FAA Navigation Programs Update

Presented to:  Civil GPS Service Interface Committee

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Agenda

• FAA Navigation Programs Strategy
• GPS Civil Update
• Wide Area Augmentation System (WAAS) Update
• Navigation Resiliency
  – DME/VOR/TACAN Sustainment
  – NextGen DME Program Update
  – VHF Omni-directional Range (VOR) Minimum Operational Network (MON) Program Update
  – Tactical Air Navigation (TACAN) Rationalization to a Resilient Operational Network (RON)
  – Instrument Approach Strategy
• Summary
FAA Navigation Programs Strategy

- **Provide resilient navigation services to sustain operations during potential GNSS disruptions**
  - GPS/WAAS provide navigation for all Performance Based Navigation (PBN) and Automated Dependent Surveillance Broadcast (ADS-B)
  - NextGen DME Program provides an Area Navigation (RNAV) backup for aircraft equipped for DME navigation
  - VOR Minimum Operational Network (MON) Program provides a backup for aircraft that are not equipped for DME navigation
  - DME/VOR/TACAN (DVT) Sustainment program will replace conventional systems retained for resiliency

- **Rationalize conventional navigation systems**
  - Discontinue unneeded VORs to establish the MON
  - Reduce TACANs to a Resilient Operational Network (RON) for military

- **Innovate navigation services to enable new capabilities**
  - Support Multi-Constellation GNSS and Advanced RAIM (ARAIM)
  - Continue transitioning Approach Lighting Systems (ALS) to LED technology

- **The Navigation Programs Strategy update published in June 2022**
GPS Civil Update
GPS Modernization Support

- FAA supporting National PNT Engineering Forum (NPEF)
- Supporting implementation of OCX
  - Civil Signal Monitoring
  - L5 and civil signals navigation messages
  - Supporting safety assessment for GPS RAIM ($P_{const}$)
    - Signal monitoring to detect anomalies in a timely manner
    - Pre-check to verify satellite uploads prior to implementation
- Supporting Position Signal Integrity Continuity Assurance (PSICA) activities with DOD to improve reliability
- Reimbursable agreement with Air Force Research Lab (AFRL) for the Navigation Test Satellite (NTS) 3
National PNT Policy

• National Timing Resiliency and Security Act (NTRSA) 2017
  – Requires DOT to establish, sustain, and operate a complementary backup timing system if GPS timing signals are corrupted or otherwise unavailable

• National Defense Authorization Act (NDAA) 2017 and 2018
  – Requires demonstrations of Complementary PNT technologies that could provide resiliency during GPS outages
  – Develop requirements and analysis of alternatives for complementary PNT
  – Navigation Programs supports DOT by providing technical expertise

• Executive Order (E.O. 13905), February 12, 2020
  – Protects the reliable and efficient functioning of National critical infrastructure from disruption due to jamming and spoofing of GPS

• Space Policy Directive 7 (SPD-7), January 15, 2021
  – Establishes National PNT governance and the implementation of E.O. 13905 plan to reduce the vulnerability of critical infrastructure from GPS disruptions
Executive Order 13905 “Responsible Use of PNT/GPS”

• FAA implementing Resilient Navigation Infrastructure to sustain operations during GPS disruptions (jamming)
  – Resiliency is provided by VORs and DMEs, and ADS-B relies on primary and secondary radar for backup positioning
  – Backup timing services to be provided as part of telecommunications services

• GPS disruption and signal manipulation (jamming and spoofing) is a concern to aviation
  – DOT/FAA establishing government and industry partnership to mitigate impacts at systems and applications levels
  – FAA investigating potential to monitor and detect jamming and spoofing by leveraging data available through the ADS-B system
  – FAA investigating COTS portable electronic devices to alert potential GPS spoofing; GNSS receivers, telephony signals (e.g., 5G), and SDRs
  – FAA purchased next generation receivers to validate new standards and test potential mitigations for spoofing
Support to National Space Policy

• Space Policy Directive 7 (SPD-7)
  – Replaces NSPD-39 to maintain the free and open use of GPS
  – Establishes National PNT governance and the implementation of E.O. 13905 to reduce the vulnerability of critical infrastructure from GPS disruptions
  – Commits to implement modernized signals, and requires implementation of data and signal authentication for GPS and WAAS
  – FAA investigating data and signal authentication for WAAS to mitigate interference
  – FAA supporting DOT interference detection and mitigation initiatives in protection of radio frequency environment for uninterrupted GPS PNT signal reception
    – FAA investigating the use of WAAS Reference Stations to perform RFI detection using COTS components
WAAS UPDATE
WAAS Phase 4 Status

- Phase 4A (2014-2019)
  - Combination of infrastructure improvements and tech refresh in support of operational system and future incorporation of dual frequency
  - Incorporated two new GEOs for WAAS constellation sustainment replacing two legacy GEO services.

- Phase 4A/B Transition (FY20-22)
  - Release 6 improves WAAS by correcting anomalies to the O&M, Test Support Software and network critical message logging capabilities; Fielding completed March 2021
  - Release 7 will integrate GEO 7 into WAAS and integrate new signal generators at ground uplink stations (GUS) to include retrofitting at legacy GUS sites. GEO 7 projected to be operational by June 2022.

- Phase 4B (FY22-31)
  - Introduces WAAS Dual Frequency services using L1 and L5
    - WAAS DF Initial Operational Capability (DF IOC) ~ 2027
    - WAAS DF Final Operational Capability (DF FOC) ~ 2028
  - WAAS Technical Refresh
    - Processor replacement coupled with transition to Linux-based operating system
    - GUS receiver refresh
    - Conversion of existing ground telecommunication circuits to IP based circuits
WAAS Phase 4 Dual Frequency Operations (DFO) Status (cont’)

- **Dual-Frequency Multi-constellation Capability (DFMC)**
  - Standards development progressing
    - GPS L5 and DFMC SBAS SARPs material was prepared for Navigation Systems Panel and approved November 2020
    - RTCA and EUROCAE working a joint DFMC SBAS MOPS, expect to complete in 2022
  - WAAS assisting IWG with providing SBAS perspective on DFMC capability

- **Advanced RAIM (ARAIM)**
  - ARAIM algorithm development continuing in standards group for multi-constellation GNSS capability
  - Integrity Support Message for GPS broadcast working through the GPS change process
  - FAA focusing on development of initial requirements for horizontal navigation (H-ARAIM)
Airports with WAAS LPV/LP Instrument Approaches

• Most of the airports throughout the National Airspace System contain WAAS Procedures

• As of Sept 2022 there are currently 1,612 ILS procedures while WAAS has 4,825 LPV/LP procedures published
WAAS Avionics Equipage Status

• Over 154,952 WAAS equipped aircraft in the NAS
  – WAAS receivers provided by companies such as:
    • Garmin, Universal, Rockwell Collins, Honeywell, Avidyne, Innovative Solutions & Support (IS&S), Thales and Genesys Aerosystem (Chelton), CMC

• Since 2006, aircraft equipage has increased each year

• All classes of aircraft are served in all phases of flight

• Enabler for NextGen programs
  – Automatic Dependent Surveillance Broadcast (ADS-B)
  – Performance Based Navigation (PBN)
WAAS GEO Constellation

- GEO 5 (Eutelsat 117WB) - Operational March 2018
- GEO 6 (SES-15) - Operational July 2019
- GEO 7 (Intelsat G-30) – Operational April 2022
- GEO 7 Integration (integration of ground segment with the GEO) occurred in June 22
Navigation Resiliency
Navigation Resiliency

• DME/VOR/TACAN [DVT] service is required for the foreseeable future as part of a resilient navigation infrastructure

• DME supports continued Area Navigation (RNAV) during GPS service disruptions
  – NextGen DME Program is adding approximately 123 new DMEs
  – 100 DMEs not needed for PBN are targeted for discontinuance
Navigation Resiliency (cont’)

• The VOR MON will provide conventional navigation service during unplanned GPS outages in the Contiguous United States (CONUS)
  – Navigation: new VOR Standard Service Volumes (SSVs) are being published to establish coverage starting at 5,000’ Above Ground Level (AGL). This will allow VOR-to-VOR navigation
    • 130 out of the planned 491 facilities have new SSVs
  – Landing: MON airports will support a conventional approach within 100 nautical miles
  – VORs that do not meet criteria are being discontinued. To date, 135 out of the planned 306 VORs have been discontinued

• ILSs are being retained to support continued operations at the busiest airports during GPS outages
DVT Sustainment Program

• Most DVT systems are 30+ years old and becoming unsustainable
• VOR MON and NextGen DME Programs do not sustain DVT systems
• Procurement contracts are not available to replace VORs or TACANs
• A TACAN Antenna procurement planning is underway to address urgent, short-term needs
• DVT Sustainment completed Investment Analysis Readiness Decision in September 2020
• Anticipated DVT system inventory:

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• Next Steps
  – Continue procurement activities for the TACAN Antenna
  – Reach Final Investment Decision
DVT Sustainment Phased Approach

**IARD for the Program – Sept. 2020**
- FID for Phase 1

**Strategic**
- NavAid procurements
- New technology Qualification
- Rapid supply chain
- Key sites

**Tactical**
- Equipment obsolescence
- Facility conditions
- Long lead-time repair items
- Site assessments

**TACAN Antenna**
- Market Survey
- Specification SIR
- Critical Sites
- Contract Award
- Testing Qualification
- Critical Sites

**DVT Planning**
- Congressional Communications
- Specifications Approvals
- SIR Development
- Vendor Engagement
- Prioritization

**PHASE 1 ~ 2025–2031**

- **DVT Contract Award (multiphase)**
- **Testing and Qualification**
- **DVT Implementation at Key Sites (first articles)**
- **Planning—FID for Phase 2**
- **TACAN Antennas**
  - In-Service Decision & Deployment
- **Tactical**
  - Additional identified needs based on Sustainment Analysis

**PHASES 2–4 ~ 2031–2047**

- **FID for Phase 2**
- **Implementation at n# Sites based on priorities**
- **Pre-planned Product Improvement**
- **Planning—FIDs for Phases 3–4**
- **TACAN Antennas**
  - Coupled with DVT Implementations
- **Tactical**
  - Additional identified needs based on Sustainment Analysis
NextGen DME Program Timeline

- Navigation Service Group (NSG) Airports grouped into clusters to maximize benefits
- Clusters grouped into discrete segments
  - Segment 1: En Route Coverage
  - Segment 2: Terminal Coverage for 15 Navigation Service Group (NSG)-1 and 11 NSG-2 Airports
  - Segment 3: Terminal Coverage for 36 NSG-2 Airports
The VOR MON program will be completed in 2 Phases:

Phase 1: FY16 – FY20
- Published Final Policy FRN: “Provision of Navigation Services for the Next Generation Air Transportation System (NextGen) Transition to Performance Based Navigation (PBN) - 07/26/2016
- Removed, Replaced, Amended affected Instrument Flight Procedures (IFPs)
- Discontinued 82 VORs

Phase 2: FY21 – FY30
- Received Phase 2 Program Approval - 03/18/2020
- Continue IFP work
- Plan to discontinue approximately 224 VORs
  - As of 9/9/2022, discontinued 53 VORs
TACAN Resilient Operational Network (RON)

- Retain TACANs needed for instrument approach procedures (IAP) and feeder routes at military and civil airports needed for safe recovery during outages.
- Significant numbers of military airports have closed reducing the need for TACANs
- Expanding the TACAN service volume enables additional TACANs to be removed
- Approximately 122 of 407 existing TACAN sites can be removed to establish the MON
Instrument Approach Strategy

- Retain existing CAT-II/III ILSs for commercial aircraft
- Publish RNAV(GPS) charts with LPV minimums to satisfy new requirements for CAT-I vertically guided approach service
  - 4092 LPVs currently published
  - LPVs will be published at all qualifying runways
  - Design criteria changes add additional qualifying runways for LPV
- VOR MON replacing conventional routes and procedures as VORs are discontinued
- Category-I ILS, LOC, or VOR, approaches will be retained at MON airports to support recovery during GPS outages
- Redundant NDB and VOR approaches will be cancelled
Summary
Summary

- FAA is supporting GPS Modernization and coordinated efforts around National Policy
- WAAS is replenishing GEOs, Performing Tech Refresh, and planning for Phase 4B to integrate DFO
- FAA continues to support Cat I GBAS operations
- Resiliency
  - DME/VOR/TACAN (DVT) Sustainment Program is planning for Final Investment Decision in September 2023
  - NextGen DME Program implementation is underway
  - VOR MON program – 130 VORs have new SSVs and 135 VORs have been discontinued
  - TACAN Rationalization Course of Action has been coordinated with DoD PBFA and is in early stages of planning
  - ILS Rationalization has been on hold; Strategy Decision to be revisited in December 2022
Questions?