Pat Reines
(pat.reines@honeywell.com)

# SmartPath®
# Ground Based Augmentation System (GBAS)
## *A New Era in Precision Navigation*

Honeywell

# Flight Plan

- 0900-0915 Welcome (PANSA)
- 0915-0930 Introductions (All)
- 0930-1100 GBAS Overview (Honeywell: Pat Reines)
- **1100-1130 Break (All)**
- 1130-1200 DFS GBAS Experience and Program Services (DFS: Detlef Schulz-Rückert)
- 1200-1215 Warsaw & Krakow Approach Concepts (Honeywell: Pat Reines)
- 1215-1230 GBAS Videos (Honeywell: Pat Reines)
- **1230-1300 Lunch Break (All)**
- 1300-1400 GBAS Approval Processes (Honeywell: Brian Koosmann)
- 1400-1430 Installation Examples (Honeywell: Brian Koosmann)
- **1430-1500 Break (All)**
- 1500-1530 Questions and Answers (All)
- 1530-1600 Discussion and Wrap Up (All)

# Flight Plan

- **Ground Based Augmentation System (GBAS) Overview**
- **SmartPath Enabled Air Operations Overview**
- **SmartPath Installations Update**
- **SmartPath Status and Growth**
- **SmartPath Value Summary**

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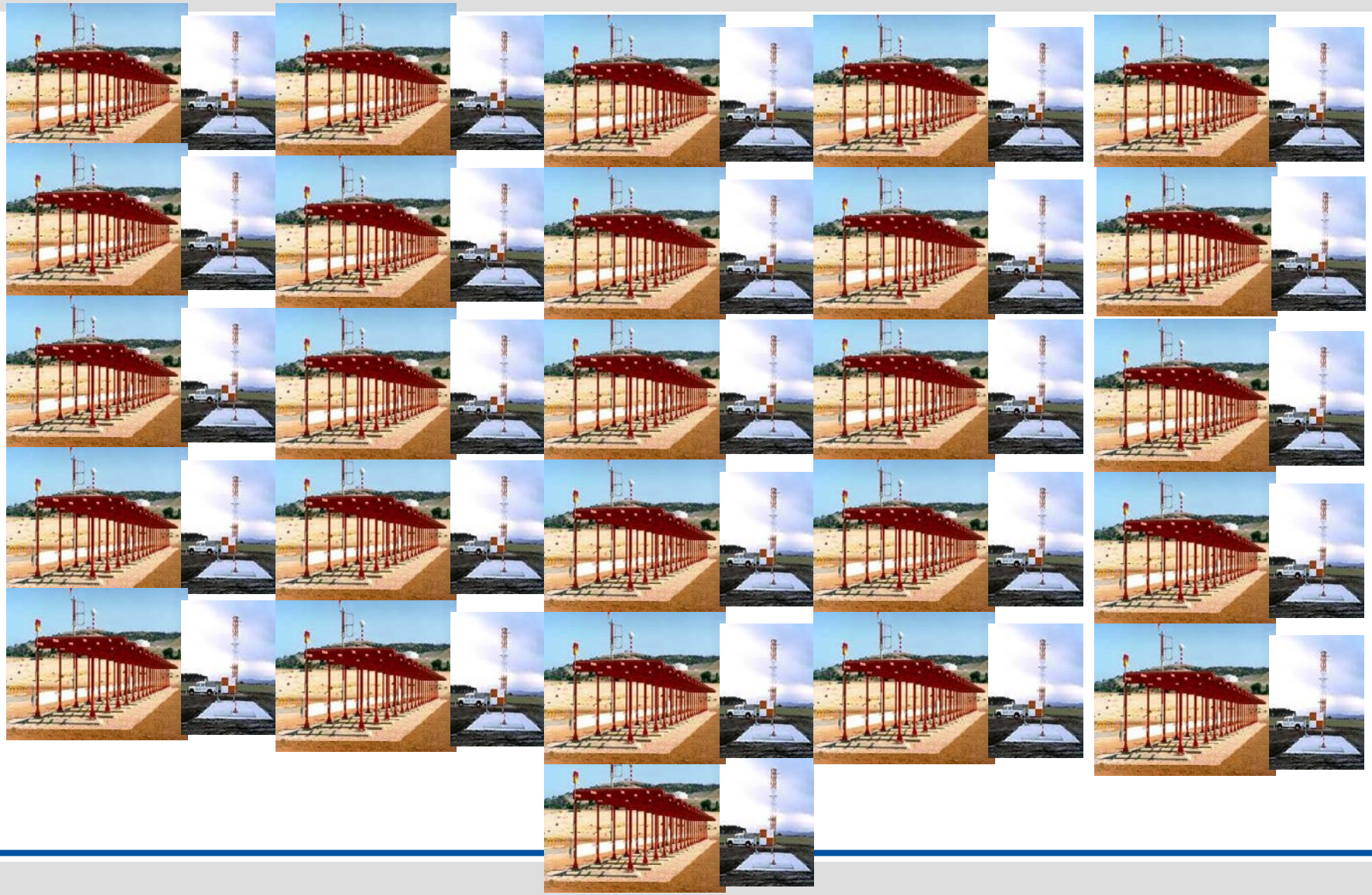
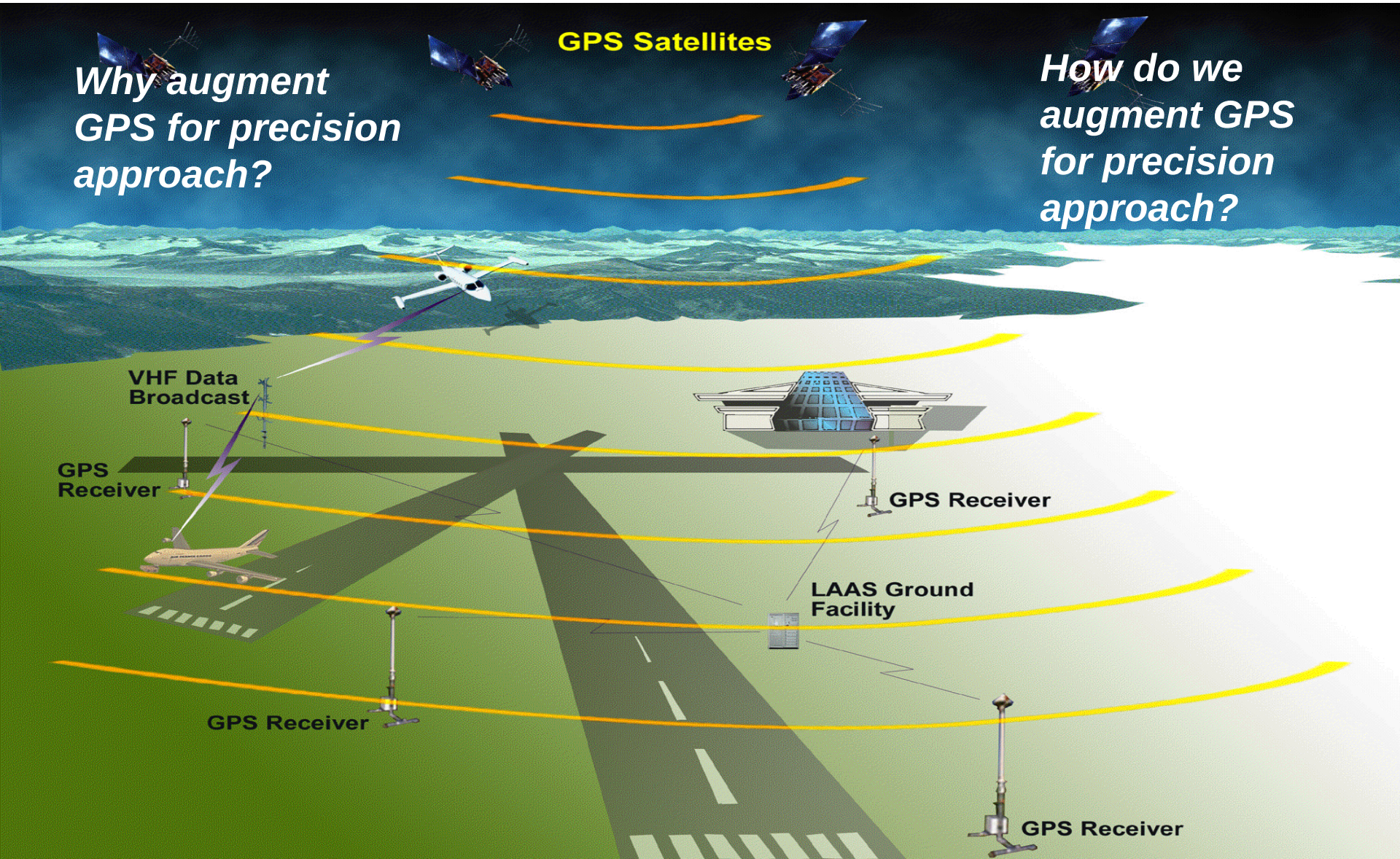
# 26 ILS Approaches = 26 Localizers and Glide Slopes



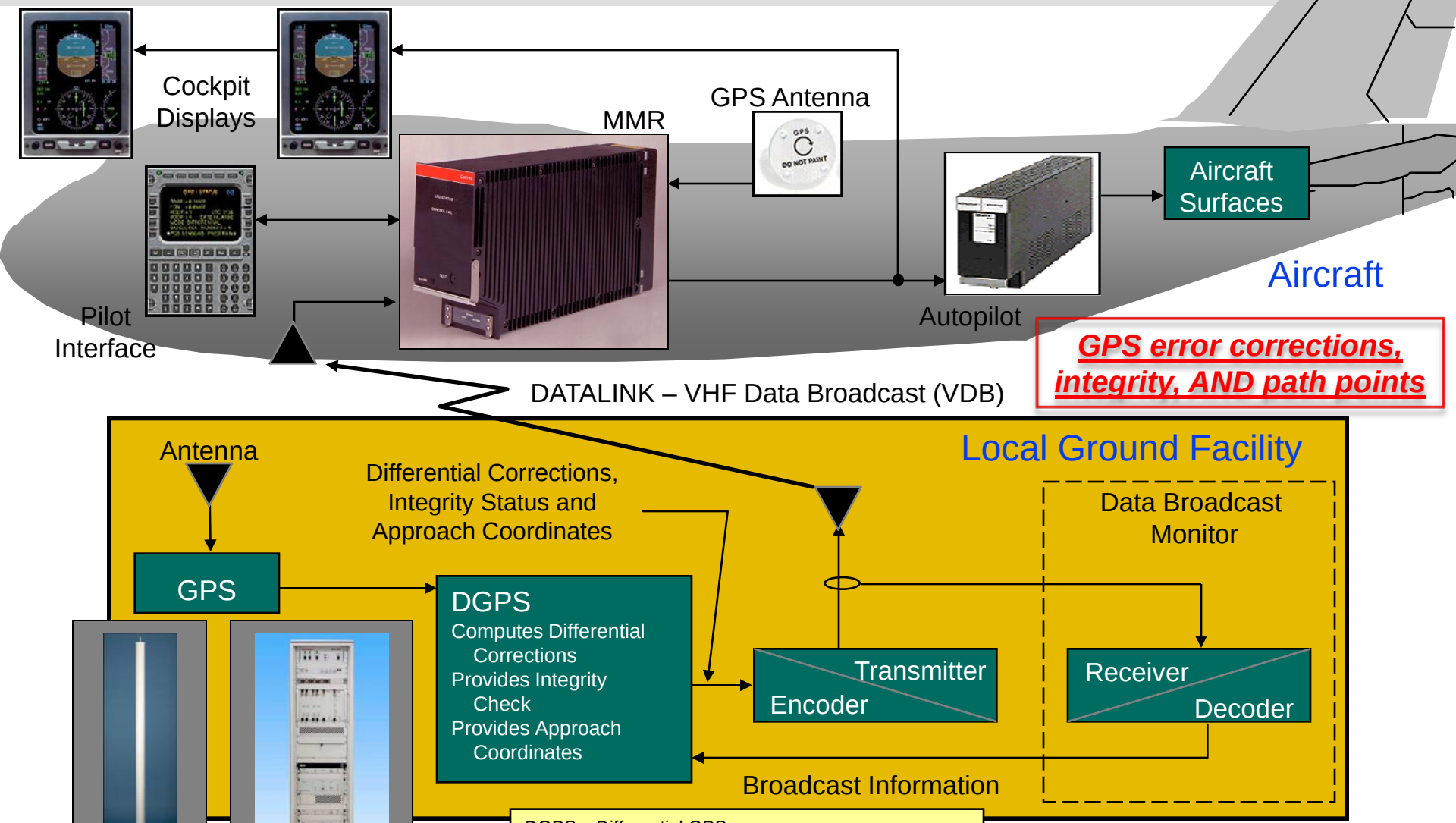
# 26 ILS Approaches = 26 Localizers and Glide Slope

**= 1 GBAS**

# Ground Based Augmentation System (GBAS)

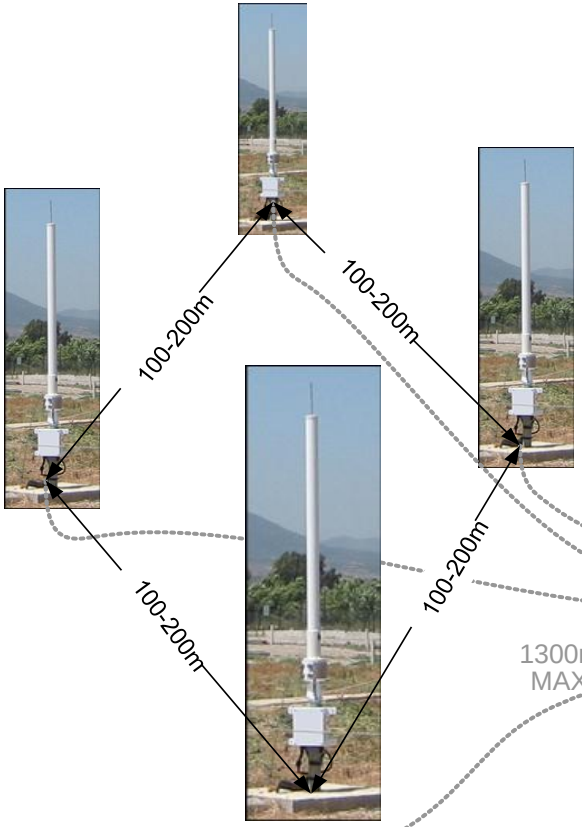


# GLS: GBAS Airborne Implementation



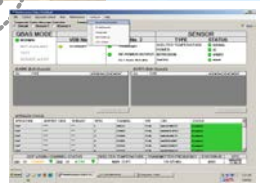

DGPS – Differential GPS
MMR – Multi-Mode Receiver (GPS, VDB, ILS, etc)
VDB – VHF Data Broadcast (Link to aircraft)

# Honeywell SmartPath® GBAS




## Dual Processor Channels

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

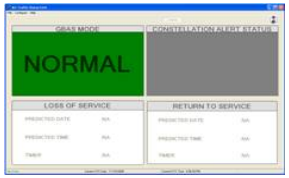


## VHF Broadcast

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

100m
MAX

Airport LAN




## Maintenance Data Terminal

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

## Reference Receivers

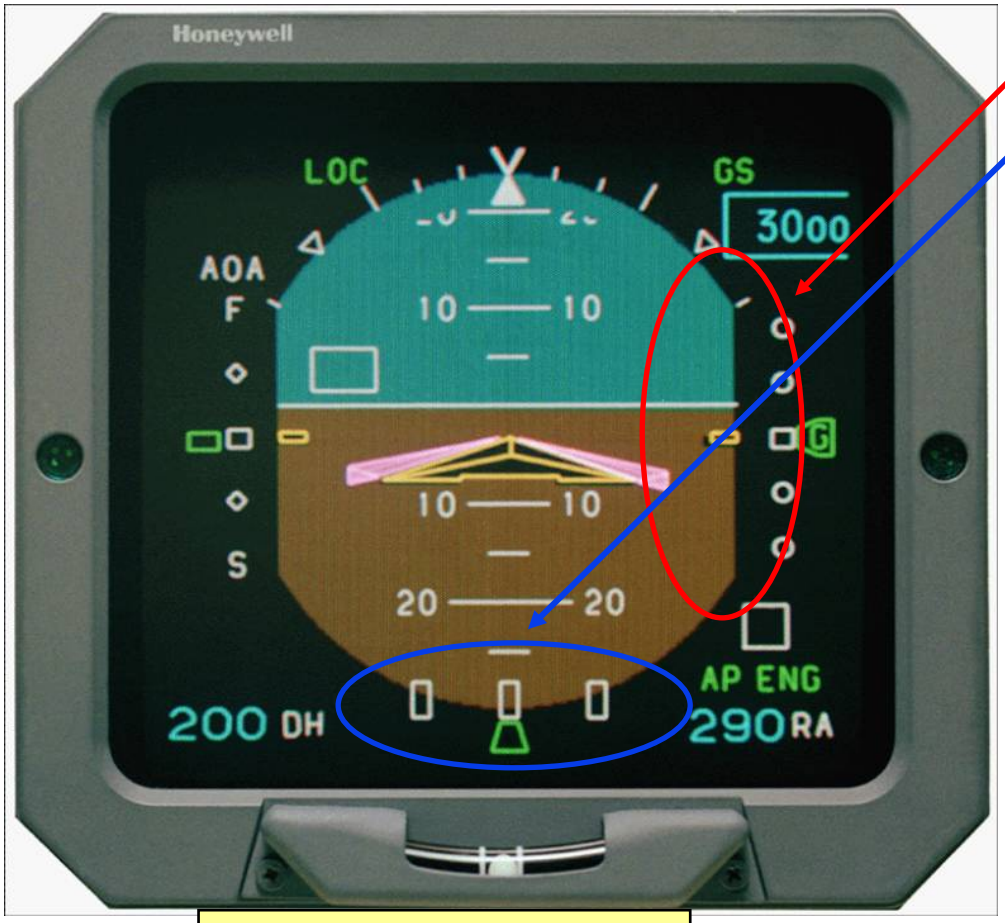
- Multipath Limiting Antenna (MLA)
- Narrow Correlator GPS Receiver
- 2 Hz Measurements
- 4 GPS Receivers

## Air Traffic Status Unit

- System Mode
- System Availability

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

# GLS Uses Existing Aircraft Architecture




GLS – GNSS Landing System
ILS – Instrument Landing System

- ILS look alike
  - Glideslope
  - Localizer

737-07-XX July XX, 2007

GLOBAL POSITIONING LANDING SYSTEM (GLS) PROCEDURES

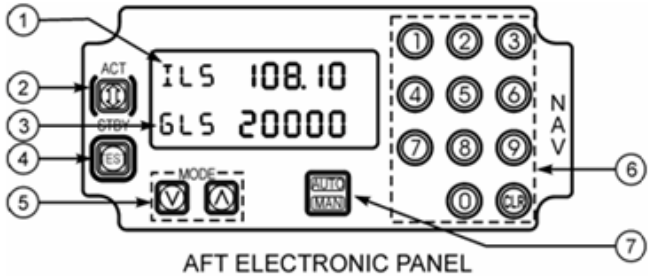
This bulletin describes aircraft systems and procedures for GLS approaches.

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)




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

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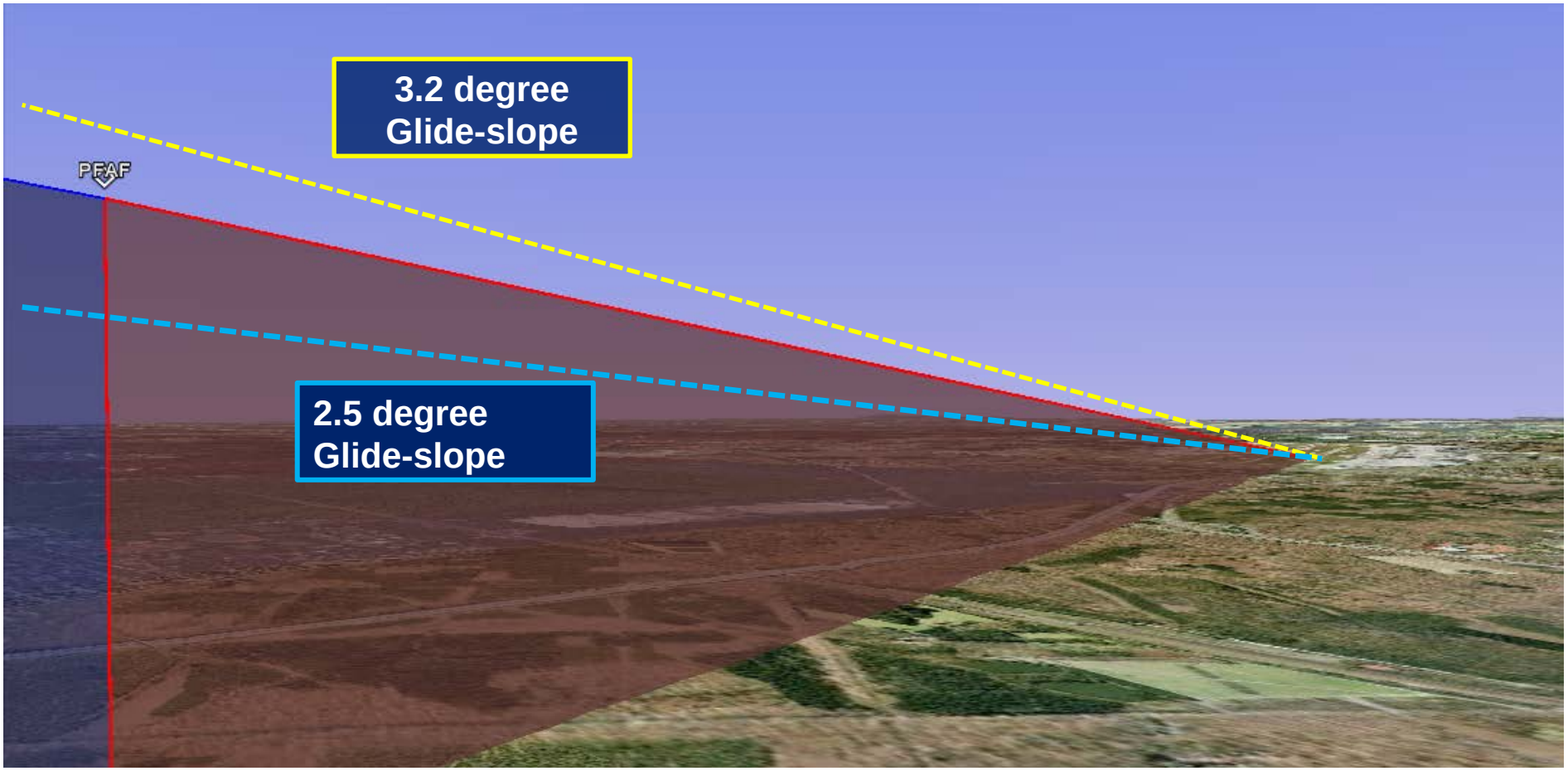
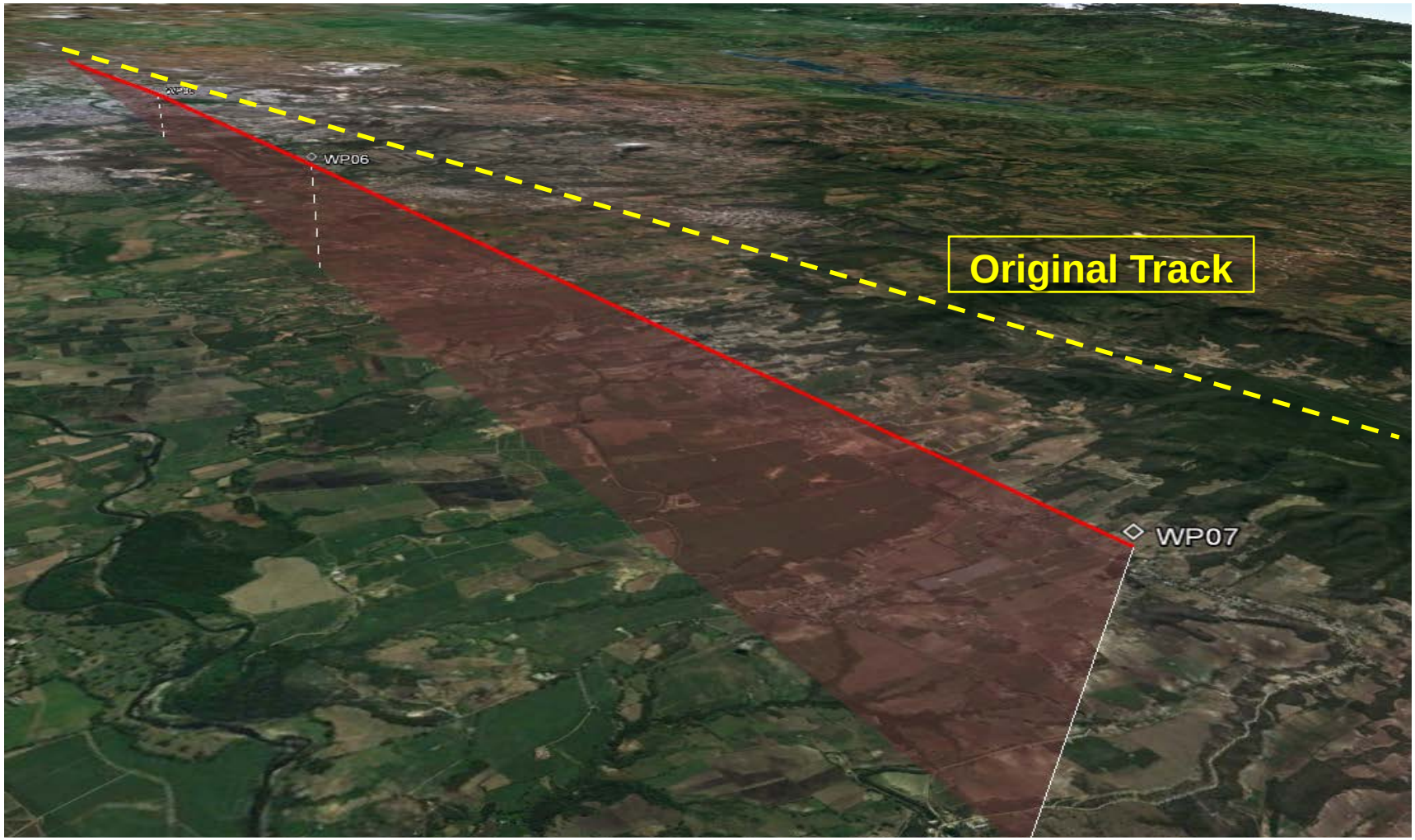
# GBAS: Programmable Touchdown Points and Path

- ILS: single defined vertical path, same touchdown point on runway
- SmartPath GBAS: multiple touchdown points and glide slope combinations

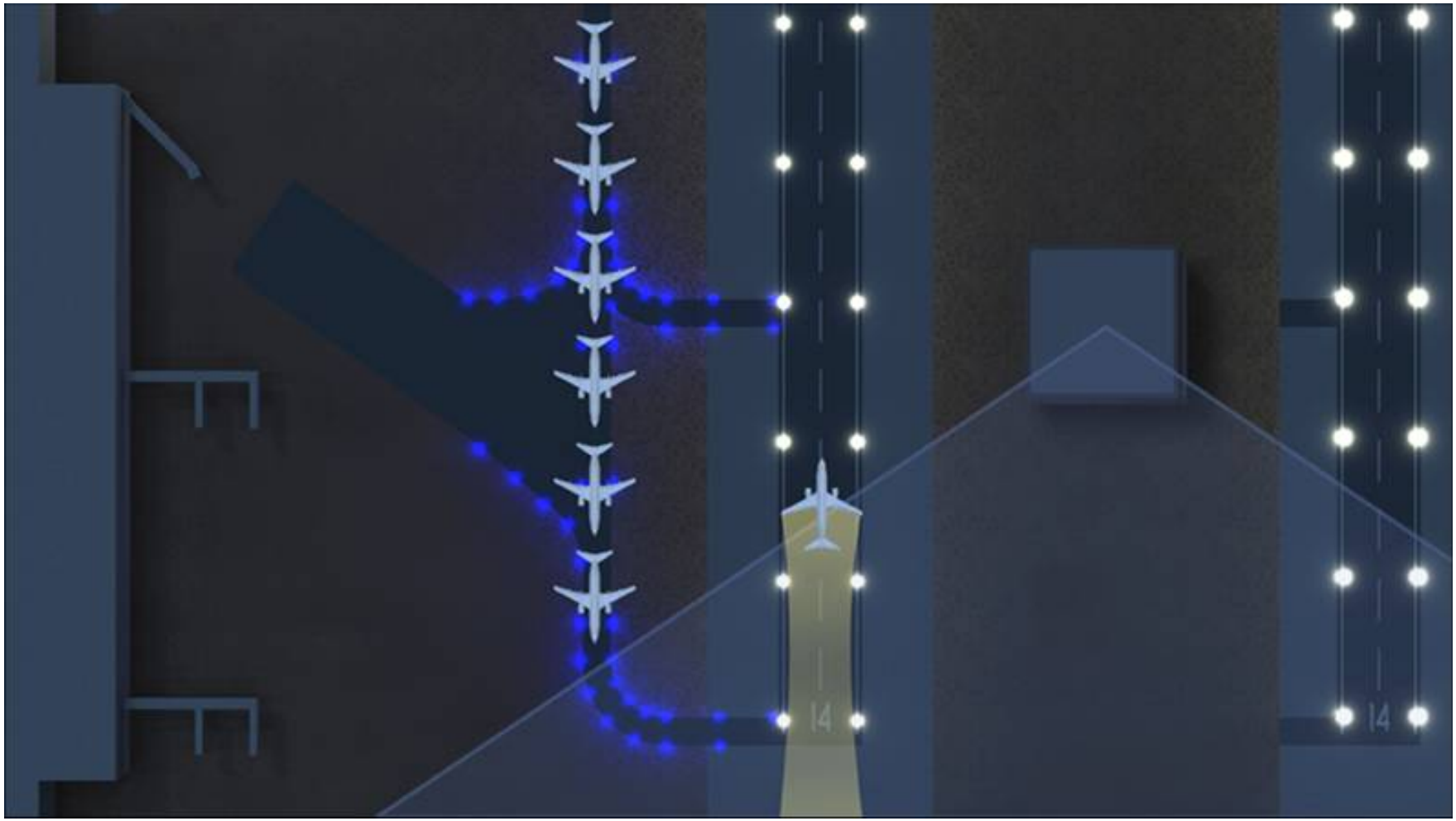
# GBAS: Programmable Touchdown Points and Path



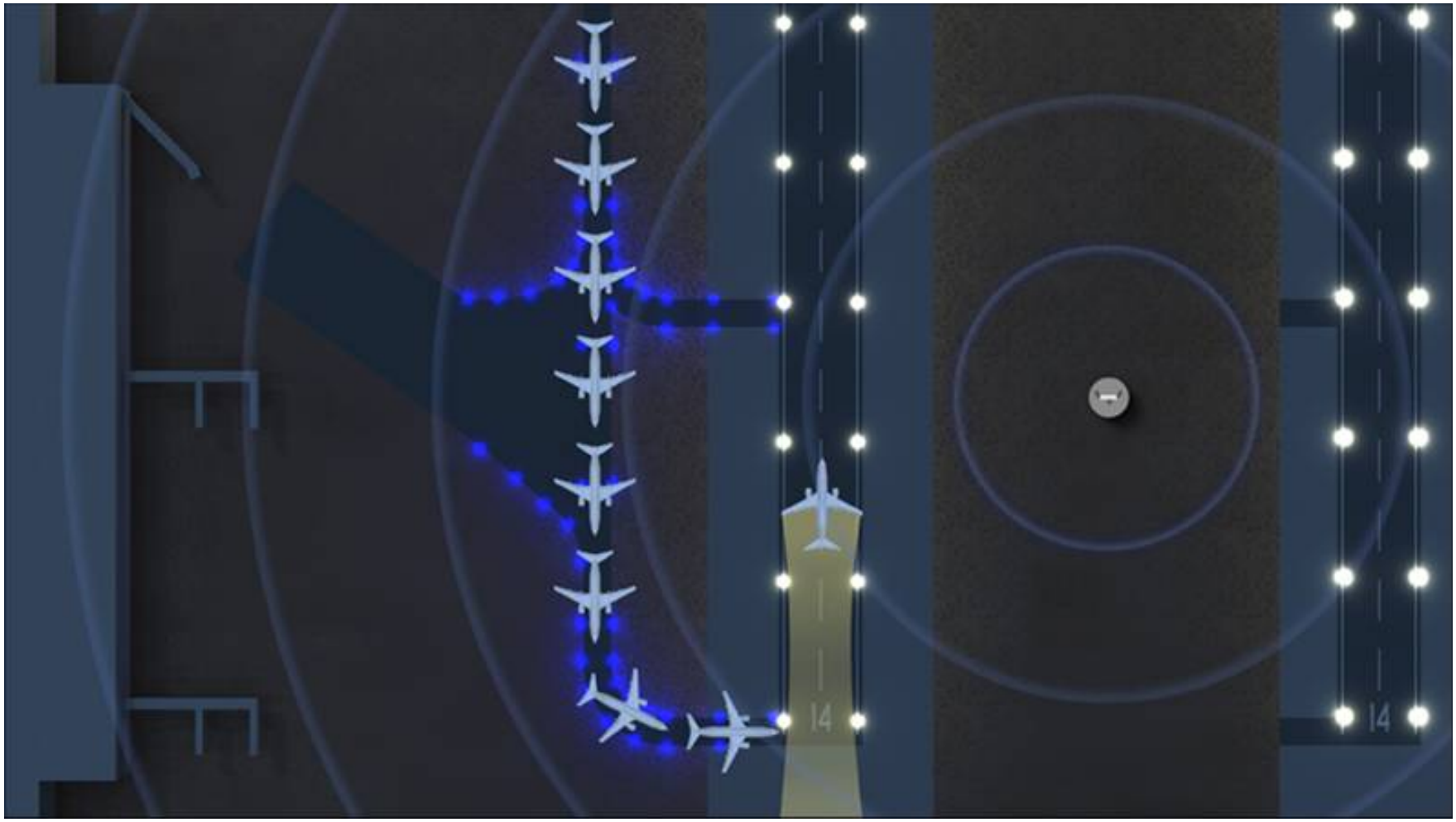
# GBAS Offset Approaches



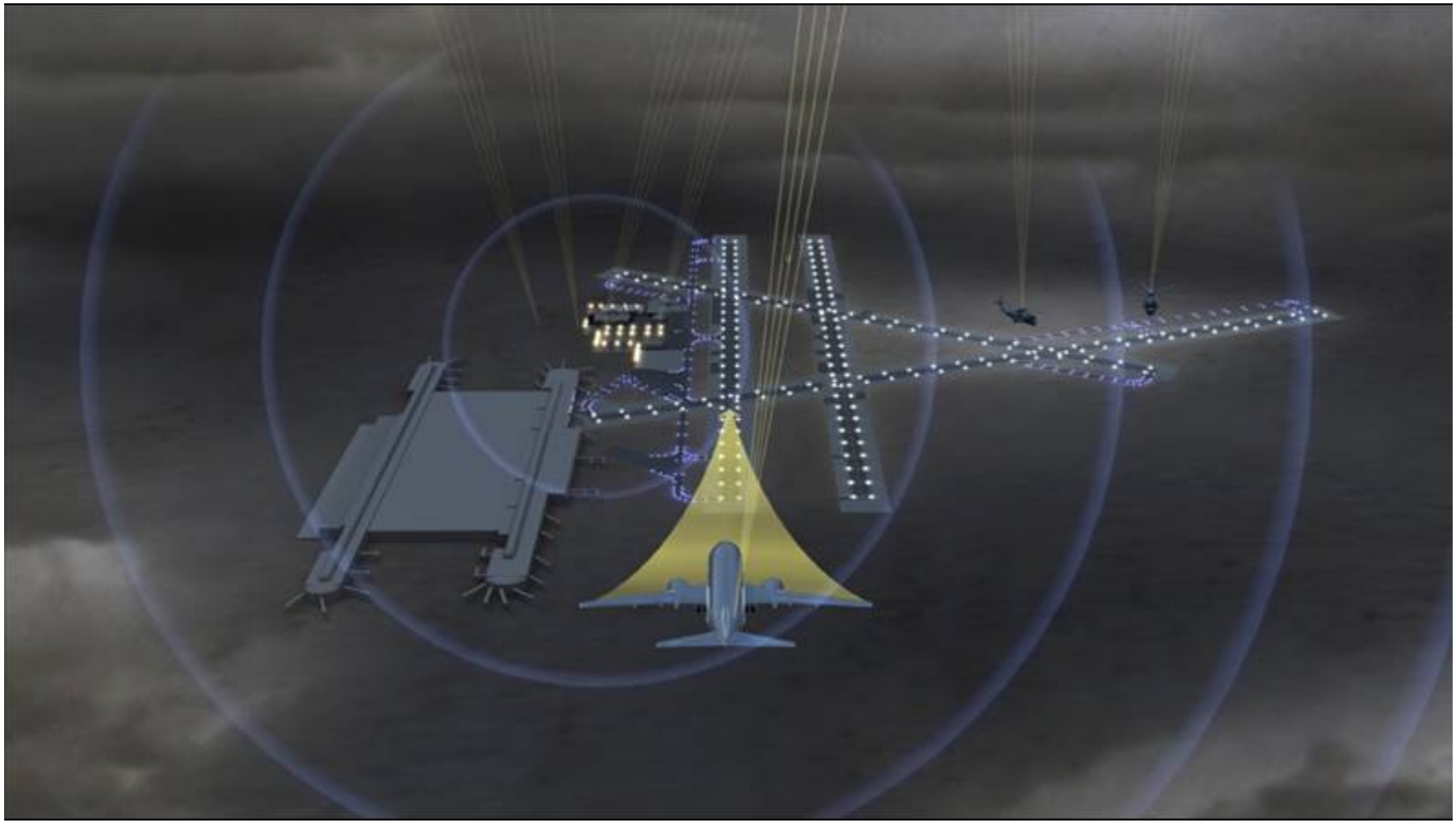
# ILS Clear Zones



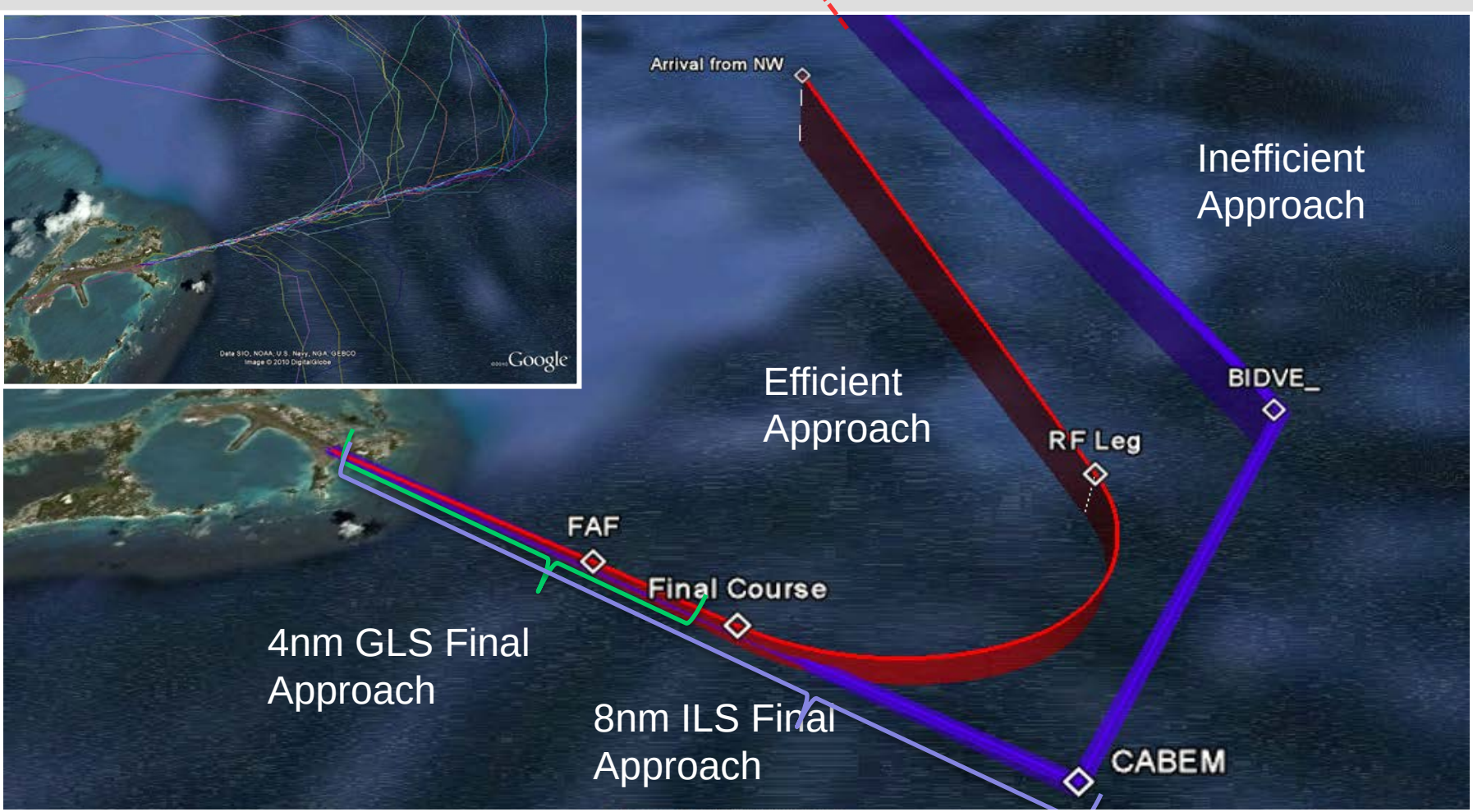
# GBAS Requires No Clear Zones



# GBAS Multiple Concurrent Operations



# RNP + GBAS GLS: Enabling Maximum Efficiency

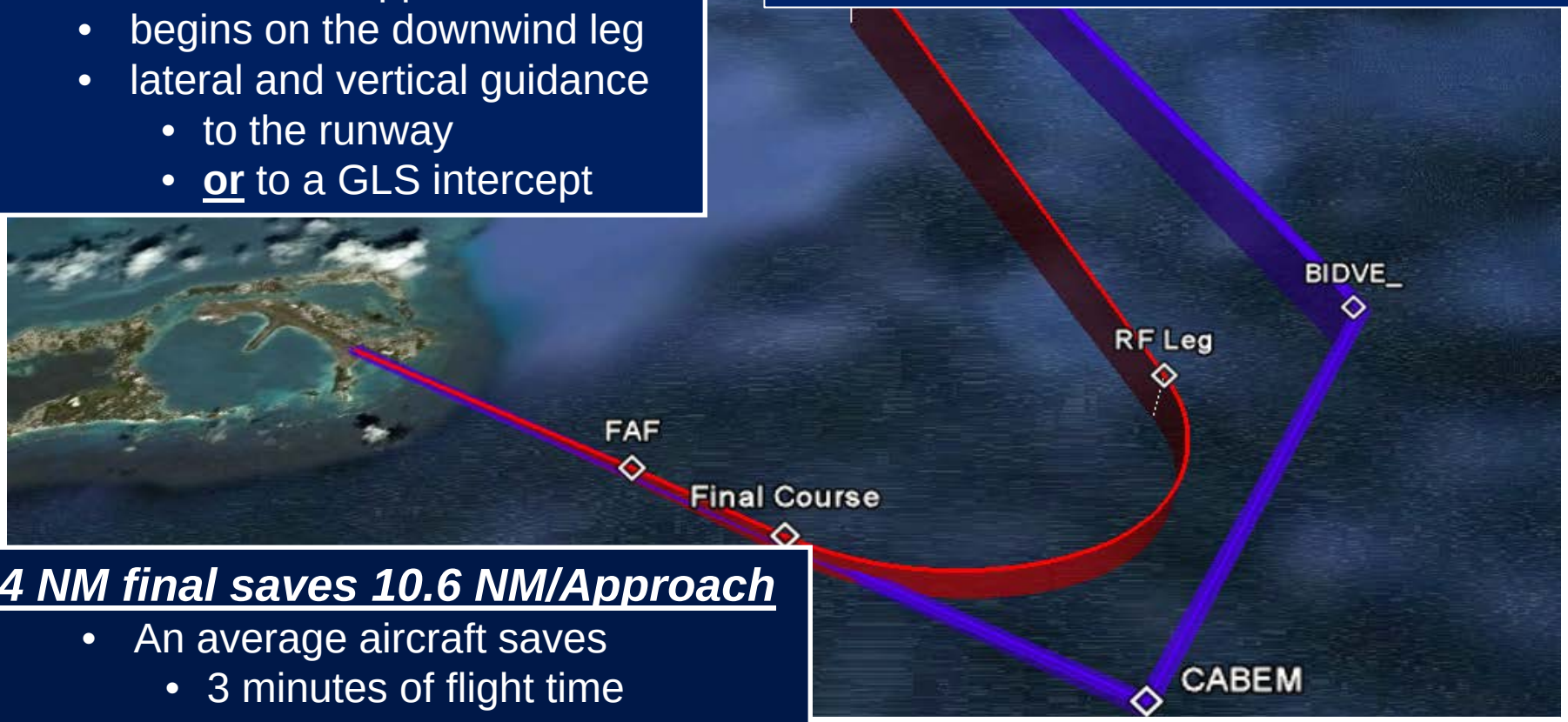


# RNP + GBAS GLS: Efficiency Quantified

**RNP Approach:**

- curved final approach
- begins on the downwind leg
- lateral and vertical guidance
  - to the runway
  - **<u>or</u>** to a GLS intercept

CO2 emission reductions of 1.4243lkg per each 1kg of fuel saved




***<u>4 NM final saves 10.6 NM/Approach</u>***

- An average aircraft saves
  - 3 minutes of flight time
  - 82.7 kilograms of fuel
  - 104 liters of fuel

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# DFS: Bremen First Flight

World's 1st/Only FAA/ICAO Compliant

FAA CAT-I Certified 4 Sep 2009

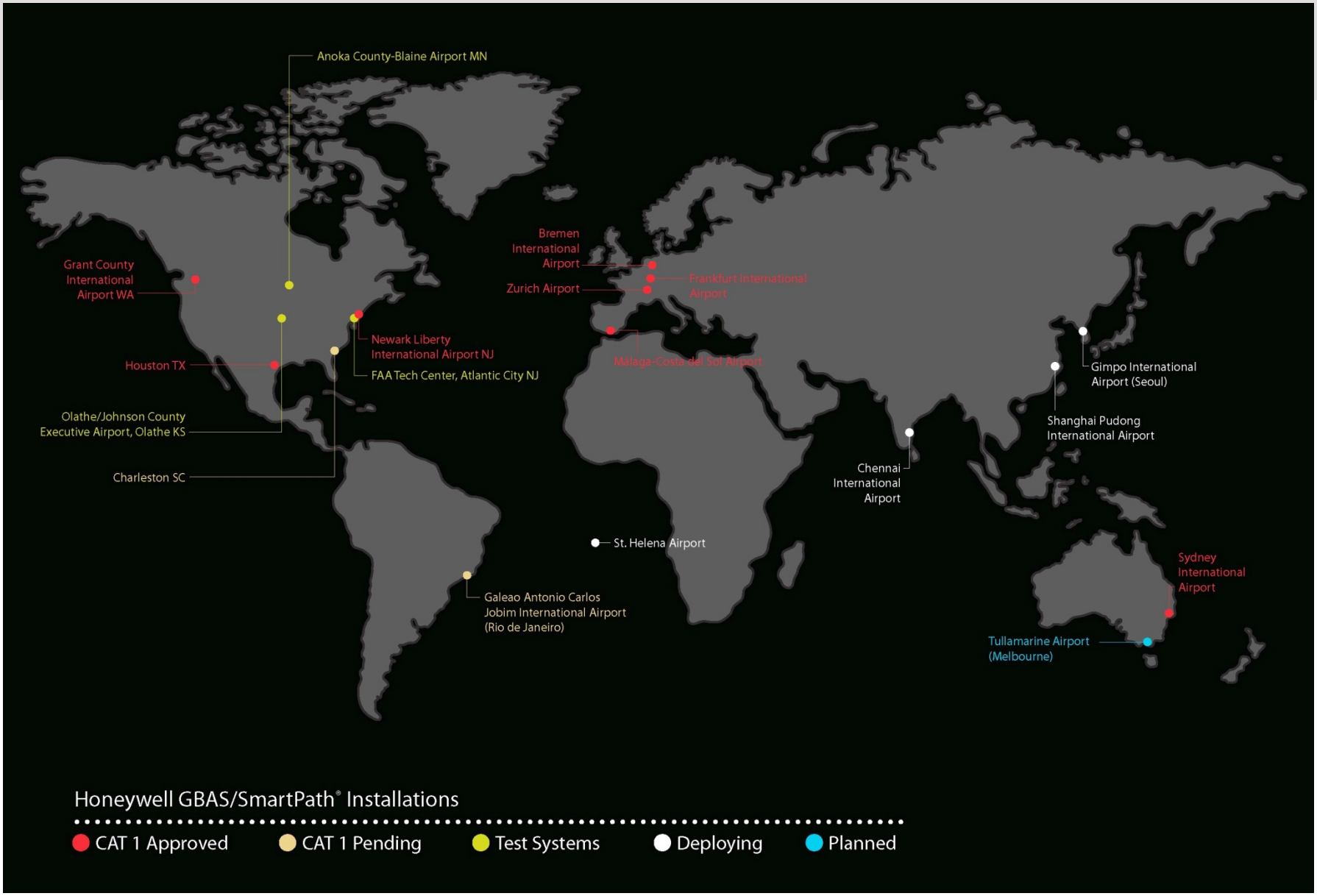
German BAF Certified 28 Nov 2011

Spanish CAA Approval 5 May 2014

Switzerland GBAS Operational 14 October 2014

Australian CASA Approval 29 May 2014

- The world's first unrestricted GLS landing occurred at Bremen, Germany
- 9 Feb 2012: Air Berlin 6573 landed at 21:52 using Honeywell's SmartPath GBAS


Anoka County-Blaine Airport MN
Grant County International Airport WA
Houston TX
Olathe/Johnson County Executive Airport, Olathe KS
Charleston SC
Newark Liberty International Airport NJ
FAA Tech Center, Atlantic City NJ
Bremen International Airport
Zurich Airport
Frankfurt International Airport
Málaga-Costa del Sol Airport
Gimpo International Airport (Seoul)
Shanghai Pudong International Airport
Chennai International Airport
St. Helena Airport
Galeao Antonio Carlos Jobim International Airport (Rio de Janeiro)
Sydney International Airport
Tullamarine Airport (Melbourne)
Honeywell GBAS/SmartPath® Installations
CAT 1 Approved
CAT 1 Pending
Test Systems
Deploying
Planned

# GLS: GBAS Airborne Implementation

**737NG: GLS certified,**
**650 GLS activated = 20% of operators**
**900 GLS provisioned = 40% of operators**
**787: GLS certified, basic = 886 aircraft**
**747-8: GLS certified, basic**

**A-380: GLS certified, 8 airlines**
**A-320 family: GLS certified, 8 airlines**
**A-330/340: GLS certified 2013**
**A-350: GLS certified at entry into service, 4 airlines**

# GLS: GBAS Airborne Implementation

**737NG: GLS certified,**
**650 GLS activated = 20% of operators**
**900 GLS provisioned = 40% of operators**
**787: GLS certified, basic = 886 aircraft**
**747-8: GLS certified, basic**

**GLS Equipped Aircraft by 2016: 4000+**

**A-380: GLS certified, 8 airlines**
**A-320 family: GLS certified, 8 airlines**
**A-330/340: GLS certified 2014**
**A-350: GLS certified at entry into service, 4 airlines**

# Airbus GLS Customers

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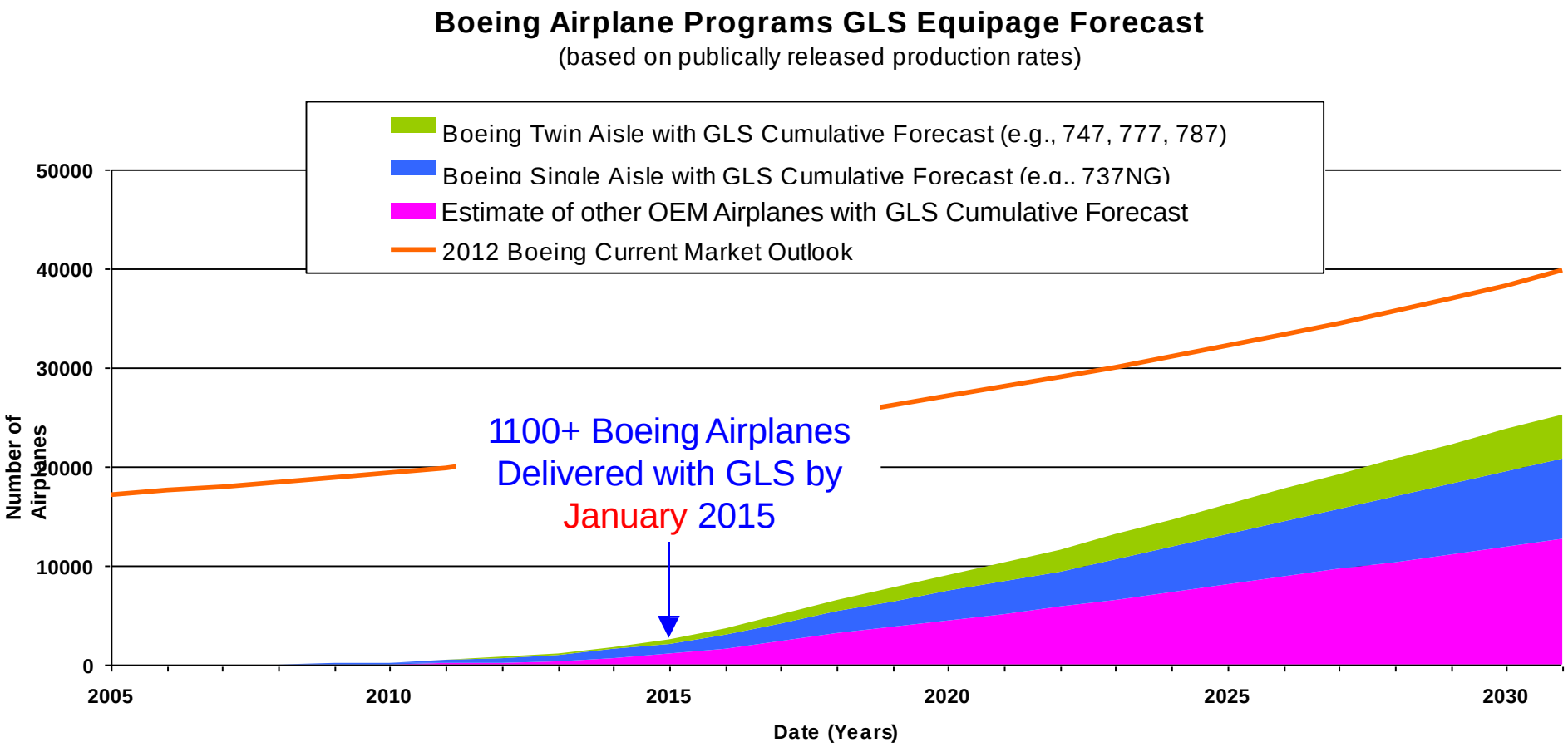
# Boeing GLS Program | Equipage Forecast Update

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# SmartPath Certification Baseline, Growth

- **SmartPath Cat I System Design and Operational Approvals**
  - FAA (US): September 2009
  - BAF (Germany): November 2011
  - Other approvals: Spain, Australia, Switzerland
  - **In revenue passenger service**

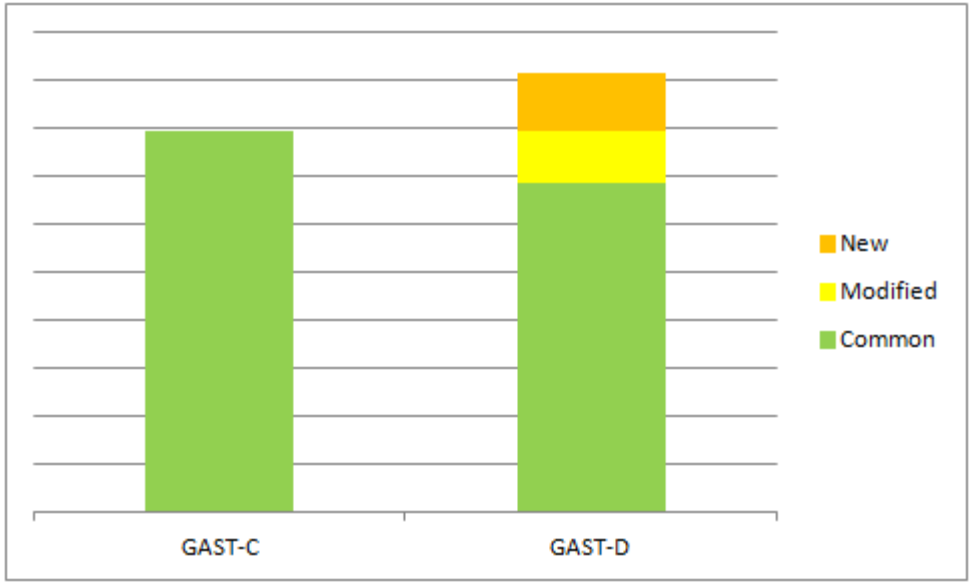
- **Cat II performance from Cat I system**
  - 2 methods
    - Aircraft and flight operations requirements
    - Cat I with SBAS
      - SBAS network provides iono status: benign iono enables GBAS parameter changes
  - No new avionics needed
  - **Available 2015**

# SmartPath Certification Baseline, Growth

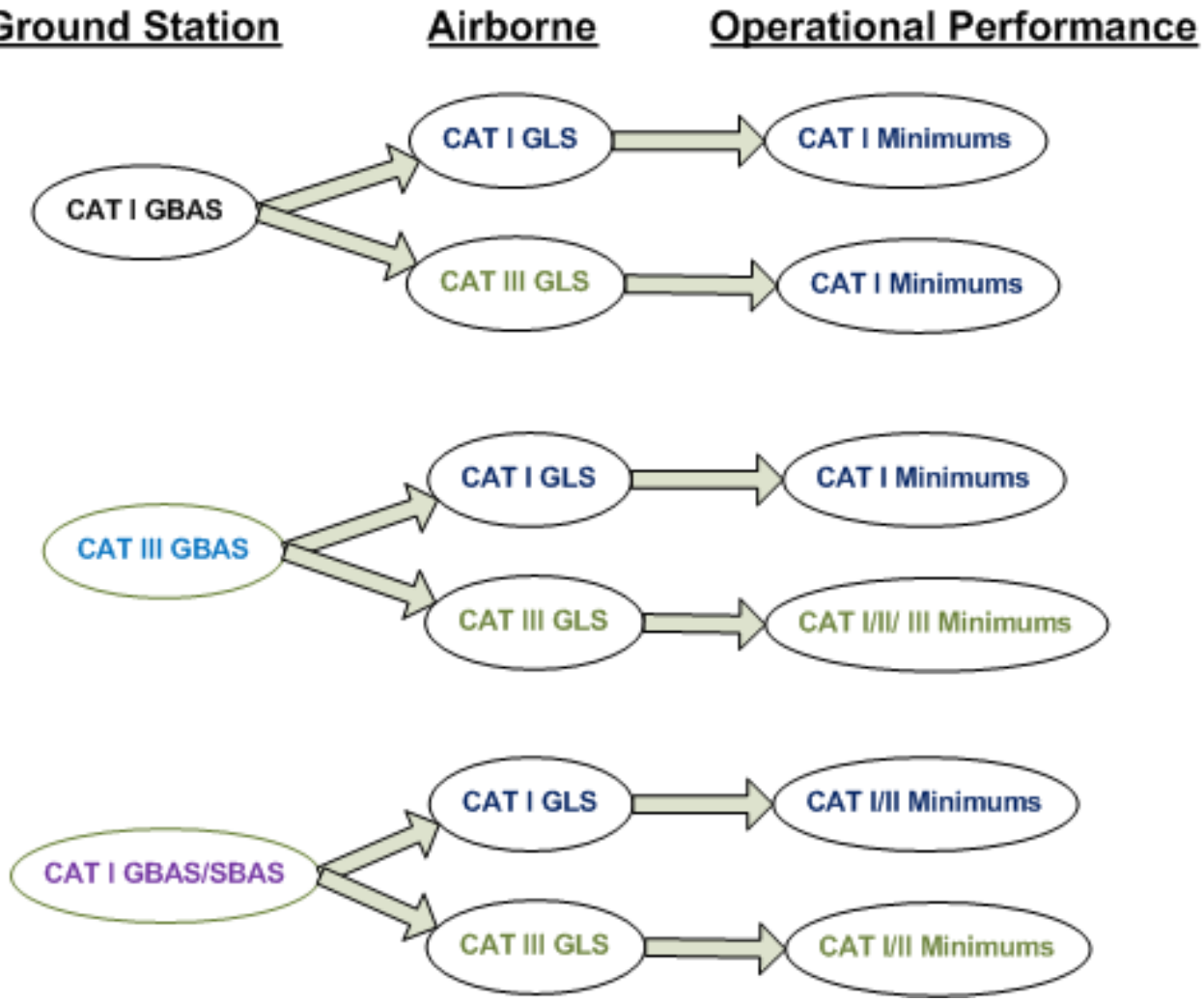
- **Cat III development and validation underway**
  - **Cat I station is upgradeable to Cat III**
  - **Cat III GBAS works with Cat I and Cat II/III GLS avionics**
  - FAA Cat III ground station/avionics contracts to Honeywell: 2010
    - Prototype ground station/avionics based on SLS-4000 and INR
  - Flight testing and additional development: 2012-2016
    - FAA testing 2012
    - SESAR flight tests October 2013
    - Boeing ecoDemonstrator 2014
  - Certifications: 2017-2018
    - FAA/Honeywell approval project underway
  - **Forecasted to be operationally available: 2019**

# GAST-D (CAT II/III)

- Honeywell has initiated an FAA approval plan for a GAST-D system
- Core architecture unchanged from GAST-C SLS-4000 system
- Two new monitors for GAST-D
- Requirements prototyped and validated by the FAA



# SmartPath Certification Baseline, Growth



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# SmartPath Summary

- ***Increased airport efficiency:***
  - Eliminates ILS critical zones
  - Enables flexible approaches; synergistic with RNAV/RNP
  - Offers precision approach where ILS cannot due to geography
- ***Lower life-cycle cost:***
  - 26 different precision approaches from a single ground station
  - One SmartPath GBAS serves all runways, initial acquisition cost is lower
  - Lower maintenance cost
  - Lower flight inspection cost
  - Growth to Cat II/III
- ***Increases level of safety:***
  - Signal stability (immune to signal bends inherent in ILS)
  - Precision lateral and vertical guidance
- ***Reduced noise/ shorter routes:***
  - GBAS final approach segment optimizes curved path approaches
  - Lower approach minimums
  - Autoland capability

# 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***

# Thank You!

Honeywell