GAST-A Using SBAS Correction Data

Thomas Dautermann, Thomas Ludwig, Robert Geister
Thomas.Dautermann@dlr.de

IGWG Denver

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

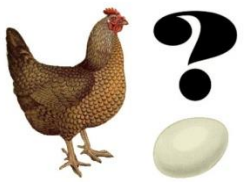
Manufacturers:
- Support Airlines (Air) and ANSPs/Airports (Ground) to create business cases for investments and align Ground/Air efforts

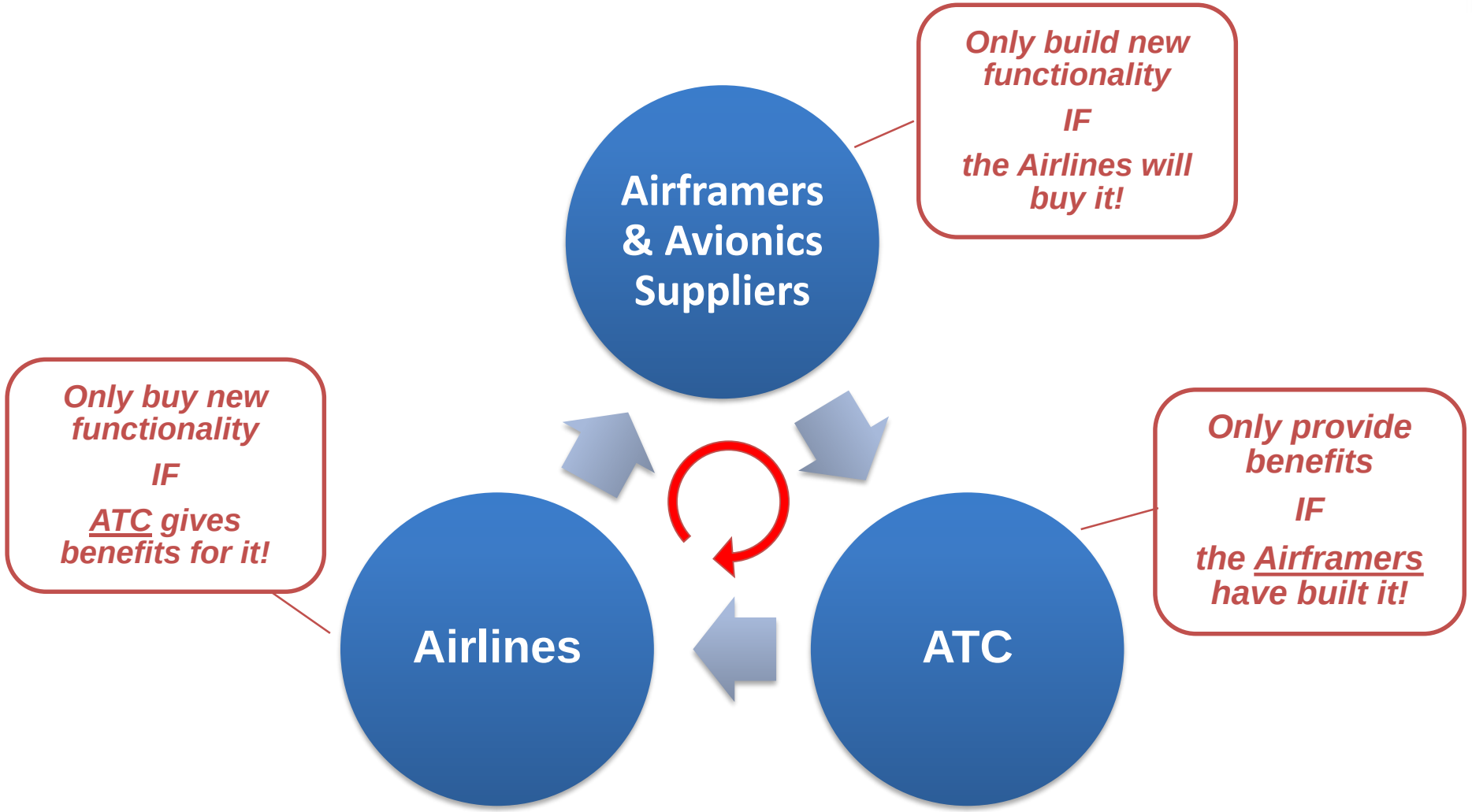
ICAO/Regulators:
- Deliver appropriate framework to allow quick progress

An approach towards sustainable GBAS deployment
Group ATM Development | SESAR
Seite 4

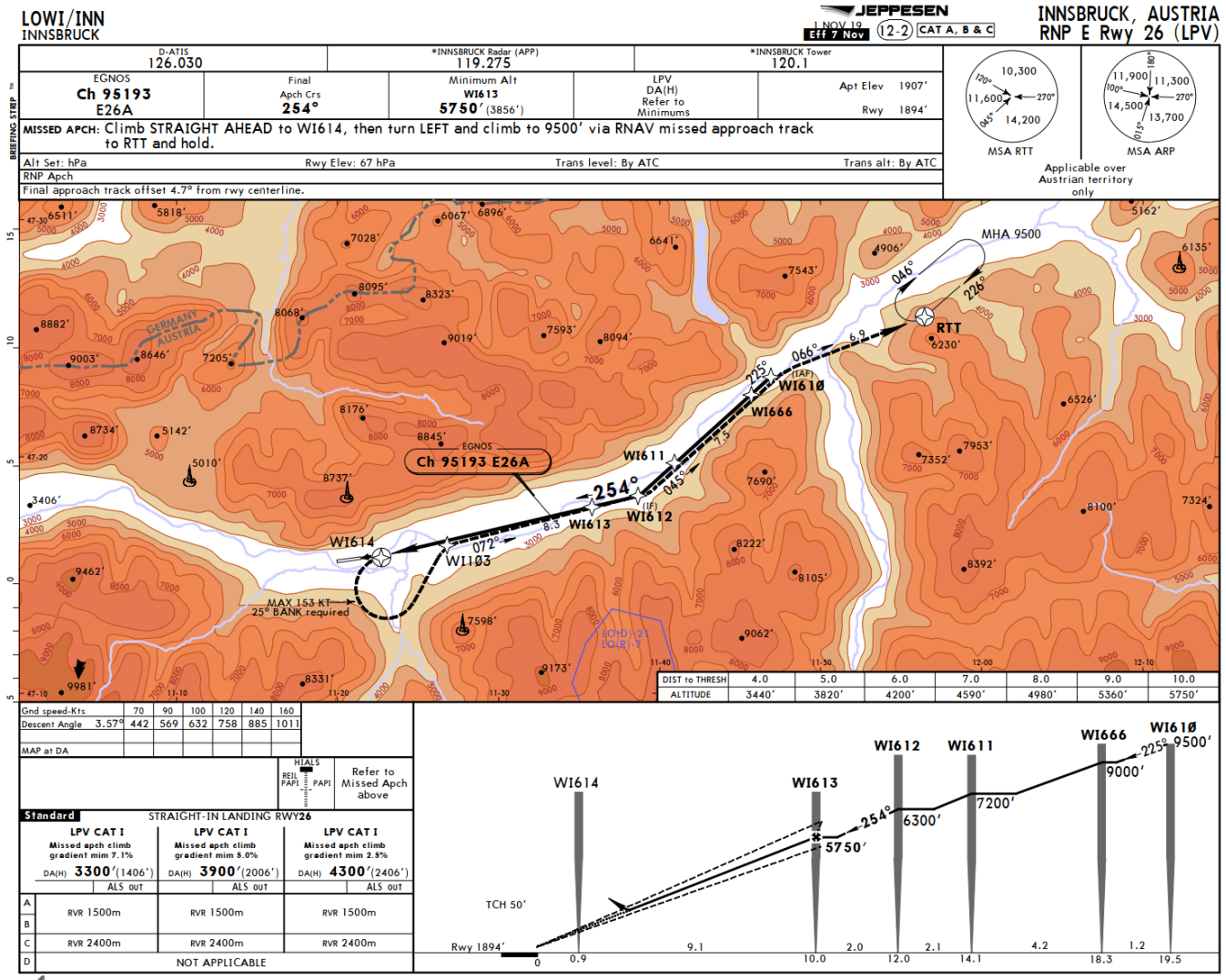
Lufthansa Group

Tackling the“Chicken-and-Egg Problem”



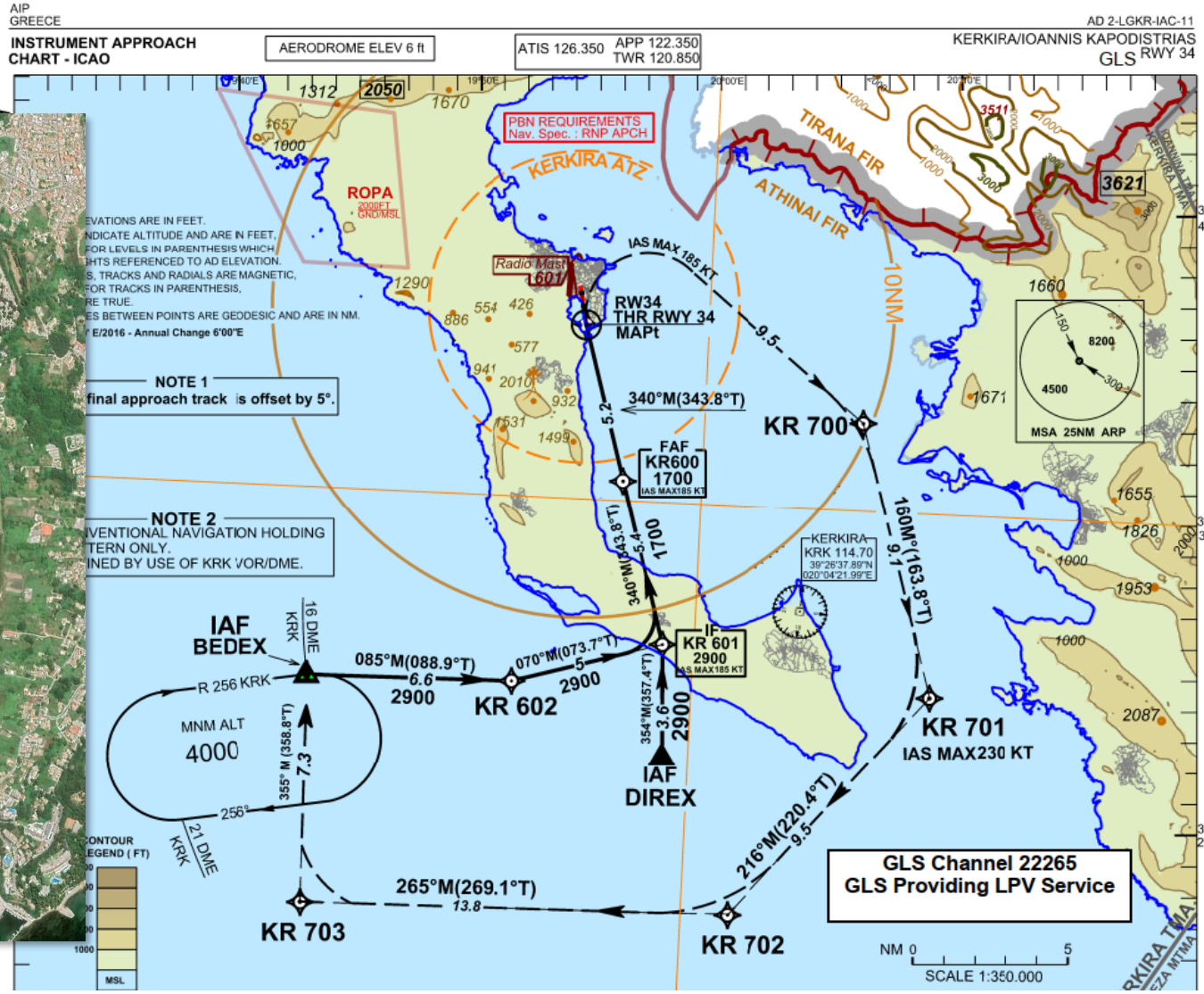


Business Case: Approaches with LPV Only



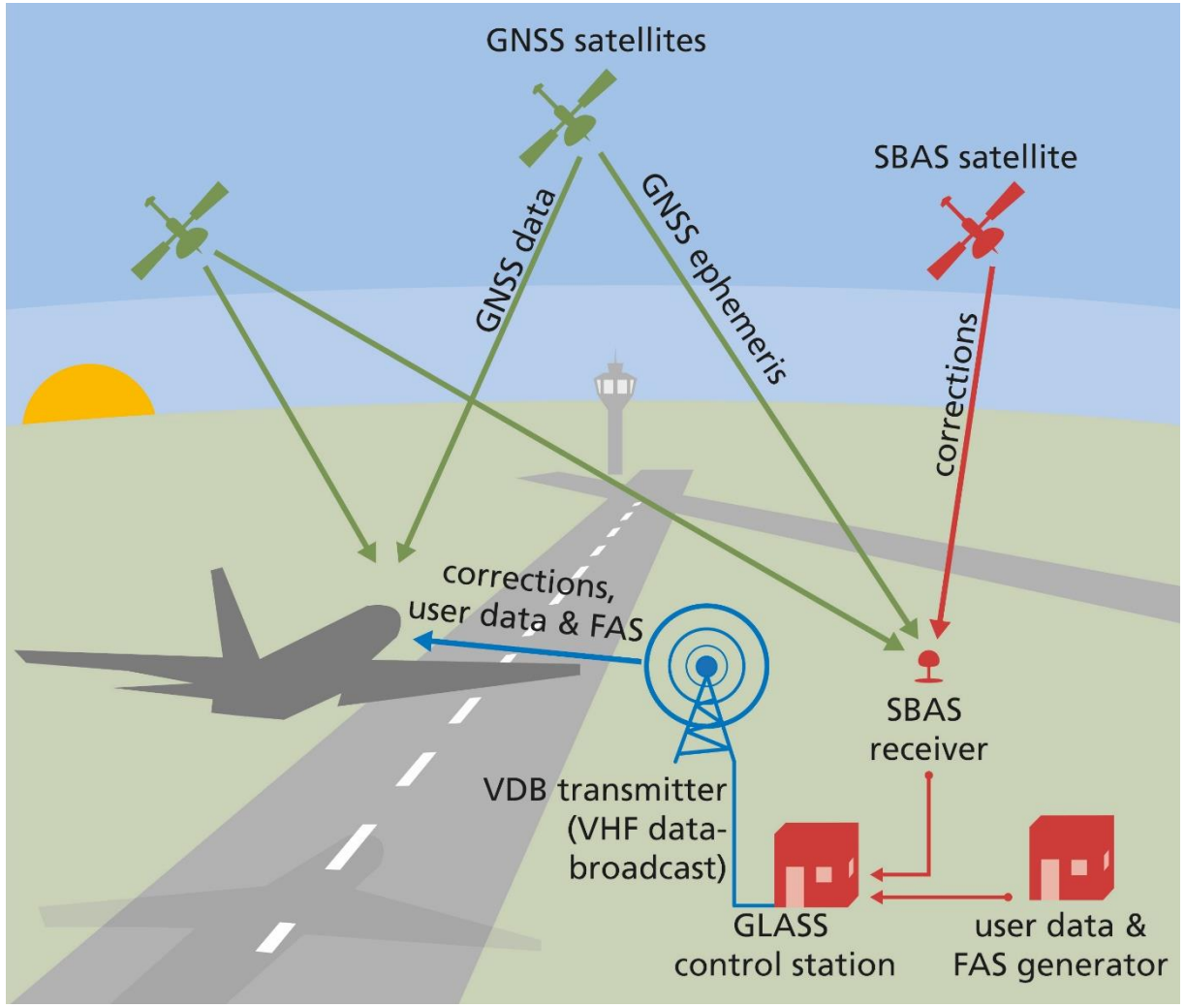
Business Case: Constraints at Airports

→ Spatial and monetary constraints



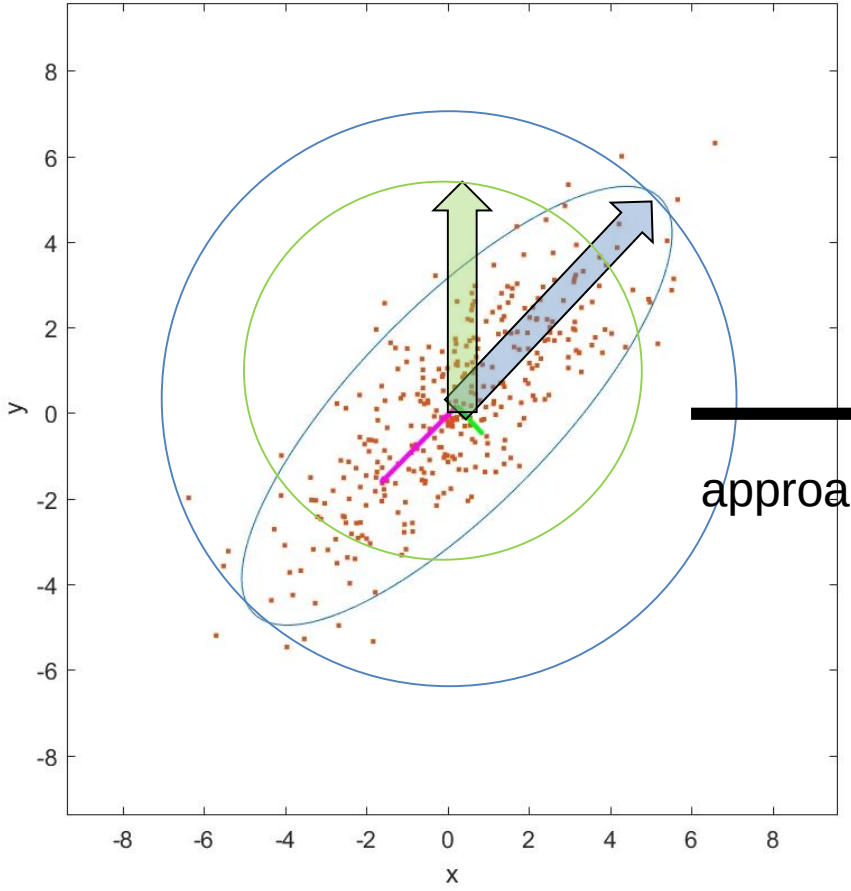
LNAV Minimum 770ft

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

Technical: SBAS to GBAS Differences



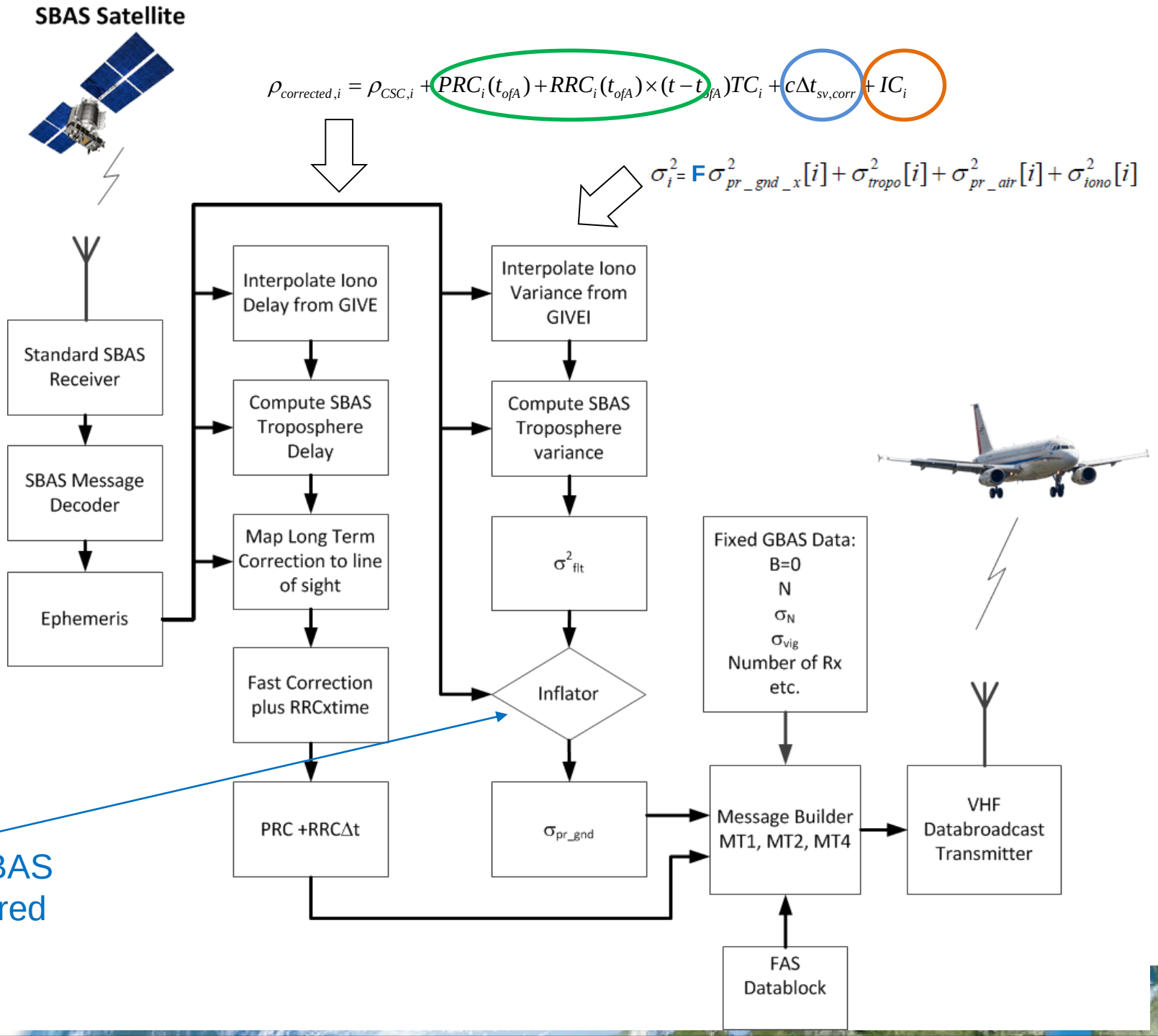
approach direction

- 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

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

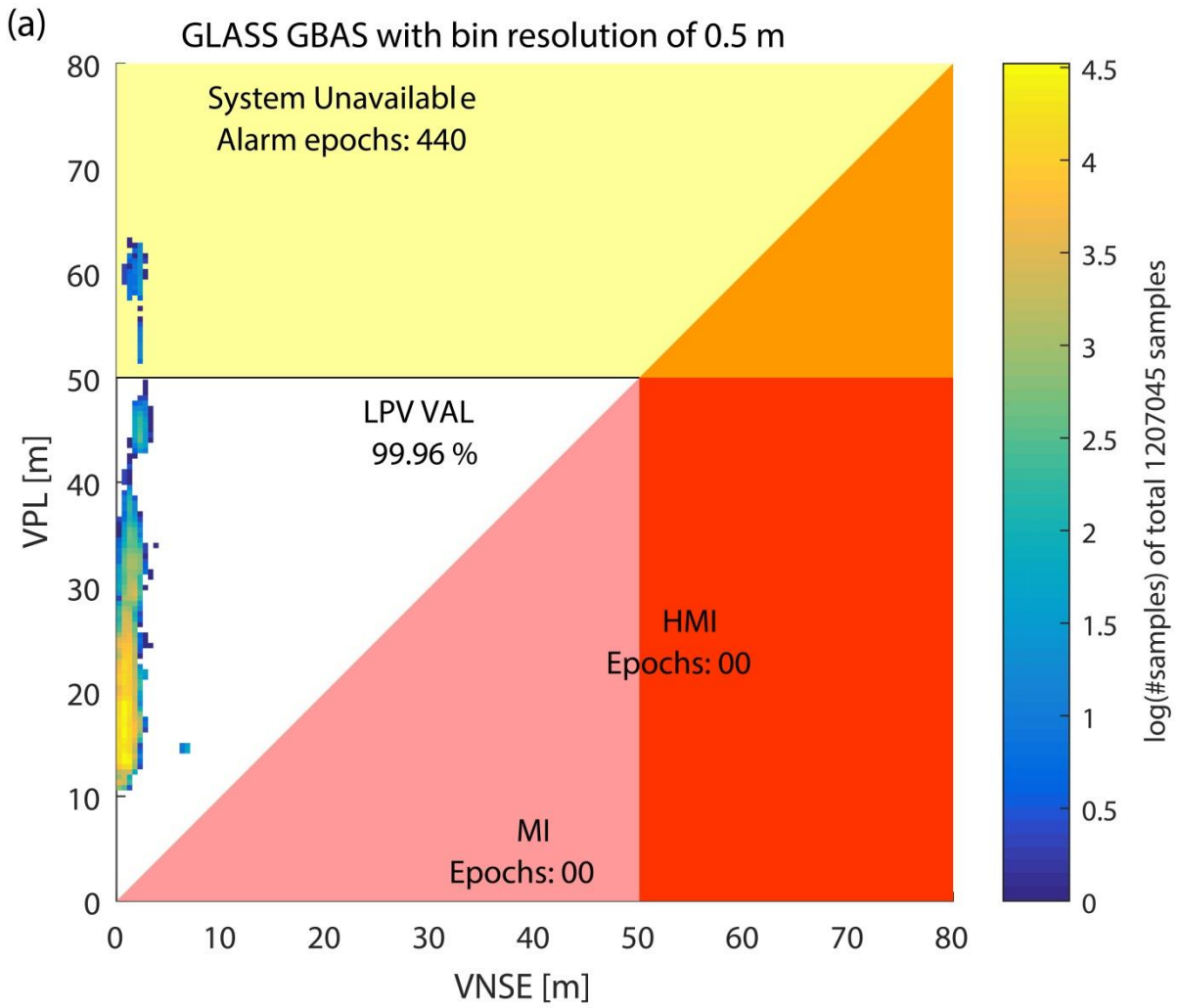
- This affects both lateral and vertical protection levels
- But: Not really needed for GLS approach service, because the approach direction is known.

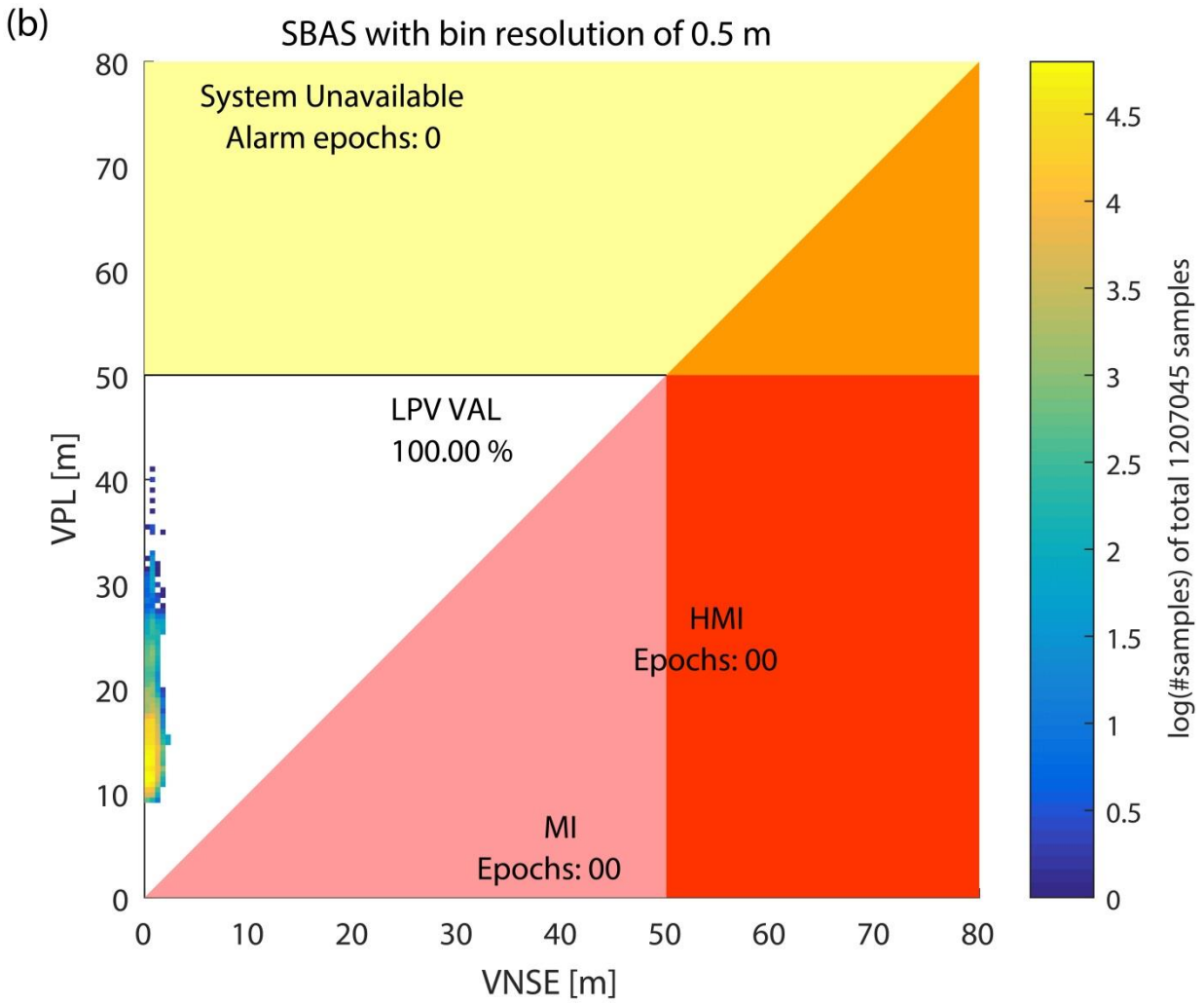
GLASS Technical Flow



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

Effect of Inflation





FAS DB & Associated Issues

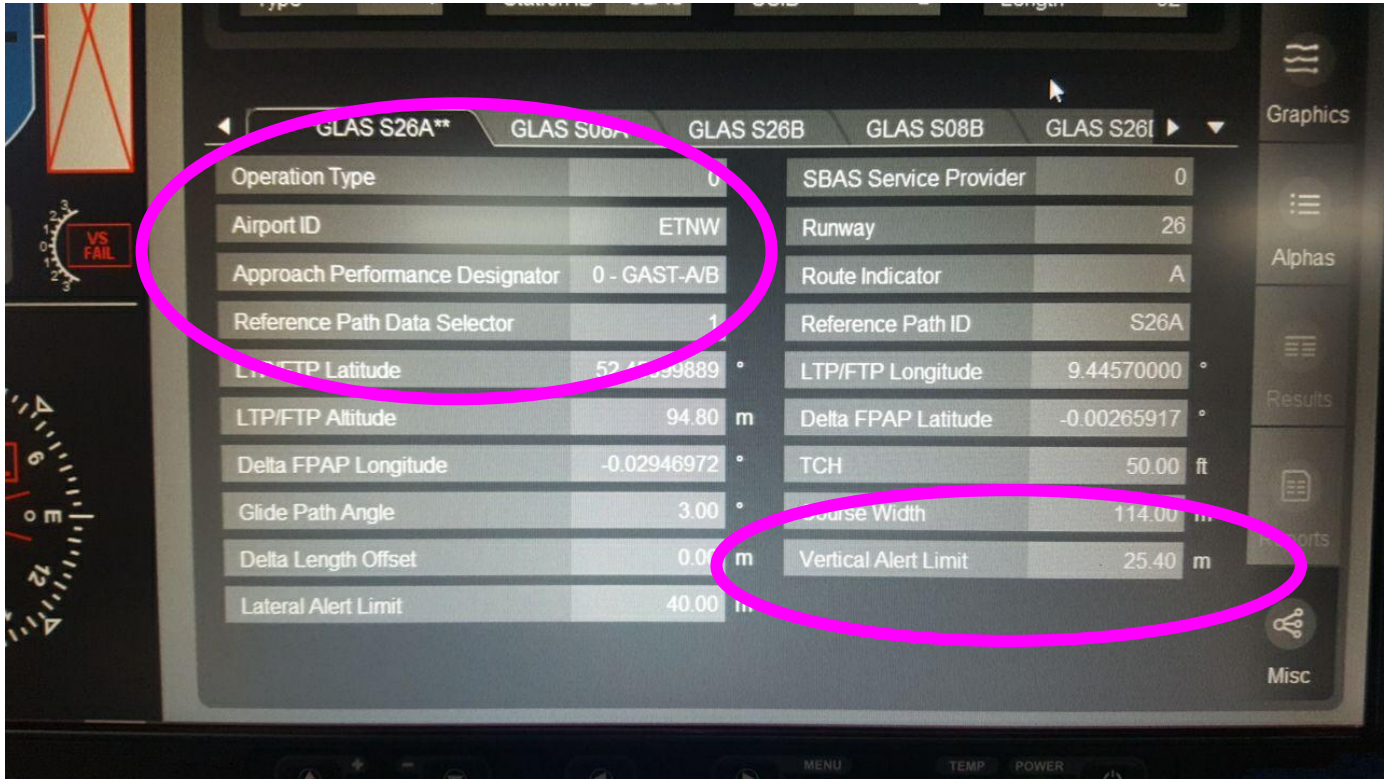


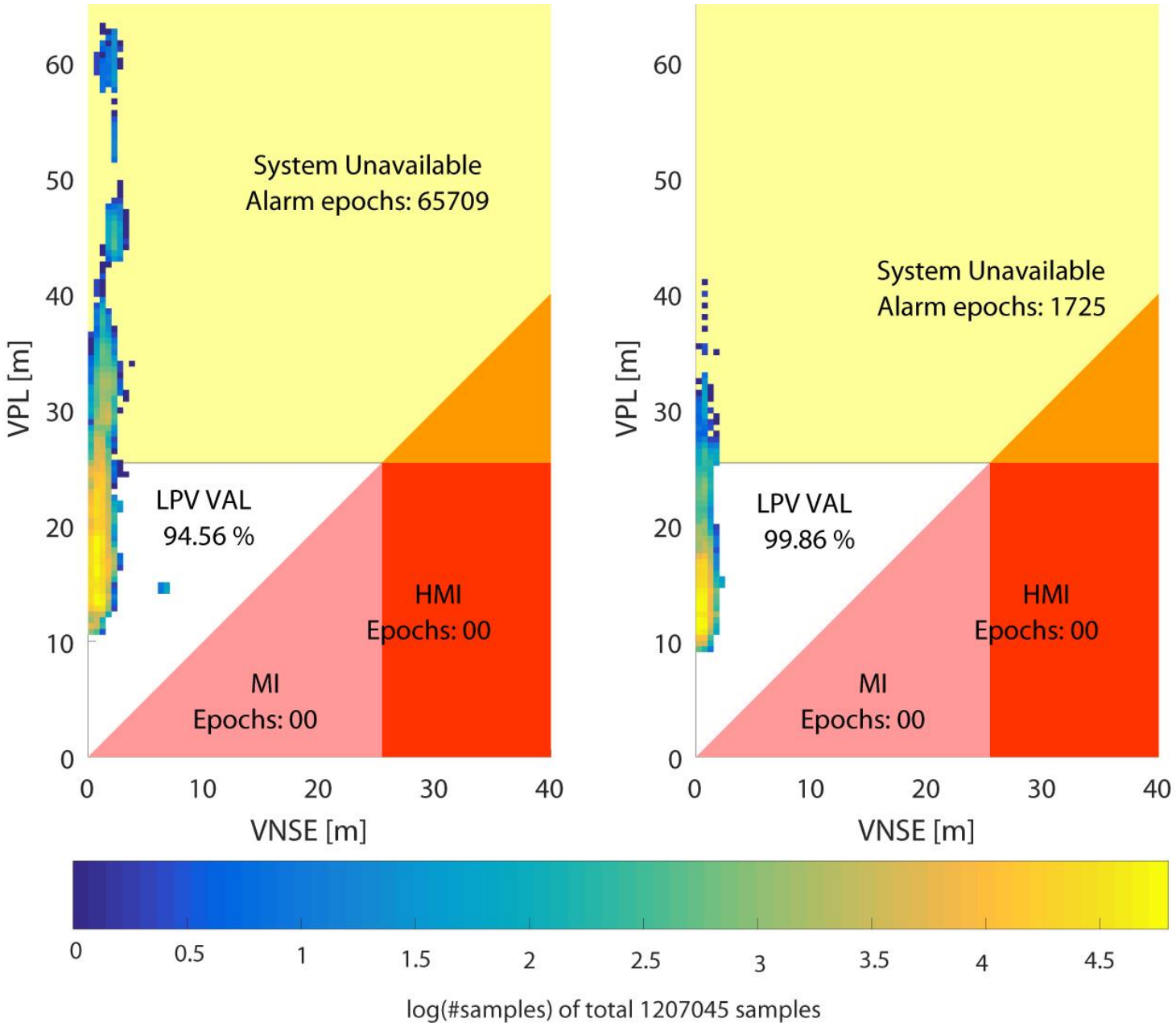
Image Credit: AERODATA, taken with AERO FIS – CMA-6024 Receiver

Approach Performance Designator APD=0

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

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:

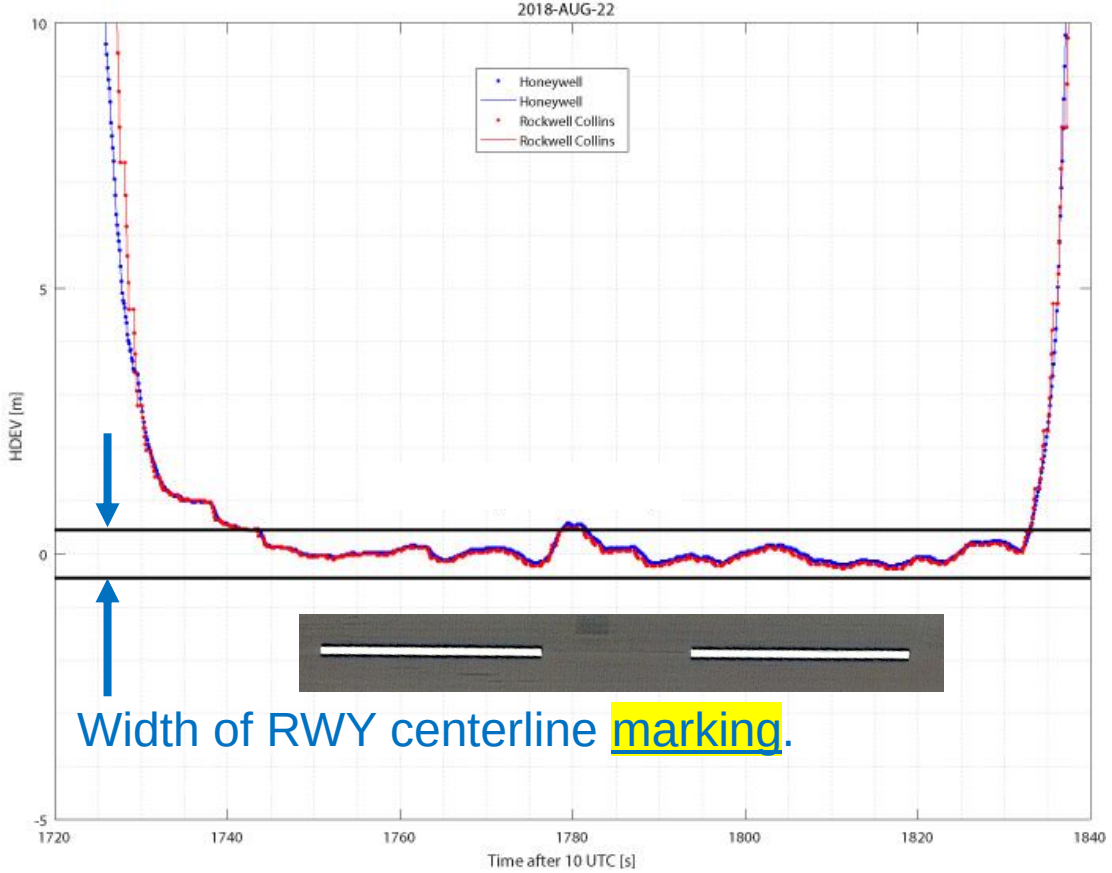
- The SiS TTA is the 5.2s from SBAS (unpublished proof in *“EGNOS Signal-in-Space System Safety Case Part A (Design, Development and Deployment) Issue 3 from 21 February 2008.”)*
- 3. 5s for the missed message allocation
- 10s - 3.5s - 5.2s = 1.3s

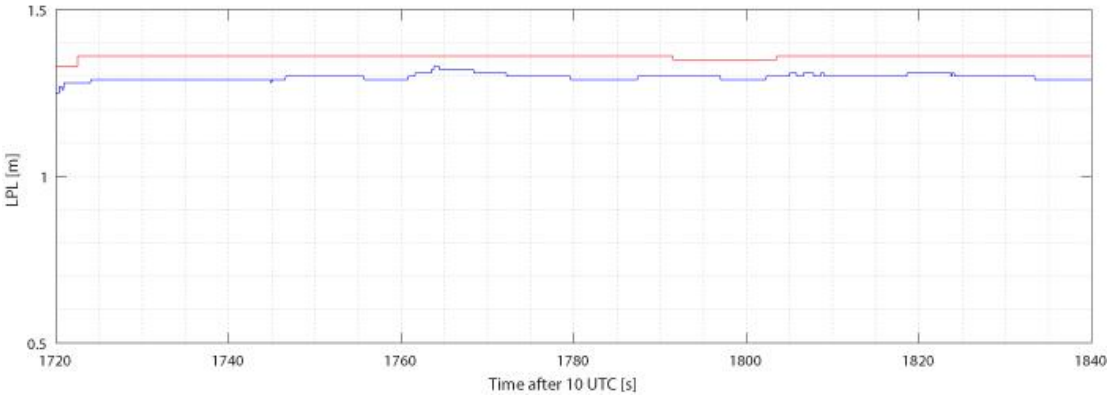
Processing on a Standard Linux PC takes about 20ms

Ground Testing

Using real avionics

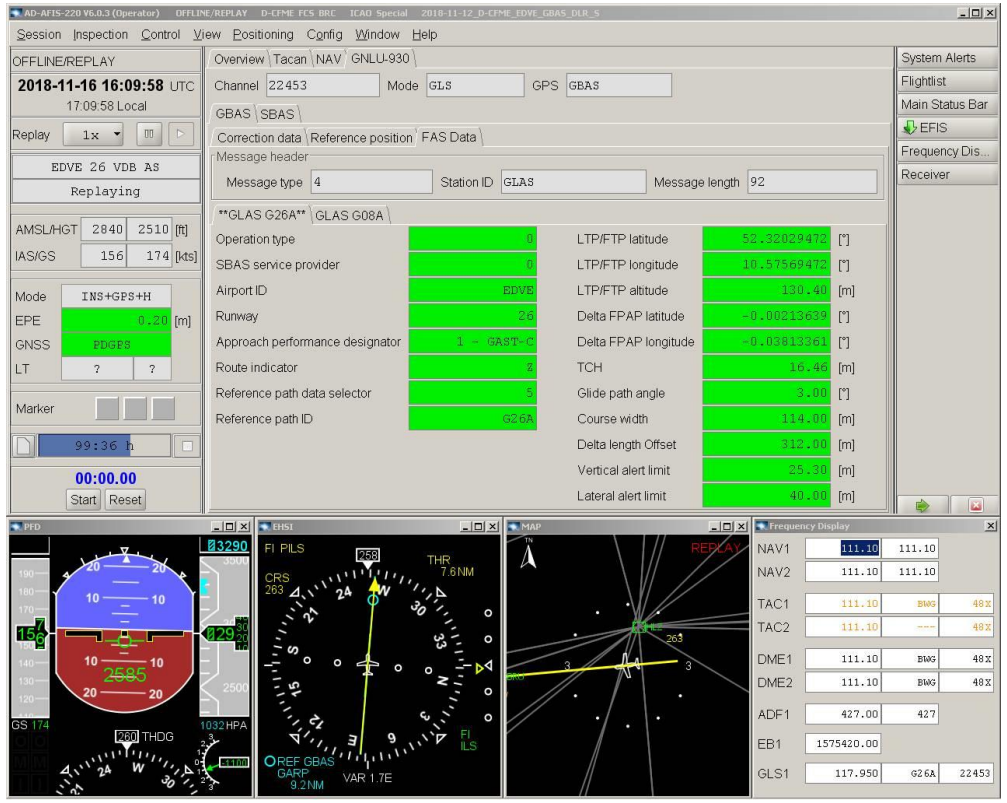
- Rockwell Collins GLU 925 (Airbus version)
- Honeywell INR (B787 version)

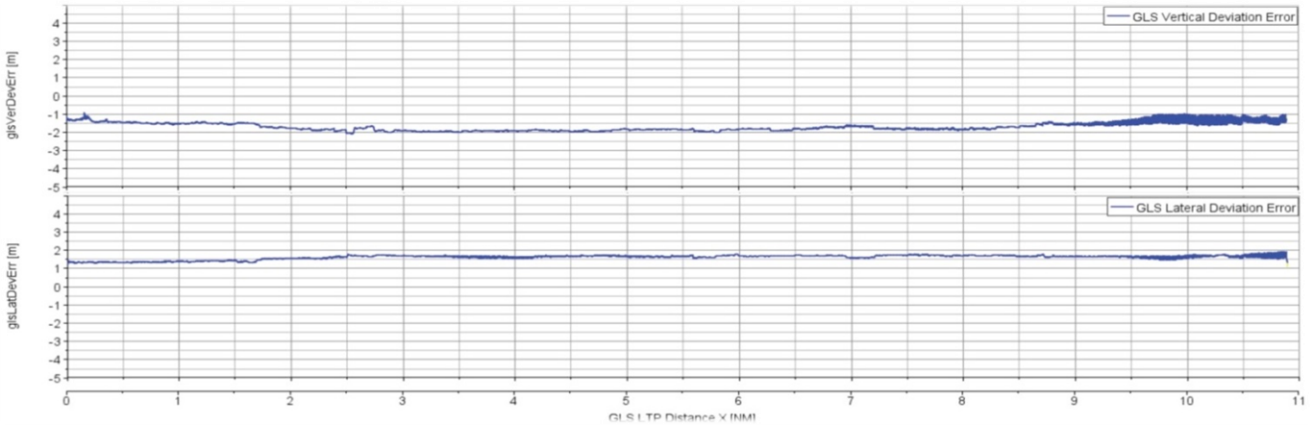




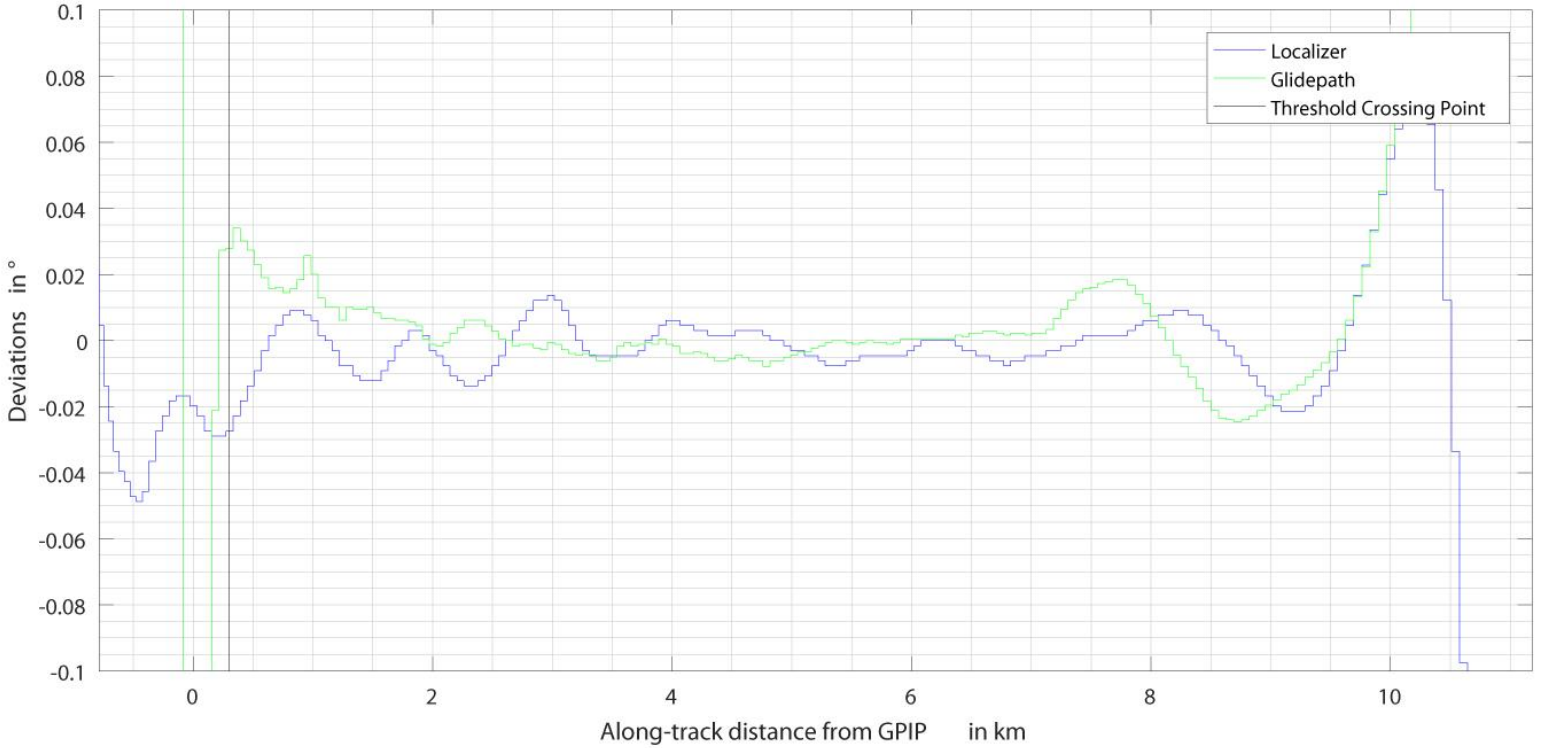
Flight Validation

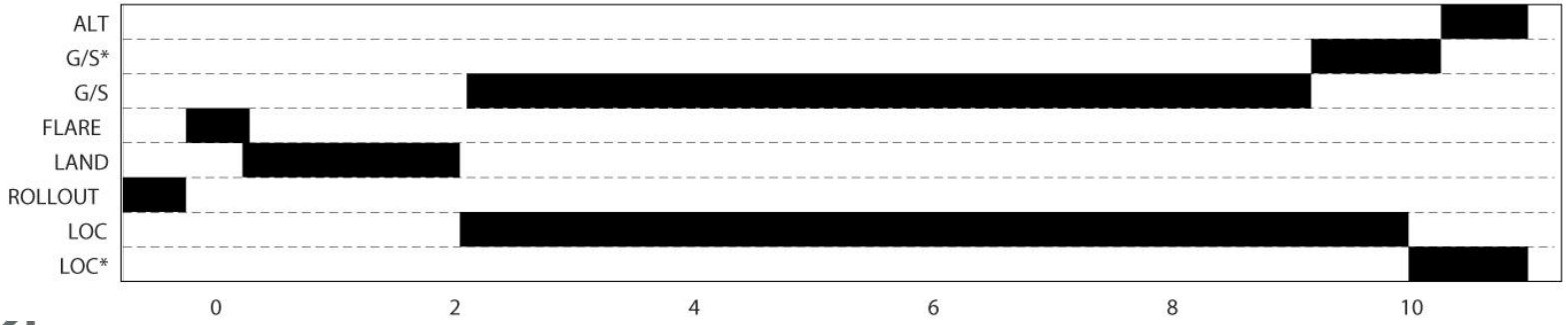
Flight Calibration Services performed standard GBAS Flight Validation





Lufthansa Charter D-AIBI (A319)

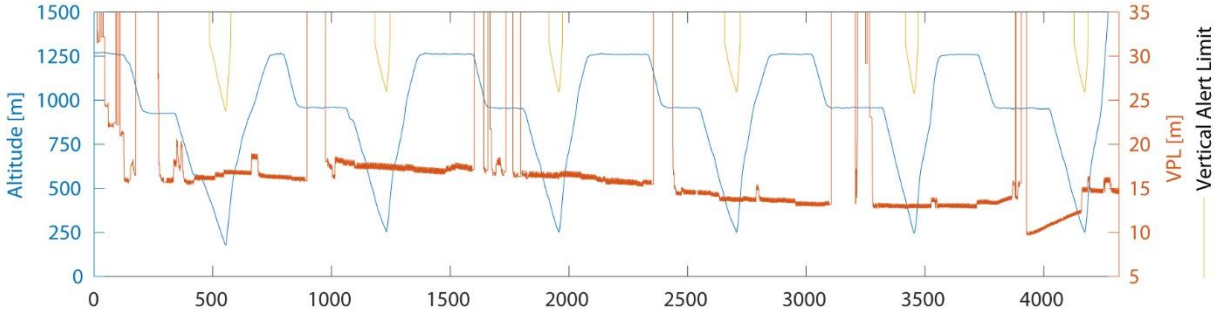


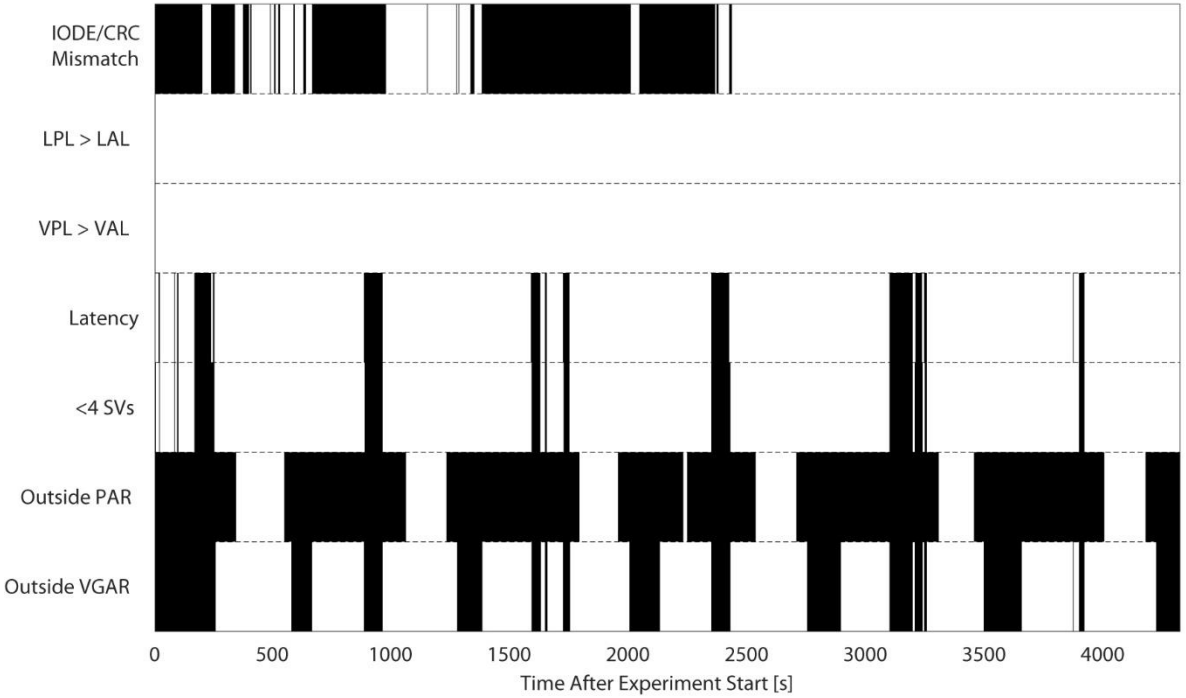


DLR’s Advanced Technology Research Aircraft


GS 161 TAS 152
Event 000
ILS1
S15A 222.65
CRS 151
271 / 28
15
S
12
21
E
24
06
W
03
30
N
33

Flight Tests in Kerkyra (CFU)





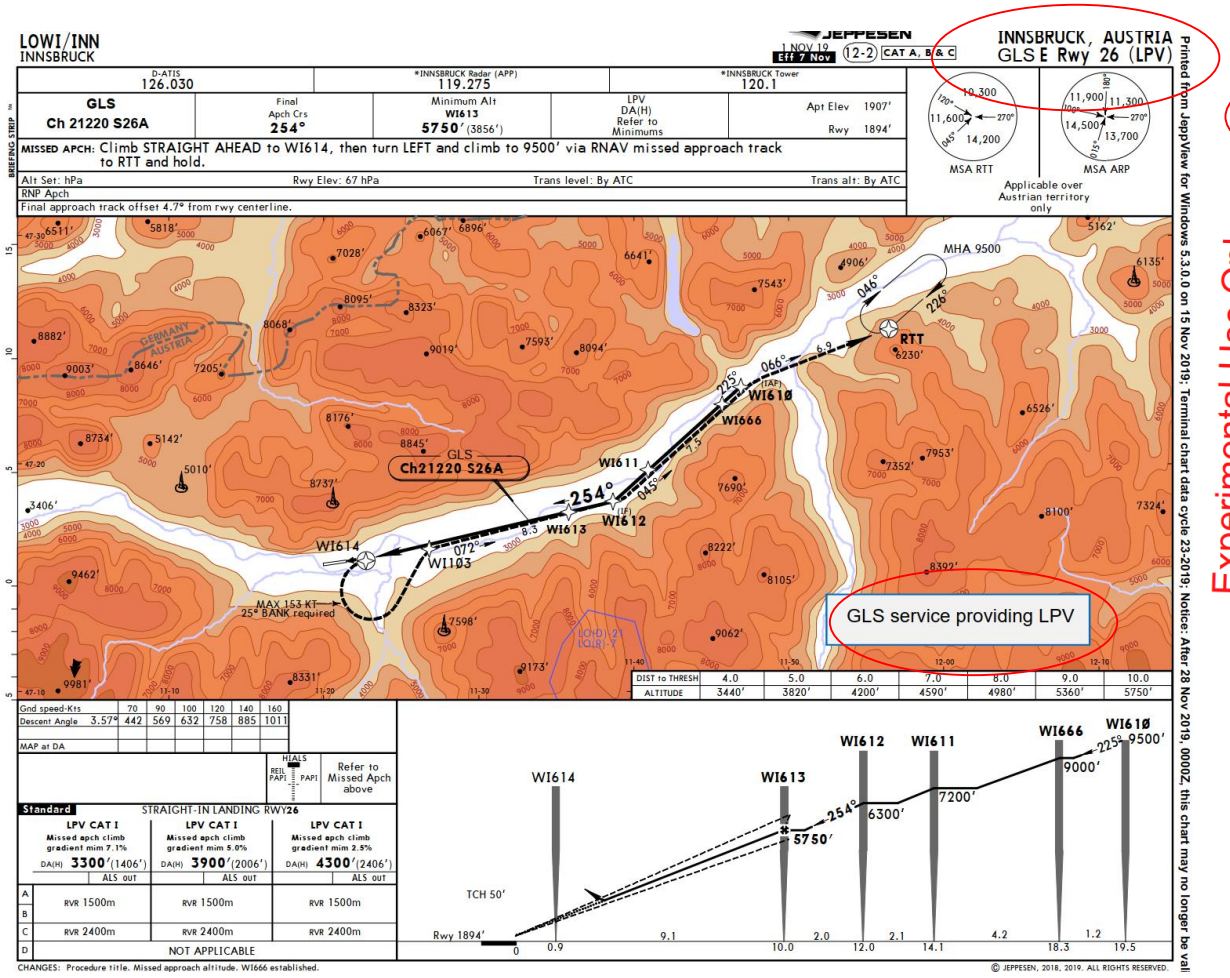
Test with German Air Force

Installation at Wunstorf ETNW

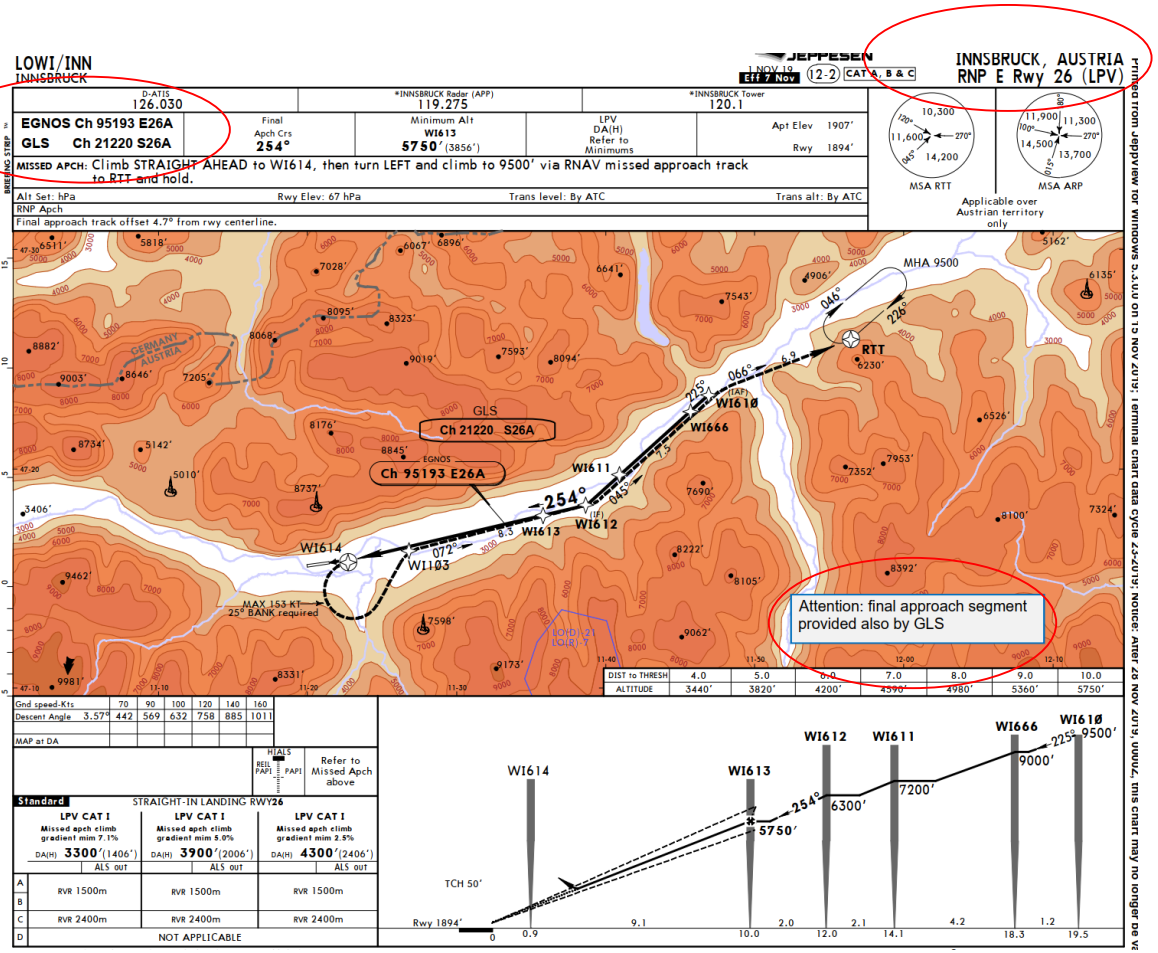
- Airbus A400M test upcoming

Operational Concept

Experimental Use Only



Experimental Use Only



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