FAA Navigation Programs Update

Presented to:  Civil GPS Service Interface Committee

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Agenda

• FAA Navigation 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
  – ILS Rationalization Status
• Summary
FAA Navigation Strategy

• Provide resilient navigation services to enable transition of the NAS to PBN operations
  – GPS and WAAS enable all PBN operations and ADS-B
  – A nominal population of legacy conventional NavAids must be sustained to provide a resilient NAS infrastructure
  – NextGen DME Program supports PBN operations and provides an RNAV backup to mitigate for the loss of GNSS
  – VOR Minimum Operational Network (MON) Program will repurpose VORs to provide a backup for non-RNAV aircraft
  – DME/VOR/TACAN Sustainment program preparing for investment decision

• Rationalize the legacy NavAid infrastructure
  – Discontinue redundant VORs to establish the MON
  – Possible rationalization of ILS at airports where LPV provides redundancy is currently on hold indefinitely

• Innovate navigation services to enable new capabilities
  – Multi-Constellation GNSS
  – LED technology, etc.
GPS Civil Update
GPS Modernization Support

- FAA supporting National PNT Engineering Forum (NPEF)
- Supporting development of system safety analysis artifacts for GPS
- Provided requirements for GPS Civil Signal Monitoring
- Supporting implementation of OCX civil signal monitoring capabilities
Support for Executive Order 13905 “Responsible Use of PNT/GPS”

• FAA implementing resilient navigation infrastructure to limit GPS outage impacts
  – Navigation relies on VORs and DMEs, and ADS-B relies on primary and secondary radar for backup positioning
  – Backup timing services are being implemented as part of telecommunications services

• GPS spoofing is a concern to aviation
  – FAA investigating potential to monitor and detect jamming and spoofing by leveraging ADS-B system assets
  – RTCA addressing spoofing in next generation avionics; FAA avionics activities enable support
  – FAA to facilitate compliance by aircraft, airport and other operators of supporting infrastructure
Support to National Defense Policy

• FY18 National Defense Authorization Act (NDAA)
  – FAA supporting demonstrations of Complementary PNT technologies to provide resiliency during GPS outages
    • NASA & DOT hosted demonstrations from 11 vendors from December 2018 to March 2020; No single technology met all needs

• National Timing Resilience and Security Act (NTRSA) in 2017
  – FAA supporting DOT efforts to establish, sustain, & operate complementary backup timing system
  – DOT Developing formal System Requirements Document (SRD Package) for Private Sector implementation
Support to National Space Policy

• **Space Policy Directive 5 (SPD-5)**
  – Policy to protect space systems from cyber incidents and potential impacts critical infrastructure
  – FAA implementing signal authentication for WAAS
  – Supporting radio frequency interference monitoring efforts for Ligado

• **Space Policy Directive 6 (SPD-X)**
  – DOT to provide transportation sector strategy and implementation plan
  – FAA developing the aviation sector strategy and implementation plan
    • FAA will work with industry to cooperatively develop the Aviation Sector Strategy and Implementation Plan
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 (FY20-21)**
  - Release 6 improves WAAS by correcting anomalies to the O&M, Test Support Software and network critical message logging capabilities; Fielding planned for October 2020 – 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
• **Dual-Frequency Multi-constellation Capability (DFMC)**
  - Standards development progressing
    - GPS L5 and DFMC SBAS SARPs material prepared for Navigation Systems Panel approval in November 2020
    - RTCA and EUROCAE working a joint DFMC SBAS MOPS, expect to complete in 2021
  - 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 August 2020 there are currently 1,612 ILS procedures while WAAS has 4,785 LPV/LP procedures published
WAAS Avionics Equipage Status

- Over 131,953 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)

- Since 2006, aircraft equipage has increased each year

- All classes of aircraft are served in all phases of flight
  - Recent STC for Boeing 737-600/700/800 avionics

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

- CRE (Telesat Anik F1R) - Operational July 2007
- GEO 5 (Eutelsat 117WB) - Operational March 2018
- GEO 6 (SES-15) - Operational July 2019
- GEO 7 (Intelsat G-30) – Pre-Operational
  - Successful launch August 15, 2020
  - Expect operational in mid-2022
Navigation Resiliency
Navigation Resiliency

- DME/VOR/TACAN service is required for the foreseeable future as part of a resilient navigation infrastructure
- DME infrastructure supports continued PBN operations during GNSS service disruptions
  - NextGen DME Program is being implemented
    - Established interim siting criteria
    - 100 DME targeted for discontinuance
    - Approximately 123 new DMEs will be installed
- VOR MON has discontinued 82 out of approximately 307 VORs to date
  - Phase 2 Final Investment Decision (FID) (FY21-FY30) was achieved in March 2020
    - Approximately 225 VORs will be discontinued
- ILSs are being retained to support continued operations at the busiest airports during GPS outages
DVT Sustainment Program

- DVT Sustainment achieved Investment Analysis Readiness Decision in September 2020
  - 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
  - Anticipated DVT system inventory (Service Delivery Points)

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- Next Steps
  - Continue addressing short-term needs
  - Reach Final Investment Decision in September 2021
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

* After program revised scope, April 2018
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
- Remove, Replace, Amend affected Instrument Flight Procedures (IFPs)
- Completed Phase 1 - discontinued (82) VORs

Phase 2: FY21 – FY30
- Received Phase 2 Program Approval 03/18/2020
- Continue IFP work
- Phase 2 – Discontinue approximately (224) VORs

Initial (CONUS): 896
VOR MON (End-State): 589

VOR MON Program Milestones

- Phase 1 Program Approval
- Phase 2 Program Approval

VOR MON Implementation

FY16 FY17 FY18 FY19 FY20 FY21 FY22 FY23 FY24 FY25 FY26 FY27 FY28 FY29 FY30
DVT Sustainment Phased Approach

IARD for the Program – 4QFY20

FID for Phase 1 – 4QFY21

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

DVT Planning
- Congressional Communications
- Specifications SIR
- Contract Award
- Vendor Engagement
- Prioritization

Phase 1 (FY21-27)

DVT Contract Award (multi-Phase)

Testing and Qualification

Implementation at Key Sites

FID for Phase 2

TACAN Antennas
Continue Implementation

Phases 2-6 (FY28-62)

Implementation at n# SDPs based on priorities

Tech Refresh

FID for Phases 3-6

TACAN Antennas
Coupled with DVT Implementations

Tactical
- Additional identified needs based on Sustainment Analysis

Additional identified needs based on Sustainment Analysis
Instrument Approach Strategy

- Retain existing CAT-II/III ILSs for commercial aircraft
- Publish LPV approach procedures to satisfy new requirements for CAT-I vertically guided approach service
  - Provide LPV approaches to all qualifying runways
  - Modify design criteria to qualify additional runways for LPV approaches
- Category-I ILS, LOC, or VOR, approaches will be retained at MON airports to provide a backup during GPS outages
- Redundant NDB and VOR approaches will be cancelled
- Initiative to consider ILS rationalization placed on hold for the foreseeable future
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 achieved Investment Analysis Readiness Decision in September 2020; with Final Investment Decision planned for September 2021
  – NextGen DME Program implementation is underway
  – VOR MON implementation – 84 VORs discontinued through FY2020
  – ILS Rationalization effort placed on hold for the foreseeable future
Questions?
BACKUP
GBAS Overview

• NextGen Program Closeout
  – GBAS is managed by the FAA Technical Operations Non-Federal Policy and Oversight Office, NextGen supports GBAS efforts by means of an FAA-internal Project Agreement

• Ongoing FAA Activities
  – ICAO/RTCA standards for VDB signal measurement methods for Flight Inspection
  – Non-Federal Policy & Oversight Office (AJW-1X) has identified a three-phase process to manage and review requests for approval of emerging Non-Federal technologies
  – Honeywell SLS-4000 Block II Updates to “code carrier divergence” for better availability / Upgrade from copper to fiber
  – GBAS status monitoring requirements for Air Traffic Control towers and TRACONS

• Ongoing Industry Activities
  – PANYNJ –LGA & JFK GBAS planning (2020/2021)
  – SEATAC GBAS Planning (2020)
  – SFO GBAS Planning (2020)
  – Request for GAST-D (CAT-III) SDA Information from Indra Navia
  – United Airlines and Delta Air Lines request for CAT II approval for GBAS GAST-C system

• Operational Data & Equipage
  – 5675 approaches conducted at Newark, NJ and Houston, TX
  – Southwest, United, Delta Air Lines continue GLS equipage
Houston GBAS Operational Status

- Houston GBAS was upgraded to SLS-4000 Block II w/ SBAS in May 2018
  - Upgrade error: no approaches were enabled
    - Procedural error during upgrade
    - All approaches have been re-enabled and Honeywell process has been reworked to strengthen return-to-service checks for upgrades
    - FAA ground inspection checklist also being updated to ensure that approach statuses are correct
  - GBAS monitors indicated the system was operating normally
    - HAS personnel were not trained to observe approach status
    - ICMS only shows 'green' or 'red' at a system level; no approach by approach status shown
  - Issue was not identified for over two weeks, ~16 approaches cleared
- Due to failures in communication of PIREPs and questions about monitoring, the GBAS has been NOTAM’ed OTS since
  - OMM, LOA between ATC and HAS being updated
  - ICMS changes may be deemed necessary
  - Local SMS panel will be held before the system is returned to operation