Federal Aviation Administration

FAA Satellite Navigation Update

May 2014
Topics

• Wide Area Augmentation System (WAAS) Update
• Ground Based Augmentation System Update (GBAS)
• Alternative Positioning, Navigation & Timing (APNT) Update
• Questions
Wide Area Augmentation System (WAAS)

- 38 Reference Stations
- 3 Master Stations
- 6 Ground Earth Stations
- 3 Geostationary Satellite Links
- 2 Operational Control Centers
WAAS Development Phases

• **Phase I: IOC (July 2003) Completed**
  - Included Development of a robust safety architecture
  - Included establishment of WAAS expert panel to evaluate potential integrity threats

  - Completed a Safety Risk Management Decision (SRMD) to support LPV-200 (VAL of 35m)
  - Expanded WAAS coverage to Mexico and Canada while modifying the System to address observed ionospheric threats

• **Phase III: Full LPV-200 Performance (2009 – 2013) Completed**
  - Completed System updates to improve performance during moderate ionospheric activity
  - Supported continuous monitoring of system data that contributes to continued integrity assurance
  - Began transition of Second Level Engineering from contractor based to organic FAA capability

• **Phase IV: Dual Frequency (L1,L5) Operations (2014 – 2044)**
  - Includes the transition from use of L2 to L5 in WAAS reference stations
  - Infrastructure modifications to support future L1/L5 user capability
  - Support sustainment of WAAS GEOs
WAAS 2014 Planned Activities

- WAAS is scheduled for a JRC Final Investment Decision (FID) by April 2014
- Ground Segment Release 4 (Phase 2)
  - Build Merge & Code Clean up
  - Planned completion in March 2014
- GEO 5 will complete the Critical Design Review (CDR) in September 2014
  - PDR Completed in January 2014
- The WAAS Program plans to award the Dual Frequency Contract by August 2014
WAAS 2014 Planned Activities (cont.)

- WAAS Safety Computer will complete its Functional and Physical Configuration Audits (FCA/PCA) by May 2014
- Procuring Communication Nodes for the Pacific Operations Control Center (POCC) and National Operations Control Center (NOCC) by May 2014
- Publish 180 WAAS procedures at applicable sites by September 2014
- Deliver 100 G-III WAAS Reference Receivers by September 2014
Airports with WAAS LPV/LP Instrument Approaches

• As of March 6th, 2014
  • 3,912 LP/LPVs combined
  • 3,379 LPVs serving 1,667 Airports
  • 852 LPV-200’s
  • 2,266 LPVs to Non-ILS Runways
  • 1,113 LPVs to ILS runways
  • 1,532 LPVs to Non-ILS Airports
  • 533 LPs serving 388 Airports
  • 531 LPs to Non-ILS Runway
  • 2 LPs to ILS Runways

• Remaining Surveys for LPV/LP
  • 388 Completed Surveys
  • 112 Planned Surveys for FY14
  • 400 Estimated Procedures Remaining
  • Note: Approximately 20% of all Surveys will not qualify for a LP/LPV procedure
Dual-frequency SBAS standardization activities are focused on L1 and L5.
Ground Based Augmentation System (GBAS)
GBAS CAT I Operational Status

• GBAS CAT I Status
  – Newark, NJ: Operational since Sept. 2012
  – Houston, TX: Operational since April 2013
  – Moses Lake, WA: private, owned by Boeing
  – Charleston, SC: private, owned by Boeing

• System Design Approval for CAT I, block II started in January 2014

• Airport Operations (Status as of January 2014)
  – Newark, NJ – 147 Operations (737/787)
  – Houston, TX – 233 Operations (737/787)
  – Total of 380 approaches

• United Airlines GLS Equipage
  – 90+ B737/B787
  – United Airlines investigating with FAA on requirements / approval for CAT II approaches against GBAS CAT I system
GBAS CAT III Validation Status

• System Design Approval for CAT III starting in 2014
• CAT III Ground Prototype
  – FAA's develops prototype CAT-III with SLS4000 upgrades
• CAT III Avionics
  – FAA validation efforts use Honeywell INR/upgrades as CAT III prototype
  – FAA and Boeing developed Memorandum of Understanding for CAT III cooperation
• CAT I lessons learned are integrated into CAT III architecture
  – Brief but daily outages attributed to the Signal Distortion Monitor (SDM) satellite exclusions
  – Honeywell CAT I BLII design eliminates conservative SDM satellite exclusions
Alternative Positioning, Navigation, and Timing (APNT)

• Why does APNT need to be the back-up to GPS?
  – Many NextGen Operational Improvements (OIs) depend on PNT services to enable RNAV and RNP and there is a great dependence on GPS-based PNT
  – National Policy requires the provision of a backup in the event of a GPS interference event or outage
  – National Policy
    • Homeland Security Presidential Directive-7 (HSPD-7 was superseded by PPD-21)
    • Presidential Policy Directive (PPD)-21
  – The new system will maintain safety and security and preclude significant economic impact

• Today’s APNT consists of legacy systems that will not support the NextGen OI’s, provides limited function for RNAV, and no function for RNP or Trajectory Based Operations (TBO)
  – Very High Frequency Omni-directional Range (VOR)
  – Distance Measurement Equipment (DME)
  – Tactical Air Navigation (TACAN)
**APNT**

*What options are being considered for APNT?*

- The FAA’s APNT Team is investigating three alternatives:
  - Enhanced Distance Measuring Equipment (DME) Network
  - Wide Area Multi-lateration (WAM)
  - Pseudolites
Basic Hybrid APNT Operations

- Hybrid APNT position with 1 DME & 1 other station
  - Single channel DME (not DME/DME) + PL
  - Interference benefits
- DME provides timing info with DME & PL
- Good onboard clock ("air clock") not assumed

Ground clock ~ $10^{-12}$
Enhanced Hybrid APNT Modes

- Air clock allows positioning with any 2 stations
- Tactical INS allows positioning without stations for ~ 3 minutes to go from FAF to min decision altitude (MDA)

With Good Air Clock

With Good Air Clock & Inertial
**APNT Schedule**

**CNS Avionics Rulemaking Activities**
- Proposed Rulemaking
- Notice of Proposed Rulemaking
- Final Rulemaking

**APNT IARD Artifacts**
- Shortfall Analysis Report
- Safety Risk Management (OSA)
- Preliminary Requirements Document
- Enterprise Architecture Products
- Range of Alternatives
- Estimate Cost and Benefits
- Investment Analysis Plan
- Final ACAT Designation

**APNT Roadmap Decision Points**
- Investment Analysis Readiness Decision
- Initial Investment Decision
- Final Investment Decision

Legend:
- JRC Decision Point
- Milestones

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- Mid-Late 2014
- Late 2018
- 2021 or Later
- 6/14
- 8/15
- 6/15
- 8/15
- 3/15
- 3Q CY 15
- 3Q CY 16
- 3Q CY 17
Questions