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) MON
  - Instrument Approach Strategy
- **Summary**

FAA Navigation Programs Strategy

- **Provide resilient navigation services to enable sustained operations during potential GNSS disruptions**
  - GPS and WAAS provide primary navigation for all PBN operations and ADS-B
  - NextGen DME Program provides a PBN backup to sustain operations for aircraft equipped for DME navigation during GNSS disruptions
  - VOR Minimum Operational Network (MON) Program provides a backup for aircraft that are not equipped for DME navigation
  - TACANs being reduced to a MON to support military aircraft operations
  - DME/VOR/TACAN Sustainment program preparing for investment decision
- **Rationalize the legacy NavAid infrastructure**
  - Discontinuing unneeded VORs to establish the MON
  - Investigate rationalization of ILS at smaller airports where most aircraft are equipped with LPV.
- **Innovate navigation services to enable new capabilities**
  - Support implementation of Multi-Constellation GNSS and Advanced RAIM (ARAIM)
  - Develop solutions to transition Approach Lighting Systems (ALS) to LED technology

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**

National PNT Policy

Navigation Programs provides FAA representation and technical expertise for these policies

- **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
  - DOT will leverage National Institute for System Timing (NIST) experience and FAA technical expertise and acquisition strategy support
- **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 disruption 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

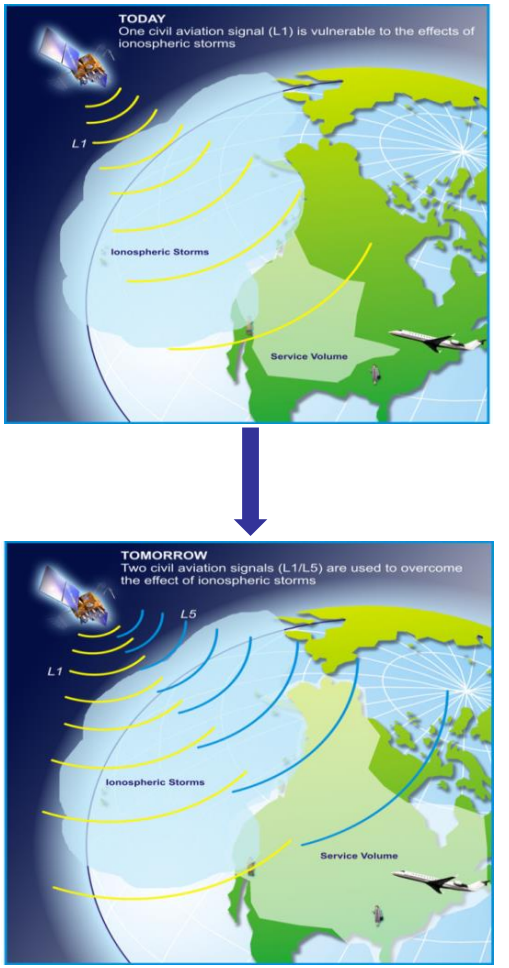
Support to National Space Policy

- **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

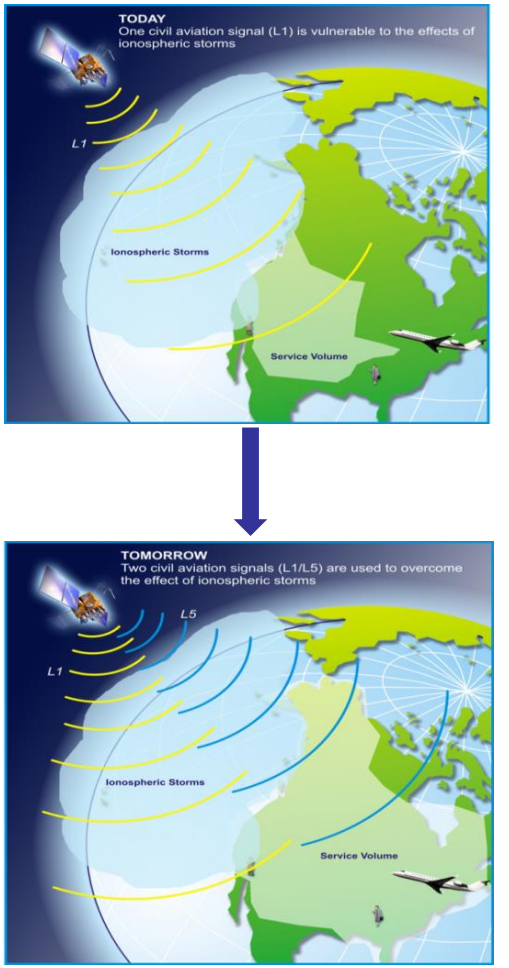
WAAS Phase 4 Status

- **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')

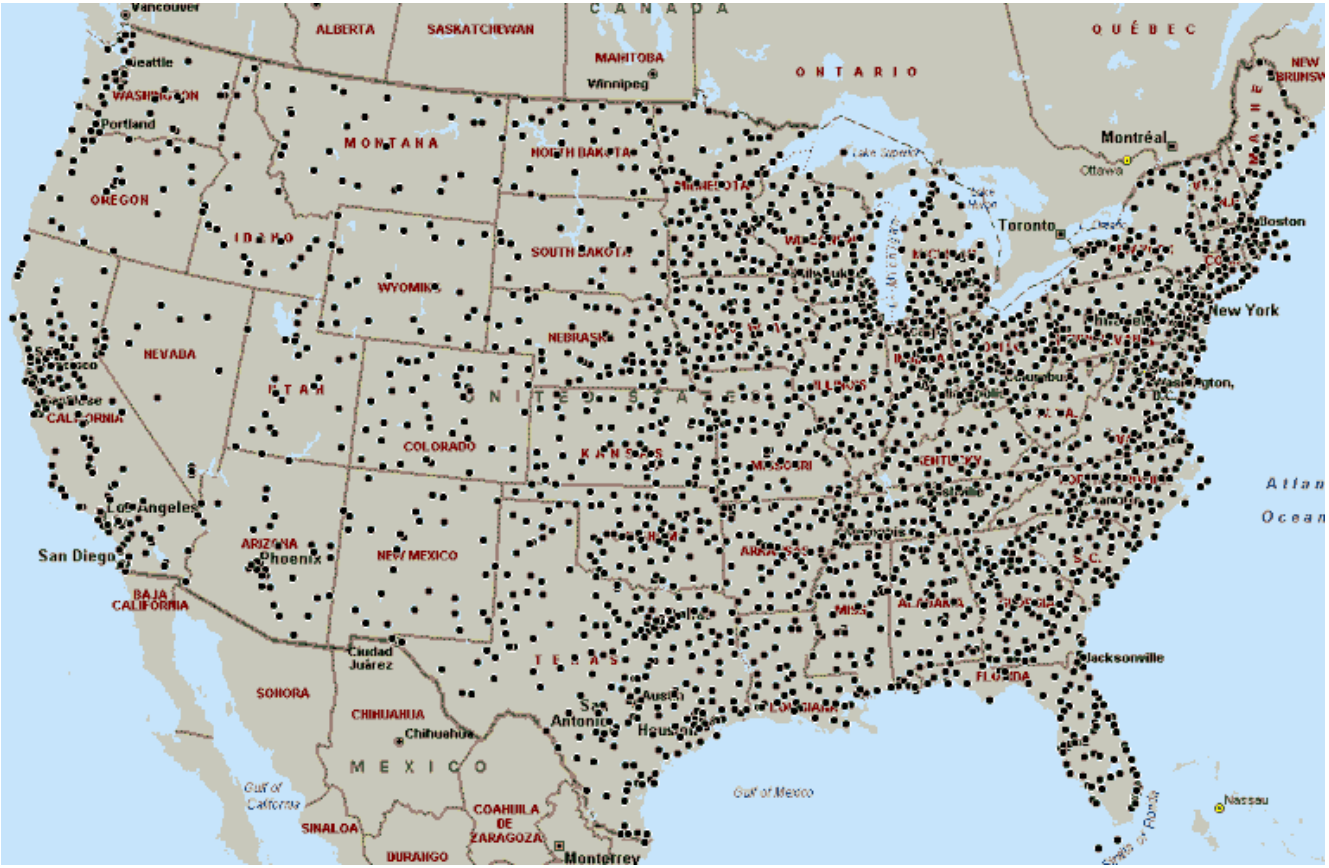
- **Dual-Frequency Multi-constellation Capability (DFMC)**
  - Standards development progressing
    - GPS L5 and DFMC SBAS SARPs material was prepared for Navigation Systems Panel and approved November 2020
    - RTCA and EUROCAE working a joint DFMC SBAS MOPS, expect to complete in 2022
  - WAAS assisting 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 August 2021 there are currently 1,612 ILS procedures while WAAS has 4,817 LPV/LP procedures published**

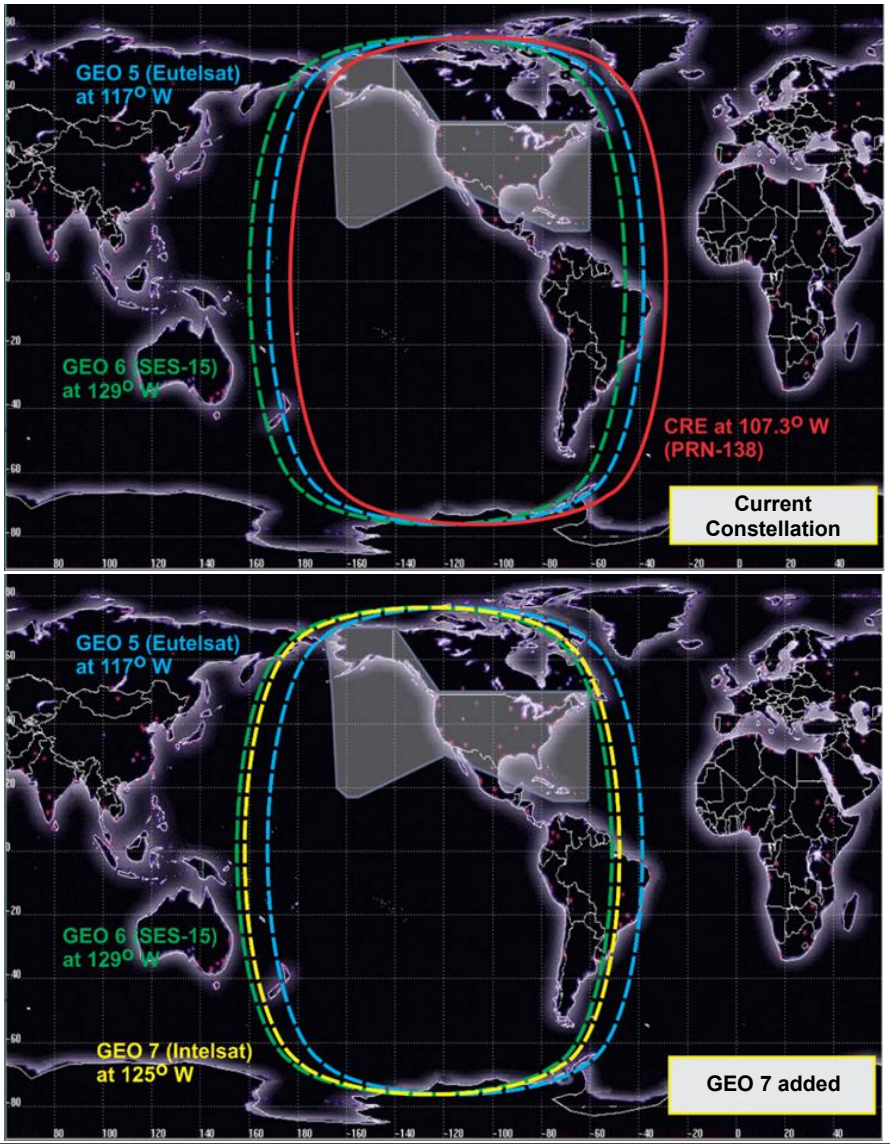


WAAS Avionics Equipage Status

- **Over 144,265 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 June 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 109 of approximately 306 VORs to date**
  - Phase 2 Final Investment Decision (FID) (FY21-FY30) was achieved in March 2020
    - Approximately 224 VORs will be discontinued
- **ILSs are being retained to support continued operations at the busiest airports during GPS outages**

DVT Sustainment Program

- **DVT Sustainment completed 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)

	VOR	VOR/DME	DME	VORTAC	TACAN	TOTAL
SDPs	17	270	19	381	55	920

- **Next Steps**
  - Continue addressing short-term needs
  - Reach Final Investment Decision in September 2023

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 | Contract Award

Testing Qualification | Critical sites

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

Tactical

Additional identified needs based on Sustainment Analysis

Phases 2-6 (FY28-62)

Implementation at n# SDPs based on priorities

Tech Refresh

FID for Phases 3-6

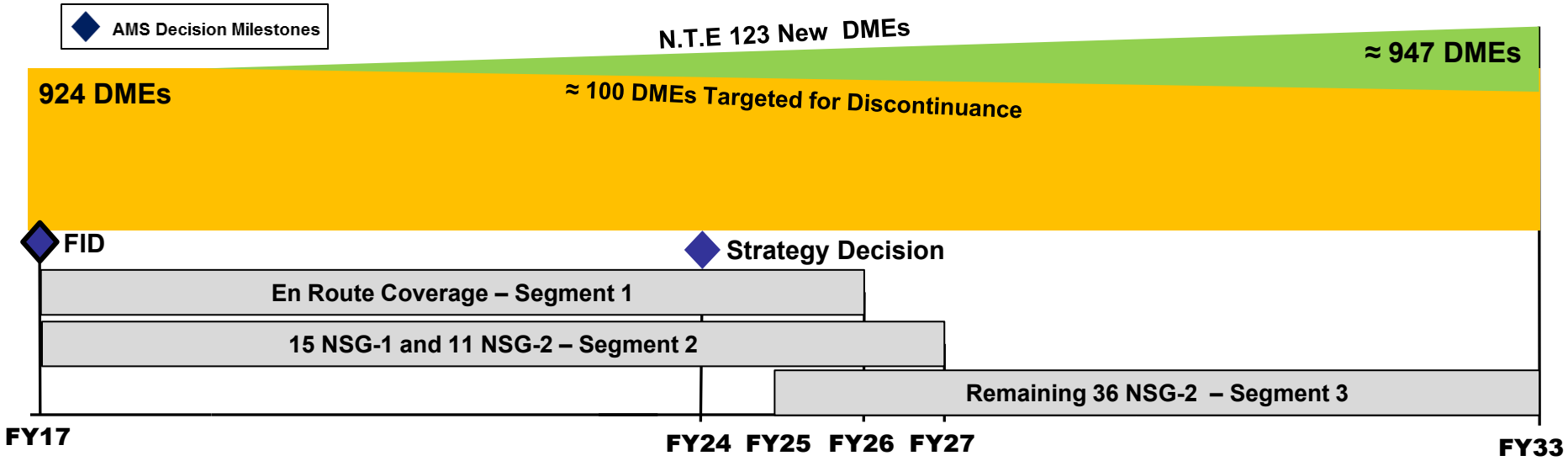
TACAN Antennas

Coupled with DVT Implementations

Tactical

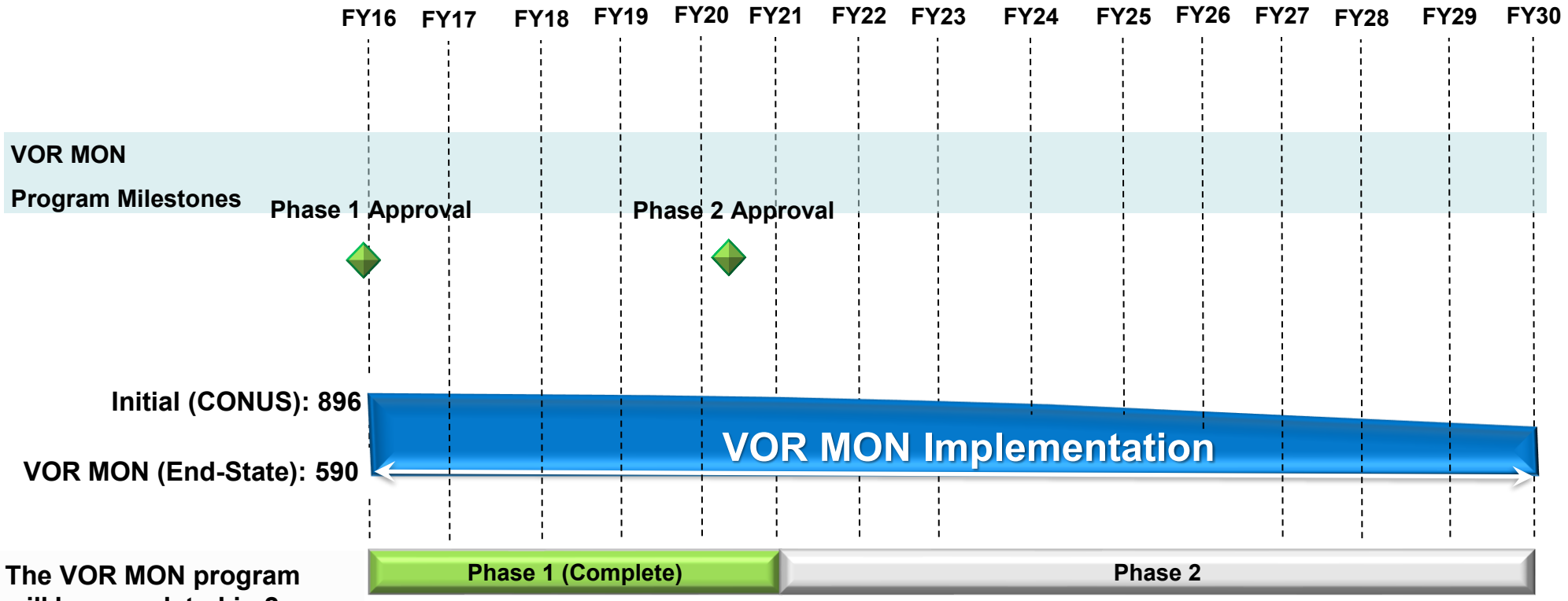
Additional identified needs based on Sustainment Analysis

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

Timeline



The VOR MON program will be completed in 2 Phases:

Phase 1: FY16 – FY20
Phase 2: FY21 – FY30

- 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

- Received Phase 2 Program Approval - *03/18/2020*
- Continue IFP work
- Plan to discontinue approximately 224 VORs
  - As of 9/9/2021, discontinued 27 VORs

TACAN MON

- **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 513 existing TACAN sites can be removed to establish the MON**

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**
- **Possible rationalization of ILS at airports where LPV provides redundancy.**
  - Activity has been on hold since Jan 2020
  - FAA plans to revisit the Strategy Decision for ILS Rationalization in March 2022

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 2023
  - NextGen DME Program implementation is underway
  - VOR MON implementation – 109 VORs discontinued through FY2021
  - TACAN MON Course of Action still being coordinated with DoD
  - ILS Rationalization has been on hold; Strategy Decision to be revisited in March 2022

Questions?

BACKUP