GAST-A Using SBAS Correction Data

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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 differantiation)
- 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
Tackling the “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!
Business Case: Approaches with LPV Only

[Diagram of airport approach track and instructions for flight]
Business Case: Constraints at Airports

→ Spatial and monetary constraints

LNAV Minimum 770ft
From GBAS & SBAS to GLASS (GLS Approaches using SBAS)

Technical: SBAS to GBAS Differences

- 4 dimensional covariance position error ellipse (horizontal shown)
- SBAS bounds horizontal error
- GBAS bounds lateral error
  → SBAS HPL is larger than GBAS LPL
- Inflate GBAS lateral error by adding factor F to error distribution
  \[ \sigma_i^2 = F \sigma_{pr_{-grad}}^2[i] + \sigma_{mapc}[i] + \sigma_{pr_{-atr}}^2[i] + \sigma_{Ion}[i] \]
- This affects both lateral and vertical protection levels
- But: Not really needed for GLS approach service, because the approach direction is known.
GLASS Technical Flow

\[ P_{\text{corrected}} = P_{\text{SC}i} \times PRC(t_{\text{gb}i}) + RRC(t_{\text{gb}i}) \times (1 - \Delta_{\text{gb}i})IC_i + \eta \]

\[ \sigma_i^2 = F \sigma_{\text{pr.gnd}}^2[i] + \sigma_{\text{propa}}^2[i] + \sigma_{\text{pr.atr}}^2[i] + \sigma_{\text{iono}}^2[i] \]

Inserted, if mapping of SBAS HPL to GBAS LPL is desired
Effect of Inflation

(a) GLASS GBAS with bin resolution of 0.5 m
System Unavailable
Alarm epochs: 440
LPV VAL 99.96%
HMI Epochs: 00
MI Epochs: 00

(b) SBAS with bin resolution of 0.5 m
System Unavailable
Alarm epochs: 0
LPV VAL 100.00%
HMI Epochs: 00
MI Epochs: 00
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
APD 0 Effect

- APD=0 is not evaluated
- VPL is reduced and limits availability
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)
DLR’s Advanced Technology Research Aircraft
Flight Tests in Kerkyra (CFU)
Test with German Air Force

Installation at Wunstorf ETNW

- Airbus A400M test upcoming
Operational Concept

How to present it to the Pilot ➔ ongoing study, but GLS preferred
Questions for the Group

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

Receiver behavior: APD-0 is being ignored

Planned tests: Collins GLU2100, Thales MMR, Honeywell IMMR

Compliance with DAL is checked in German Project with Funke Avionics