Release 4 SESAR Solution #55

Precision approaches using GBAS CAT II/III based on GPS L1

Contextual note – SESAR Solution description form for deployment planning

Purpose:

This contextual note introduces a SESAR Solution with a summary the results stemming from R&D activities contributing to deliver it. It provides a summary of the SESAR Solution in terms of scope, operational and performance benefits and relevant system impacts as well as additional activities to be conducted during the industrialization phase or as part of deployment. This contextual note is part of the data package prepared for the SESAR Solution for which maturity has been assessed as sufficient to support a decision for industrialization. It complements a technical data pack comprising available deliverables required for further industrialization.

Improvement in Air Traffic Management (ATM)

The SESAR Solution "Precision approaches using GBAS CAT II/III based on GPS L1" aims at improving Low Visibility Operation using GBAS Cat II/III based on GPS L1. The solution enables precision approach procedures relying on GNSS signals and composed of ground and airborne segments.

This solution improves resilience in low visibility conditions. In current ILS operations there is a need to protect the ILS critical and sensitive areas which result in restricted ground movements and extra spacing margins between aircraft in order to accommodate the longer runway occupancy times (ROT). This solution proposes the use of GBAS which has limited (GBAS Local Object Consideration Areas) or no protection areas, usually located outside aircraft movement areas. This allows for reducing the runway occupancy times in low visibility conditions resulting in reduced spacing between arrival aircraft. The amount of runway throughput gained depends on wake turbulence separation and any other additional spacing needs.

While with regular ILS operations one ground station per runway is needed, one GBAS ground station can be used for multiple runways operations.

GBAS supports enhanced level of service for all phases of approach, landing and departure.

The solution is based on the existing single frequency GPS L1 (1575.42 MHz). Future GBAS based CAT II/III solutions may make use of multi-constellations and/or multi-frequency signals.

Operational Improvement – OI Steps & Enablers

AO-0505-A[1] "Improve Low Visibility Operation using GBAS Cat II/III based on GPS L1": Use GBAS Cat II/III based on GPS L1 for precision approaches.

[1] Integrated roadmap Data set 14 (www.atmmasterplan.eu/working)

The Enablers supporting this solution are:

- A/C-56a "Flight management and guidance to support GBAS CAT II/ III using GPS L1";
- A/C-02a "Enhanced positioning using GBAS single frequency" (only partially i.e. positioning in flight. The aspects related to the positioning on airport surface are not required for the solution);
- CTE-N07 "Ground Based Augmentation System (GBAS)" (this enabler is baseline);
- CTE-N07b "GBAS Cat II/III based on Single-Constellation / Single-Frequency GNSS (GPS L1)";
- CTE-N01* "GPS L1/L5" (this is an enabler for the solution but satellite constellations are beyond the work done under SESAR programme).

Background and validation process

The solution has been V3 validated:

- Through V2 Fast Time Simulation activities in order to validate the expected performance benefits in terms of runway capacity resilience in low visibility conditions;
- Through initial Real Time Simulation activities (aircraft oriented) to validate the flyability of the GBAS cat II/III landing procedures;
- Through Flight Tests conducted at Toulouse and Frankfurt airports using mainline aircraft as well as business aircraft. It has been considered very important to verify several ground and airborne systems from different points of view to be sure that conclusions take into account a wide range of options (e.g. to assess the airframe and environment influence). The SESAR solution has been assessed on two-runway airports operations in segregated mode (flight tests);
- Through additional V3 Real Time Simulation activities in order to validate, in a generic airport environment, ATC oriented aspects e.g. including runway operations at both segregated (arrival only) and mixed (arrival/departure).

Results and performance achievements

It has been demonstrated that under Low Visibility Conditions (CATII/III) this SESAR Solution enables:

- More sustained accuracy in aircraft guidance on final approach based on GBAS Automatic Approach and Landing down to Cat IIIb minima for Mainline Aircraft compared to current approach systems:
    - Automatic roll-out, DH < 50 ft down to no DH & RVR between 50m and 200m.
- More sustained accuracy in aircraft guidance on final approach based on GBAS Automatic Approach and Landing down to Cat II or Cat IIIa minima for Business and Regional Aircraft compared to current approach systems:
    - 50 ft < DH < 200 ft & 200 m < RVR < 550m;
    - CAT IIIb considerations for Business Aircraft for possible future use.
- GBAS guided take-off.

In terms of performance benefits:

- Interoperability between independent airborne and ground subsystems was demonstrated (validation and verification activities included performance interoperability assessment between two ground prototypes and two airborne prototypes);
- Pilots confirm that nowadays they experience some ILS signal interferences due to previous landing aircraft. However, by using GBAS on-board-equipment, those interferences are not experienced any more;
- GBAS in LVP operations for segregated runways can bring the expected resilience benefits (limiting runway throughput decrease in LVP conditions) without negatively impacting safety and human performance. GBAS in LVP operations for mixed mode runway operations is more challenging. The spacing to be applied in this scenario needs to take into account local airport environment and a procedural separation of aircraft performing a missed approach procedure;
- The mixed ILS and GBAS operations also provide for resilience benefits and are acceptable in terms of ATC workload and safety;
- Runway capacity resilience (Percentage of Airport and Airspace capacity loss avoided) is increased in poor weather conditions by using GBAS. Resilience benefits strongly depend on the level of capacity loss that, currently, an ILS-equipped airport suffers when LVP are put in place. The validation showed that ILS-equipped airports, when Low visibility procedures are activated, decrease their capacity around 50-60%; however, assuming that 60% of traffic fleet is GBAS-equipped the decrease would be just of 46-45% correspondingly;

Recommendations and Additional activities

This SESAR Solution does not need any additional R&D activity in segregated mode. Mixed mode runway scenario might need further refining.

The proposed phraseology reveals that a more distinct difference of the phraseology compared to ILS is required in order to avoid misunderstandings.

Supplemental Interoperability Validation flight exercises are still ongoing outside SESAR. No significant protocol or performance issues have been reported to-date.

Actors impacted by the SESAR Solution

Actors involved are:

- Pilots
- Approach and Tower Controllers
- GBAS Procedure designers
- Aerodrome Operator.

Impact on Aircraft systems

Aircraft should be equipped with GBAS capability (MMR- Multi Mode Receiver).

Impact on the Primary Flight Display HMI (PFD).

Impact on Ground Systems

Implementation of a GBAS ground station on the airport platform.

Impact on tower controller HMI:GBAS station command and status, aircraft GBAS labelling.

Regulatory Framework Considerations

Recommendation is to have a significantly distinct phraseology between ILS and GBAS in order to avoid misunderstandings.

Additional information can be found in the regulatory overview associated to this solution.

Standardization Frameworks Considerations

Results are reflected on ICAO level as input to Annex 10 GAST D[2] standard. The Navigation System Panel (NSP/1) in April 2015 has accepted all SESAR contributions and validated the majority of the requirements of the Standard proposal.

EUROCAE WG28 initiated preparation of ground MOPS (ED-114 update for CAT III GBAS (GAST D).

Results will be reflected on ICAO level as input to Annex 10 GAST D standard and traced to MOPS (RTCA DO-253D).

Considerations of Regulatory Oversight and Certification Activities

In the frame of FAA coordination, SESAR members participating in AWOH ARC[1] have supported the development of GAST-D airborne approval material for the FAA. This material now needs to be integrated in EASA and NSA/NAA regulatory activities. On the ground and system aspects SESAR activities include an ongoing regulatory support task to answer eventual EASA and NSA requests, following the presentation of the GAST-D concept in May 2013 and autumn 2014. Comments received on the initial concept paper are being replied to in the frame of this task.

Solution Data pack

The Data pack for this Solution includes the following documents:

- Regulatory overview;
- OSED: 06.08.05 -D47 - Edition 00.01.01 date 30/06/2015;

[2] GBAS Approach Service Type D
[1] All Weather Operations Harmonization Aviation Rulemaking Committee

- SPR:
  - Safety Assessment Report: 15.03.06-D22 - Edition 00.01.00 date 28/01/2015 ;
- Technical Specifications:
  - 15.03.06-D04 provides the ground subsystem technical specification, Edition 00.01.00, Edition 00.01.00 date 21/03/2013;
- Verification Report:
  - 9 12-D27 executive summary, Edition: 00.01.00 date 03/03/2016.

Intellectual Property Rights (foreground)

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