GPS in the National Airspace System

Presented To: PNT Advisory Board
16 October 2008

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GNSS Group
Overview

- Wide Area Augmentation System (WAAS) Status
- Local Area Augmentation System (LAAS) Status
- Automated Dependent Surveillance Broadcast (ADS-B) Status
FAA Satellite Navigation Program
WAAS Architecture

38 Reference Stations
3 Master Stations
4 Ground Earth Stations
2 Geostationary Satellite Links
2 Operational Control Centers
Geostationary Satellites (GEO)
Localizer Performance Vertical (LPV) Coverage
WAAS Avionics Status

• **General Aviation**
  – Over 37,000 Units Sold
  – Increasing at ~1000 Units Per Month
  – New Products Coming to Market in Late 2008

• **Business & Regional Aircraft**
  – Over 500 Units Sold Since 2007
  – Two Additional Products Coming to Market in Late 2008
  – Cessna CJs Delivering with WAAS Avionics in 2009
  – Acceptance Rates Should Increase Significantly in 2009

• **Air Carrier & Cargo Aircraft**
  – Southwest Airlines Equipping 200 Boeing 737s
  – Federal Express Has Equipped 253 Caravan Aircraft
  – Horizon Airlines Equipping 48 Bombardier Aircraft

• **Helicopter Aircraft Implementing WAAS**
  – Significant Growth Projected for First Responders

• **WAAS Avionics are Interoperable with Other SBASs**
WAAS Approach Procedures
- Exceeded Instrument Landing Systems (ILS) - September 2008

- 1,333 WAAS LPV Approach Procedures
- 785 to Non-ILS Runways
- 327 to Non-ILS Airports

WAAS Procedures to be Published to All Instrument Runways in the NAS by 2018
WAAS Enterprise Schedule

Phase II (FLP Segment)
Development
Operational

Phase III (LPV-200 Segment)
JRC
Technical Refresh
Operational

Phase IV (Dual Frequency)
JRC
Technical Refresh
Operational

Inmarsat
Lease Extension
9/06

GEO #3 – Intelsat
Launch
10/05
Operational

GEO #4 – TeleSat
Launch
9/05
Operational

GEO #5 – TBD
Launch
7/12
Operational

GEO #6 – TBD
Launch
7/15
Operational

Approach Development
WAAS Procedure Development

FY 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Future Considerations

Galileo (EU)

GLONASS

Other?

GPS
Local Area Augmentation System (LAAS)

- Precision Approach For CAT-I, II, III
- Multiple Runway Coverage At An Airport
- 3D RNP Procedures (RTA), CDAs
- Navigation for Closely Spaced Parallels
- Super Density Operations
GBAS Pathway Forward

• Cat-I System Design Approval at Memphis – Early 2009
• Cat-III Prototype Validation by - 2010
• Cat-III System Design Approval by - 2012
• Evaluating Potential to Leverage Resources with DoD Joint Precision Approach Landing System (JPALS)
LAAS/GBAS International Efforts

- Rio De Janeiro, Brazil
- Agana, Guam
- Malaga, Spain
- Sydney, Australia
- Frankfurt, Germany
- Bremen, Germany
Automatic Dependent Surveillance - Broadcast (ADS-B)

- **Automatic**
  - Periodically transmits information with no pilot or operator input required
- **Dependent**
  - Position and velocity vector are derived from the Global Positioning System (GPS)
- **Surveillance -**
  - A method of determining position of aircraft, vehicles, or other asset
- **Broadcast**
  - Transmitted information available to anyone with the appropriate receiving equipment
Notice of Proposed Rulemaking (NPRM)

- **Aviation Rulemaking Committee (ARC)**
  - ARC is considering 36 summary recommendations
    - 26 recommendations will be resolved before any rule is adopted
      - ADS-B Link Strategy
      - ADS-B Program and Business Case
      - Performance Requirements
      - Required Equipment
      - Communication, Navigation and Surveillance Equipment
    - 10 recommendations for future consideration
      - ADS-B Program and Business Case
      - Required Equipment
      - Communication, Navigation and Surveillance Equipment
      - Security, Privacy, and Malicious Use
    - 4 recommendations have PNT considerations
# Summary of Recommendations for Final Rule

<table>
<thead>
<tr>
<th>Recommendation #</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation #14</td>
<td>Performance Requirements per domain</td>
</tr>
<tr>
<td>Recommendation #15</td>
<td>Latency recommendations</td>
</tr>
<tr>
<td>Recommendation #16</td>
<td>Not apply vertical position accuracy in NAC 9</td>
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<tr>
<td>Recommendation #17</td>
<td>Allow for foreign satellite constellations</td>
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<td>Recommendation #18</td>
<td>Non-Diversity Antenna</td>
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<td>Recommendation #19</td>
<td>Use DO-289 MASPS to define SIL</td>
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<tr>
<td>Recommendation #20</td>
<td>Broadcast message element recommendations</td>
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<tr>
<td>Recommendation #21</td>
<td>Calculate/report continuity of RNP parameters</td>
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<tr>
<td>Recommendation #22</td>
<td>Specify continuity requirement</td>
</tr>
<tr>
<td>Recommendation #23</td>
<td>Specify 2 continuity requirements for ASSA and FAROA</td>
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## Summary of Longer Term Recommendations

<table>
<thead>
<tr>
<th>Recommendation #</th>
<th>Summary</th>
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<tbody>
<tr>
<td><strong>ADS-B Program and Business Case</strong></td>
<td></td>
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<tr>
<td>Recommendation #27</td>
<td>Define strategy for ADS-B In</td>
</tr>
<tr>
<td>Recommendation #28</td>
<td>Fuse data in automation to accommodate lack of Mode 3/A Code</td>
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<tr>
<td>Recommendation #29</td>
<td>3nm en route separation</td>
</tr>
<tr>
<td><strong>Required Equipment</strong></td>
<td></td>
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<tr>
<td>Recommendation #30</td>
<td>Implement transponder removal for low altitude operators not equipped with ACAS</td>
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<tr>
<td>Recommendation #31</td>
<td>Enhance ELT with tracking service</td>
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<tr>
<td>Recommendation #32</td>
<td>Replace ELTs</td>
</tr>
<tr>
<td><strong>Communication, Navigation, and Surveillance Equipment</strong></td>
<td></td>
</tr>
<tr>
<td>Recommendation #33</td>
<td>Integrated CNS strategy to deal with GNSS outages</td>
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<tr>
<td><strong>Security, Privacy and Malicious Use</strong></td>
<td></td>
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<tr>
<td>Recommendation #34</td>
<td>ICAO codes treated under privacy laws</td>
</tr>
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<td>Recommendation #35</td>
<td>Use Anonymity for UAT, develop a feature for it on 1090 MHz</td>
</tr>
<tr>
<td>Recommendation #36</td>
<td>Assign ICAO codes so they don't correlate with tail numbers</td>
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## Rulemaking Next Steps

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Planned Date of Completion</th>
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<tbody>
<tr>
<td>ARC Recommendations finalized and submitted to the FAA</td>
<td>September 26, 2008</td>
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<tr>
<td>Internal Stakeholders Meeting</td>
<td>October 30, 2008</td>
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<tr>
<td>Comment period on ARC recommendations closes</td>
<td>November 3, 2008</td>
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<tr>
<td>Internal Stakeholders Meeting (ISD Focus)</td>
<td>November 20, 2008</td>
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<tr>
<td>FAA Rulemaking Team finalizes RPR Phase 3</td>
<td>November 30, 2008</td>
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<tr>
<td>RPR Phase 3 Approval (Director and Associate Level)</td>
<td>December 8, 2008</td>
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<tr>
<td>Internal Stakeholders Meeting</td>
<td>December 18, 2008 (Tentative)</td>
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<tr>
<td>RPR Phase 3 Approval (Associate Administrator / COO / AGC-1)</td>
<td>December 19, 2008</td>
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<tr>
<td>RPR Phase 3 Submitted to ARM</td>
<td>December 30, 2008</td>
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<tr>
<td>Rulemaking Council Approval of RPR</td>
<td>January 27, 2009</td>
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Summary

• The WAAS Program Has Matured Through Development and is Rapidly Progressing Through Operational Implementation

• The First Certified LAAS is Expected In Early 2009

• LAAS is Expected to Achieve Category-III By 2012

• ADS-B Program Progressing On Track