

Michael  
Underwood  
9 April 2018

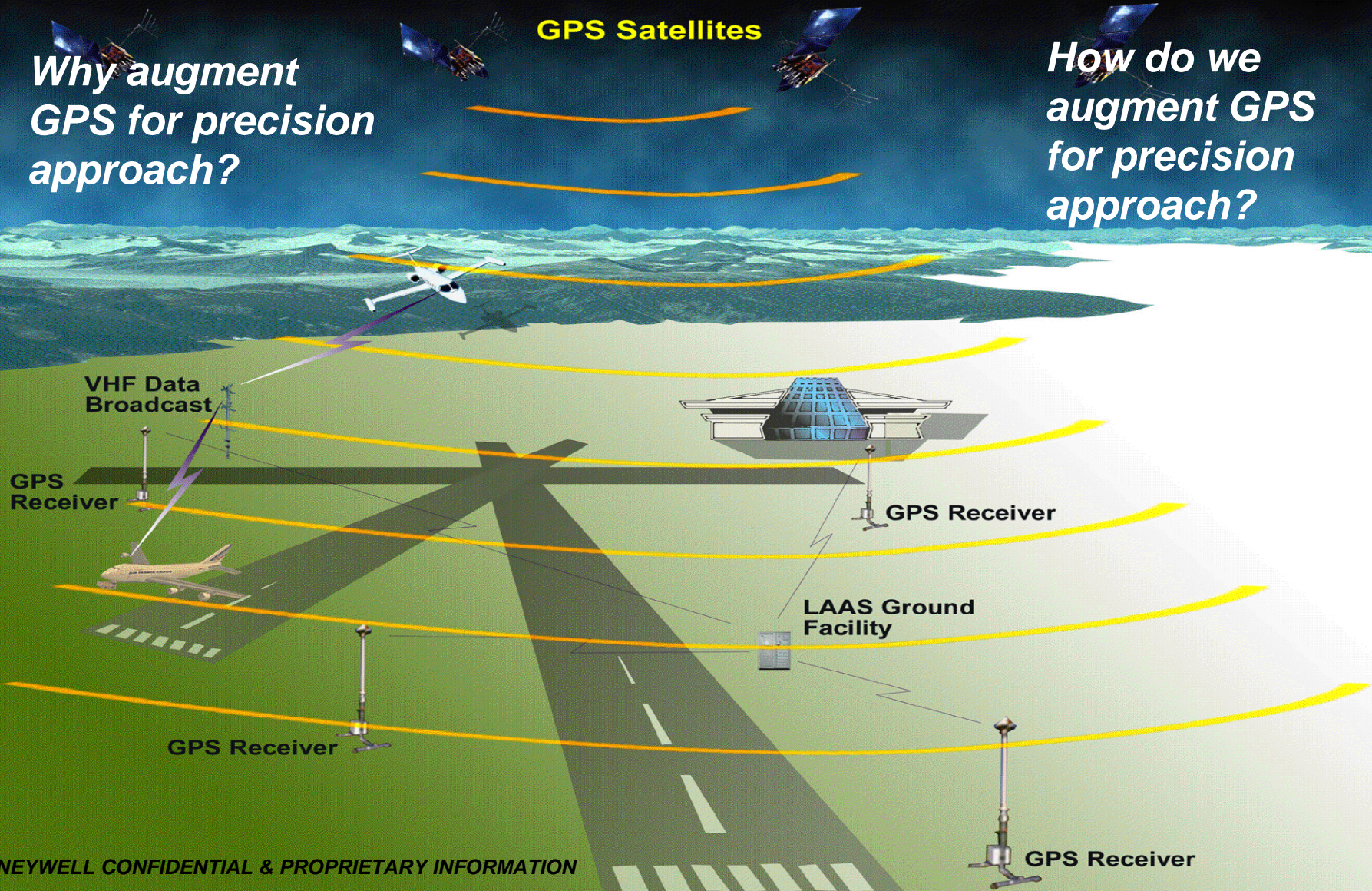
## HONEYWELL GBAS PRESENTATION

# Ground Based Augmentation System (GBAS)

*Why augment  
GPS for precision  
approach?*

**GPS Satellites**

*How do we  
augment GPS  
for precision  
approach?*



**VHF Data  
Broadcast**

**GPS  
Receiver**

**GPS Receiver**

**LAAS Ground  
Facility**

**GPS Receiver**

**GPS Receiver**

# Honeywell's SmartPath® Ground-Based Augmentation System (GBAS)

SCAT I

World's First  
DGPS Cert



SCAT-I  
Certified  
Sep 1998

SLS-1000/2000

Portable

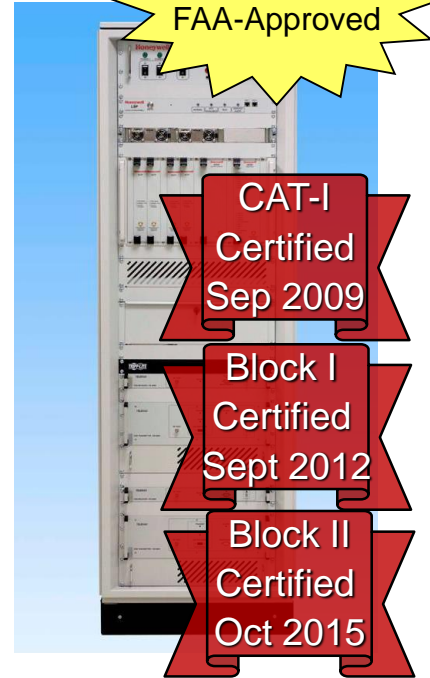


Migrated to  
Portable Unit

SLS-3000

CAT I

World's Only  
FAA-Approved



CAT-I  
Certified  
Sep 2009

Block I  
Certified  
Sept 2012

Block II  
Certified  
Oct 2015

SLS-4000

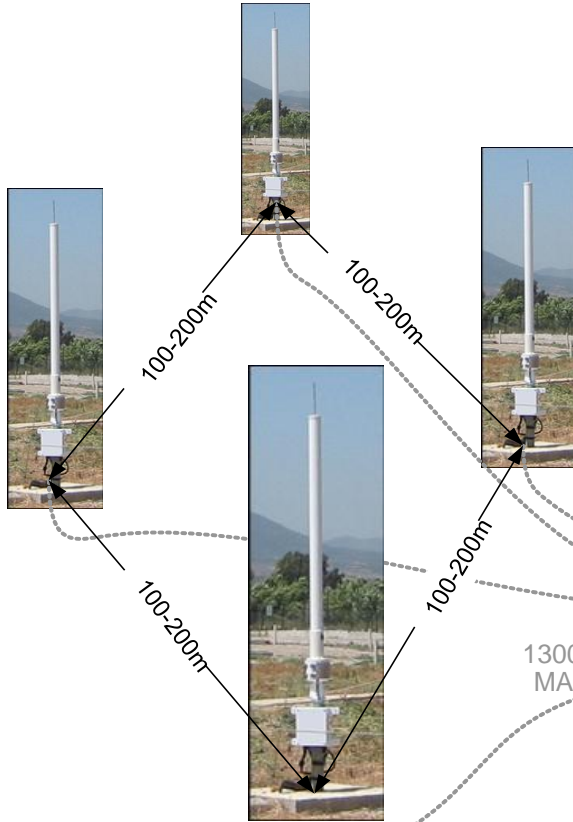
CAT II/III



In Development  
SDA Planned  
TBD

SLS-5000

# Honeywell SmartPath GBAS



## Reference Receivers

- Multipath Limiting Antenna (MLA)
- Narrow Correlator GPS Receiver
- 2 Hz Measurements
- 4 GPS Receivers

## Dual Processor Channels

- Differential Corrections
- Overall System Integrity
- Approach Database
- Redundant Channel

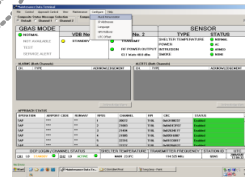


## VHF Broadcast

- Corrections, Integrity, Approaches
- Horizontally Polarized, Omni-Directional
- 108-118 MHz
- 2 TDMA Time Slots (typ.)
- 2 Hz Corrections
- Redundant Radio

200m MAX

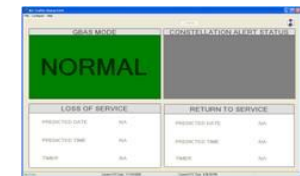
Airport LAN



## Maintenance Data Terminal

- System Status, Mode, Control
- System Alerts, Alarms
- Approach Control

TDMA – Time Division Multiple Access  
 Hz – Hertz  
 LAN – Local Area Network (typ. Ethernet)



## Air Traffic Status Unit

- System Mode
- System Availability

# Next Generation Landing System- Available Now

- Today's presentation focuses on the next generation of landing system (GBAS) that provides:
  - **Enhanced Safety:**
    - Multiple ANSP Certification Pedigree
    - Signal Stability (immune to signal bends inherent in ILS)
    - Wake Vortex Mitigation – Customizable Glide Paths/Approaches
  - **Increased Airport Capacity:**
    - Offers precision approach where ILS cannot due to geography
    - Enables flexible approaches (48), improved accuracy versus ILS
    - Airport benefits from increased revenue (landings fees, concessions, etc.) and cost avoidance (capacity increase without adding runways)
  - **Lower Life-cycle Costs:**
    - One SmartPath GBAS Station serves all runways/runway ends at any airport
    - Lower maintenance costs/lower flight inspection costs
  - **Environmental Friendliness:**
    - Variable Glide Slopes, RNAV/RNP to GLS Finals
    - Airline fuel & emission savings, increased schedule flexibility, avoid noise violations
    - Airports increased capacity and schedule flexibility, improved community relations

# Regulator



## Airlines

Lowers operational cost, and increases schedule reliability



## ANSP

Enhances safety, environmental impacts, ATM modernization



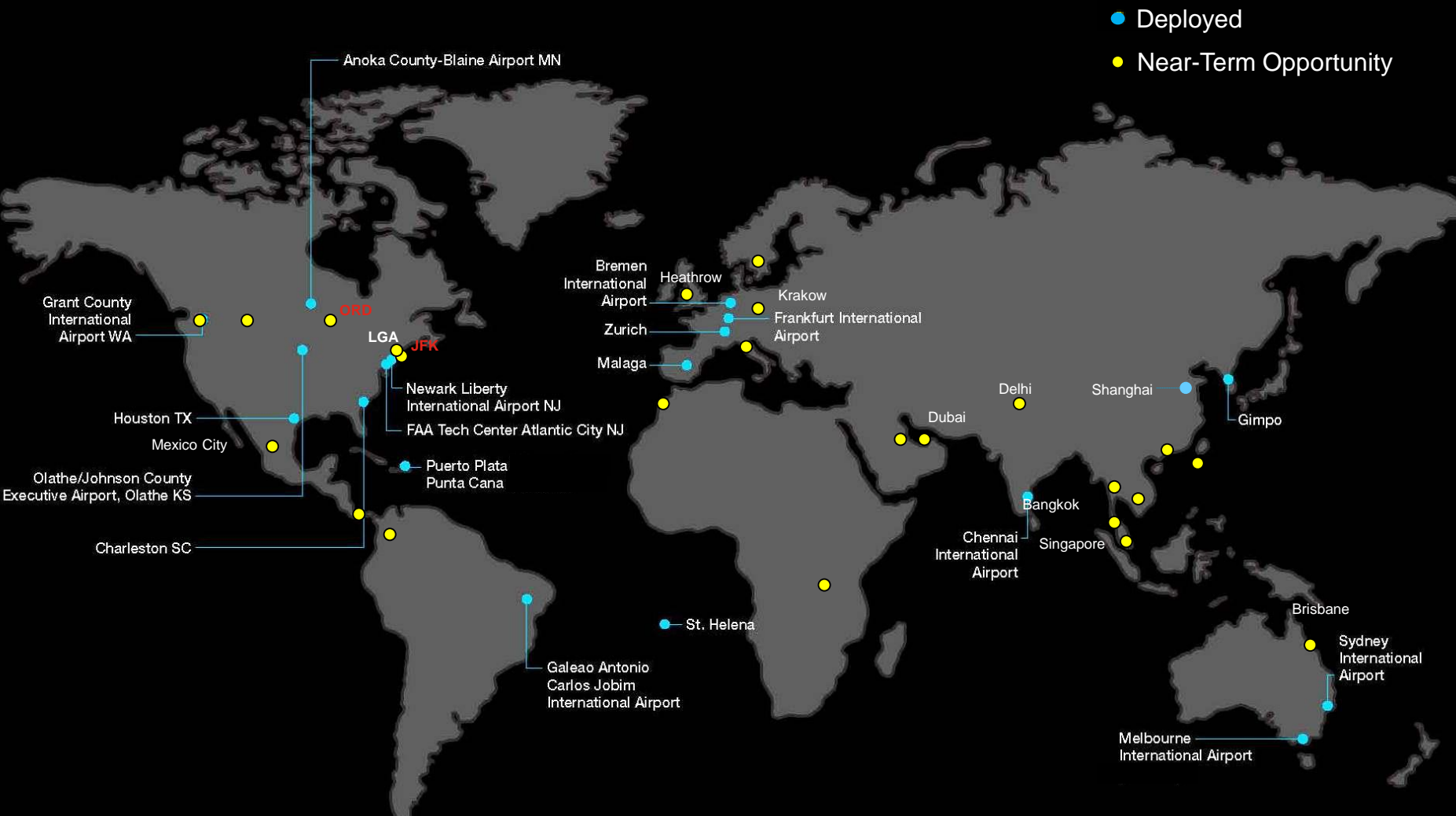
## Airports

Improves capacity, lowers cost, future proof to CAT III

Value is shared across all stakeholders

***Stakeholder Involvement Throughout the Whole Project =  
Successful Implementation***

# SmartPath® GBAS Deployment Expanding Globally



**Numerous Near-Term Opportunities for Network Expansion**



# SLS-4000 Block II SW – What Improves?

- Honeywell Achieved System Design Approval for our 3<sup>rd</sup> Generation Block II GBAS Software in October 2015

- Enhances Availability

- Include satellites that are currently omitted in Block I
- Change fault reactions to re-admit faulty satellites sooner
- Operate on two receivers for common masking
  - Block I requires three receivers to broadcast corrections

- Provides Configurability Options

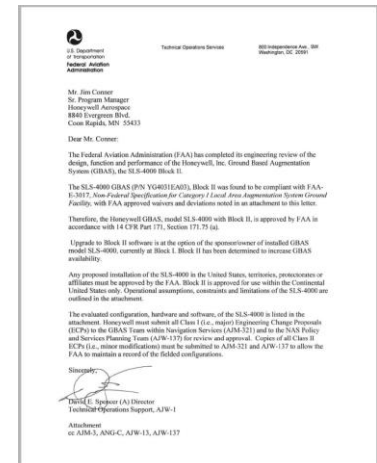
- Allows for a user-defined iono threat model
  - Enables improved availability in all geographies
- Allows for automatic user-defined GLS approach procedures for a specific time period
  - Motivated by low latitudes – Set up to broadcast only during specific time periods

- Maintenance Improvements

- Enable or disable VHF broadcast without going into test mode
- Display enhancements for usability

- Enables 48 FAS Data Blocks (from 26)

## FAA System Design Approval





# Demonstrating the Value of GBAS

2014

eco  
Demonstrator  
PROGRAM



SESAR 9.12  
GBAS CAT II/III – 150  
Trials

Honeywell



2015

Shanghai Pudong GBAS  
Trials



Honeywell

2015 - 2016

Large Scale Demonstrations  
(2016)



NETJETS



skyguide



ZÜRICH AIRPORT

DSNA



- RNP to GLS with 1.4 nm short final approach
- 3.5 – 4.0 deg Glideslope approaches with up to 1000 ft displaced threshold
- CAT III “hands-off” Autoland by an airline crew
- GBAS landing in Asia Pacific (Australia excluded)
- Published RNP to GLS approaches (2016)

# Customer Testimonial – DFS, Germany

CUSTOMER SUCCESS STORY

**Honeywell**

## DFS embraces new precision approach technology

Honeywell SmartPath® GBAS increases airspace efficiency and capacity with the prospect to lower airport costs



### Overview

With global air travel continuing to rise, airports need to find new ways to handle additional aircraft movements without incurring the costs of building more runways. GBAS has been identified by ICAO, the U.S. Federal Aviation Administration (FAA), and Eurocontrol as an enabler for improving air traffic and Honeywell's solution, the SmartPath Precision Landing System, is the world's only certified system. Bremen Airport in Germany was the first airport in the world to adopt the technology.



### AT A GLANCE

#### Customer

Names: DFS Deutsche Flugsicherung GmbH  
Location: Bremen, Germany  
Industry: Air navigation service provider  
Website: [www.dfs.de](http://www.dfs.de)

#### Honeywell solution

SmartPath Ground-Based Augmentation System (GBAS)

#### Why DFS chose Honeywell

- ▶ GBAS identified by ICAO, FAA and Eurocontrol as an enabler for improving air traffic capacity
- ▶ Honeywell SmartPath is world's first and only certified GBAS system
- ▶ DFS wanted to familiarise itself with GBAS as the organisation sees it as an eventual successor to ILS technology

#### Customer results

- ▶ Reduced the chances of taxi time delay and much less impact from weather or significant sitting obstacles on the airfield, unlike ILS critical areas
- ▶ Significantly reduced maintenance effort as GBAS requires fewer checks by flight inspection than ILS systems
- ▶ Used by airlines under IMC down to CAT I decision altitudes



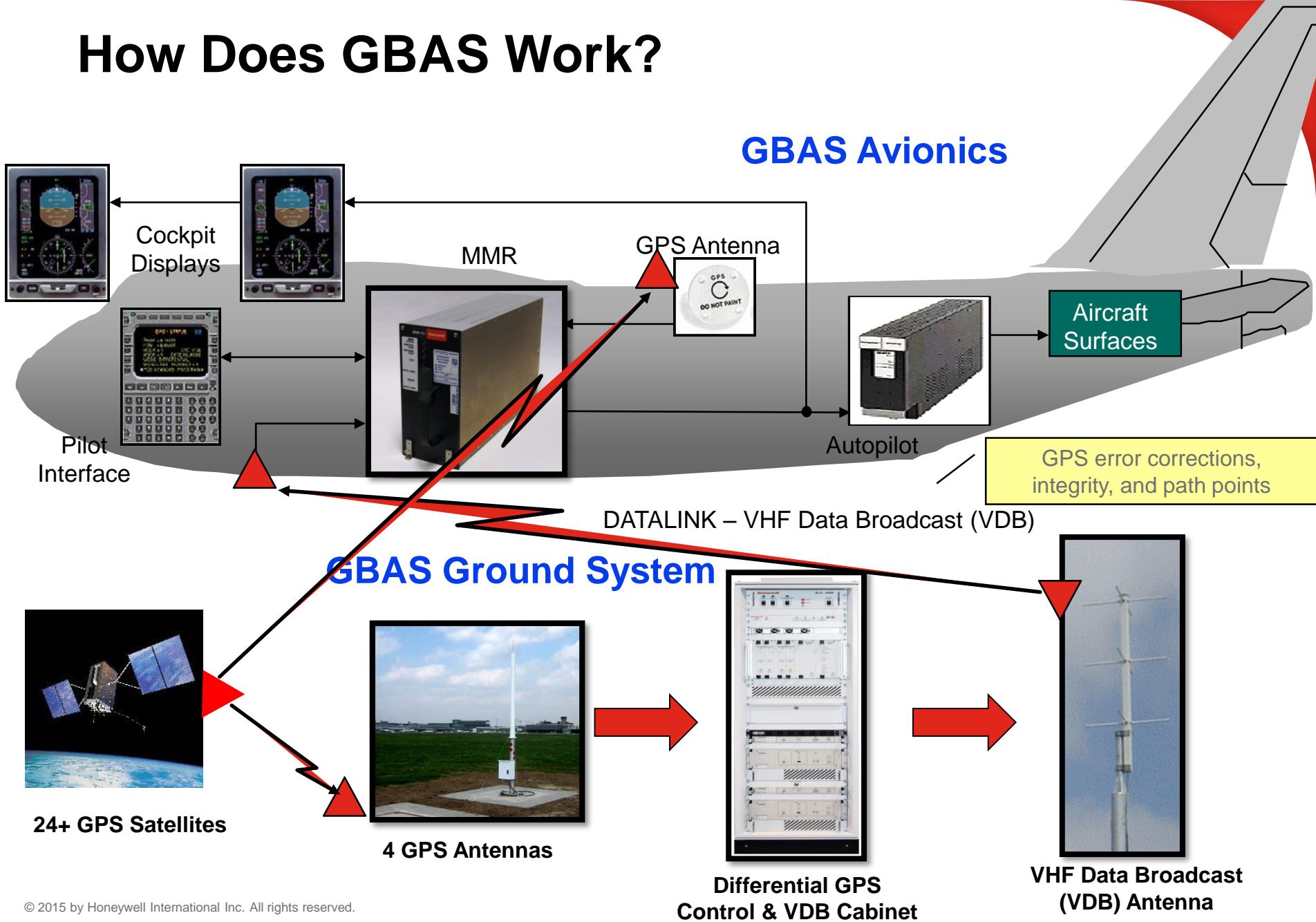
Honeywell Safety  
& Connectivity  
April 9 2018

# GBAS AVIONICS UPDATE

Honeywell's Integrated Multi-Mode Receiver

**Honeywell**

# How Does GBAS Work?



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**Honeywell Uniquely Provides Both Air and Ground GBAS Equipment**

# GLS Uses Existing Aircraft Architecture



- ILS look alike
  - Glideslope
  - Localizer

7-07-XX

July XX, 2007

## GLOBAL POSITIONING LANDING SYSTEM (GLS) PROCEDURES

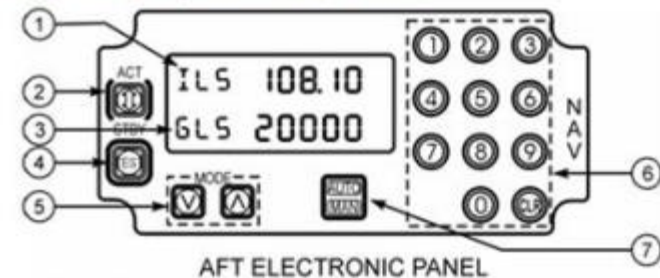
This bulletin describes aircraft systems and procedures for GLS approaches.

The initial aircraft to obtain this system will be the Continental Micronesia 737-800's. Installation will commence at the end of June, with flight procedures to begin in the fall timeframe.

The aircraft will have the following physical differences on the flight deck:

1. Multi-Mode Navigation Control Panel. This is visually identical to the panel currently installed in the 500's. The difference is the ability to select GLS frequencies.

Multi – Mode Navigation Control (If Installed)



7370-11005

- Active (ACT) Mode and Frequency Indicator  
Indicates the active mode and frequency.
- ▶ Transfer Switch

# Aircraft GLS Capable

## Boeing

737NG – GLS forward fit, retrofit

787 – GLS basic

747-8 – GLS basic

## Airbus

A320 – GLS option

A330 – GLS option

A340 – GLS option

A350 – GLS option

A380 – GLS option

Airbus & Boeing committed to RNP RNAV 0.1 (or less) and GLS

- FMS changes complete or planned for most models

- LPV not in current plans at Boeing or Airbus

- Over 4000 aircraft already equipped with GLS, and 700 on order

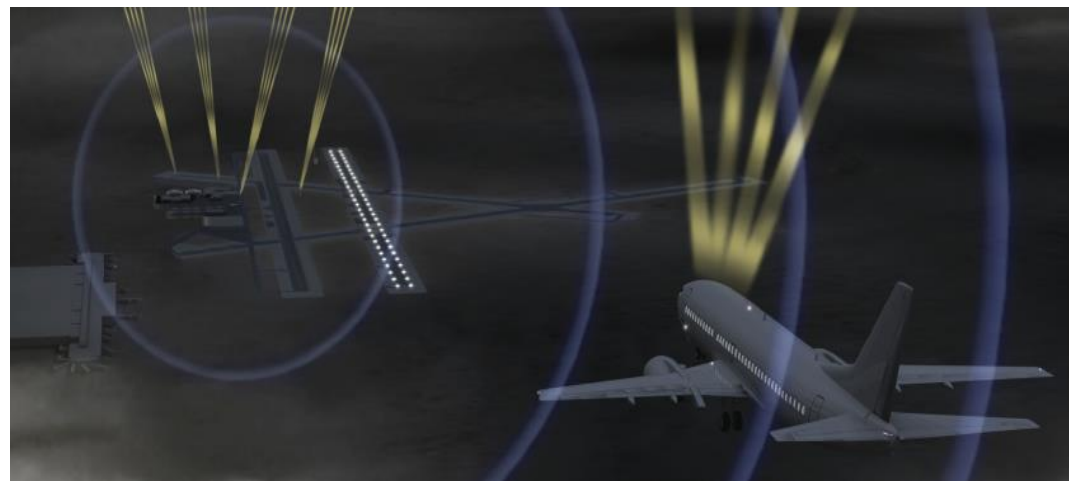
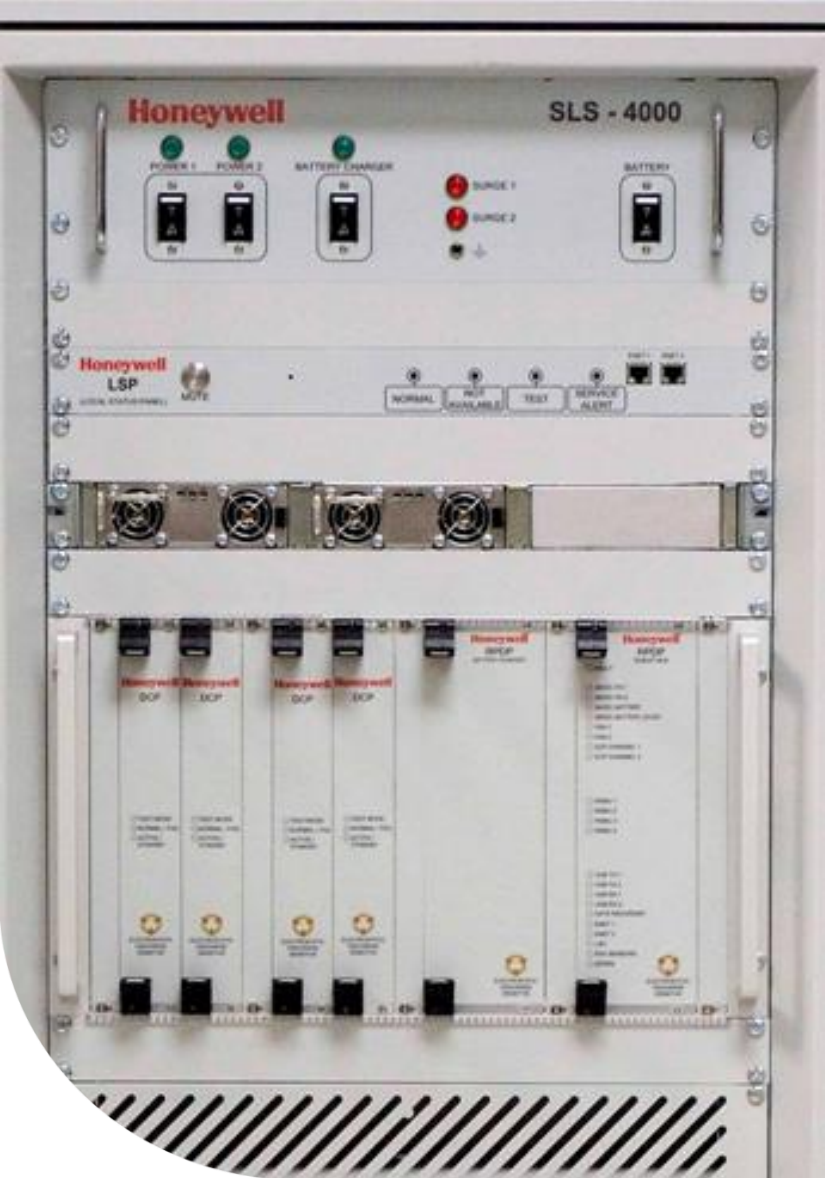
Embraer and Honeywell are developing Similar Strategic Roadmaps

- RNP-0.1 in development for Honeywell Epic platforms

GLS equipped aircraft are in service

# Summary

- CAT III GBAS is no longer a question of *if*, it is who, where and how soon for each airport and airline operator
- By working together with airlines, national regulators, air navigation service providers, key airports, and aircraft OEMs, Honeywell is uniquely positioned to support, both in the air and on the ground, with CAT I/II/III GBAS and eventually Multi-Constellation GNSS
  - We can influence the results and expedite the benefits to all stakeholders
- We want your business
  - Honeywell provides the optimal path to not only equip, but also achieve the value out of this game-changing technology
- Partnering on GBAS deployment
  - Proactive communications between Airlines, Airports, OEMs, and the regulatory authorities will expedite GBAS deployment and value realization by all stakeholders



# SMARTPATH CERTIFICATION OVERVIEW



# GBAS Approval Categories

- To be approved the system must meet ICAO, FAA and/or other recognized standard
- The standard for SmartPath is the FAA LAAS Specification 3017 which also traces to the ICAO requirements

## SYSTEM DESIGN APPROVAL

- System Safety
- System Engineering
- Software Design Assurance
- Hardware Design Assurance
- System Verification
- Commercial Instruction Book
- Training Material
- Operational Evaluation

## FACILITY APPROVAL

- Operations
- Maintenance
- Installation
- Flight Procedures
- Flight Inspection
- Spectrum Management
- Training
- Safety Management

## SERVICE APPROVAL

- Aircraft Approval
- ATC Training
- Pilot Training
- Instrument Flight Criteria

# GBAS Certification Phases

- **System Design Approval (SDA) – Manufacturer**
  - Ground station system design meets requirements
  - Developed to appropriate design assurance levels
  - Accuracy, integrity, availability requirements satisfied
- **Facility Approval – Owner/ANSP/Airport**
  - Ground station installed properly, safely
  - Approach plates/procedures developed
  - Signal-in-space, coverage volume verified, approaches verified
  - Maintenance technicians trained, certified
- **Service Approval – Operator/Airline**
  - Aircraft equipped
  - Pilot crews trained
  - Control tower personnel trained

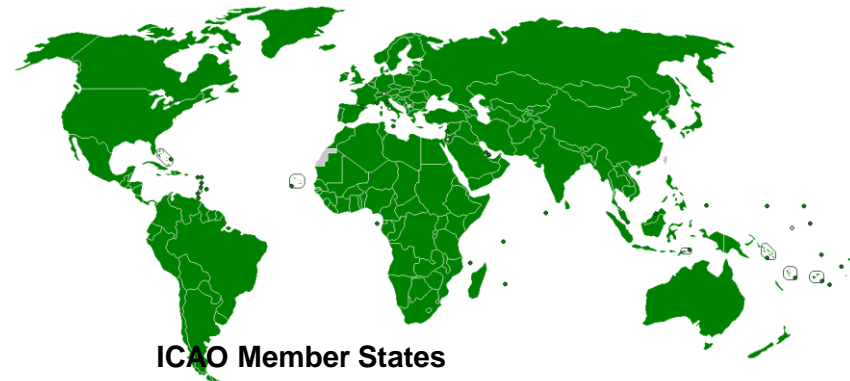
# Approval Outside the USA

# International Civil Aviation Organization

**ICAO is a standards organization.  
Each country can adopt ICAO into  
their aviation regulations.**

For example, Australia ratified ICAO standards through *Air Navigation Act 1920*.

*GBAS is specified under ICAO SARPS Annex 10, Attachment D*



# Germany

- Country requirements for type certification
- Top level requirements: ICAO, EUROCAE
- Honeywell obtained type certification with BAF

**Bremen**



**Frankfurt**



# Germany - Requirements

- **NfL II-51/08, Notification concerning the requirements for type-certification of GBAS ground facilities as aeronautical radionavigation stations**
  - System safety and security
    - ICAO Annex 10, Volume 1
    - ARP4761, Safety Assessment Process
  - Software requirements
    - Developed according to EUROCAE ED-109
  - Technical functional requirements
    - ICAO Annex 10, Volume 1
    - Tests per EUROCAE ED-114
    - Ground and Flight inspections per ICAO Doc 8071 chapter 4
    - All weather operations, NfL I-1/99
    - Remote monitoring
  - Environmental requirements
    - ED-114
    - NfL I-328/01, Guidelines Concerning Obstacle Clearance for Instrument Runways

# Germany - Requirements

- **NfL II-51/08, Notification concerning the requirements for type-certification of GBAS ground facilities as aeronautical radionavigation stations**
  - Facility Documentation
    - Installation manual
    - Technical system description
    - Operators manual
    - Maintenance manual
  - Legal telecommunication requirements
    - Declaration of conformity to radio equipment and telecommunications standards
  - Applicable to Cat I operations
  - Independent audit of Honeywell's FAA SDA data package

# Spain

- Top level requirements: FAA specification
- Aena prepared approval package for certification authority





# Australia

- Top level requirements: FAA, ICAO
- Airservices Australia prepared approval package for certification authority CASA
- CASA participated in FAA audits



# Questions?



***Thank You!***

**Honeywell**