions:
    - Automatic visual tracking: the PTZ camera can be used for the automatic tracking of moving objects;
    - Overlay information: the visual reproduction may be enhanced with additional overlaid information over the OTW, such as meteorological conditions (e.g. QNH, actual wind, RVR…), flight information obtained from flight plan data, etc. The visual tracking overlay increases the ATCO's ability to spot and follow relevant moving objects;
    - Additional cameras may be used at selected positions such as hot spots or dead zones not visible from the local tower to enhance the situational awareness of the controller;
    - Ground surveillance display might be used in addition to air surveillance.

The ATS/CNS Systems as well as any control HMI (like control of lighting) used in the conventional tower must also be available at the remote contingency facility.

Regulatory Framework Considerations

The regulatory framework is set with the guidance material provided by EASA Decision 2015/014/R.
EUROCAE published the ED-240 document on 'Minimum Aviation System Performance Specification for Remote Tower Optical Systems'.
While regulation and standardisation are covered for Europe by EASA and EUROCAE, equivalent guidelines should be provided by ICAO to facilitate worldwide implementation.

Standardization Framework Considerations

The standardisation work is ongoing within EASA and EUROCAE WG-100 and is based on the requirements developed for small sized aerodromes. The solution data pack will contribute to these standardisation activities with some aspects regarding advanced functionality (e.g. object bounding and automatic PTZ-tracking) to be considered for medium size aerodromes.

Considerations of Regulatory Oversight and Certification Activities

The cost of introduction of the technology needed has to be assessed in a local CBA dependent on existing systems.

Solution Data pack

The Data pack for this Solution includes the following documents:

- 06.08.04, D94, OSED for Remote Provision of ATS to Aerodromes
  Edition 00.07.01 (15.07.2016)
- 06.08.04, D110, 6.8.4 SAR Contingency Tower - Final Update
  Edition 00.02.01 (22.08.2016)
- 06.08.04, D111, Human Performance Assessment - Contingency Tower
  Edition 00.02.01 (22.07.2016)
- 12.04.07, D09, Remote Tower Technical Specifications
  Edition 01.00.00 (07.03.2016)

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