# 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

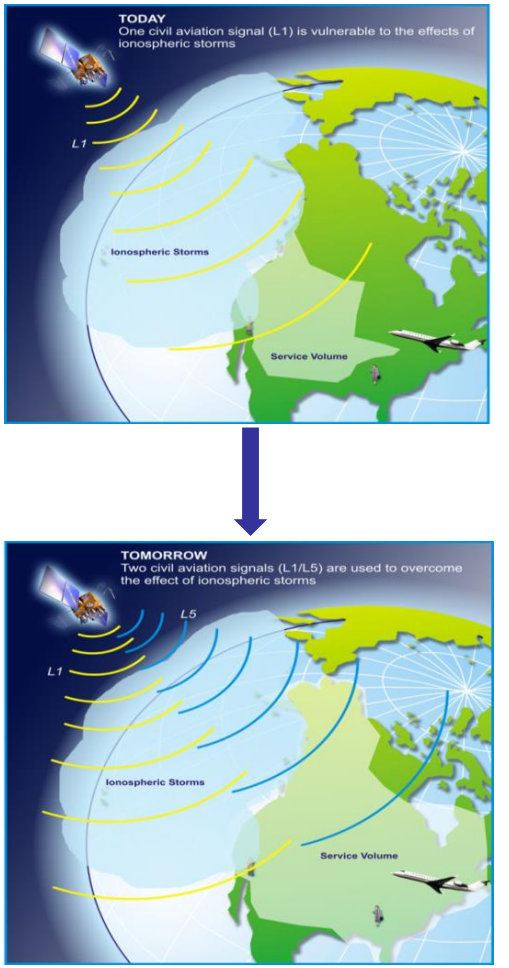
# Support to National Space Policy

- **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 UPDATE

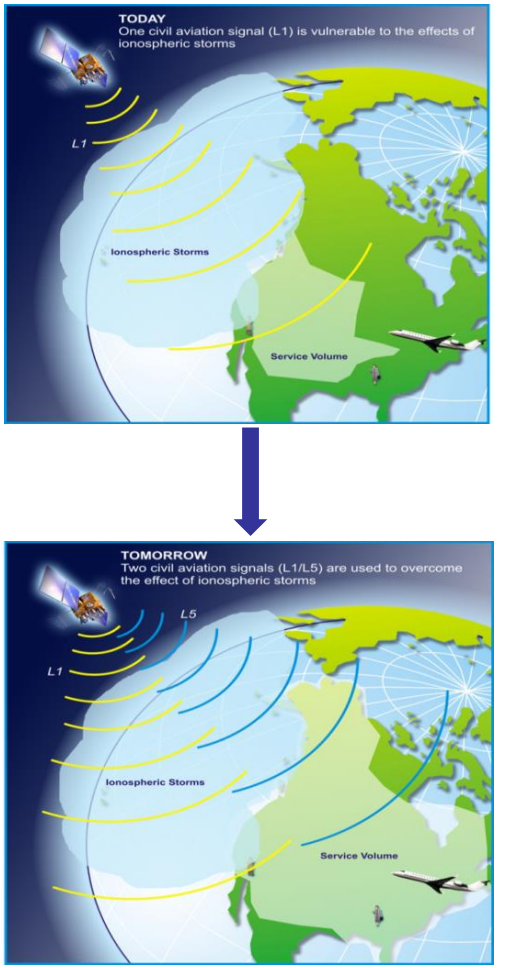
# WAAS Phase 4 Status

- **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 (FY20-21)**
  - 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



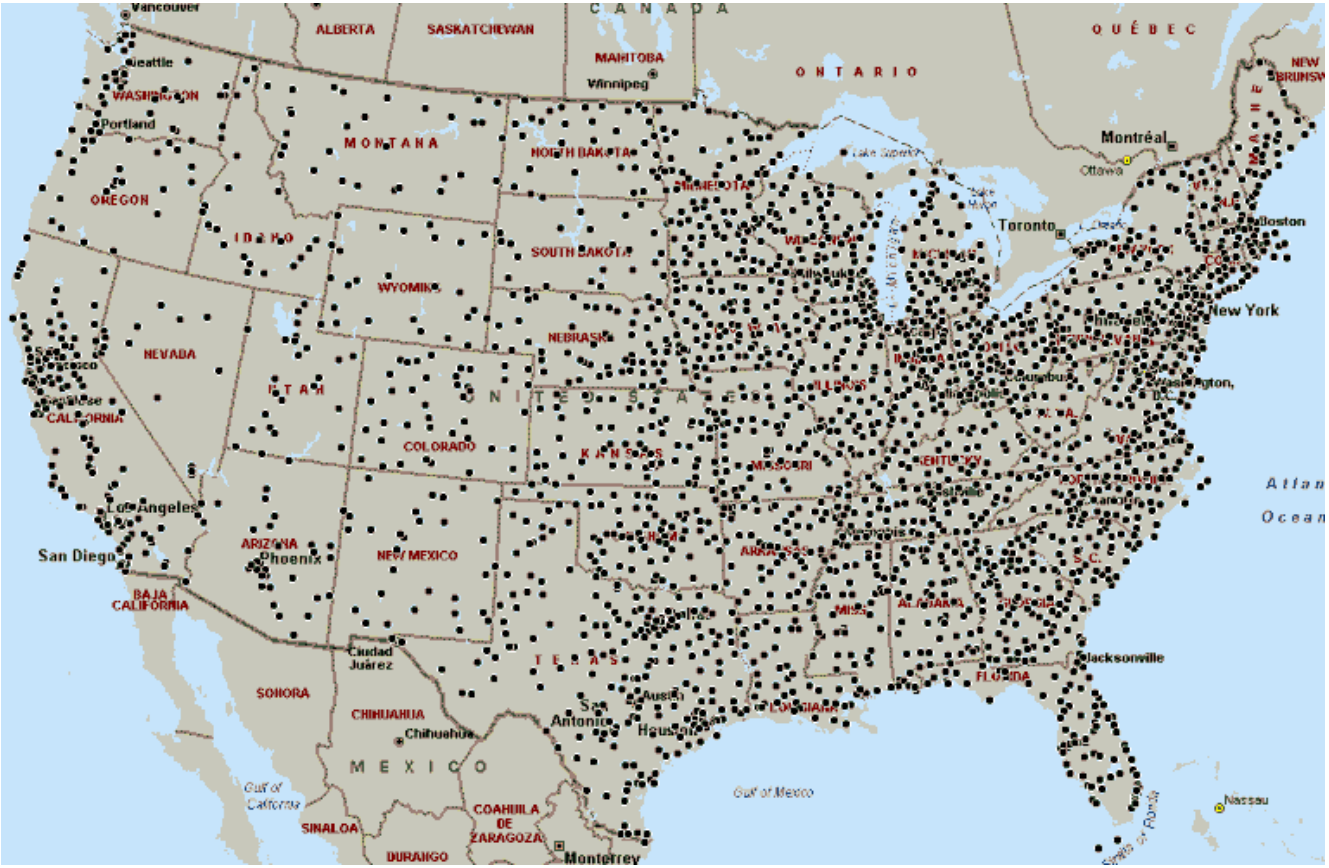
# WAAS Phase 4 Dual Frequency Operations (DFO) Status (cont')

- **Dual-Frequency Multi-constellation Capability (DFMC)**
  - Standards development progressing
    - GPS L5 and DFMC SBAS SARPs material 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



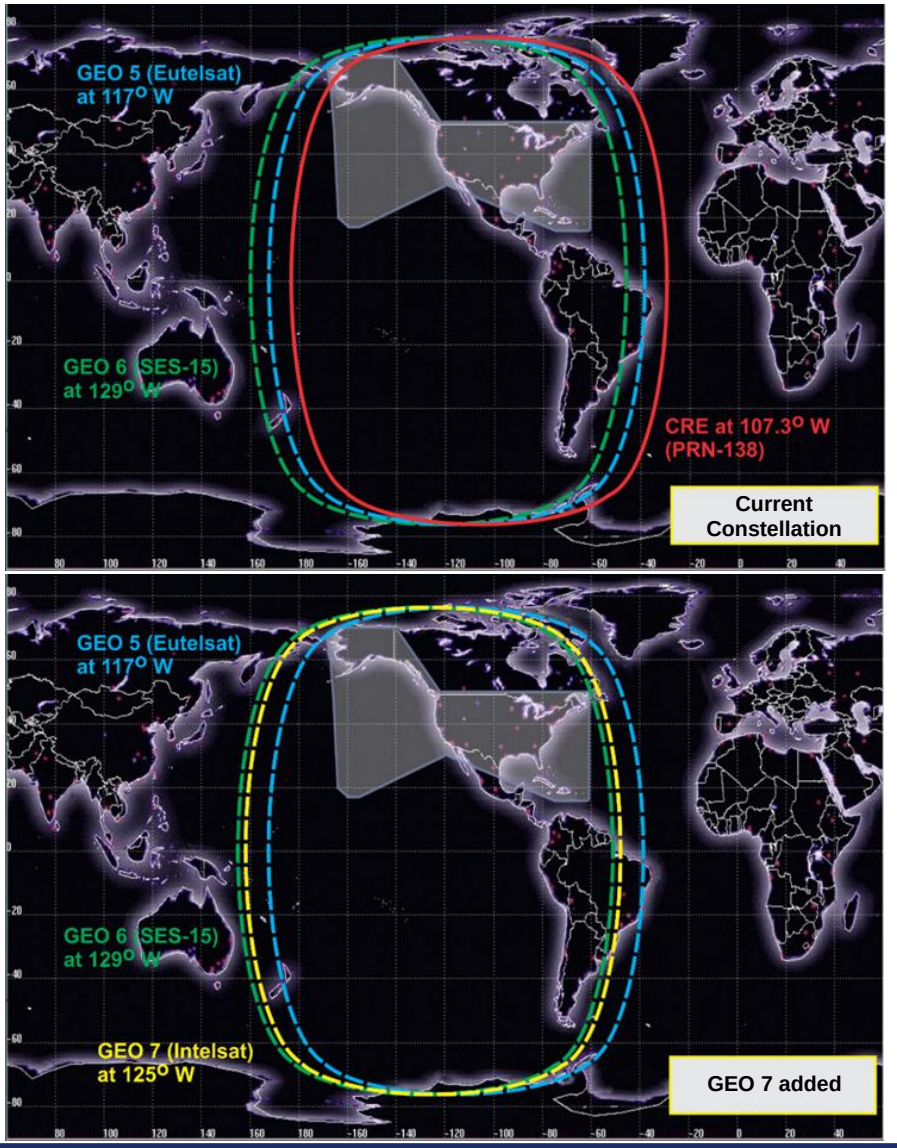

- As of August 2020 there are currently 1,612 ILS procedures while WAAS has 4,785 LPV/LP procedures published

# 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 discontinue
- **ILSs are being retained to support continued operations at the busiest airports during GPS outages**

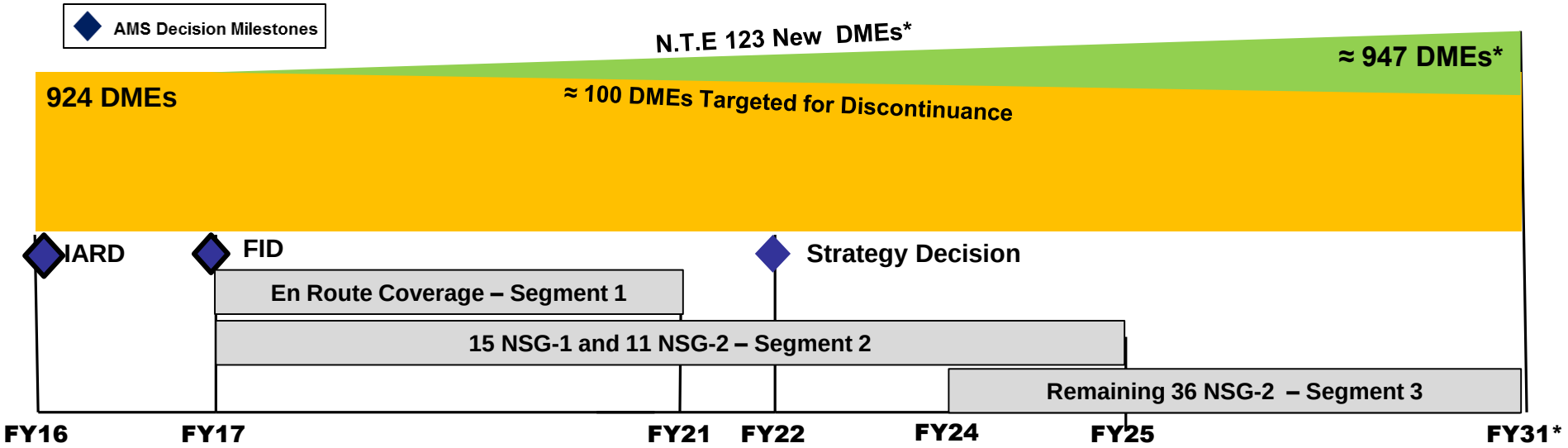
# DVT Sustainment Program

- **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)

| | 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 2021

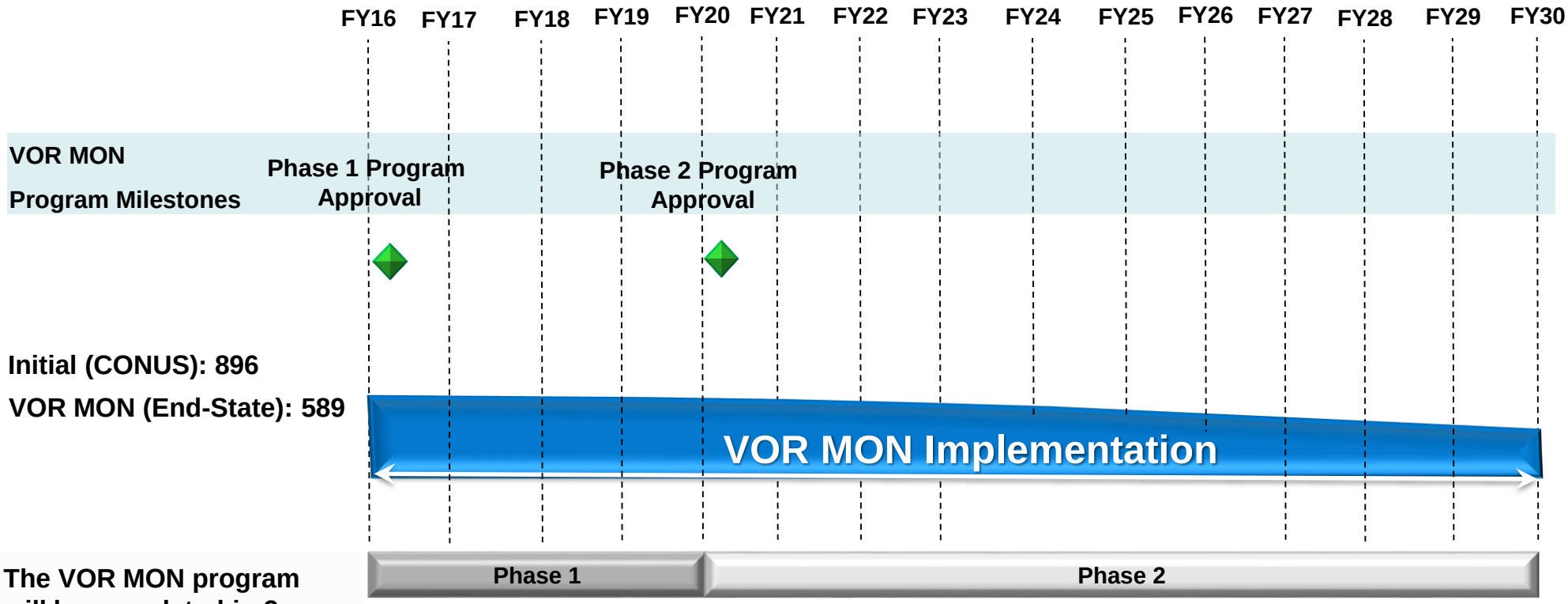
# NextGen DME Program Timeline




- **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*

# VOR MON Program 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*
- Remove, Replace, Amend affected Instrument Flight Procedures (IFPs)
- Completed Phase 1 - discontinued (82) VORs

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

# 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

# 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

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- **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