WAAS, GBAS, and APNT Program Status

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Presented to: Civil GPS Service Interface Committee (CGSIC)

Date: September 2014
Agenda

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

- WAAS is a combination of ground based and space based components that augments the GPS Standard Positioning Service (SPS)
- WAAS provides the capability for increased availability and accuracy in position reporting, allowing more time for uniform and high quality worldwide air traffic management
- WAAS provides coverage over the entire National Airspace, with a precision approach capability at over 3,000 runway ends

3 Geostationary Satellite Links
2 Operational Control Centers
38 Reference Stations
3 Master Stations
6 Ground Earth Stations
WAAS Dual Frequency Operations

- Current WAAS uses L1 and L2 P(Y) signals to provide single-frequency (L1) service
- WAAS will implement use of GPS L5 in accordance with GPS modernization
  - Supports the USG Federal Register Notice announcement regarding ‘sunset’ of L2 P(Y) signal use in December 2020
  - Establishes WAAS baseline that will support new future dual frequency L1/L5 service
    - Improves overall WAAS availability and continuity
  - Implementation divided into two Segments
    - Segment 1 - Develop infrastructure improvements to support use of L5 (5 year effort)
    - Segment 2 - Implementation of L1/L5 user capability (5 year effort)
- GEO sustainment will occur throughout WAAS lifecycle
  - Maintain minimum of dual coverage over WAAS service area
  - GEO Sustainment currently planned until 2044
WAAS LPV/LP Equipped Aircraft
August 2014 (Estimated)

- 8 Vendors producing WAAS certified receivers
  - Garmin
  - Universal
  - Rockwell Collins
  - Honeywell/CMC
  - Avidyne
  - Genesys Aerosystems (Chelton)
  - Innovative Solutions & Support (IS&S)
  - Thales

- **Multiple Type and Model Ratings**

- **Majority of receivers installed in General Aviation and Business Jet Aircraft**
  - Helicopter and Commercial airframes increasing in equipage

- **TOTAL Estimated WAAS LPV Equipped Aircraft** – 76,115
Recent Accomplishments

• Obtained approval of a Final Investment Decision (FID) for WAAS Phase IV Dual Frequency Operations – Segment 1 from the Joint Resource Council (JRC) May 2014

• Conducted Critical Design Review (CDR) for the GEO 5 satellite in July 2014
  – SatMex 9 service vehicle launch scheduled for late CY15
  – Will provide coverage over entire WAAS service area

• Executed the second purchase order on the G-III production contract March 2014
  – 47 addition G-III receivers ordered bringing product acceptance and delivery to 100 units

• ARAIM Draft Milestone IIB report completed in July 2014
Upcoming Actions

- WAAS Dual Frequency Operations (DFO) Contract award by September 2014
- Complete initial stages of G-III/Comm Cutover for Network 1 & 2 (Cores & OCCs) in FY 2015
- Sustain existing GEO availability through execution of option year/years for Inmarsat (AMR) GEO in FY 2015
- Developing Draft RTCA MOPS in support of use of GPS L5 and multiple constellations
  - App A & J projected to complete by September 2015
- Complete G-III Installation at first Wide-area Reference Station (WRS) by September 2015
- Complete Environment Stand up for WAAS Dual Frequency Operations by March 2015
Ground Based Augmentation System (GBAS)
Ground Based Augmentation System

- Ground-Based Augmentation System (GBAS) provides an internationally harmonized satellite-based alternative to the Instrument Landing System (ILS) for precision approach and landing
- GBAS is the only GNSS solution/alternative for Category III precision approach
FAA GBAS Program Focus

- Validation of ICAO SARPS for GBAS Approach Service Type D (GAST-D) Requirements (CAT III)
  - GAST-D to support approach and landing operations using CAT III minima by augmentation of the L1 single frequency service of GPS
  - Validation includes work producing commercial prototypes (ground system and avionics at FAA Technical Center) for overall program risk reduction
    - GAST-D Flight Testing at FAA Technical Center
    - SARPS Validation
  - Boeing-FAA cooperation for GAST-D validation

- System Design Approvals (SDA) for GAST-C and GAST-D systems
  - GAST-C (CAT I)
    - Honeywell CAT I SLS 4000 approved for operations by the FAA
    - GAST-C Block II changes address improving availability and additional operational improvements (projected completion in spring 2015)
  - GAST-D (CAT III)
    - Honeywell submitted design approval request for GAST-D in August 2013
    - GAST-D SDA completion estimated for mid 2018
FAA GBAS Program Focus Cont.

• Limited CAT I implementation support / Operational data collection and lessons learned
  – Gather operational experience with GBAS equipment installed within the National Airspace System (NAS) (Newark NJ, Houston TX, Moses Lake WA)
  – Coordinate data collection with airlines and airports

• GBAS technical exchange – international cooperation
  – Technical interchange effort with SESAR for GBAS standards development
  – Cooperation with Brazil on lower latitudes IONO threat model
  – Co-chair International GBAS Working Group (IGWG)
    • Last meeting: Eurocontrol Experimental Center in Bretigny, France (June 3-6, 2014)
    • IGWG Website - flyGLS.net
GBAS Operations in the US

• Fully operational and FAA approved GBAS systems
  – Newark NJ, Houston TX (public systems)
  – Moses Lake / Charleston (Private Boeing systems for production testing)

• Airport Operations (Status: July 2014)
  – 780+ GLS approaches to date (Newark/Houston)
  – United Airlines Boeing 737 and Boeing 787

• United Airlines (operational)
  – B 737 – 95 aircraft / B 787 – 12 aircraft
  – All new B 737 aircraft will be GBAS capable

• Delta Airlines (Ops Spec in progress)
  – Presently 34 B737 aircraft GLS capable
  – Total order of 112 GBAS B737 GLS capable aircraft
  – 45 A321 future deliveries being considered for GBAS

• International Airline Operations in the US
  – British Airways (BA) B787 with regular service to Newark since July 11, 2014
  – Emirates and Lufthansa plan on GLS at Houston (A380)

GLS is currently offered either as a standard feature or option on most production Airbus and Boeing aircraft

• GLS certified aircraft
  – A320 Family, A 330, A380 – Option,
  – B737NG / Max – Option
  – B787 – Standard
  – B747-8 – Standard
  – B767 tanker - Standard

• GLS on new production
  – A340, A350 aircraft - option
  – B777X aircraft - standard
Alternate Positioning, Navigation, and Timing (APNT)
Why Alternate PNT?

• Presidential Policy Directive 21 (PPD-21), *Critical Infrastructure Security and Resilience*
  – Advances a national unity of effort to strengthen and maintain secure, functioning, and **resilient** critical infrastructure

• FAA needs to maintain aviation operations in the event of a Global Navigation Satellite System (GNSS) interference event or outage
  – Maintain safety and security
  – Maintain a reasonable level of capacity and efficiency
  – Minimize economic impact
NextGen Alternate PNT

• The Alternate Positioning, Navigation, and Timing project is investigating alternatives for providing higher precision back-up for Global Positioning System (GPS)-based position, navigation, and timing (PNT) services.

• GPS PNT services are the enablers of performance-based navigation (PBN) and Automatic Dependent Surveillance Broadcast (ADS-B) services that, in turn, enable Trajectory-Based Operations (TBO), area navigation (RNAV), Required Navigation Performance (RNP), and other NextGen improvements.

• NextGen APNT will provide a means for users to seamlessly continue RNAV and RNP operations.
**Notional Schedule**

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- **CONOPS** Q2 2012
- **Concept & Requirement Readiness Decision** Complete Q2 2011
- **Investment Analysis Readiness Decision** Q4 2015
- **Initial Investment Decision** Q4 2016
- **Final Investment Decision** Q4 2017
- **Solution Implementation**
- **Deployment**
- **Initial Operational Capability** 2023
- **Final Operational Capability** TBD
- **APNT MOPS Development** *3-5 years*

**CY15 Planned R&D Activities:**
- Achieve Investment Analysis Readiness Decision (IARD)
- Prepare for Initial Investment Decision (IID)

**Legend**
- Blue diamond: Planned
- Green diamond: Complete

**Risk:** 5-7 years nominally to develop the Minimum Operational Performance Standards (MOPS)– current program timeline and funding profile puts the program at risk in accomplishing NextGen 2025 objective.
Questions