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 techology deployment

SESAR

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 equippage rate (e.g. Best Equipped Best Served concept)*

Airports:
- Reduced impact of aircaft 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 benefitial effects and to decrease ATC controllers workload (traffic differantiation)
- Train and motivate pilots to execute GBAS approaches

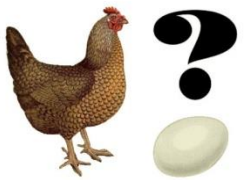
Manufacturers:
- Support Airlines (Air) and ANSPs/Airports (Ground) to create business cases for investments and align Ground/Air efforts

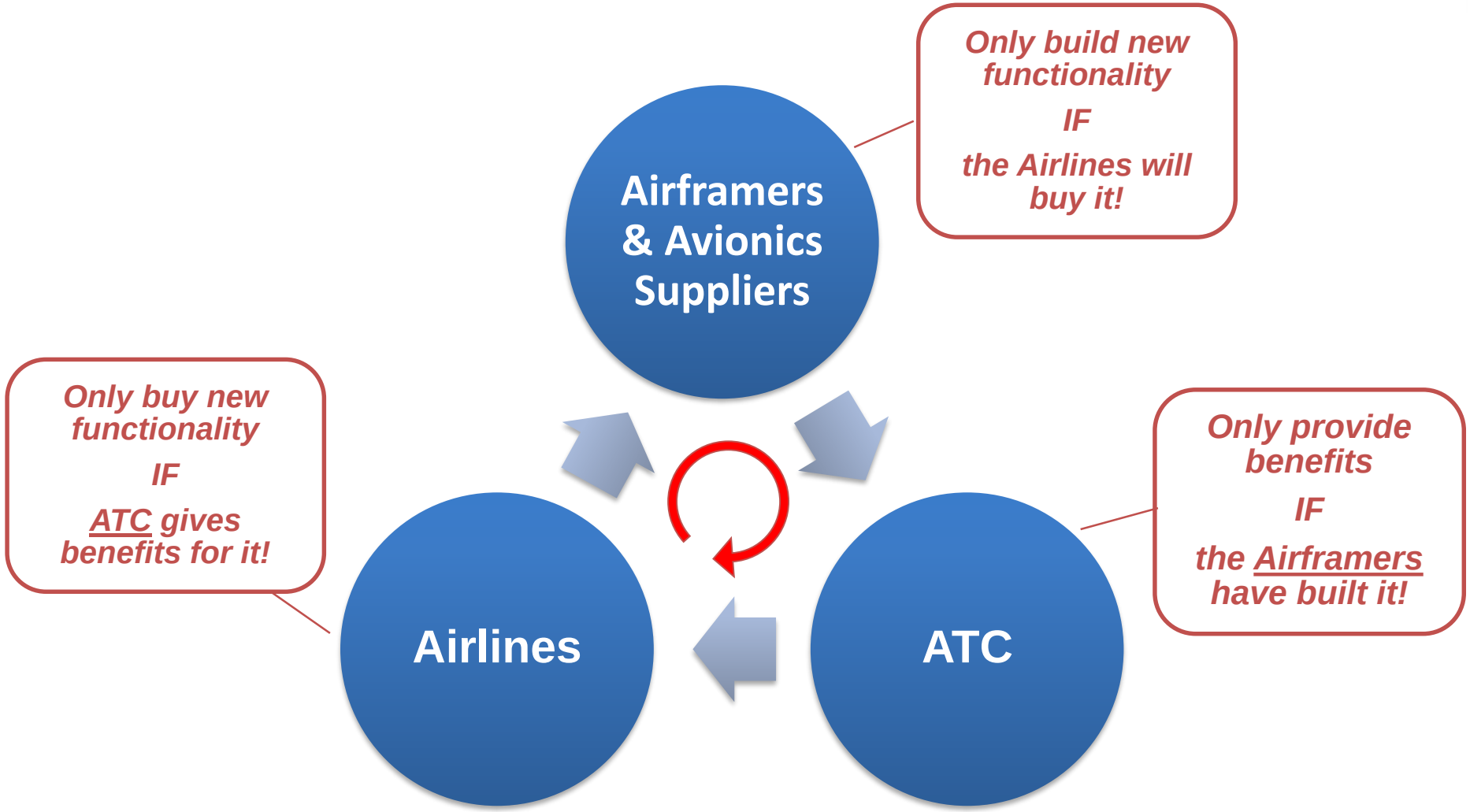
ICAO/Regulators:
- Deliver appropriate framework to allow quick progress

Lufthansa Group

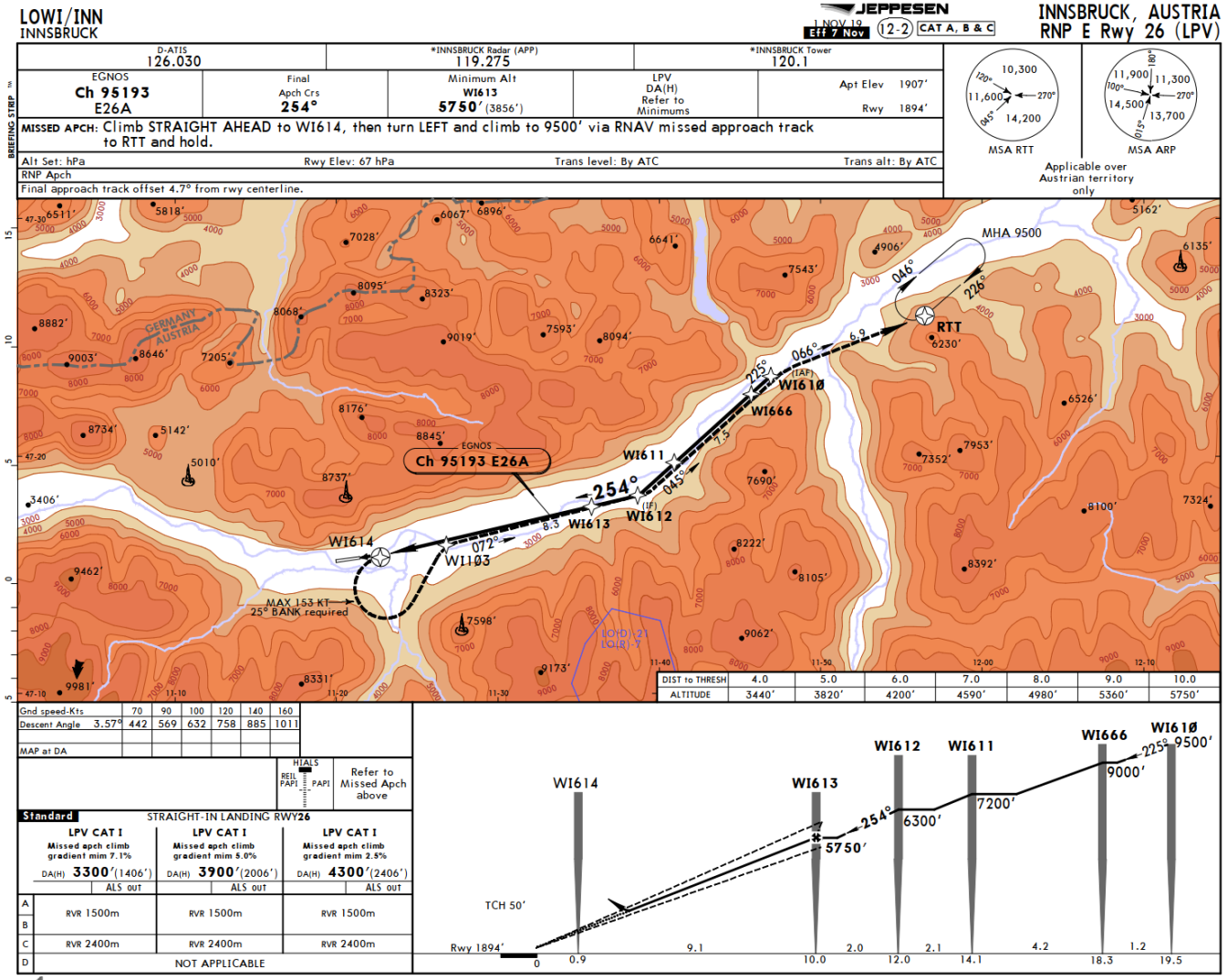
DLR

GLS ... “Chicken-and-Egg Problem”

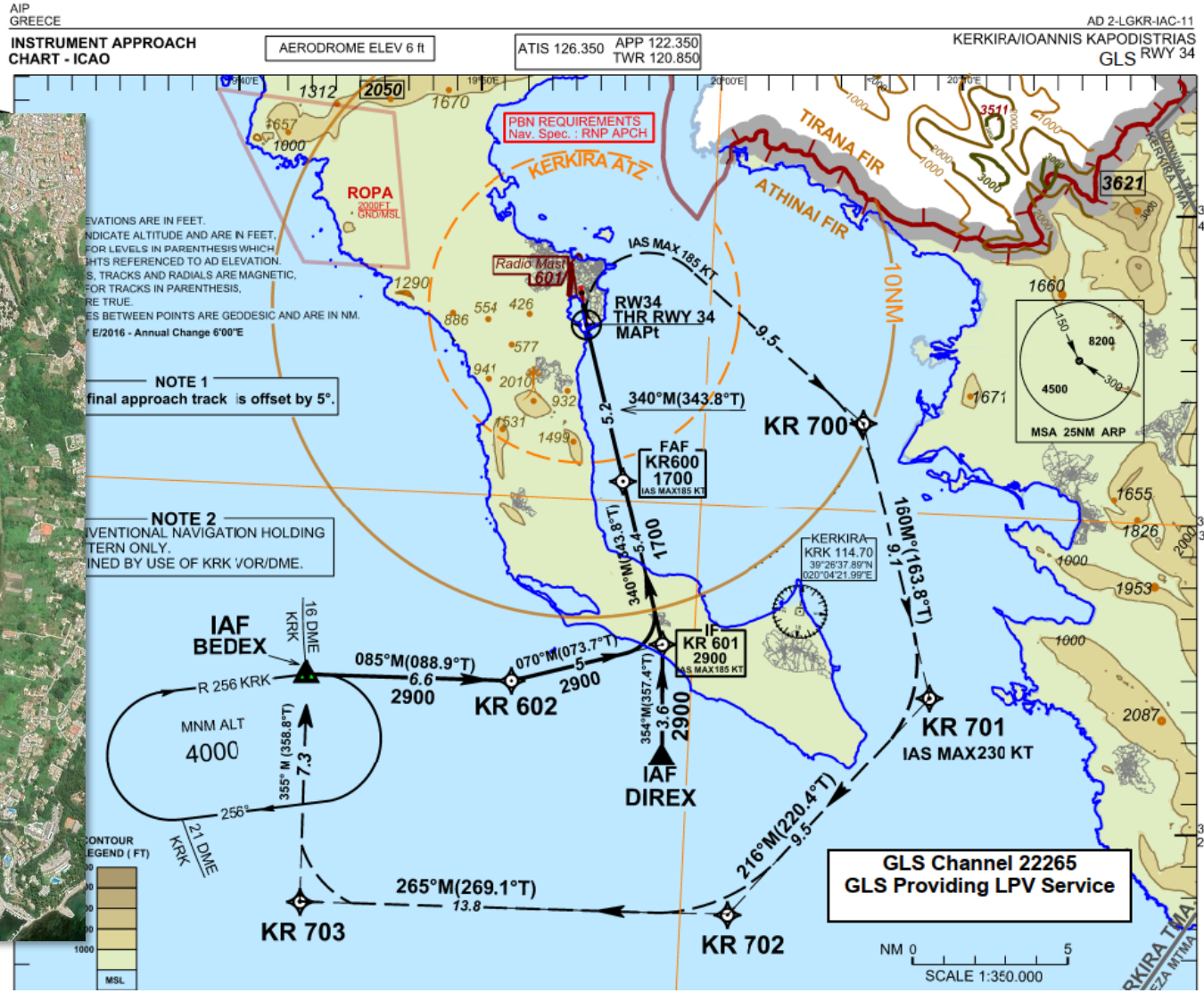




Business Case: Approaches with LPV Only

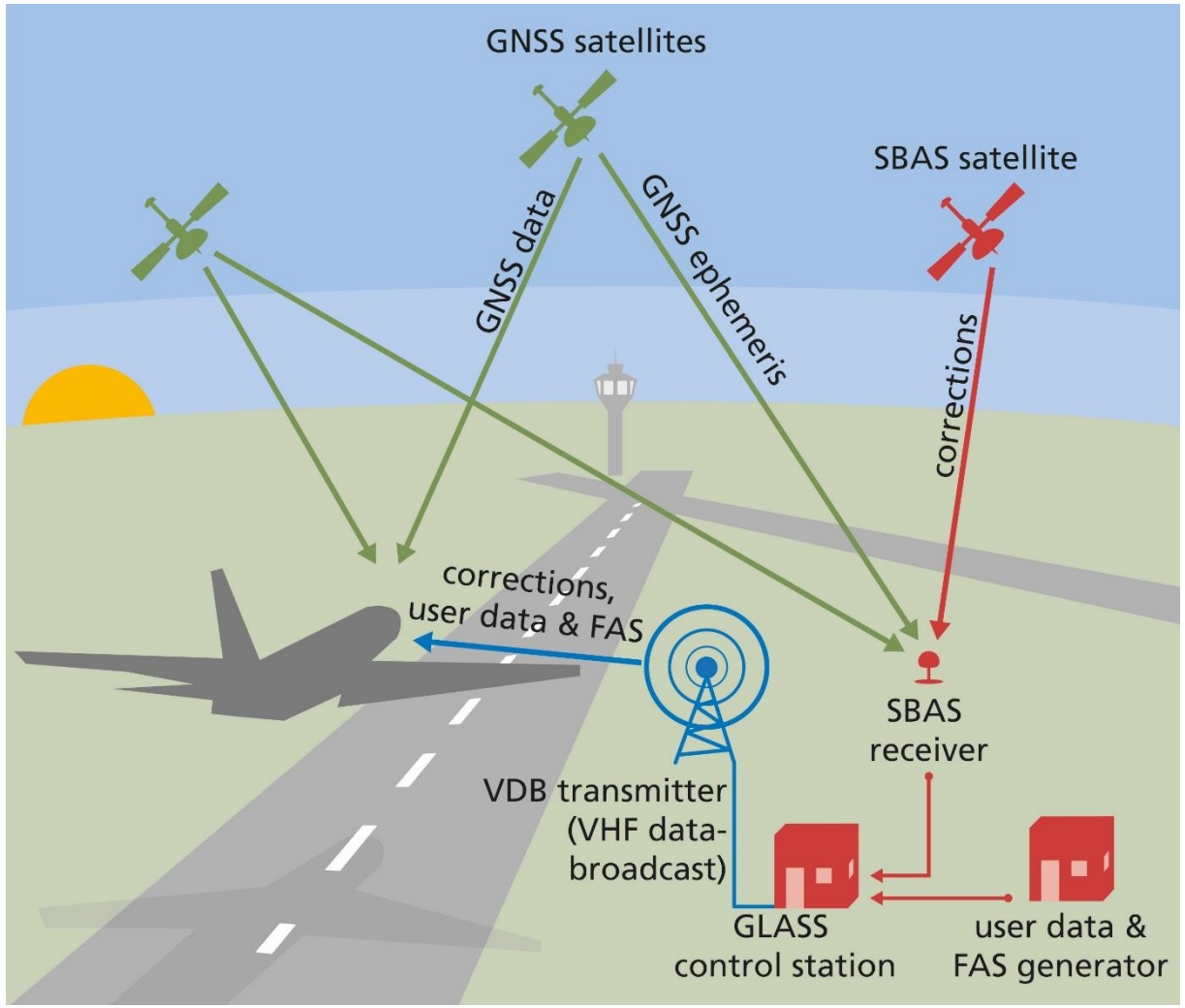


Business Case: Constraints at Airports



LNAV Minimum 770ft

From GBAS & SBAS to GLASS (GLS Approaches using SBAS)

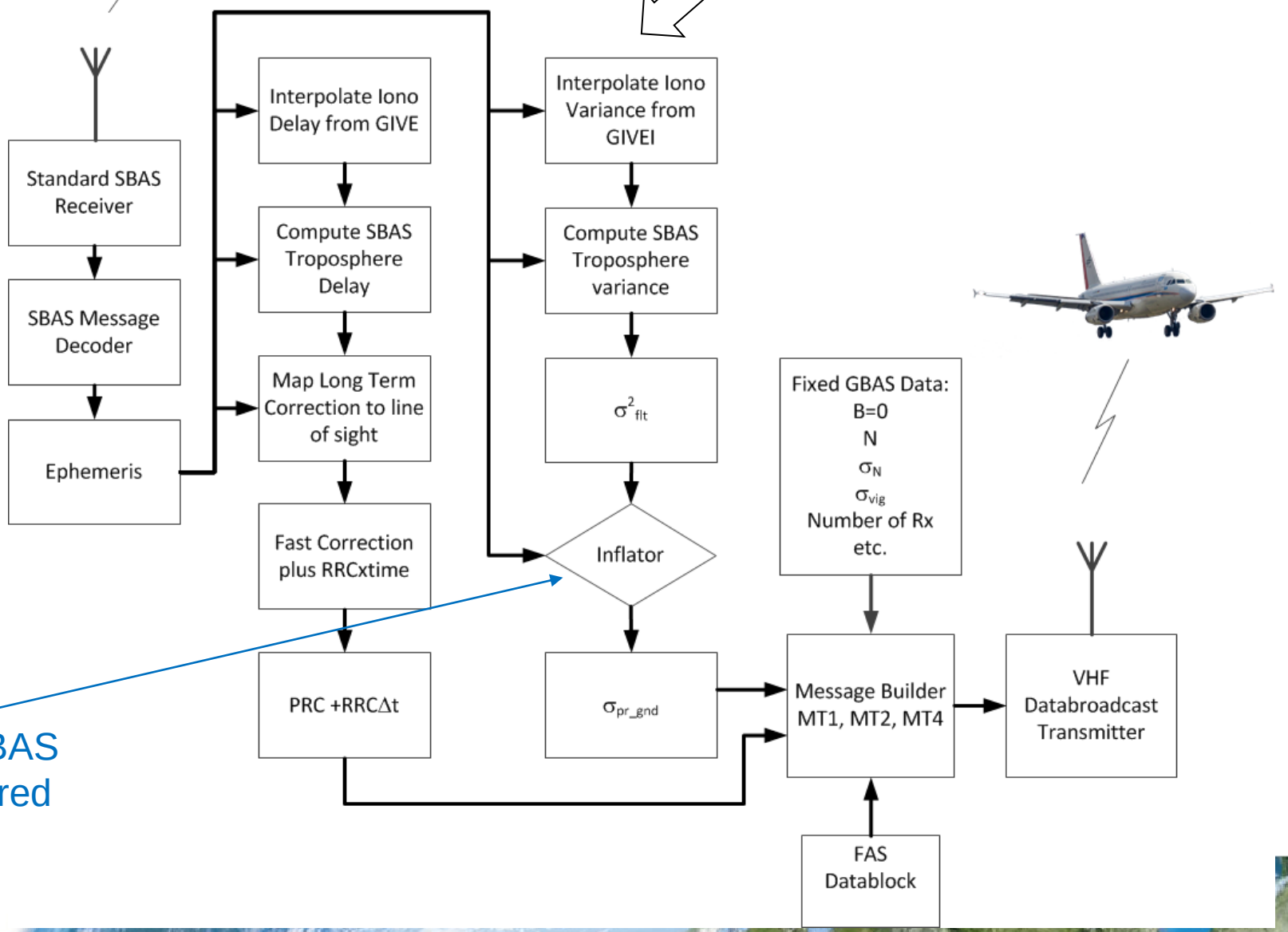


Dautermann T., Ludwig T., Geister R. *et al.* Extending access to localizer performance with vertical guidance approaches by means of an SBAS to GBAS converter. *GPS Solutions* **24,** 37 (2020). https://doi.org/10.1007/s10291-019-0947-7

GLASS Technical Flow

$$\rho_{corrected,i} = \rho_{CSC,i} + PRC_i(t_{ofA}) + RRC_i(t_{ofA}) \times (t - t_{ofA})TC_i + c\Delta t_{sv,corr} + IC_i$$

$$\sigma_i^2 = F\sigma_{pr\_gnd\_x}^2[i] + \sigma_{tropo}^2[i] + \sigma_{pr\_air}^2[i] + \sigma_{iono}^2[i]$$



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

FAS DB & Associated Issues

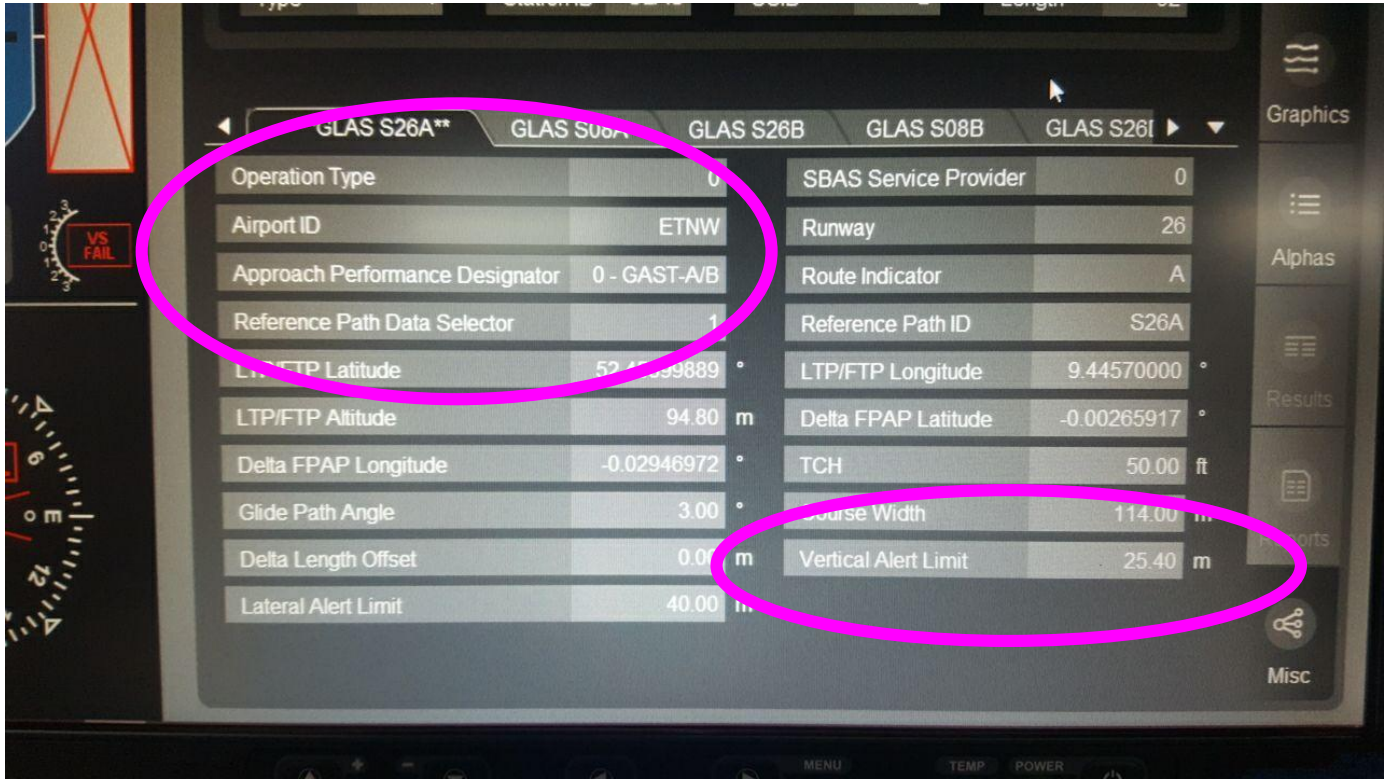


Image Credit: AERODATA, taken with AERO FIS – CMA-6024 Receiver

Approach Performance Designator APD=0

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

The “Time to Alert” Question

APV-1 → Requires 10s Time-to-Alert

Calculation for the GLASS System:

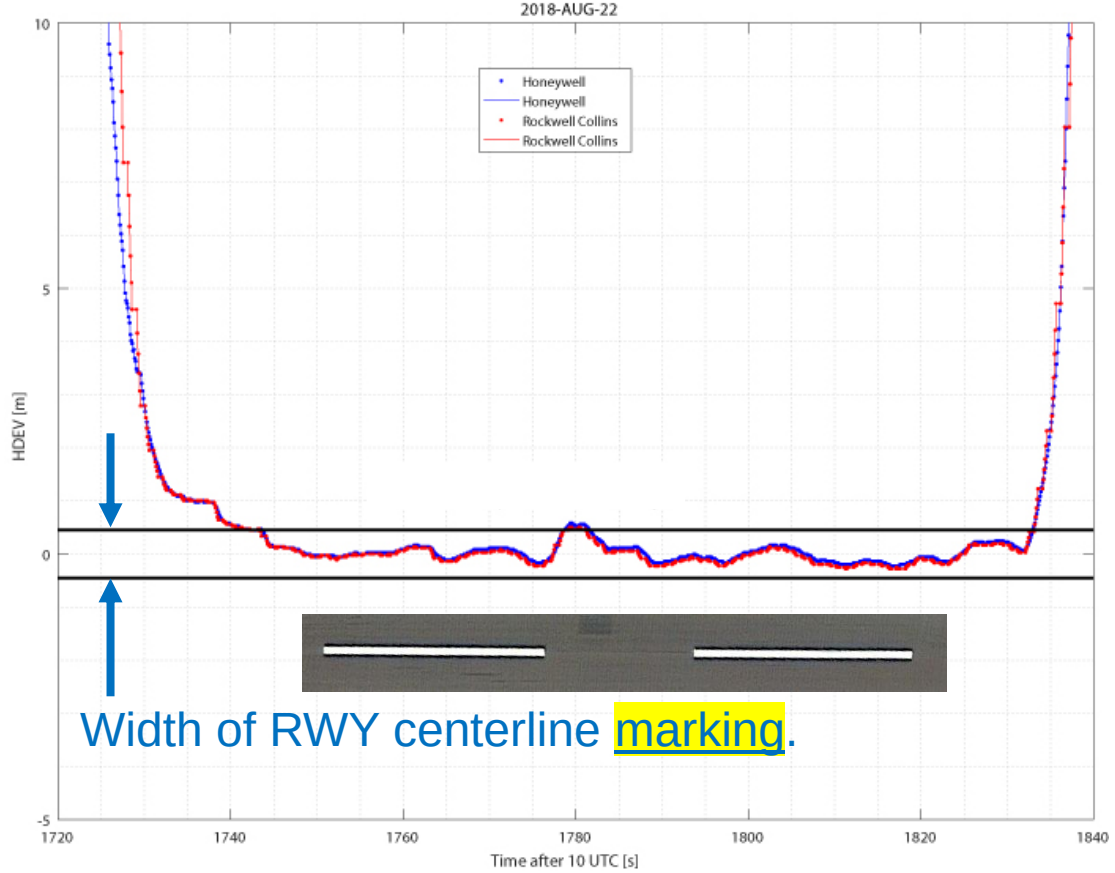
- The SiS TTA is the 5.2s from SBAS (unpublished proof in *“EGNOS Signal-in-Space System Safety Case Part A (Design, Development and Deployment) Issue 3 from 21 February 2008.”)*
- 3. 5s for the missed message allocation
- 10s - 3.5s - 5.2s = 1.3s

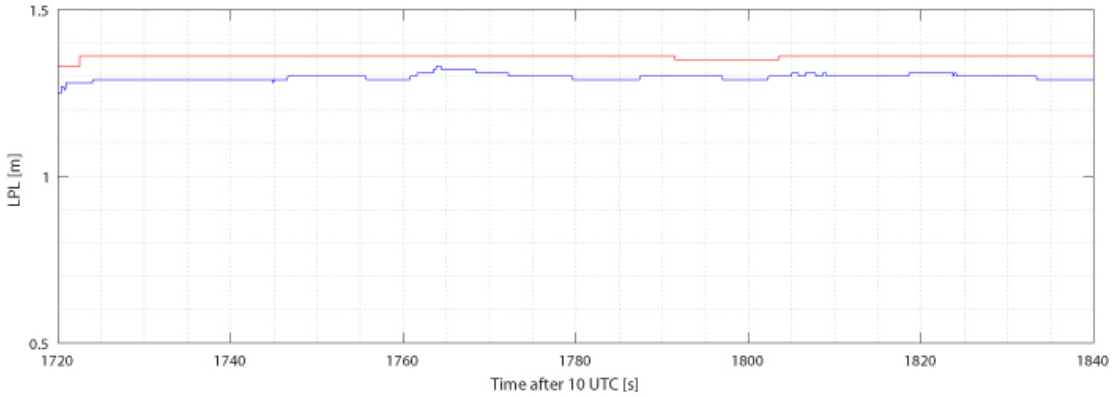
Processing on a Standard Linux PC takes about 20ms

Ground Testing

Using real avionics

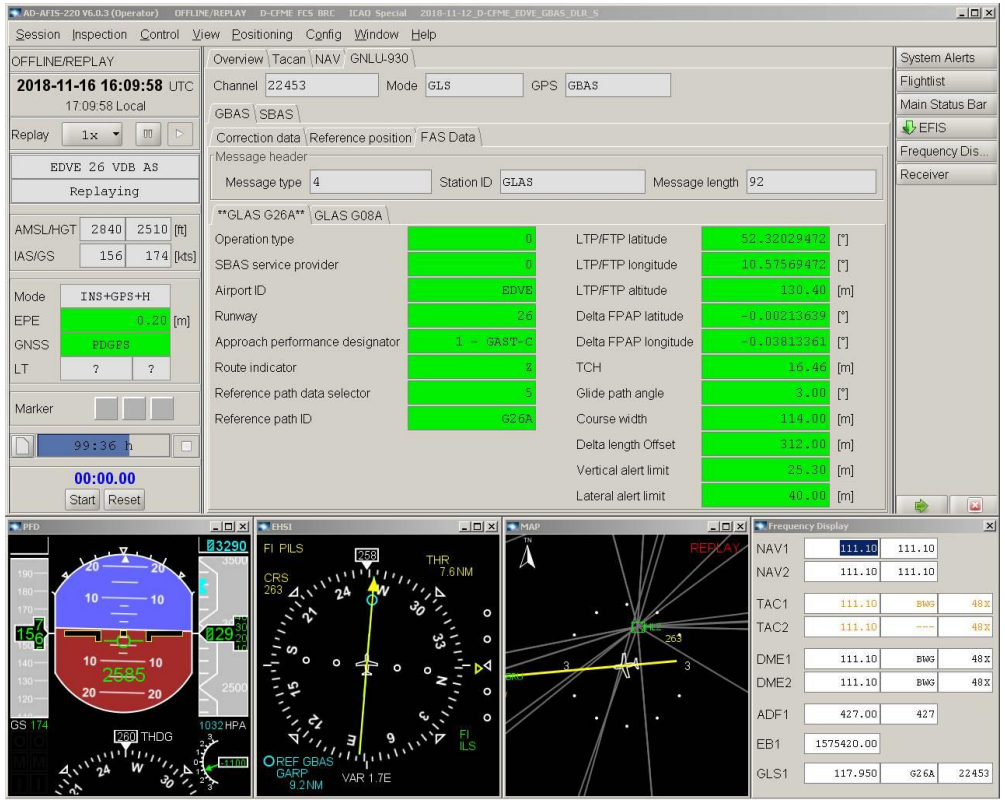
- Rockwell Collins GLU 925 (Airbus version)
- Honeywell INR (B787 version)

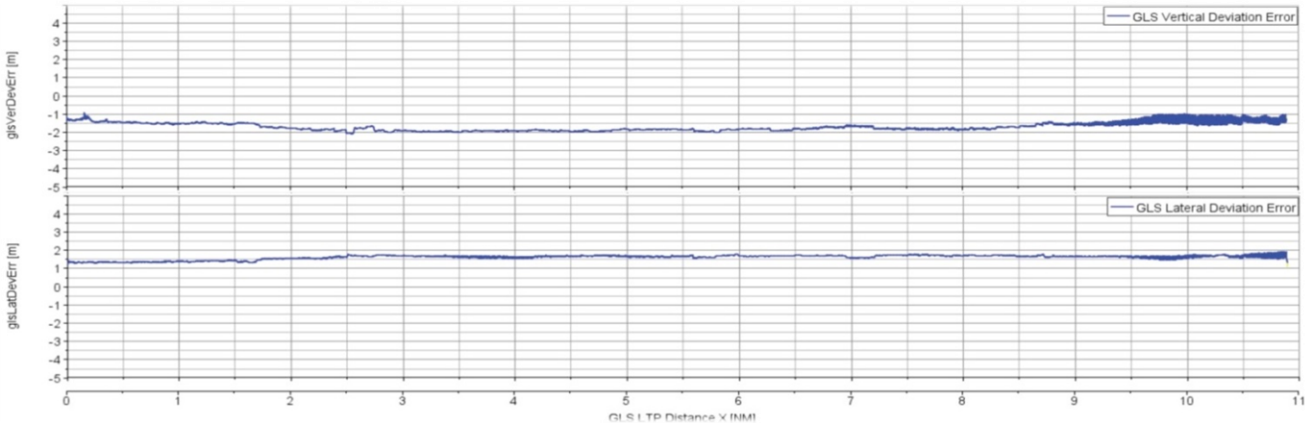




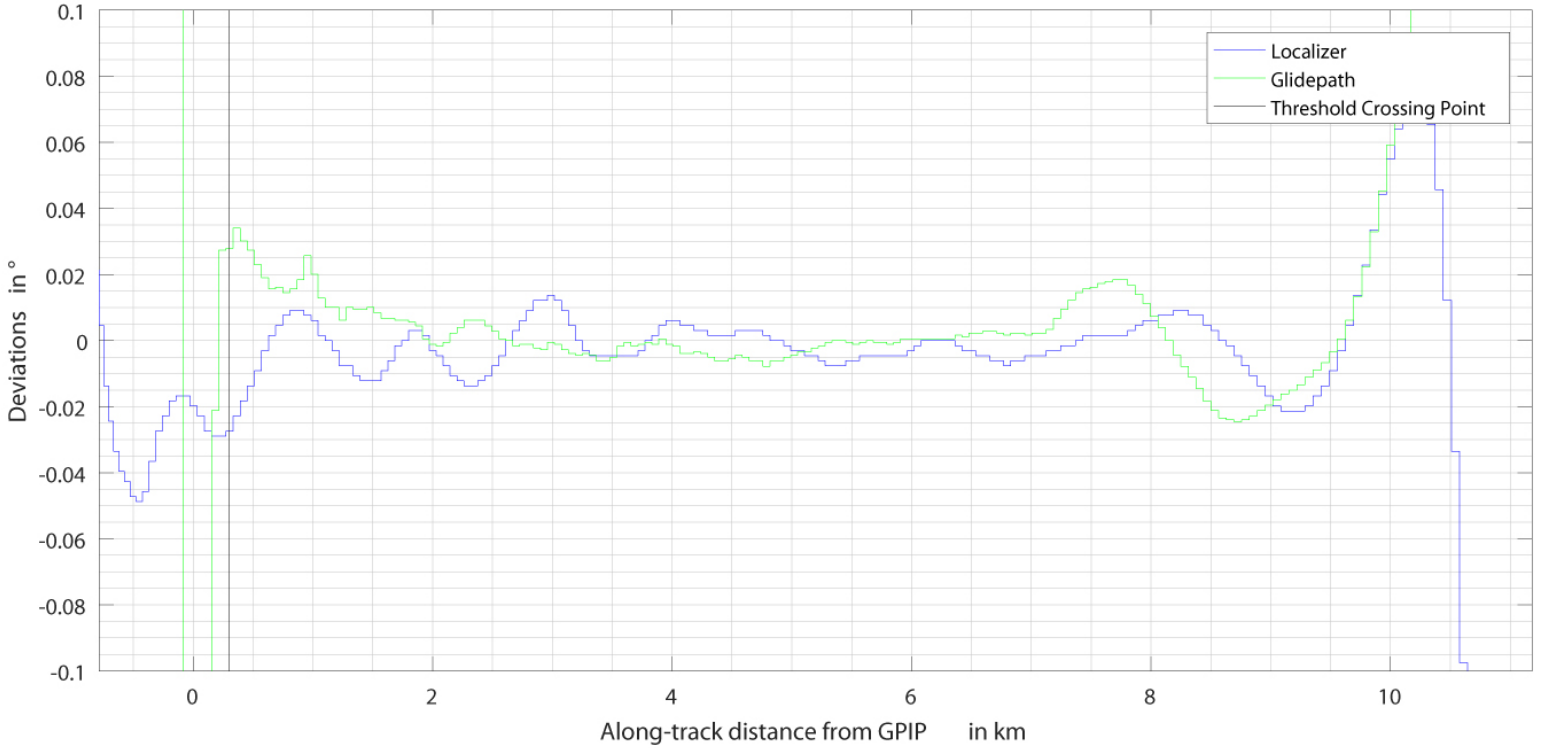
Flight Validation

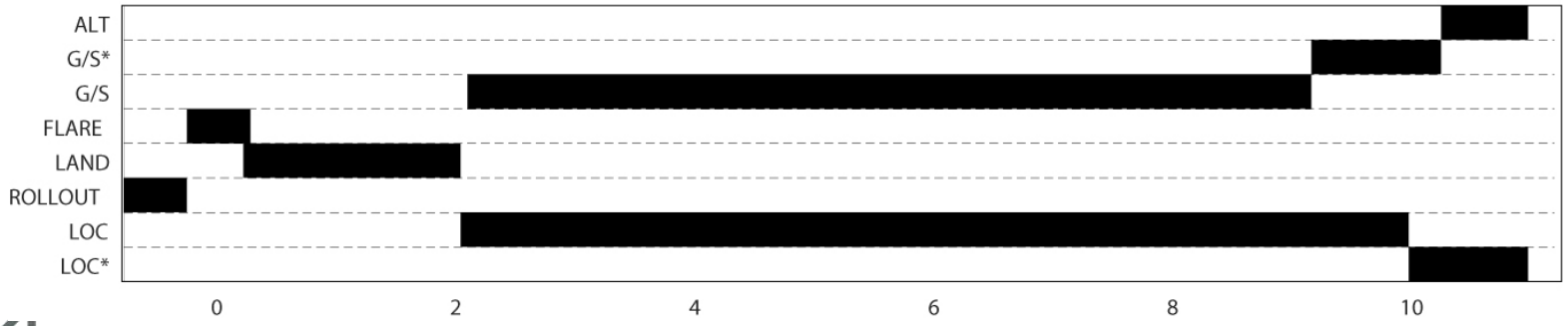
Flight Calibration Services performed standard GBAS Flight Validation





Lufthansa Charter D-AIBI (A319)





DLR’s Advanced Technology Research Aircraft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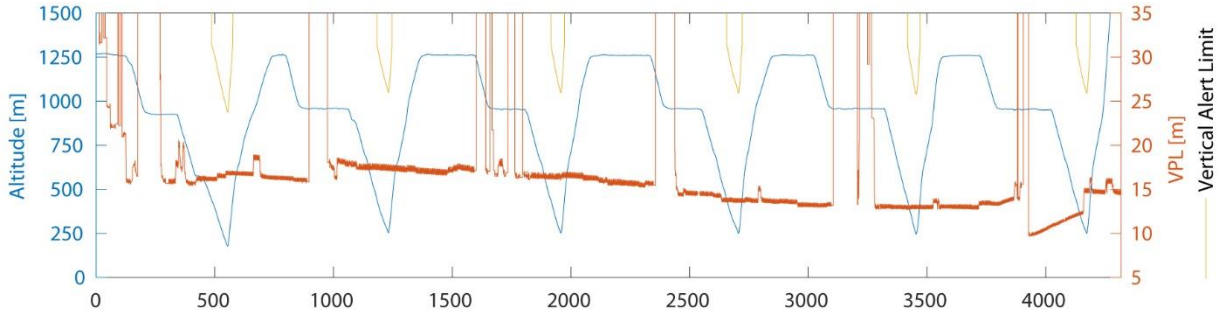
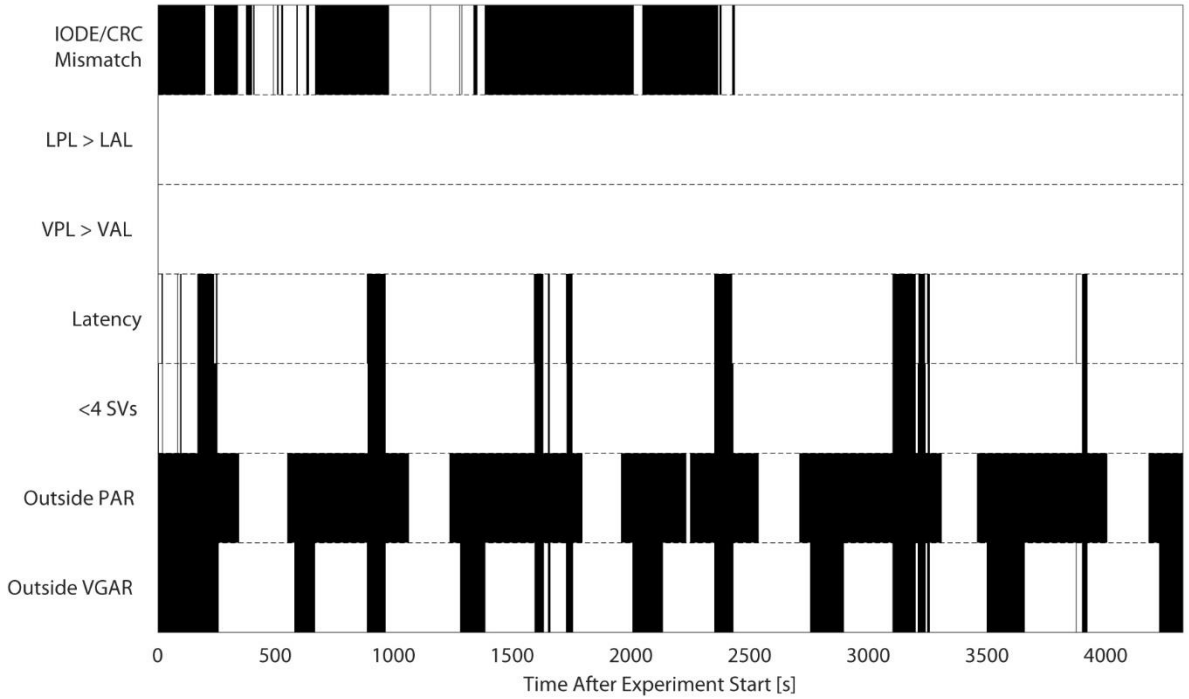
Flight Tests in Kerkyra (CFU)





Test with German Air Force

Installation at Wunstorf ETNW

- Airbus A400M test upcoming

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