Der Business Case für GLS - GAST-A Anflüge mit SBAS Relay

Thomas Dautermann
Background - GBAS & SBAS

GBAS (Ground-Based Augmentation System) and SBAS (Satellite-Based Augmentation System) are augmentation systems for the global navigation satellite system (GNSS) that provide additional precision for aircraft and other users. GBAS is used for new technology demonstrations and airport applications, while SBAS is used for route operations. Both systems provide improved navigation accuracy and integrity compared to the standard GNSS signals.

GBAS works by using a network of ground-based reference stations to calculate corrections that are broadcast to aircraft and other users. These corrections are then combined with the standard GNSS signals to provide enhanced positioning information.

SBAS works similarly, but instead of using ground-based reference stations, it uses satellite constellations to broadcast corrections. This allows for wider coverage and can be used in areas where ground-based reference stations are not available.

Both GBAS and SBAS are used to support the operation of precision approach and landing systems (PALS) at airports, allowing for more accurate and reliable navigation during approach and landing.

The diagrams illustrate the flow of GNSS data, corrections, and user data within the GBAS and SBAS systems, showing how these systems enhance the accuracy and reliability of the GNSS signals.
Augmentation Systems and Users

GBAS

Commercial Air Transport

SBAS

General Aviation & Regionals
A synchronized common approach is crucial to break the wall and create a positive momentum on GBAS technology deployment.

**ANSPs:**
- Reduced cost of operation after decommissioning of ILS Technology (at least partially)
- Implement concepts of operations (and motivate ATCOs), that deliver benefits to Airlines to push equipage rate (e.g. Best Equipped Best Served concept)

**Airports:**
- Reduced impact of aircraft noise by higher glide slope intercept altitudes (avoid low level flight segments) or steeper glideslopes
- Higher airport capacity in low visibility operations (LVO)
- Establish concepts to clear traffic off the runways in LVO

**Airlines:**
- Strive for high equipage rates of aircraft crucial to realize beneficial effects and to decrease ATC controllers workload (traffic differentiation)
- Train and motivate pilots to execute GBAS approaches

**Manufacturers:**
- Support Airlines (Air) and ANSPs/Airports (Ground) to create business cases for investments and align Ground/Air efforts

**ICAO/Regulators:**
- Deliver appropriate framework to allow quick progress
GLS ... “Chicken-and-Egg Problem”

Airframers & Avionics Suppliers

Only build new functionality IF the Airlines will buy it!

Airlines

Only buy new functionality IF ATC gives benefits for it!

ATC

Only provide benefits IF the Airframers have built it!
From GBAS & SBAS to GLASS (GLS Approaches using SBAS)

Business Case: Approaches with LPV Only
Business Case: Constraints at Airports

LNAV Minimum 770ft
FAS DB & Associated Issues

Approach Performance Designator APD=0

Normally should trigger a multiplier of 2 for the coded FASVAL → not evaluated by CMA-6024, GLU925, INR

Image Credit: AERODATA, taken with AERO FIS – CMA-6024 Receiver
The “Time to Alert” Question

APV-1 → Requires 10s Time-to-Alert

Calculation for the GLASS System:

- The SiS TTA is the 5.2s from SBAS (unpublished proof in “EGNOS Signal-in-Space System Safety Case Part A (Design, Development and Deployment) Issue 3 from 21 February 2008.”)
- 3.5s for the missed message allocation
- 10s - 3.5s - 5.2s = 1.3s

Processing on a Standard Linux PC takes about 20ms
Ground Testing

Using real avionics

- Rockwell Collins GLU 925 (Airbus version)
- Honeywell INR (B787 version)

Width of RWY centerline marking.
Flight Validation

Flight Calibration Services performed standard GBAS Flight Validation
Lufthansa Charter D-AIBI (A319)

Chart 15

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Along-track distance from GP/IL in km

Deviations in °

Localizer
Glidepath
Threshold Crossing Point

ALT
G/S
FLARE
LAND
ROLLOUT
LOC
LOC*
DLR’s Advanced Technology Research Aircraft
Flight Tests in Kerkyra (CFU)
Test with German Air Force

Installation at Wunstorf ETNW

- Airbus A400M test upcoming
Conclusions

SARPS has little content about GAST-A, if so mostly related to GRAS

Receiver behavior: APD-0 is being ignored