INTRODUCTION AND SETTING THE SCENE

OLIVIER MONGÉNIE
SESAR JU
Agenda

• **16:00 – Introduction by the SJU**
  Olivier Mongénie, SESAR Joint Undertaking, Airport Integration & Throughput Programme Manager

• **16:10 – GBAS concept and technology**
  José Manuel Rísquez, ENAIRE (INECO), OFA01.01.01 (LVPs using GBAS) Coordinator

• **16:25 – How is the GBAS SESAR Solution validated?**
  – *Operational validation activities in Release 4*
    Andreas Lipp, EUROCONTROL, OFA01.01.01 Contributor
  – *Technical validation activities in Release 4*
    • Overview of the technical validations and ground system
      Udo Knick, Thales, 15.03.06 (GBAS Cat II/III L1 Approach) Project Manager
    • Airborne system (mainline aircraft)
      Dietmar Kleinitz, Airbus, 09.12 (GBAS Cat II/III) Project Manager
    • Airborne system (business aircraft)
      Jolana Dvorska, Honeywell, OFA01.01.01 Contributor

• **17:00 – Demonstration activities: Augmented Approaches to Land Large Scale Demonstration Project**
  Jolana Dvorska, Honeywell, Augmented Approaches to Land Contributor

• **17:05 – Standardisation activities**
  Andreas Lipp, EUROCONTROL, OFA01.01.01 Contributor

• **17:15 – Regulatory activities**
  Maria Algar Ruiz, EASA, ATM/ANS-SESAR Coordinator

• **17:25 – Conclusion and Q&A session**
  Olivier Mongénie, SESAR Joint Undertaking, Airport Integration & Throughput Programme Manager

• **17:45 – Wrap up and close**
The SESAR Pipeline

Phase 1
- Exploratory research
  Explores novel concepts, ideas and emerging technologies in order to stimulate creativity in the ATM research domain.

Phase 2/1
- Applied research
  Takes accumulated knowledge and theories and applies them to practical ATM challenges.

Phase 2/2
- Development (Release process)
  Takes concepts through a rigorous validation process resulting in new SESAR solutions.

Phase 3
- Demonstration Activities
  Showcases solutions in a real operational environment involving multiple stakeholders across Europe.

Delivery
- SESAR Solution Packs
  Documentation that comes with each SESAR solution is packed together and made available online to support further take-up by industry.
SESAR Development Methodology

European Operational Concept Validation Methodology (E-OCVM)

**SESAR Scope**

**Pre-industrial development & integration**

**Industrialisation**

**ATM needs**

**V0**

Gather and access ATM performance needs

**V1**

Scope operational concept and develop validation plans

**V2**

Iteratively develop and evaluate concept

**V3**

Build, consolidate and test

**V4**

Industrialisation and approval

**SESAR Scope**

**Concept validation**

**Requirements development**

**Concept development**

**Technical development and verification**

**Integration**
The SESAR Airport Concept Elements

- **CWP Airport**
  - Integrated Controller Working Position

- **Integrated Arrival/Departure Management at Airports**
  - Arrival & Departure Management

- **Enhanced Runway Throughput**
  - Enhanced ROT
  - Time based separation
  - Dynamic vortex separation

- **Airport Safety Nets**
  - Ground safety nets
  - Surveillance
  - Ground System Enhancement

- **Integrated Surface Management**
  - Enhanced situational awareness
  - Surface planning & routing

- **Remote Tower**
  - Remote Tower

- **LVPs using GBAS**
  - Low Visibility procedures using satellite GBAS

- **Pilot enhanced vision**
  - Enhanced Vision System
  - Synthetic Vision Guidance System
  - Combined Vision System

- **Airport Operations Management**
  - System Wide Information Management
  - System interoperability with air & ground data sharing

- **Enhanced Decision Support Tools**
  - Enhanced situational awareness
  - Enhanced Decision Support Tools
The SESAR Airport Concept Elements

**CWP Airport**
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**LVPs using GBAS**
- Low Visibility procedures using satellite GBAS

**Airport Operations Management**
- System Wide Information Management
- User Driven Prioritisation Process
- Enhanced Decision Support Tools
- Enhanced Runway Throughput
- Time based separation
- Dynamic vortex separation
- Enhanced ROT

**Network Management**
- Enhanced situational awareness

**System interoperability with air & ground data sharing**
The SESAR GBAS Community
GBAS SESAR Solution

• Precision approaches using GBAS CAT II/III based on GPS L1
  – Part of Release 4
  – Supported by 3 V3 validation exercises
    • 1 operational validation
    • 2 technical validations
  – All validation activities have taken place
  – Initial validation results and final documents still need to be consolidated and assessed
  – SESAR Solution data pack expected by end 2015
GBAS CONCEPT & TECHNOLOGY

JOSÉ MANUEL RISQUEZ
ENAIRED/INECO
• Augmentation principles
• GBAS applications in SESAR
• SESAR SOLUTION: Validation & Demonstration Strategy
Augmentation Principles
• NAVSTAR GPS fully operational in 1995 (Enroute-TMA)
• However...not good enough to allow safe landings
• ICAO and industry foresaw an alternative solution to ILS, to provide an approach supported by the GPS and appropriate augmentation.
• The system is called the Ground Based Augmentation System (GBAS)
Augmentation principles

GBAS relies on differential GNSS (e.g. GPS) signal

1. Satellites (e.g. GPS) producing ranging signals.
2. Ground subsystem providing a VDB (the final approach path, corrections and data for integrity)
3. Airborne subsystem:
   • Receives and processes GPS and VDB data,
   • Computes a position and deviations
GBAS concept Quiz

Antenna real position is 40,40° N – 3,60° W

Antenna GPS position is 40,42° N – 3,61° W

GBAS ground system informs you that there is an error of 0,02 °N and 0,01°W

Your flight GPS position is 40,49° N – 3,67° W

Your more accurate position with GBAS would be 40,xx ° N – 3,yy° W ??
GBAS concept Quiz: Solution

Antenna real position is
40,40° N – 3,60° W

Antenna GPS position is
40,42° N – 3,61° W

GBAS ground system informs you that there is an error of 0,02 ° N and 0,01°W

Your flight GPS position is
40,49° N – 3,67° W

Your more accurate position with GBAS would be 40,47 ° N – 3,66° W
Augmentation principles: GBAS CAT I Ground Stations

Extracted from flyGLS.net
GBAS applications in SESAR
GBAS Apps in SESAR: Displaced Thresholds

- GLS approach - Less risk of wake vortex encounter: Reduced separation (GLS:GBAS Landing System)
- GBAS can transmit multiple Final Approach Segments: better cost-effectiveness vs ILS.
- Less RWY Occupancy time and noise impact reduction are other benefits.
GBAS Apps in SESAR: Increase Glide Slopes

- GBAS is capable of transmitting multiple Final Approach Segments and even **different Glide Path Angles (GPA)** with a single installation.
- GLS-Noise-reduced approaches are possible by avoiding low-flying over densely populated areas.
GBAS Apps in SESAR: RNP-GLS-Curved Approaches

- **RNP**: Very predictable Initial and Intermediate curved approach segments (Radius to Fix turns)
- **GBAS**: GLS Final Approach Segment (i.e. different slopes, different THR, shortest possible length)
- Noise-reduced approaches are possible due to a more flexible approach path adaption
SESAR SOLUTION:
GBAS CAT II/III
Validation & Demonstration Strategy
• CAT I approaches using GBAS (GAST-C) already certified
• However, CAT II/III approaches require better performance as well as new functions and monitors in ground stations and on board receivers...
• GBAS Approach Service Type D CAT II/III (GAST-D) is based on existing GPS constellation...
• Additional GNSS constellation may improve resilience
Why?

- When low-visibility conditions occur on an airport, a better quality of ILS signal has to be provided to arrivals.
- Larger protection areas must be respected.
- Larger arrival separation must be provided.
- Higher delays and flight cancellations.
GBAS GAST-D can overcome these limitations.

SESAR Solution:

*an integrated set of system and operational elements that will allow performing ILS look-alike CATII/III operations without such protection areas.*
**Operational Concept:**

- ATC can use a less constraining landing clearance line for aircraft vacating the runway.
- ATC can provide the pilots with late landing clearance, up to 1NM before threshold.
- ATC can reduce the final approach spacing in LVP in front of GBAS equipped aircraft.
Benefits:

- Under Low Visibility Conditions, GBAS CATII/III operation vs ILS CATII/III operation will bring us:
  - higher airport resilience
  - better predictability
  - less delays
  - less use of alternative airports and
  - less flight cancellations
To deploy properly all these elements in any European airport in an homogeneous way, it is required to accomplish in parallel a great standardization and regulatory challenge.

SESAR Advantage: people involved in R&D project are also involved in official standardization and regulatory activities.
Validation & Demonstration Strategy

European – Operational Concept Validation Methodology (Iterative Process)

- v0: ATM Needs
- v1: Scope
- v2: Feasibility
- v3: Industr.
- v4: Deploym.
- v5: Operat.
- v6: Decom.
- v7: 

Transversal Areas:
- Safety
- Human Performance

Pre-industrial development & Integration

Operational Concept RTS

Interoperability

Ground Systems
Two airports

Airborne Systems
Mainline Business
HOW IS THE GBAS SESAR SOLUTION VALIDATED?
OPERATIONAL VALIDATION ACTIVITIES RELEASE 4

ANDREAS LIPP
EUROCONTROL
Agenda

• Operational concept description
• Validation objectives and method
• Validation scenarios and platforms
• Validation execution
• Achievements
GBAS Cat II/III – Operational Improvements

- **Optimised Low visibility operations using GBAS concept based on:**
  - ATC to use **a landing clearance line** for aircraft vacating the runway, instead of today’s ILS CAT III holding
  - ATC to provide the pilots with **late landing clearance**, up to **1 NM** before threshold
  - ATC to **reduce the final approach spacing** in LVP in front of GBAS equipped aircraft

- Main actors affected; final approach and tower air traffic controllers as well as pilots
Validation objectives

- To reach V3 maturity based on previous V2 validation exercises (fast-time)

- To assess the increase of runway throughput in LVP considering:
  - Runway configurations
    - Arrival only (segregated runway)
    - Arrival and departure (mixed mode runway)
  - Aircraft fleet equipage
    - Only GBAS aircraft
    - Mix of aircraft equipage between GBAS (60%) and ILS (40%)

- To evaluate the suitability of runway safety nets and assess the safety of optimised LVP operations based on GBAS

- To evaluate the ATC workload and the new ATC procedures for final approach spacing.

- To validate that provision of late landing clearance by ATC does not impair the pilot capability to prepare the landing
Validation approach

- **Real-time simulation**
  - **Simulation Platforms**
    - **EUROCONTROL eDEP/ITWP** - Early Demonstration and Evaluation Platform / Integrated Tower working position
    - **EUROCONTROL ESCAPE** – A real-time air traffic control simulator for en-route, TMA and approach
    - **EUROCONTROL MCS** - Multi Cockpit simulator
  - **Simulation scenario**
    - Charles de Gaulle Airport
Simulation Airport

- The simulated Airport is Paris CDG
- The setup of the scenarios was such as to apply to a generic airport
- Peak traffic in order to achieve the optimised throughput

- CDG Airport TMA -

- CDG Airport north runways -

- Only north RWY 27L simulated
- RWY 27L was used for arrivals only and in mixed mode arrivals/departures
eDEP/ITWP - low visibility settings
eDEP/ITWP - Controller working position
eDEP/ITWP – GBAS specific HMI changes
ESCAPE/Approach - controller working positions
ESCAPE/Approach – GBAS specific HMI changes
Cockpit simulator
The simulations included six validation scenarios
- ILS arrivals only (baseline scenario)
- ILS arrival/departures (baseline scenario)
- GBAS arrivals only
- GBAS arrival/departures
- GBAS/ILS arrival only
- GBAS/ILS arrivals/departures

Each scenario was run in a simulation hour
Several safety scripts, failure scenarios included
Real Time Simulation schedule

Training: ENAV Air Traffic Controllers training with the new RTS platforms from 16 to 18 September 2014

Simulation: One week, 29 September – 3 October 2014 in EUROCONTROL Experimental Centre, Bretigny

Participants:
- Three air traffic controllers from ENAV, licensed for both Approach and Tower
- Three pilots from Novair, TuiFly and Airfrance using MCS
- Other visitors from ATC Unions and SJU
Validation results

- In all validation scenarios an increase of runway throughput or at least the same level was recorded.
- ATC workload considered acceptable
- Good situational awareness by ATC
- The safety of operations is maintained.
- The final approach spacing for arrival only runway configuration was considered appropriate
- The final approach spacing for mixed mode runway need to be fine tuned according to airport local constraints.
- Positive feedback on GBAS HMI elements
HOW IS THE GBAS SESAR SOLUTION VALIDATED?
TECHNICAL VALIDATION ACTIVITIES IN RELEASE 4 & GROUND SYSTEM

UDO KNICK
THALES
Agenda

- Project Objectives
- SESAR CAT II/III Validation
- GBAS CAT III Ground Station
- Ground Subsystem Performance Demonstration
- CAT III Ground Station Prototype Performance Summary
gbas cat iii projects objectives

gbas cat iii technology based on gps l1 c/a (single frequency) to support

- automatic approach and landing (including automatic roll-out) down to cat iii b
- guided take off

gbas cat iii validation performed in sesar projects for

- cat iii b (including automatic roll-out and guided take off) for mainline aircraft
- cat ii or cat iii a for business and regional aircraft

sesar system validation for v3 level of maturity at end of sesar 1 - demonstration of readiness of the solution for industrialization & approval

- confirm that gbas cat iii has no operationally relevant critical & sensitive zones
- verify gbas cat iii touch-down performance by autoland flight tests & ground and airborne analysis, simulation & measurements
- validate gbas cat iii system standard
Prototype 1: GBAS CAT III Ground Station

Thales DGRS 610/615

VDB Transmitter Receiver Antenna

GNSS Reference Receiver & Antenna

Portable Maintenance Data Terminal

Air Traffic Controller Windows

Toulouse GBAS GAST D Installation

Thales Ground Equipment used in SESAR Release 4 Validation
Prototype 2: GBAS CAT III Ground Station

4x GPS RRA

Normarc 8100 GBAS ground station rack

250m data cable

Normarc 8100 GBAS VDB rack

1x VDB Tx antenna

FROM INNOVATION TO SOLUTION
Ground Subsystem Performance Demonstration

Hardware (HW) / Software (SW) Implementation

Lab Test
Hardware in the Loop Simulation & Test

⇒ Confirmation of Error bounding

Algorithm

Software Implementation & Hardware Integration

⇒ Confirmation of Error bounding

Field Test
Operation of Equipment & Data logging

Data logging
- Long term observation
- Specialized test scenarios

⇒ Confirmation of continuous fault free operation

Site Implementation

Long-term evaluation of ground equipment algorithm performance by Thales

Long-term evaluation of performance at user level conducted by DSNA
CAT III Ground Station Prototype Performance Summary

Ground Performance: Accuracy & Integrity & Continuity & Availability
⇒ Aircraft Touch-Down Performance

- **Accuracy:** Very accurate GBAS correction information (<5 cm); User position accuracy ~ 0.5 m ⇒ Requirement far exceeded

- **Continuity:** Capability of extreme low monitor false alarm rate (one Ground monitor induced missed approach per 20 Million landings) demonstrated

- **Integrity:** Capability to ensure CAT III ranging source integrity (Catastrophic event is extremely improbable) demonstrated

- **Availability:** No unscheduled interruption of service in more than one year
Initial System Validation Results

- Ground Correction Performance
- Airborne Navigation Performance
- Aircraft Landing Performance

Confirmed by Ground Performance Results
Confirmed by Airborne Performance Results
Confirmed by Autopilot Simulation & Flight Test Results

Safe Landing

Confirmed Safe GBAS CAT III Landing!
Summary

- Very Positive Mainline & Business Aircraft Flight test results

- CAT III GBAS validation exercise using GBAS ground station in Toulouse successfully conducted

- Results significantly contribute to ICAO GBAS CAT III standard validation

- Validation results are expected to demonstrate full V3 maturity on GBAS CAT II/III technology

- Development of GBAS towards CAT IIIb is on the way for implementation
AIRBORNE SYSTEM (MAINLINE AIRCRAFT)

DIETMAR KLEINITZ

AIRBUS
Agenda

- Validation Objectives
- GBAS Cat II/III (GAST-D) prototype development
- Airbus Flight Test campaign 2013/14
- Flight Test installation
- Flight Test conduction
- Validation Results
Validation Objectives

From CAT I to CAT IIIb

Validate the GBAS GAST-D System Specification

- Verify the performance of a Mainline aircraft system implementation under operational conditions
- Verify the performance of an airborne component (Multi Mode Receiver, MMR) with respect to the functional implementation
- Validate test means (tools) and methods to ensure the Certification
<table>
<thead>
<tr>
<th>Activities/Milestones</th>
<th>Dates</th>
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</thead>
<tbody>
<tr>
<td>Prototype specification</td>
<td>Nov. 2011</td>
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<tr>
<td>Prototype flight test readiness</td>
<td>July 2013</td>
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<tr>
<td>Airbus A380 flight test (prelim. validation) with ground station prototype 1, Toulouse/Blagnac</td>
<td>Nov.-Dec. 2013</td>
</tr>
<tr>
<td>Analysis of preliminary flight test results, prototype and test set up adaptations</td>
<td>Dec. 2013 – April 2014</td>
</tr>
<tr>
<td>Airbus A320 flight test (design&amp;product validation, ) with ground station prototype 1, Toulouse/Blagnac</td>
<td>Sept.- Oct. 2014</td>
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</table>
Airbus Flight Test campaign  2013/14

- A320 and A380 test A/C applied to represent the extreme examples of the Airbus mainline aircraft spectrum.
- Up to now, Airbus aircraft are certified for GBAS approaches with Cat I minima.
- GBAS Cat II/III approaches require better performance with respect to integrity and continuity.
Flight Test installation

Installation within A320 test A/C
HMI function implementation on test A/C

- HMI is not changed specifically for GBAS Cat II/III;
- “ILS-look alike”- concept applied to make the precision approach procedure transparent to the crew.
Flight Test conduction

- 19 approaches with Toulouse-Blagnac ground station
  - from inside and outside of approach areas
  - all combinations of runway and landing directions
  - Touchdown and roll out manoeuvres
- Taxiing
- GAST-D and GAST-C configurations tested
- further GBAS operational aspects checked: Guided Takeoff
Positive GBAS GAST-D operation validation results achieved with Airbus mainline aircraft A380 and A320.

- Flight test scenarios and manoeuvres have been applied, verifying the good functioning of the GBAS Cat II/III function implementation at aircraft architecture and MMR level;
- Touch down performance of automatic flight and NSE (navigation sensor error) well within expectations;
- The Thales Multi Mode Receiver (MMR) prototype based on a certified Line Replacable Unit (LRU) has been successfully tested in operational GLS (GNSS Landing System) conditions;
- Interoperability between aircraft implementation and GAST-D ground system can be confirmed;
- Capability to ensure Cat III **positioning source Integrity** was demonstrated;
- Results indicate that **Continuity** requirements can be achieved.

GBAS GAST-D function and operation concept validation results should allow to reach full V3 maturity on GBAS Cat II/III technology, system components ready to enter product phase.

* SESAR JU assessment of the validation results is ongoing*
AIRBORNE SYSTEM (BUSINESS AIRCRAFT)

JOLANA DVORSKA
HONEYWELL
Agenda

• Airborne Subsystem – Business Aircraft GBAS CAT II/III Validation
  – Validation Objectives
  – Data Collection Campaign
  – Aircraft Installation & Displays
  – Flying GBAS
  – Validation Results

• LSD – Augmented Approaches to Land
  – Project Objectives
  – Key Stakeholders
  – Live Trials
  – RNP to GBAS Landing System
AIRBORNE SYSTEM – BUSINESS AC
GBAS CAT II/III VALIDATION

Jolana Dvorska, Honeywell
March 10, 2015
Business Aircraft – Validation Objectives

- Verify performance in operational environment for business aircraft.
- Verify performance of Honeywell avionics receiver VIDL/G to perform GBAS CAT II/III approaches.
- Collect data to support validation of simulation tools.
Flight Tests:  
Phase 1 – Sep /Oct 2013  
Phase 2 – Jun / Jul 2014  
Honeywell exp. Dassault F900EX  
Tests included: GBAS CAT I and CAT II/III flights  
In nominal, non-nominal conditions, regression tests  
Overview of tested airports & systems  

<table>
<thead>
<tr>
<th>Airport Name</th>
<th>ID</th>
<th>City</th>
<th>State</th>
<th>Ground Station</th>
<th>Phase</th>
</tr>
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<tbody>
<tr>
<td>New Century AirCenter Airport</td>
<td>KIXD</td>
<td>Olathe</td>
<td>KS</td>
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<td>experimental</td>
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<td>George Bush Intercontinental Airport</td>
<td>KIAH</td>
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<td>KACY</td>
<td>Atlantic City</td>
<td>NJ</td>
<td>FAA /HON – GAST D</td>
<td>1 &amp; 2</td>
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<td>Frankfurt Airport</td>
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<td>Frankfurt</td>
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<td>NATMIG – GAST D</td>
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<td>Toulouse-Blagnac Airport</td>
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<td>Toulouse</td>
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<td>Thales – GAST D</td>
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<td>experimental</td>
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<td>certified</td>
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A total of 150 approaches were successfully flown and data were collected to support validation.
Tested avionics receiver coupled with autopilot enabled automatic GBAS CAT II/III approaches.
Prototype GBAS Landing System Annunciations – designed for flight test only.

Honeywell experimental display - GBAS CAT II/III approach in Atlantic City.
Let’s Fly GBAS...
Business Aircraft: Validation Results

• **Complex campaign successfully performed.**
  – 16 different validation scenarios completed
  – 6 airports with 4 different ground stations tested

• **Pilots confirm very good performance in operational conditions.**

• **Honeywell avionics receiver with GBAS CAT II/III capability successfully tested.**

• **Thorough data analysis performed confirms good performance.**
  – Full V3 maturity level should be enabled with these results.

• **Simulation tools used to provide further inputs to concept validation.**

• **Inputs provided to standardization.**

*Good performance of GBAS CAT II/III avionics system in operational conditions confirmed.*
Demonstration of benefits of augmented vision and GNSS augmented navigation solutions:

- improved access
- reduced environmental impact
- to all types of airport
- for all types of Airspace users

Presentation focus is on RNP to GBAS approaches.

Bridging gap between research and deployment.
## Joint Effort of Key Stakeholders

<table>
<thead>
<tr>
<th>Domain</th>
<th>Consortium Member</th>
</tr>
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<tbody>
<tr>
<td>Airspace Users</td>
<td>EBAA, Lufthansa, NetJets, SWISS</td>
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<tr>
<td>Air Navigation Service Providers</td>
<td>ANS CR, DFS, DSNA, Skyguide</td>
</tr>
<tr>
<td>Airport Operators</td>
<td>Fraport, Zurich Airport</td>
</tr>
<tr>
<td>Airframe Manufacturers</td>
<td>Airbus, Dassault Aviation</td>
</tr>
<tr>
<td>Avionics Suppliers</td>
<td>Elbit Systems, Honeywell</td>
</tr>
<tr>
<td>Procedure Design</td>
<td>DLR</td>
</tr>
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</table>

- Demonstration of procedures and technologies in real operational environment.

- Speed up deployment and adaptation in EU.

- Over 200 demonstration flights in 2015/16.
Demonstration - Live Trials

- SWISS A320FAM aircraft
- Lufthansa A319 (photo by: Ingrid Friedl)
- Lufthansa A380 (photo by: M. Lindner und Lutz Borck)
- Lufthansa B747-8 (photo by: Jürgen Mai)
- Honeywell’s experimental F900 (photo by: Ivo Carvan ICARcz)
- Dassault experimental Falcon 7X MSN1
RNP to GBAS Landing System

Building on current infrastructure

• RNP to GLS will be demonstrated on certified GBAS CAT I stations:
  – Frankfurt
  – Bremen
  – Zurich

Over 130 approaches on revenue and business aircraft.

Expected benefits

  – Shorter path,
  – accuracy of flight,
  – decreased noise,
  – lower fuel consumption,
  – lower CO2 emissions.
STANDARDISATION ACTIVITIES

ANDREAS LIPP
EUROCONTROL
Standardization and Regulation

• Aviation - a global activity
• ICAO with 191 member states
• Multiple players in Europe
  – EASA
  – National authorities (NSA/NAA – examples)
    • LBA, BAF
    • DGAC/DSNA
    • BAZL
    • AESA (Spain)
  – EUROCAE/RTCA – Industry standards
  – Other standardisation bodies
    • EC, through:
    • ETSI, CEN, CENELEC
Complex Interactions

Design
- Safety
- Security
- Hardware
- Software
- Redundancy

Procedures
- Design
- ATC
- Training
- Maintenance

ICAO
Regulations
ITU

Reg. Stds

Satellite
System
Ground
Aircraft

Airline
Operation
Airport
ANSP

FROM INNOVATION TO SOLUTION
GBAS Standardisation WAC, March 2015
Typical Timeline and Outlook

**GBAS CAT I**
- Research
- First DGPS land
- S-CAT I
- ICAO
- RTCA
- Avionics cert.
- Preops flights
- GS approval
- Bremen
- Newark
- Sydney
- Houston
- Frankfurt
- Zurich
- 1985
- 1989
- 2000
- 2008
- 2012
- 2014

**GBAS CAT III (GPS L1)**
- Research
- Standards
- ICAO
- RTCA
- EUROCAE
- FAA AC
- GS cert. (FAA)
- Avionics
- Ops approval
- 2004
- 2014
- 2019

**GBAS CAT III (MC/MF)**
- To be developed

EASA, NSA/NAA and Industry committement needed to complete for Europe
Current Status

• GBAS CAT I
  – All required standards exist
  – Improvement and maintenance (SESAR)
  – Extension of capabilities (SESAR)

• GBAS CAT III using GPS L1
  – ICAO SARPS in final review (SESAR)
  – RTCA and EUROCAE MOPS development in final stages (SESAR)
  – ARC has concluded on airborne regulations and given a recommendation for further processing to FAA (SESAR)

• GBAS CAT III using GALILEO
  – Draft standards in development (SESAR)
Summary

- Complex and long process
- Significant interaction with development
- National specificities
- Differing timescales and priorities
- Harmonisation is a must, since global operations

➢ Early consideration by and active involvement from regulatory and standardisation bodies, as well as European industry is needed
REGULATORY ACTIVITIES

MARIA ALGAR RUIZ
EASA
Involvement of EASA GBAS activities within SESAR and future plans to support deployment

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World ATM Congress
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EASA activities – GBAS Cat I Operations

- ETSO-c161a based on DO-253C published in 2012

- Certification of airborne installations (e.g. A320, A340, A380, A350 families)

- Plans to amend AIR OPS requirements to include training and operational aspects on GBAS Cat I landing systems
EASA’s activities in GBAS Cat II/III within SESAR (R&D)

- GBAS Workshop on the 28&29 of May 2013 and follow up of the outcome
- Participation in validation exercise on the 28 of July 2014 ‘SESAR 9.12 Frankfurt Tests Phase 2 – Honeywell Business Aircraft’
- Participation in series of meetings and telephone calls within the umbrella of AWOH ARC
- Informal discussions with Industry and also regulators
- EASA is prepared for a deeper involvement in the work to support the further maturity in readiness for deployment
EASA planned activities in GBAS Cat II/III outside SESAR – general regulatory activities

- Participation in the development of industrial standards (EUROCAE and possibly RTCA) through participation or at least reviewing the proposals
- Continuing participating in AWOH ARC
- Review of proposed standards to ICAO Annex 10
- Initiate regulatory activities with aims at:
  - Review and amend ETSO-C161a if necessary
  - Review and complement if necessary Certification Specifications
  - Complement AIR OPS rules if necessary and develop AMC/GM as needed to support flight operations
  - Regulatory framework for ground stations ‘acceptance’ for manufacturing industry and supporting guidelines for ANSPs installations if necessary → slide 7
GBAS Cat II/III – roles and responsibilities in the implementation (II)

- **Airborne-A/C:**
  - TC/STC holder for the airborne installation
  - EASA as airworthiness certification authority

- **Ground stations:**
  - Industry for development and ANSP/ADR operator for installation/operation/maintenance
  - NSA/NAA approval of the ground installation (incl. the review of technical file and the ground station tech specs)

- **Aircraft operations:**
  - Airlines-A/C operators for training of flight crews and operational procedures
  - NAA for the approval
EASA proposal for ground stations:

- **Ground stations ‘technical acceptance’ by EASA**
- ANSP/ADR operator installation’s approval by NSA/NAA (approval of safety cases for the changes) based on the ‘technical acceptance’ by EASA

**Advantages:**

- Single ‘technical acceptance’ of industry’s ground stations by EASA that can be used by all ANSPs/ADR operators and their NSA/NAA in EU
- Ensuring harmonisation and level playing field
- Optimisation of resources
- Air-ground (end-to-end) safety and interoperability ensured
CONCLUSIONS AND Q&A

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Thanks for your attention