

GBAS and the Potential for Integrated Automated Solutions for Optimum Use of Augmented GPS

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Administration



Outline

- **Introduction**
- **LAAS Capabilities**
- **GBAS Integrity Analysis and Prototype Development**
- **International Cooperation**
- **GBAS Potential for Terminal Area Operations for Future Implementation**
- **GBAS and NextGen**



GPS World 10/02/06

- **Boeing**

- “Boeing’s early operational experience with GBAS has generally been excellent. As we begin use of GBAS in daily airline operations it is important for airspace managers, airline operational planners and navigation service providers to understand the potential new or improved capabilities enabled by GBAS, as well as its potential for cost reduction for existing airspace system infrastructure”

Air Carrier Support For GBAS

- **Many US Air Carriers Strongly Support LAAS**
- **LAAS Viewed as True International Precision Landing Navigation System**

- **Boeing/AIRBUS**

- Boeing achieved GLS Certification 2006
- Airbus Planning on GLS Certification 2007

- **Air Carriers**

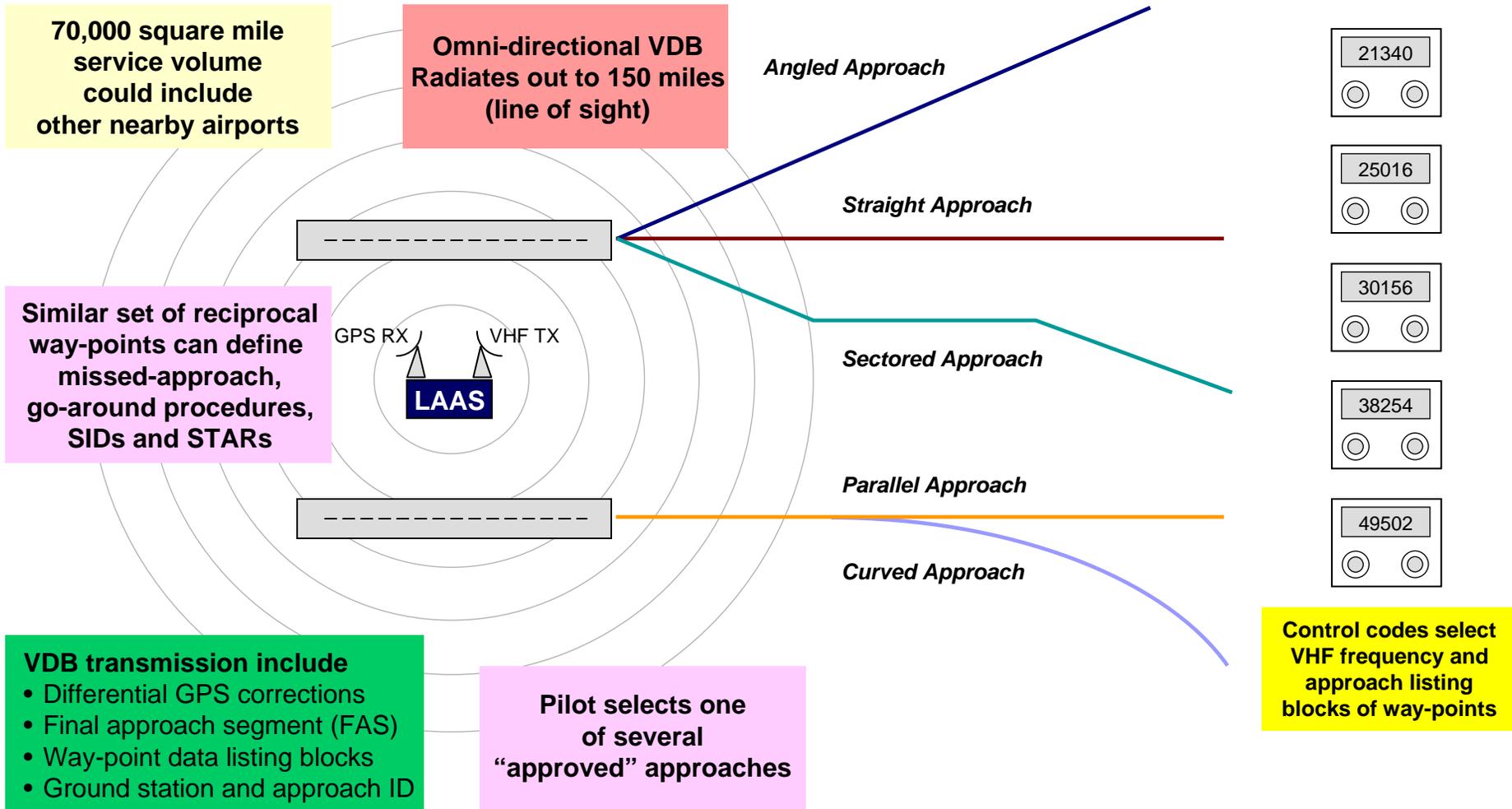
- FedEx strong partner in implementing GBAS in Memphis
- Continental leading GBAS implementation for their B737 NG aircraft in Guam
- Qantas leading GBAS implementation with B 737 NG aircraft in Sydney
- Hapag-Fly with DFS in Germany



LAAS Capabilities

- **The Local Area Augmentation System (LAAS) represents the U.S. Approach to meet the future CAT II/III demands of the National Airspace**
- **LAAS provides a navigation signal that supports the most demanding RNP requirements**
- **LAAS is complementary to SBAS**
- **One LAAS can cover the entire Terminal Area and enables precision guidance**
 - Precision approach for Category I, II & III
 - Multiple runway coverage
 - Guided procedures Guided missed approaches and departure procedures
 - Aircraft surface navigation

Multiple Approach Capability of GBAS



LAAS Status

LAAS is in research and development

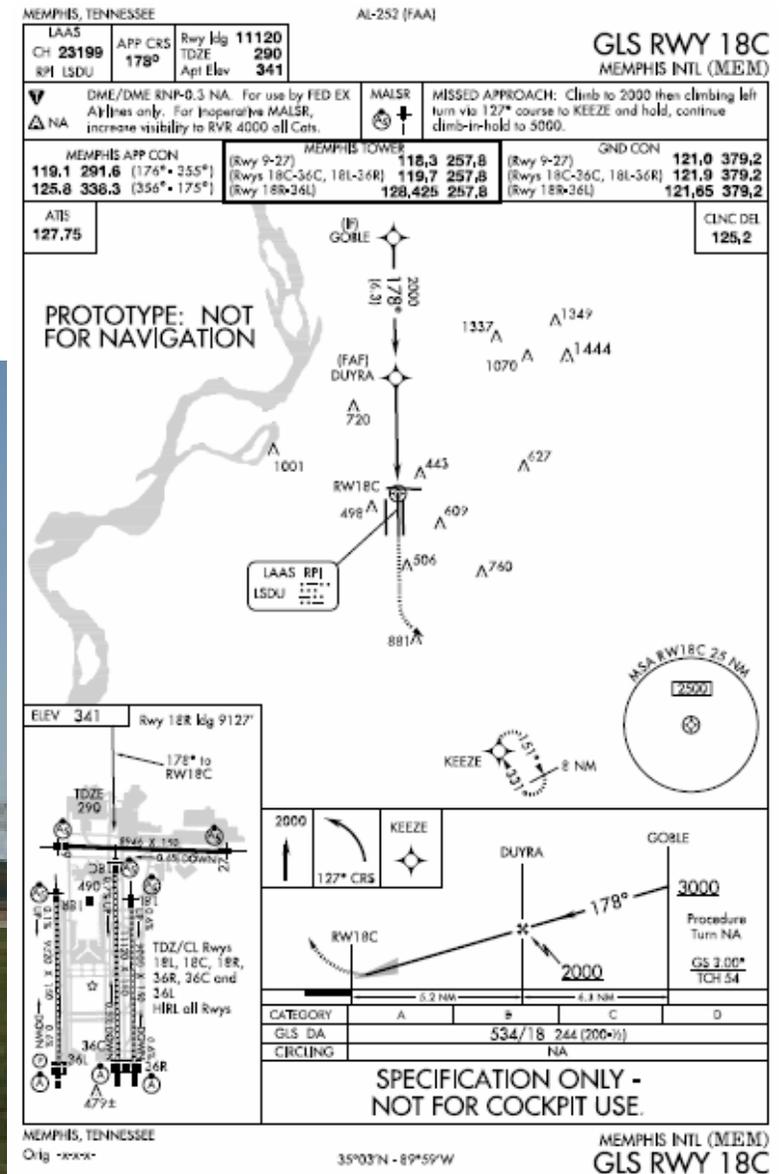
LAAS operational test bed being developed in Memphis: Ground Station, Procedures, Benefits

Avionics Already Available on Boeing (B-737NG) & Airbus Aircraft

Complex Procedures Being Flight Tested With FedEx Aircraft in Memphis

Non-Federal CAT I Approval Scheduled for 2008

Two companies submitting for ground station approval

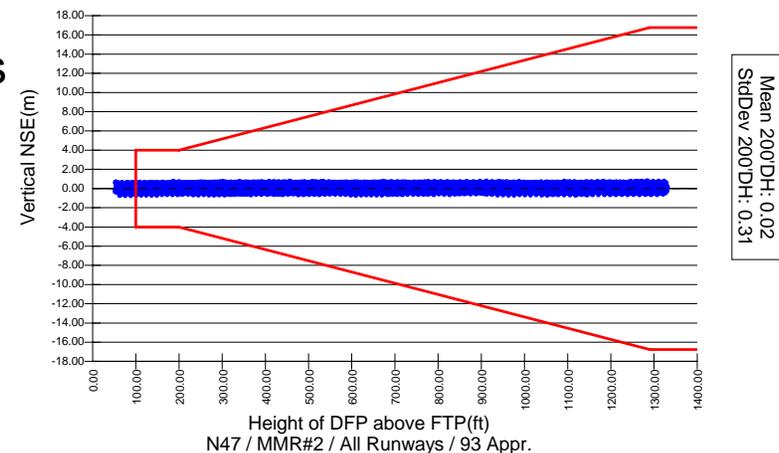


Memphis Flight Test of LAAS Prototype September 2006

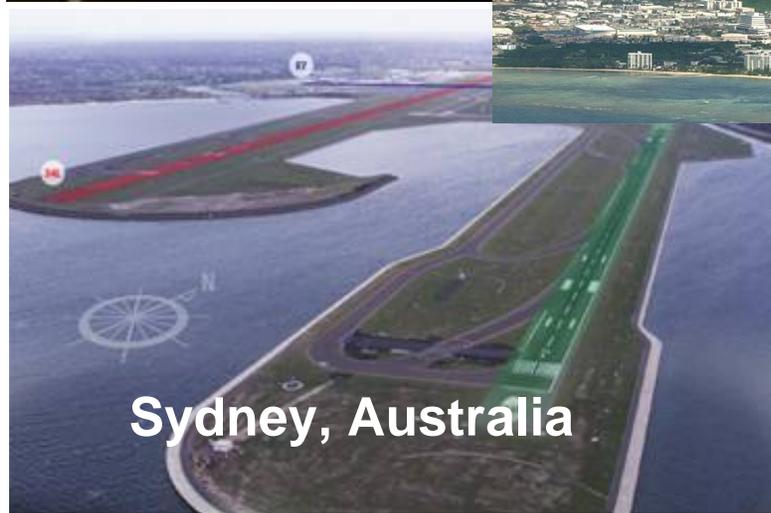
- 104 Approaches at Memphis airport
- The Flight Test Included Some VHF Data Broadcast Coverage Checks
 - The installed system provided complete coverage without any areas of concern
- Performance is Well Within the Required Performance of 16.0m Horizontal and 4.0m Vertical
 - The 95% horizontal and vertical accuracies of the system were 0.68m and 1.17m respectively
- No Integrity Related Alarms or Alerts



FAA LAAS / PSP Flight Test @ KMEM
Vertical NSE Ensemble

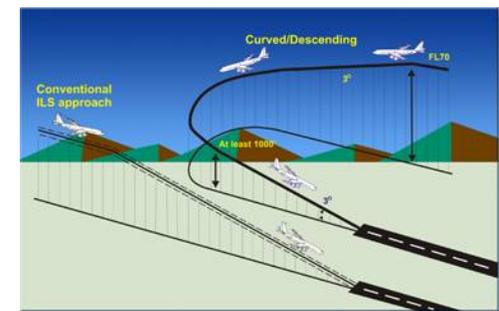


LAAS International Efforts



Avionics Integration

- **GBAS/LAAS avionics documents (MASPS / MOPS / TSO / SARPS) completed**
- **Boeing 737-800 series GBAS equipped**
 - 9 Qantas, 9 Continental, 1 Hapag-Fly aircraft delivered
- **Airbus planning for GBAS option in all new generation aircraft**
 - A320 certification planned in 2007
- **Basic (ILS Look alike) LAAS Integration into MMR completed**
 - Rockwell Collins MMR in Boeing 737/GLS Certification
- **R&D: Complex Procedure Integration**
 - Modification of the MMR to Support Complex Procedures Up-linked via the VDB
 - Capability of Terminal Area Procedures
 - LAAS Support of Implementation of RNP & RNAV
 - Aircraft Fly Same 3 Dimensional Tracks as RNP/RNAV Procedures
 - Provides Retrofit Option for Non-FMS Equipped Aircraft
 - Avoids onboard database/integration issues



GBAS and NextGen

- **Apply Emerging Technology to Optimize Terminal Area Operations for Future Implementation**
- **Emerging Technologies**
 - GNSS/GBAS
 - Pre-Defined Terminal Routing
 - Dynamic Routing Based on User Needs
 - 4DT in Terminal Area/Metering
 - Real Time Two-way Data Exchange
 - Real Time AT Management
 - Surveillance
 - Dynamic Sequencing Application Software/Proper Spacing and Merging

Operational Goals

- **Increase Approach Availability**
- **Decrease Minima Where Possible**
- **Decrease Fuel Burn and Emissions**
- **Reduce noise pollution**
- **Optimize Aircraft Sequencing in Real Time**
- **Provide a Stable Arrival/Approach to Terminal Area Operations**
- **Provide Constant Rate of Descent Throughout Arrival and Approach**
- **Minimum Flight Time in Terminal Area**
- **Minimize Impact to ATC**
- **Assess Data Fusion and Dynamic Tactical Decision Making**



Proposed Concept Evaluation

- **Develop Terminal Area Test Bed Major Airport**
 - GBAS, Terminal Area Procedures (TAP)
- **Develop Sequencing Software Applications and Algorithms**
- **Install Two-Way Data Exchange Capability in 4 to 6 Aircraft**
- **Conduct Series of Phased Flight Trials to Demonstrate Spacing and Merging Utility**

PHX ARRIVALS OVER HOMRR 12-11-06

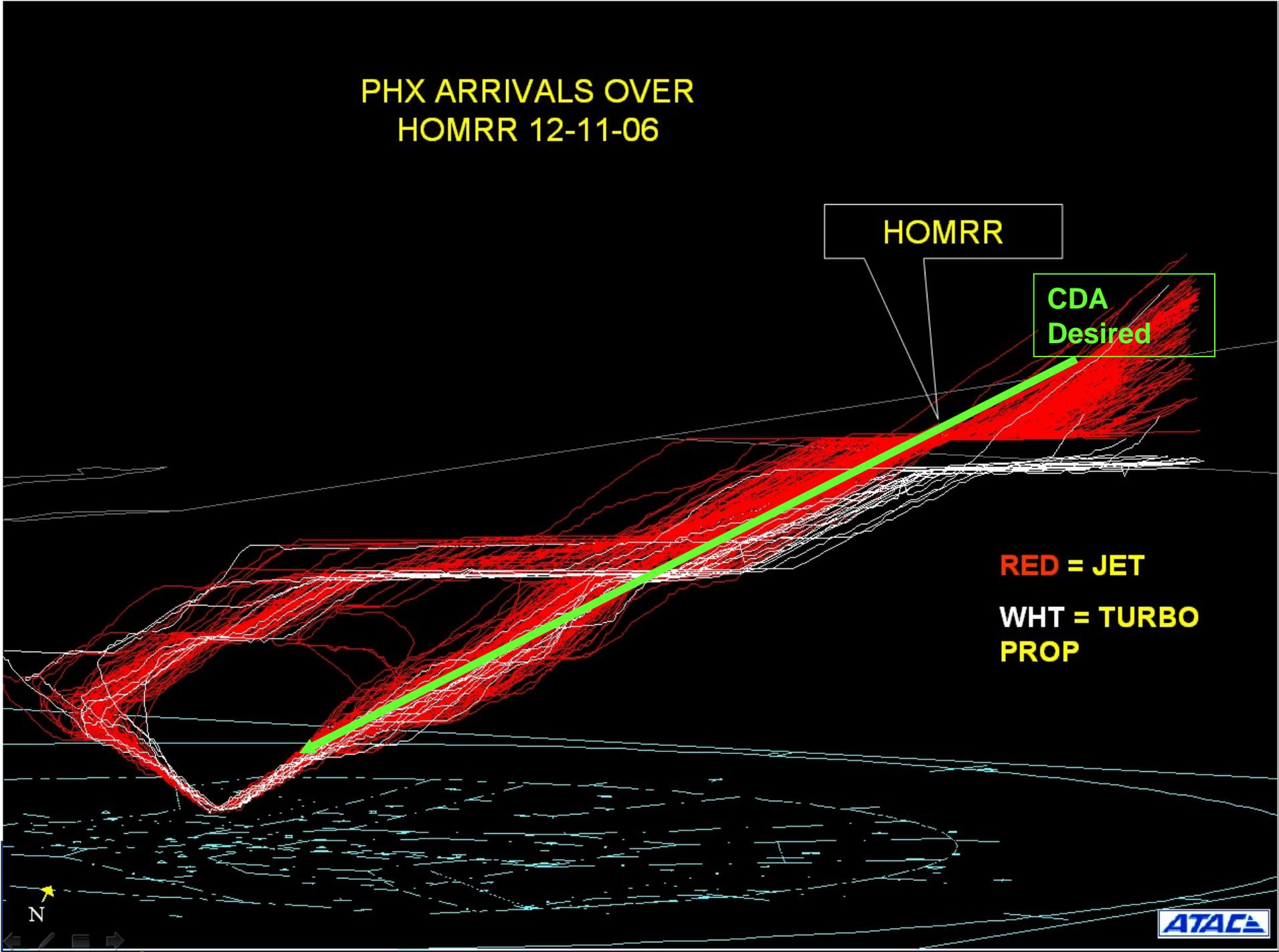
HOMRR

CDA
Desired

RED = JET

WHT = TURBO
PROP

Z



LAAS TAP Flight Tests

- **114 TAP Approaches Flown in FAA B-727**
 - Hand Flown Deviations Only
- **Mix of Pilots, Both Government and Industry**
- **Procedure is an RNAV/RNP Flight**
 - Procedure starts at 10,500 ft. and 30 miles
- **Experimented with Approach Speeds, Turn Radius, Descent Profile (Constant Descent Was Primary Goal)**
- **Low Power TAP Time Savings**
 - Approximately 4 Minutes Per Approach
- **Low Power TAP Fuel Savings**
 - Approximately 500-700 pounds Per Approach

Plan for Future Flight Testing

- **Continue Flying RNAV Area Paths for Controller/Pilot Input and Data Collection**
 - Memphis Flight Tests using FedEx B-727 (Red Label MMR)
 - Fly different TAP approaches that are based on existing charted RNAV/GPS approaches and as proposed by FedEx
- **Extend RNAV Area Paths To 60+ NM**
- **Incorporate Other Aircraft**
 - RNAV area path compliant and useable for all aircraft
 - Turn Radius and Deceleration
- **Coordinate Other Terminal Area RNAV/RNP Applications**

Plan for Future Flight Testing (cont.)

- **Continue to Work With RNP Office For Metering of Aircraft (Spacing and Timing-4D)**
 - Optimize procedures using wind simulations to determine the best aircraft separation
 - JPDO funded environmental and capacity tests in 2007
- **Develop and Implement Standardized Data Collection For All Areas and Participants**
- **Ensure Applications Have ATC Approval and Applied TERPS Criteria**



QUESTIONS?

