GBAS CON OPS
Focus on CAT I Operations

Presented: by S. GRAND-PERRET
EUROCONTROL Navigation Unit
How does GBAS impact on ATM?
What is GBAS?

GBAS (Ground Based Augmentation System) Approach and Landing System
What has changed with GBAS Approach??

GBAS approach criteria same as ILS
GBAS operating minima same as ILS
Is there any operational change??
What Aerodrome Operations Changes?

- 1 GBAS Installation where multiple ILS would be required
- Runway operation flexibility increased
- Installation close to runway NOT required – protected area located away from runway/taxiway
Actors and Systems changes

- **Aircraft**: Aircraft avionics, Pilot, Controller
- **GBAS Ground Subsystem**: Approach Designer
- **Maintenance personnel**
- **GNSS Satellites**
- **Airport**
Summary of key operational changes with GBAS

- **For the pilot,**
  - xLS concept minimising training. GLS used in phraseology and cockpit.

- **For the controller,**
  - GLS/GBAS phraseology,
  - New procedures:
    - To support mixed ILS/GBAS CAT I operations at the airport
    - Fall back procedures to address GBAS failure required
    - To facilitate switching runways or shortening approach path at some airports

- **For the maintenance staff,**
  - responsible to handle high integrity data and enable/disable GBAS approaches

- **For the approach designer,**
  - Responsible for the creation of FAS data block and providing it to the maintenance staff with a high integrity level.

- **NOTE:** Due to the ILS look alike concept, no change to the final approach capture and missed approach procedure has been considered.
Why the GBAS CON OPS?
Objectives

• Input to the safety assessment
• Educational material
Purpose of the CON OPS

• Identify any change to the current ATM environment and operation
• Describe roles/responsibility of actors
• Provide sufficient level of information of systems and subsystems to ensure that operational aspects can be fully addressed
• Support to the safety assessment and potentially security assessment.
• Identify any gaps in available GBAS ICAO provisions
• Prepare for training material for ANSPs, Maintenance Staff, Pilots etc…
Who has been involved?

- ANSPs: DFS, Skyguide, AENA, DSNA, AENA, NATS
- Eurocontrol (Navigation and ATM procedures experts)
- But also
  - Pilots
  - Controllers
  - Airbus, Rockwell Collins
- Several reviews at Eurocontrol (LATO and NSG)
- Presented to ICAO NSP CSG/WG2, ICAO AWOG PT/LVP and IGWG
Scope

• GBAS operations at a given airport
  – Multiple Runways (one vertical profile per runway)
  – Existing landing infrastructure still available
  – Mixed fleet of ILS only capable aircraft and GLS/ILS capable aircraft

• Operations: **CAT I, CAT II/III** (initial and Multi GNSS), Guided Take Off

* : **CAT II/III** material needs to be revisited based on the new proposed SARPS for GBAS CAT III L1 (GAST_D)
Proposed in SESAR GBAS projects : 6.8.5, 9.12, 15.3.6 & 15.3.7
Where does the CON OPS stop?

- Generic implementation only
- Thus no:
  - details on ATC interface integration
  - details on fall back procedures
  - local tools/network
  - local procedures
  - detailed description to address all runway/airport layout

- But
  - Generic recommendations / requirements
  - Focus on GBAS with mixed ILS/GBAS addressed in operating procedures
How is it structured?

CON OPS (High level)

- CAT I
- Initial CAT II/III
- Final CAT II/III
- Guided Take Off

Appendix 1
Appendix 2
Appendix 3
Appendix 4
CON OPS high level

- GBAS in the Navigation Strategy
- GBAS Benefits and Issues
- GBAS operations – key features:
  - Operational changes to ILS
  - GBAS Classification Scheme
  - ILS Look –alike Definition
  - Actor’s procedure implications
What does an Appendix contain?

- Assumptions of the concept
- ILS Approach (as reference to the concept)
- GBAS Specificities:
  - GBAS Certification
  - Navigation Ground Subsystem Description
  - Airport System Interfaces related to the Operations
  - Aircraft Systems Description
  - Aeronautical Information Services
  - Flight Planning and Flight Plan Issues
  - Operating Procedures
  - Communication and Phraseology
  - Training
Navigation Ground Subsystem and Actors Description

- **Aircraft**
  - Voice link
  - Including FAS Data Blocks (for all RWYs)

- **Controller**

- **VDB Antenna**

- **Ground GNSS Antenna (x4)**

- **GBAS GS**

- **Approach Designer**
  - GLS channel(s)
  - Approach chart(s)
  - RNAV DB

- **Maintenance personnel**
  - FAS DB

- **Navigation Ground Subsystem**
  - **Actors Description**
  - **GBAS**
  - **GS**
  - **VDB**
  - **Antenna**
  - **Maintenance personnel**
  - **Controller**
  - **Voice link**
  - **Aircraft**
  - **Including FAS Data Blocks (for all RWYs)**

- **AIP**

- **FAS DB**
Bremen Chart

**Chart Details:**
- **Bremen TVOM/DME:**
- **GLS HDW 49:**
- **NM to THR:**
  - 1: 390
  - 2: 700
  - 3: 1020
  - 4: 1340
  - 5: 1660
  - 6: 194
- **Altitude:**
  - 1: 390
  - 2: 700
  - 3: 1020
  - 4: 1340
  - 5: 1660
  - 6: 194
- **GS:** 190
- **kt:** 12

**AD 2 EDDW 4-6-3**
- **No Date**
- **121.750**
- **BREMEN GLS RWY 27**
- **Bearings Are Magnetic**
# Channel Allocation / Approach name (Sydney Example)

<table>
<thead>
<tr>
<th>Runway</th>
<th>Channel</th>
<th>Ident (RPI)</th>
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<tbody>
<tr>
<td>16L</td>
<td>20735</td>
<td>G16B</td>
</tr>
<tr>
<td>16R</td>
<td>21146</td>
<td>G16A</td>
</tr>
<tr>
<td>25</td>
<td>21557</td>
<td>G25A</td>
</tr>
<tr>
<td>34L</td>
<td>21968</td>
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<tr>
<td>34R</td>
<td>22379</td>
<td>G34B</td>
</tr>
<tr>
<td>07</td>
<td>22790</td>
<td>G07A</td>
</tr>
</tbody>
</table>
ATC Interface
Maintenance Interface

EXAMPLE! - ILLUSTRATIVE -
GBAS RNAV and FAS Data Block processes

Ground Station

MT1

MT2

MT4

VDB

GBAS Specific

Maintenance Staff

Approach designer

GLS AIP data

RNAV Database

Data House

Similar to ILS
Data Integrity Chain

Transfer of procedure design data

- Procedure design data check (double entry ...)
- Data transfer check
- Data upload check

Non-critical data

AIP procedure publication

Ground tests

Flight tests

Aircraft subsystem

Import and transmission of data (ground subsystem -> aircraft subsystem)

Ground subsystem

Export and transfer of FAS data (procedure design -> ground subsystem)

Data integrity

DFS Deutsche Flugsicherung GmbH
Airborne System Description

Principles:

- xLS concept
- But pilot will fly either ILS or GLS
- same operational minima
- GLS indication
- Minimise training
- ILS look alike certification
- Some aircraft certified for CAT I autoland
- RNAV/radar vector captures
Operating Procedures

- Ground station installation procedure
- Flight inspection and ground test
- Airline/pilot procedures (Normal and contingency procedures)
- ATC controller procedures (Normal operations / Contingency procedures)
- Data integrity procedures
- Authorities/regulators
Mixed Landing Mode

• ILS and GBAS on same runway
• Aircraft will fly either ILS or GLS
• Concept requests GBAS approach flown if aircraft fitted and crew qualified
• Flight planning information filled or/and RT
• For CAT I operations same spacing expected – so no specific overload identified
ATIS, NOTAM & Phraseology

ATIS: no change to ILS

NOTAM
• No change to ILS
• Recent NOTAM developments:
  EUROCONTROL Guidelines : Operating Procedures For AIS Dynamic Data (OPADD) - 08 April 2009

Phraseology
• GLS for the operation – GBAS for the system failures (ICAO PANS ATM )
• but monitoring of GLS required to see if acceptable
GBAS Protection Areas

FAA Siting Handbook: FAA GBAS LOCA

Note: ICAO EUR DOC 015: GBAS building protection (radius 300 m)

Figure 8: Extrapolated 3-D high-threat volume from two-dimensional propagation case.
Figure 11: Guidance for determining critical areas as the intersection of the LOCA and movement areas.
Additional issues that have arose – On going investigations

- Operational coverage positioning service (Annex 10)
- Ionospheric Anomalies (Annex 10)
- Siting (notably due to ionospheric anomalies for CAT II/III operations) (Eurocae ED114)
- Building restrictions - EUR Doc 015
- Parallel Operations (dependent/independent) PANS ATM
- Data Integrity Requirement (PANS OPS/ANNEX 15)
- Approach chart and AIP information (PANS OPS/Annex 15)

- Approach classification – SARPS CAT III/EU OPS requirement??
- Flight simulator needs – CAT II/III issue
- Continuity Requirement – CAT II/III issue
From CON OPS
Towards GBAS Implementation

- FHA/PSSA Generic case and
- SSA activity run at Bremen (DFS) and Malaga (AENA) to capture more information regarding local implementations
  - Customization of the generic safety material to two local cases
  - List of necessary tasks from pre-installation to post implementation
Pre-installation

1. To operate CAT 1 ensure that supporting equipment and requirements are in place (e.g. lights, runway length)
## Installation

2. Site Survey for multipath, interferences with surrounding equipment

3. Check obstacle clearance for antennas, shelter etc.

4. Frequency co-ordination

5. Site preparation

6. R&TTE directive (EC) requires demonstration of EMC, personal safety and spectrum efficiency [considered pre-installation task, GS manufacturer will do the demo of EMC as part of FAT before installation phase. During installation phase no additional work is required as GBAS is stand-alone and not integrated with other systems, checked by notified body].

7. Equipment installation (antenna coordinates surveyed)

8. Linking to power supply / grounding

9. GS configuration including loading MT2 and MT4 data (may be dummy data as approach procedure may not be available)

10. GS data evaluation (over a few day time period)

11. Monitor that all manufacturer guidelines concerning certification are met

12. Site Acceptance Tests for end of installation

13. Security of GBAS GS (e.g. protection of antenna etc.)

14. Equipment installation (antenna coordinates surveyed)

15. Ensure ANSP guidelines concerning installation are met

16. Theoretical study for VDB coverage
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<tbody>
<tr>
<td>17.</td>
<td>Development of operational documentation</td>
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<tr>
<td>18.</td>
<td>Linking to ATC interface</td>
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<tr>
<td>19.</td>
<td>Linking maintenance interface (local and remote monitoring system)</td>
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<tr>
<td>20.</td>
<td>Potential link to manufacturer for remote support (via modem when maintenance specialist is at groundstation and needs additional support)</td>
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<tr>
<td>21.</td>
<td>Further Acceptance Tests following integration with interfaces</td>
</tr>
<tr>
<td>22.</td>
<td>Ensure necessary facilities for ground and flight testing/inspection</td>
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<tr>
<td>23.</td>
<td>Ground testing (ICAO Doc 8071 – chapter 4.2) – technical</td>
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<tr>
<td>24.</td>
<td>Flight testing/inspection (ICAO Doc 8071 – chapter 4.3) – technical issues such as coverage and interference</td>
</tr>
<tr>
<td>25.</td>
<td>Development and update of any applicable maintenance programme and procedures (e.g. spares provision, documentation, training, supporting tools)</td>
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<tr>
<td>26.</td>
<td>Maintenance training</td>
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<tr>
<td>27.</td>
<td>Development of ATC procedures (nominal and contingency)</td>
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<tr>
<td>28.</td>
<td>ATC training (ops manual and NOTAMs)</td>
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<tr>
<td>No.</td>
<td>Task Description</td>
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<tr>
<td>29.</td>
<td>Instrument procedures design and validation (including FAS data block)/AIP/charting</td>
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<tr>
<td>30.</td>
<td>Ground testing (ICAO Doc 8071 – chapter 4.2) – for example FAS datapoint accuracy</td>
</tr>
<tr>
<td>31.</td>
<td>Flight testing/inspection (ICAO Doc 8071 – chapter 4.3) – manoeuvring and procedure validation</td>
</tr>
<tr>
<td>32.</td>
<td>Ask datahouse to code approach in relevant aircraft nav databases</td>
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<tr>
<td>33.</td>
<td>Update of ATC ops manual (if relevant) – whole of ANSP and local manual (e.g. phraseology etc.)</td>
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<tr>
<td>34.</td>
<td>Civil Military coordination (if relevant)</td>
</tr>
<tr>
<td>35.</td>
<td>Transfer from Prototype GS (PSP) to certified GS</td>
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<tr>
<td>36.</td>
<td>Flight Trials based on ops approval requirements</td>
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<tr>
<td>37.</td>
<td>SES regulation (community spec for GBAS including, ICAO USOAP compliance, national rules updated - rules of the air)</td>
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<tr>
<td>38.</td>
<td>Flight planning (TBC)</td>
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<tr>
<td>39.</td>
<td>Awareness campaign (AIC)</td>
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Post Implementation

40. Performance evaluation and requirements monitoring (new hazard identification from new installations and new systems)