

Release 5 SESAR Solution #101
ACAS ground monitoring system and presentation system

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 SESAR Solution “ACAS ground monitoring system and presentation system” refers to an improvement of the capability to collect continuous information about ongoing Airborne Collision Avoidance Systems (ACAS) Resolution Advisories (RAs) and a capability to manage the presentation of these RAs on the Controller Working Position (CWP).

The system consists in:

- A Ground Monitoring function, comprising:
 - a set of ACAS monitoring stations, used to collect the RA information and send the information to the linked ACAS server;
 - an ACAS server, used to filter out technically incorrect information, associate information related to the same RA, prepare an RA report and record it or send it to the next element. In addition to ACAS monitoring stations, the ACAS server can receive RA information from other Surveillance sensors (Mode-S radar, WAM and ADS-B);
- A Ground Presentation function: used to associate each RA report to an individual radar tracks, check if the display of RA should be inhibited for this track, prepare an RA event for eligible tracks and send it to the CWP.

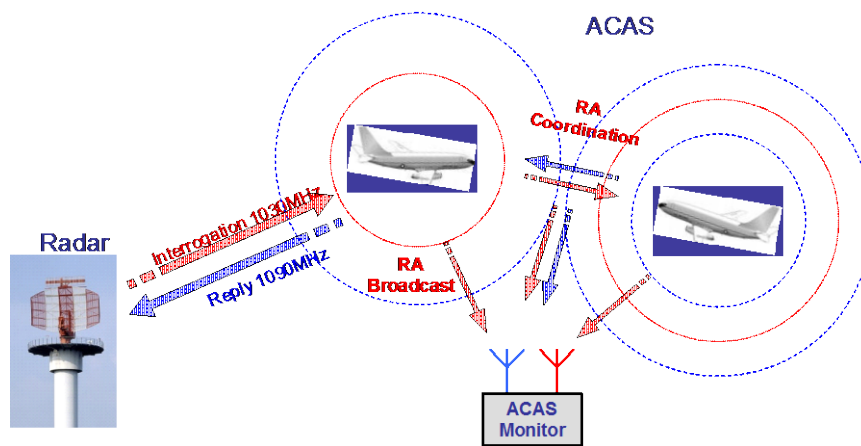
ACAS serves as a last-resort safety net, irrespective of any separation standards. ICAO PANS-ATM Document 4444 – paragraph 15.7.3.5 states that the performance of ACAS in the ATC environment should be monitored. One aim of the system is to provide more complete information about the encounter than currently available.

Indeed, there are currently three sources of information on ongoing RAs that can be listened to on the ground:

- RA Downlink - Information on the ongoing RA is stored in the Mode S transponder. When the aircraft is interrogated by a Secondary Surveillance Radar (SSR), the transponder will indicate in its reply that information on an RA is available. The radar system can now read out the data in a further interrogation. This process is referred to as RA downlink and takes place on the radar reply channel (1090 MHz).

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- RA Broadcast – A subset of the above mentioned information is transmitted via another communication process, the RA Broadcast. The RA Broadcast takes place on the radar interrogation channel (1030 MHz) and therefore cannot be received by radars.
- RA coordination messages - If both aircraft are ACAS-equipped, the RAs will be coordinated between the two aircraft. The first aircraft in which an RA occurs transmits an RA coordination message to the other aircraft, providing the sense of the RA (upwards or downwards) selected by the first aircraft. The other aircraft will send a coordination reply acknowledging the message. The coordination message uses the SSR interrogation channel (1030 MHz) and therefore cannot be received by radars. While the coordination reply uses the SSR reply channels (1090 MHz), the protocol used is specific to ACAS and radars are not designed to listen to it.



Among these three sources, only the RA Downlink is currently used. A limitation of this source is that RA information can only be collected each time the aircraft is interrogated by radar, which is in general every 8 seconds (period of rotation of the radar antenna). During this blind period, an RA can start or change without knowledge from the ground.

The two other sources (RA Broadcast and coordination messages) are broadcast messages transmitted as soon as an RA occurs or changes. Listening to these sources will then enable the ground to know precisely when an RA occurs / changes and at least the sense of the RA.

The “ACAS ground monitoring system and presentation system” is based on hardware and software capabilities of ADS-B ground stations. The ADS-B ground stations are extended by a 1030 MHz receiver unit to cover the entire ACAS communication. These multi-purpose ground stations are capable to perform ADS-B and ACAS Monitoring functions in parallel, compliant to the latest standards DO260, DO260A and DO260B.

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The improved precision of the collected information will greatly help in performance analysis of ACAS, both when computing statistics and when reconstructing an event for an incident investigation. For such an off-line use, only the Ground Monitoring function is necessary: the information is recorded by the ACAS server and can be analysed later by safety management teams.

The capability to get RA information in real-time is enabled by using the whole system. The Ground Presentation function, fed by the ACAS server, allows distributing RA information to ATC systems with a very low latency (then only due to processing and distribution times), which is a prerequisite (as is the need of an operational concept of use) for a possible display of RA information on the controller working position¹.

Operational Improvement Steps (OIs) & Enablers

The “ACAS ground monitoring system and presentation system” covers enablers **CTE-S03g**: ACAS monitoring technology and **ER ATC APP 68**: Enable Controller workstation to show when aircraft systems indicate an RA occurrence. It will support OI step **CM-0802**: Display and use of ACAS resolution advisory downlink on the controller working position.

Applicable Integrated Roadmap dataset is DS15.

Background and validation process

The Ground Monitoring function was successfully verified by the development, installation and testing of evaluation prototype platform. The platform covered the entire German airspace at least above FL100 and has been used for offline monitoring during a period of more than three years, thus providing further confidence in the technical ACAS ground monitoring concept. During prototype verification, the project performed long-term RA data collection and evaluation of airborne incidents, and verified in detail the system capabilities.

The Ground Presentation function was successfully verified by the development, installation and real-time testing of a prototype in an ANSP validation platform. Due to the rarity of RA events, the Ground Presentation function was not fed in real time by the Ground Monitoring function but used selected recordings from this function.

While both elements were validated separately, the project feels that the communication between them was emulated realistically enough by the real-time reading of the recordings. Therefore the solution can be considered as validated in a relevant environment (TRL-6).

¹ Currently, air traffic controllers rely on pilots to report RAs by radio as they occur. These reports are sometimes late, incomplete or absent. The objective is to inform controllers of an RA event faster, more reliably and in a structured way, and hence increase controller's situational awareness in critical situations.

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Results and performance achievements

The main findings from the overall verification exercises and use of the system can be summarised as follows:

- the system is capable to receive, decode and correlate RA information correctly;
- the correlation of surveillance sensor data (Mode-S radar, WAM, MLAT and ADS-B) with RA information collected on the ground is feasible and very beneficial;
- false RAs can be filtered out;
- the system is field-proven for standalone offline ACAS ground monitoring (statistical analysis and incident analysis);
- the system is able to process and distribute valid RA information to external ATM systems (controllers) no more than two seconds after the RA is generated on board an aircraft , which is one prerequisite for a possible display on the controller working position;
- the system is able to provide RA events for display on the CWP while inhibiting undesired events.

Recommendations and Additional activities

Deployment within an operational environment **to display RA information on the controller working position** will require:

- a solid operational concept;
- a safety and security assessment.

Actors impacted by the SESAR Solution

The availability of the “ACAS ground monitoring system and presentation system” **to improve offline ACAS analysis** will allow better feedback on incidents and may support change proposals to improve ACAS or airspace design. As such, it will have an impact on the following actors:

Airspace Users (Pilots), who respond to ACAS alerts, may benefit from enhanced level of safety and will have a better understanding of incidents in which they were involved.

Airlines, which equip their aircraft with ACAS, may benefit from enhanced level of safety and less disruption of their aircraft trajectories.

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Air Traffic Controllers (ATCOs) and Air Navigation Service Providers (ANSPs), who benefit from ACAS as a last resort safety net, may benefit from enhanced compatibility with their practices (e.g. fewer alerts) whilst also improving safety in their airspace.

Standardisation bodies, who develop ACAS MOPS may see proposals for mature and beneficial changes to ACAS.

When an appropriate procedure will have been validated, the availability of the “ACAS Ground Monitoring and Presentation System” **to display RA information on the controller working position** will reduce the frequency of competing RAs and ATCO instructions. As such, it will have an impact on the following actors:

Airspace Users (Pilots), who respond to ACAS alerts, will benefit from an increased level of safety through undisturbed compliance to RAs.

Air Traffic Controllers (ATCOs), who benefit from ACAS as a last resort safety net, will benefit from an increased awareness and better management of the situation.

Impact on A/C System

This SESAR solution has no impact on A/C systems.

Impact on Ground Systems

The “ACAS Ground Monitoring and Presentation System” will need to be connected to the output of Mode S radars in order to receive RA Downlink information. For a use **to improve offline ACAS analysis**, there is no other impact.

For a potential use **to display RA information on the controller working position**, the CWP may need to be adapted to the output interface of the “ACAS Ground Monitoring and Presentation System”.

Regulatory Framework Considerations

None.

Standardization Framework Considerations

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The technical project developed a change proposal for EUROCONTROL ASTERIX CAT 004 (safety net messages), used for communication between the Ground Monitoring function and the Ground Presentation function.

Considerations of Regulatory Oversight and Certification Activities

There is no specific topic in the field of Regulatory Oversight and Certification Activities to be considered in deployment, beyond the applicable existing ones.

Solution Data pack

The Data pack for this Solution includes the following documents:

- 04.08.03-D05-GEN-RADL Performance specifications of ACAS monitoring system for the collection of ACAS RA downlink information
- 15.04.03-D03-System Specification Document (Final)
- 15.04.03-D06-ACAS Monitoring Evaluation Report
- 10.04.03-D32-Final Technical Specifications for Safety Nets

Intellectual Property Rights (foreground)

Only the documents listed above in the Solution Data pack section are seen as foreground by the SJU.