

NAS

Navigation

Strategy

Executive Summary

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Presented to: The National Space-Based
Positioning, Navigation, and
Timing (PNT) Advisory
Board

Date: May 2018



**Federal Aviation
Administration**



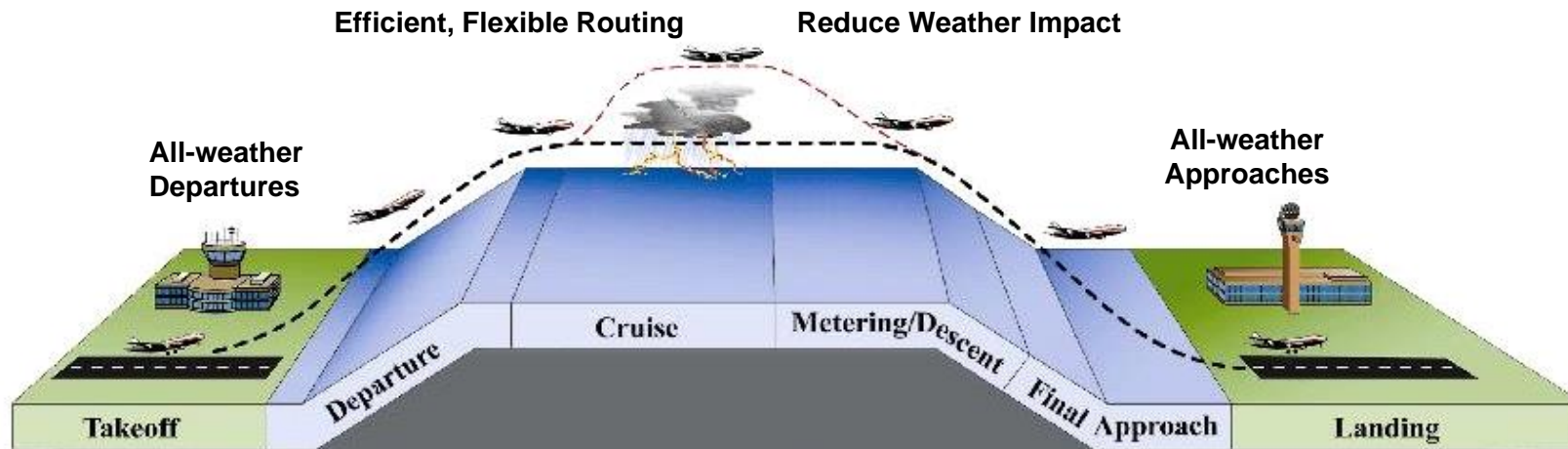
FAA Navigation Strategy Purpose

- **Plan to provide Navigation Services to support**
 - NAS Performance Based Navigation (PBN) Strategy – 2016
 - NAS Efficient, Streamlined Services (NESS) initiative
 - Lighting Systems initiatives
 - Next Generation Air Transportation System (NextGen) Goals

Navigation Strategy Goals

- **Provide resilient navigation services for the PBN NAS Strategy–2016**
 - GPS and WAAS enable all PBN operations and ADS-B
 - NextGen DME Program will provide 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.
 - Legacy conventional NavAids must be sustained to provide a resilient NAS infrastructure
- **Rationalize infrastructure to meet the NESS initiatives**
 - Discontinue redundant VORs to establish the MON
 - Rationalize ILS at airports where LPV provides redundancy
- **Innovate navigation services to enable new capabilities**
 - Multi-Constellation GNSS
 - LED technology, etc.

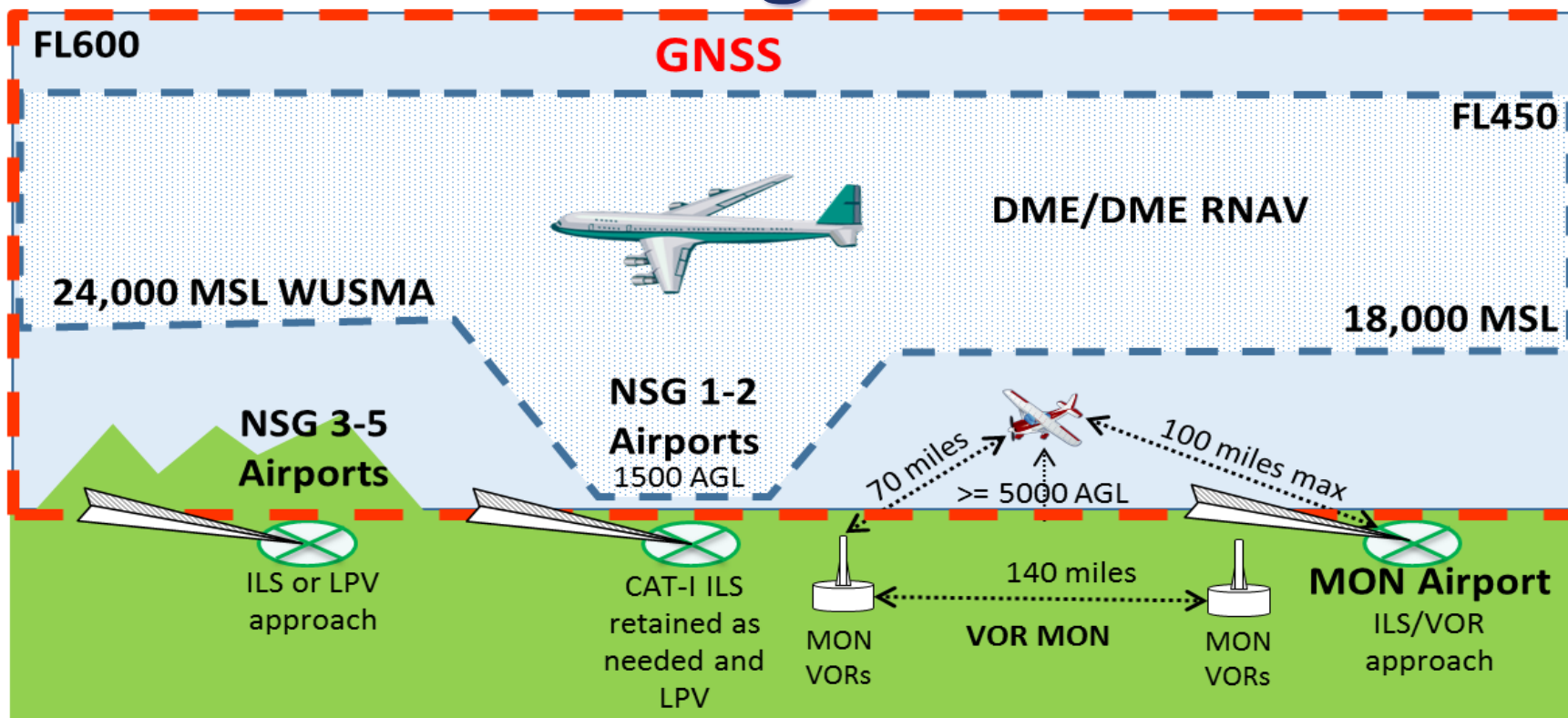
FAA Navigation Programs Portfolio



Legacy Navigation Infrastructure	LOC RVR GNSS	VOR TACAN DME GNSS	VOR TACAN DME NDB GNSS	VOR TACAN DME NDB GNSS	ILS/LOC RVR VOR / DME / TACAN / NDB GNSS MALSR ALSF-2 REIL PAPI/VASI
Future Navigation Infrastructure	GNSS LOC RVR	GNSS DME / TACAN VOR	GNSS DME / TACAN VOR	GNSS DME / TACAN VOR	GNSS ILS/LOC RVR DME / TACAN VOR MALSR ALSF-2 REIL PAPI

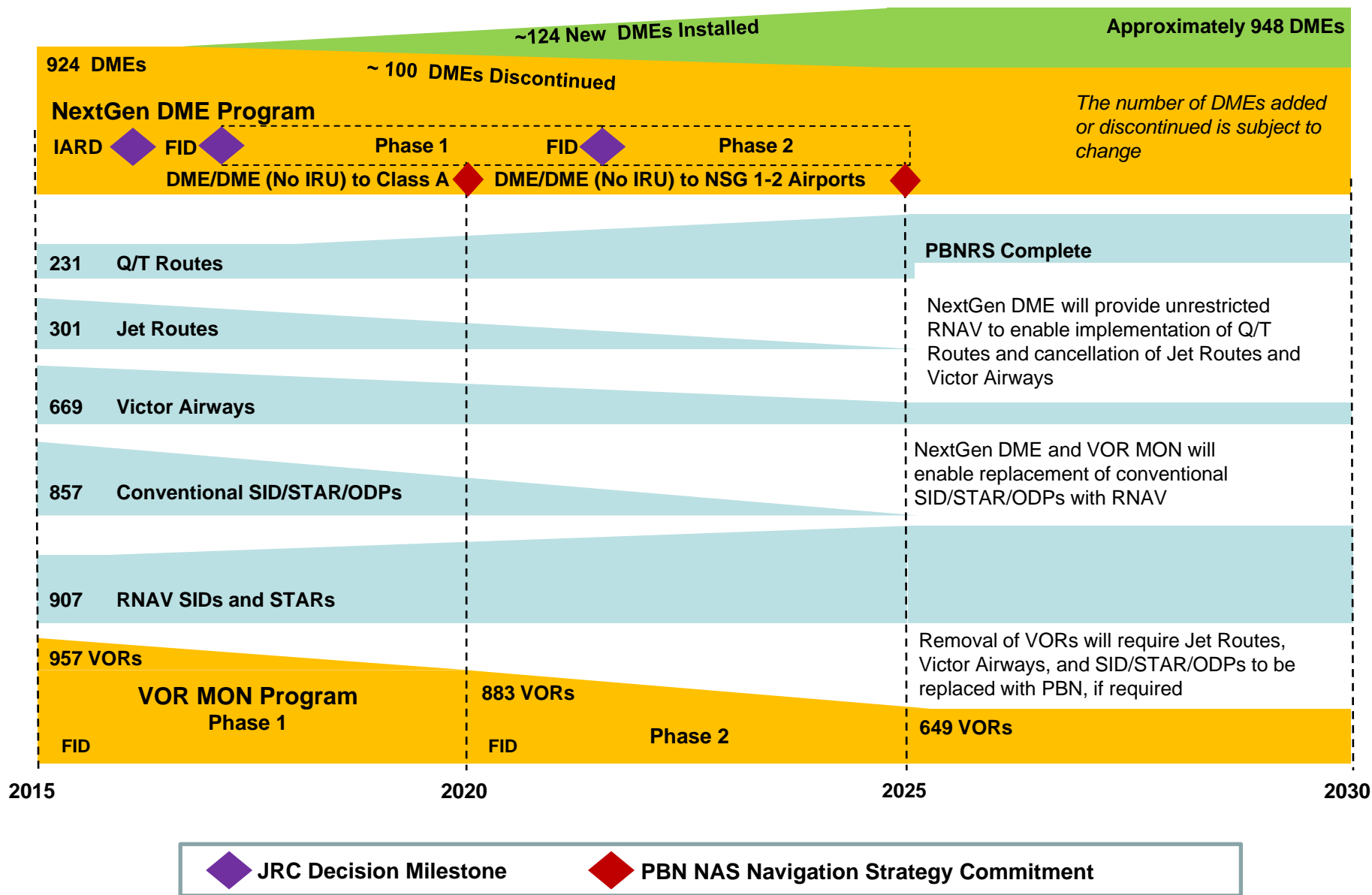
Note: NavAid system listed first in each cell is the preferred navigation service

Resilient Navigation Services



- **GNSS is the primary enabler for all PBN (RNAV and RNP) and ADS-B accuracy & integrity for all separation levels**
- **DME/DME provides an RNAV alternative**
- **VOR MON can be used by aircraft that are not DME/DME RNAV equipped**
- **CAT-I ILSs will be retained as needed to support safe recovery in the event of a GNSS outage**

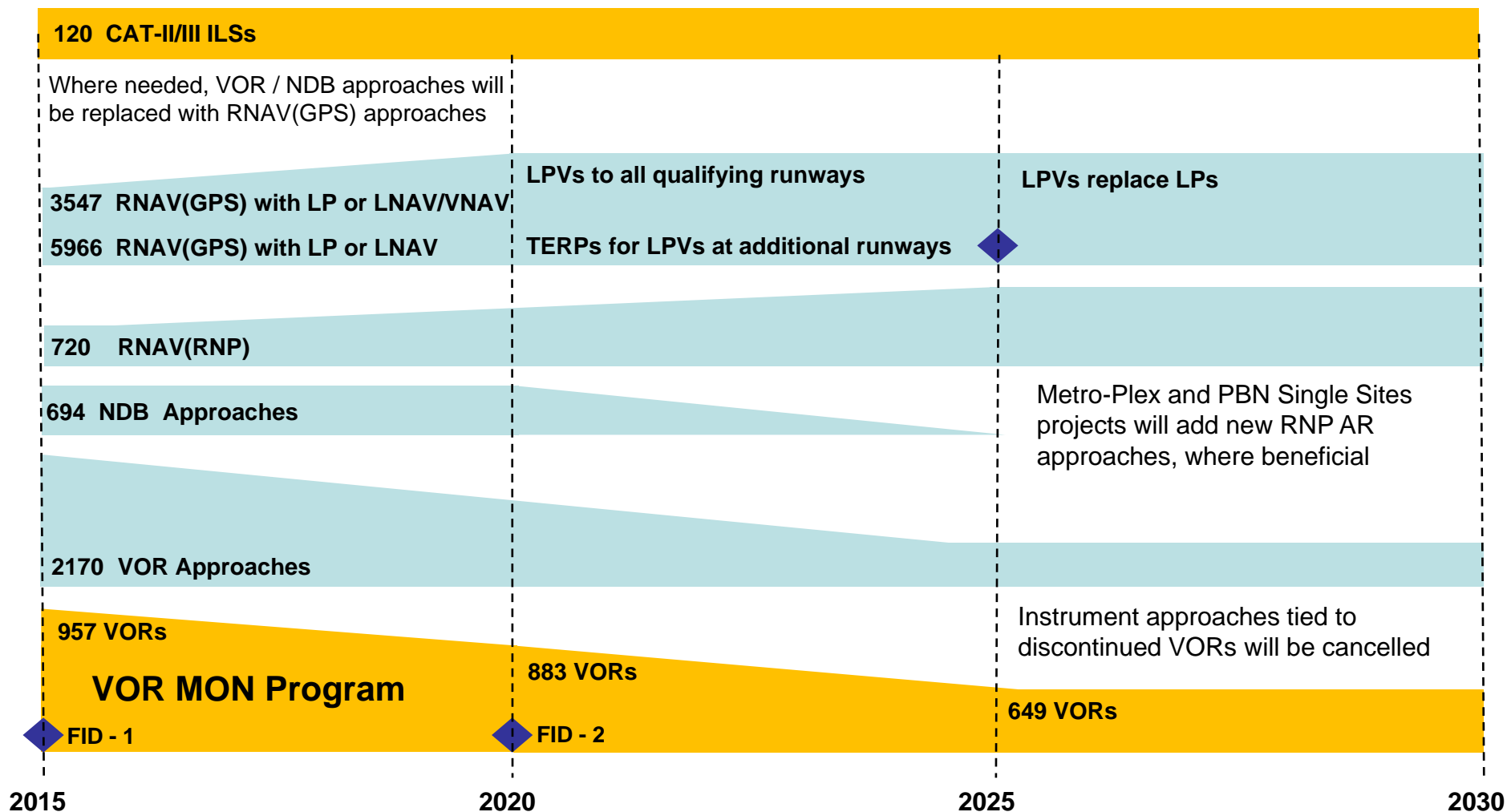
En Route and Terminal Strategy



En Route and Terminal Strategy

- **New DMEs will be implemented to enable DME/DME RNAV (without IRU) in Class A airspace and at busy airports as a backup to GNSS**
 - Fill coverage and add redundancy for en route airspace
 - Rationalize the DME network to remove unneeded facilities
- **PBN Route Structure (PBNRS) will provide structure where needed and direct point-to-point navigation where structure is not necessary**
 - Most Jet Routes and Victor Airways will be removed and replaced with RNAV Q/T Routes
- **VORs will be discontinued to a Minimum Operational Network (MON)**
 - Conventional SID/STAR/ODPs will be cancelled and replaced with RNAV SID/STAR/ODPs, where needed

Approach Strategy (except ILS CAT-I)



Instrument Approach Strategy

- **Retain existing CAT-II/III ILSs for commercial aircraft operating in low/zero visibility**
- **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
- **VOR, ILS and LOC approaches will be retained at MON airports to provide a backup to GNSS outages**
- **NDB and redundant VOR approaches will be cancelled**
- **CAT-I ILSs will be rationalized to identify systems that can be discontinued**

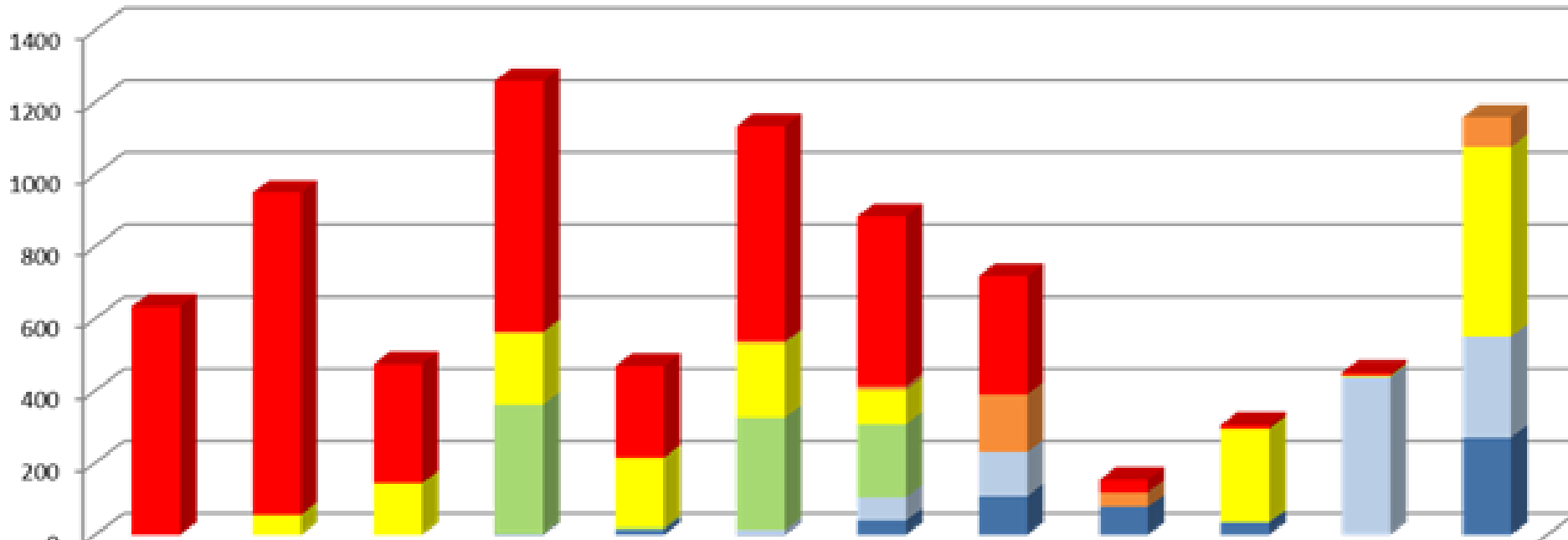
NavAids Sustainment

NavAids Sustainment

- **VOR, DME, TACANs, and ILSs will be rationalized, but the remaining systems must be sustained**
- **TACAN requirements must be coordinated with DoD**
 - No acquisition strategy in place currently
- **Lighting systems will be sustained and gradually refreshed to use LED technology**

NavAids System Age Data

As of May 2017



	VASI	VOR	TACAN	LOC	HP DME	GS	MALSR	REIL	ALS	RVR	LP DME	PAPI
■ 30+	633	893	331	695	255	597	471	329	35	11	9	
■ 25-30				4		6	12	160	41			82
■ 20-25		56	143	199	193	206	94			258	4	526
■ 15-20				359	7	311	203			3		
■ 10-15						12	64	122			437	280
■ <=10				2	14	2	40	107	77	33		270
Total	633	949	474	1259	469	1134	884	718	153	305	450	1158

NavAid Programs Next Steps

- **NextGen DME Program**
 - Install approximately 125 DMEs to provide resiliency during GNSS disruptions
- **VOR MON Program**
 - Discontinue 74 VORs and prepare for an investment decision in 2020
- **DME/VOR/TACAN Sustainment**
 - Complete DME/VOR/TACAN Supportability Study
 - Coordinate with DOD to identify TACAN requirements
 - Follow AMS process to develop acquisition strategy for DME, VOR, and TACAN to systems
- **ILS**
 - Continue to sustain Category-I ILSs at selected sites

GNSS Programs Next Steps

- **Integrate 6th GEO and establish procurement strategy for 7th GEO**
- **Continue 2nd civil signal L5 implementation**
- **Continue development of Dual-Frequency MOPS**
- **Evaluate Multi-Constellation and Advanced Receiver Autonomous Integrity Monitoring (ARAIM)**
- **Develop strategy for TDM to IP**
- **Continue technical refresh activities**

Lighting Programs Next Steps

- **Continue procurement planning activities for REIL and RVR**
- **Continue evaluating LED technology for approach lighting systems**

ELVO Next Steps

- **Complete implementation of Enhance Low Visibility Operations (ELVO) Phase II**

Innovation Initiatives

- **Support Multi-Constellation GNSS and ARAIM standards development and program coordination through ICAO, RTCA, EU, and ANSP organizations**
- **Explore the feasibility of achieving WAAS CAT-II precision approach service (w/ single & dual frequency GPS)**
- **Support operational approval activities for WAAS LPV CAT-II enabled by Enhance Flight Vision Systems (EFVS)**

Challenges

- **Leveraging the benefits of LED technology without unacceptable impacts to current operational capabilities**
- **Use of the satellite navigation spectrum by commercial terrestrial communication service providers without impact to GPS and Iridium**
- **Establishing harmonized standards for DFMC SBAS and ARAIM with benefits to incentive users to equip**
- **Addressing Congressional interest in a service-based contracting approach for DME, VOR and TACAN service**

Summary

- **Navigation Strategy provides the infrastructure to support**
 - Transition of the NAS to PBN operations
 - Rationalizing existing Navaids that are being replaced by GNSS
 - Sustaining conventional NavAids to provide resiliency
- **Planning for the future**
 - Lower approach minimums with WAAS and EFVS
 - Advanced Receiver Autonomous Integrity Monitoring (ARAIM)
 - Implementing LED technology