



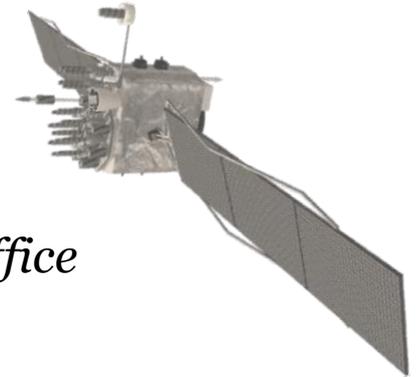
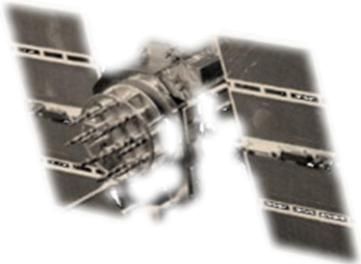
# *U.S. Space-Based Positioning, Navigation and Timing Policy and Program Update*

*8<sup>th</sup> International Committee on GNSS*

*10 November 2013*

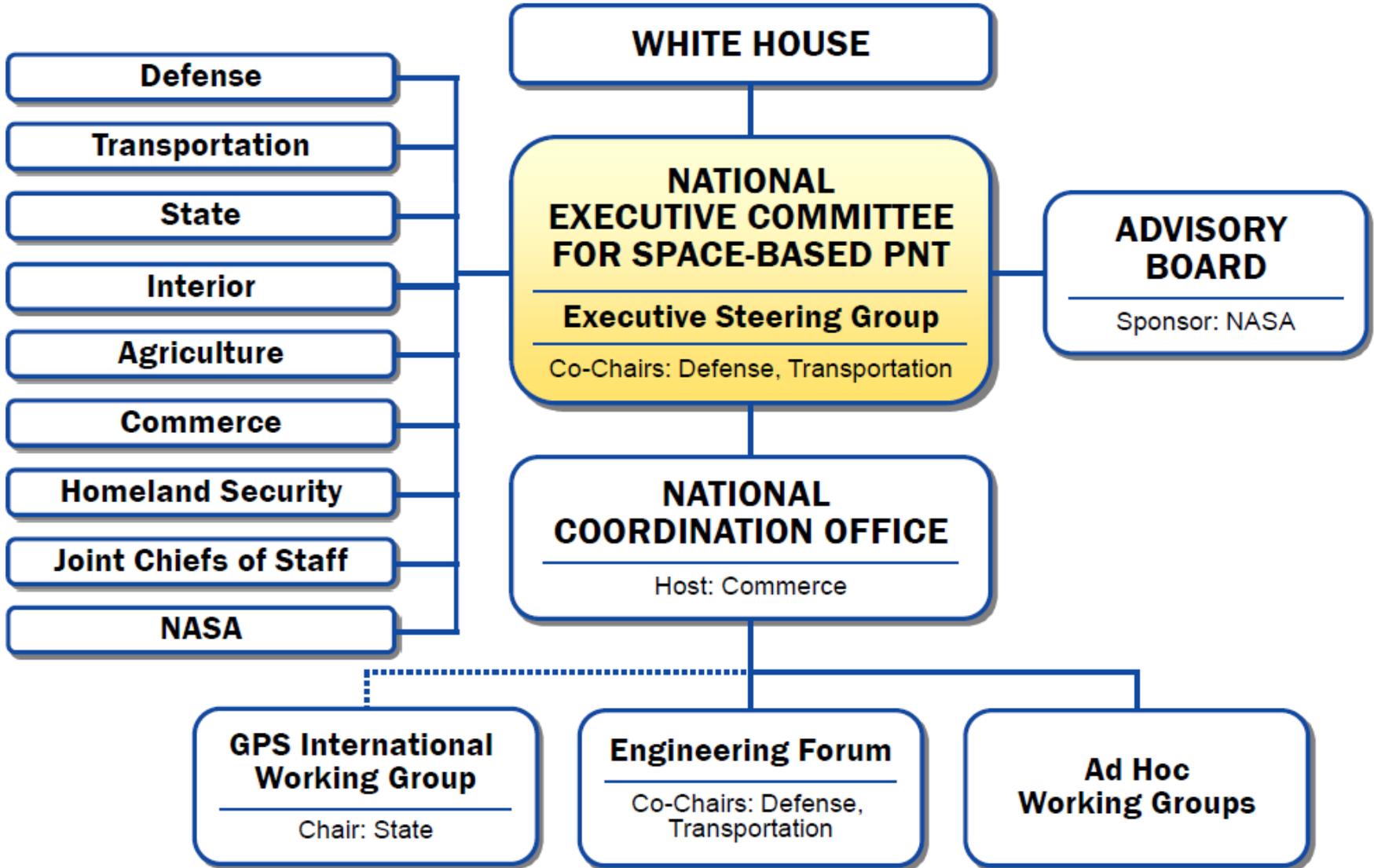
*Harold W. Martin III*

*Deputy Director, National Coordination Office  
United States of America*





# National Space-Based PNT Organization





## *U.S. Policy*



- Provide continuous worldwide access for peaceful uses, free of direct user charges
- Encourage compatibility and interoperability with foreign GNSS services and promote transparency in civil service provisioning
- Operate and maintain constellation to satisfy civil and national security needs
  - *Foreign PNT services may be used to complement services from GPS*
- Invest in domestic capabilities and support international activities to detect, mitigate and increase resiliency to harmful interference



# *U.S. Objectives in Working with Other GNSS Service Providers*



- Ensure **compatibility** – ability of U.S. and non-U.S. space-based PNT services to be used separately or together without interfering with each individual service or signal
  - Radio frequency compatibility
  - Spectral separation between M-code and other signals
- Achieve **interoperability** – ability of civil U.S. and non-U.S. space-based PNT services to be used together to provide the user better capabilities than would be achieved by relying solely on one service or signal
  - Primary focus on the common L1C and L5 signals
- Ensure a level playing field in the global marketplace

*Pursue through Bilateral  
and Multilateral Cooperation*



# *Keys to Successful U.S. Program*



- Policy Stability
- Transparency
- Program Stability
- Sustained Performance and Credibility
- Continuous Improvement

*Policy stability and transparency improve industry confidence and investment*



# *GPS IIF-4 Launch*



- Launched on 15 May 2013
- Satellite Vehicle Number 66
- PRN 27
- Set healthy 21 June 2013





## *GPS IIF Status*



- 4 total GPS IIFs on orbit
  - Enhanced GPS clock performance
  - Transmits the L5 signal in addition to the L1, L2 and L2C signals
- 8 more GPS IIFs in the pipeline
  - SV-3 (IIF-5) launch planned for late 2013
  - SVs 6-9 are in storage
  - SVs 10-12 are accepted pending testing



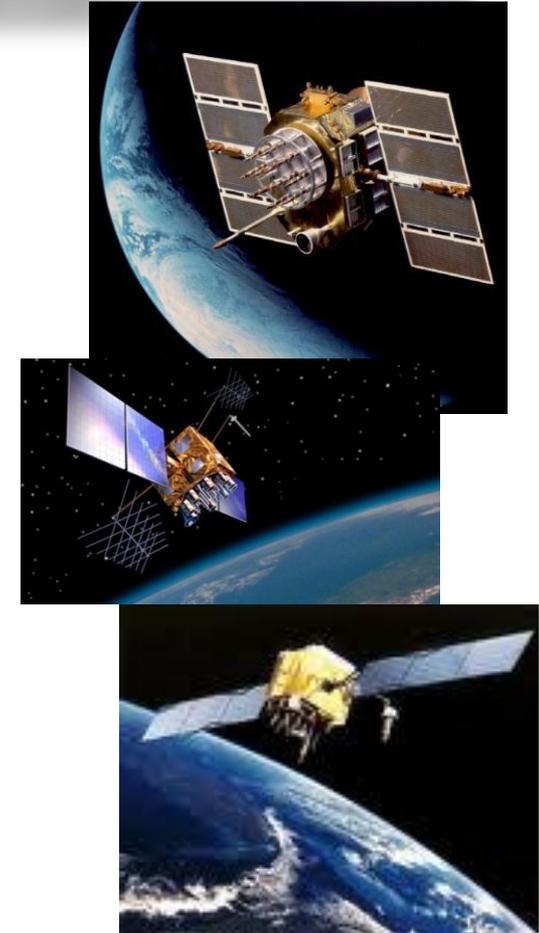


# GPS Constellation Status



*36 Satellites (31 Operational)  
(Baseline Constellation: 24+3)*

- 8 Block IIA
- 12 Block IIR
- 7 Block IIR-M
  - Transmitting new second civil signal
- 4 Block IIF
- 4 Additional satellites in residual status,  
1 in test status
- Global GPS civil service performance  
commitment met continuously since  
December 1993

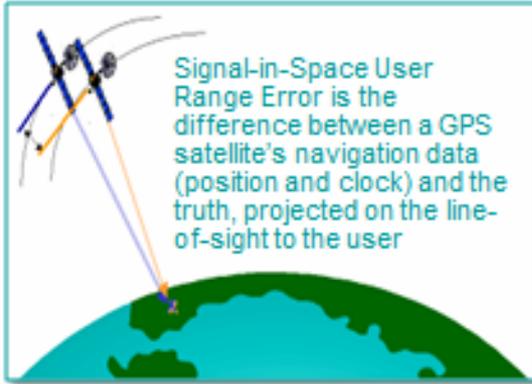




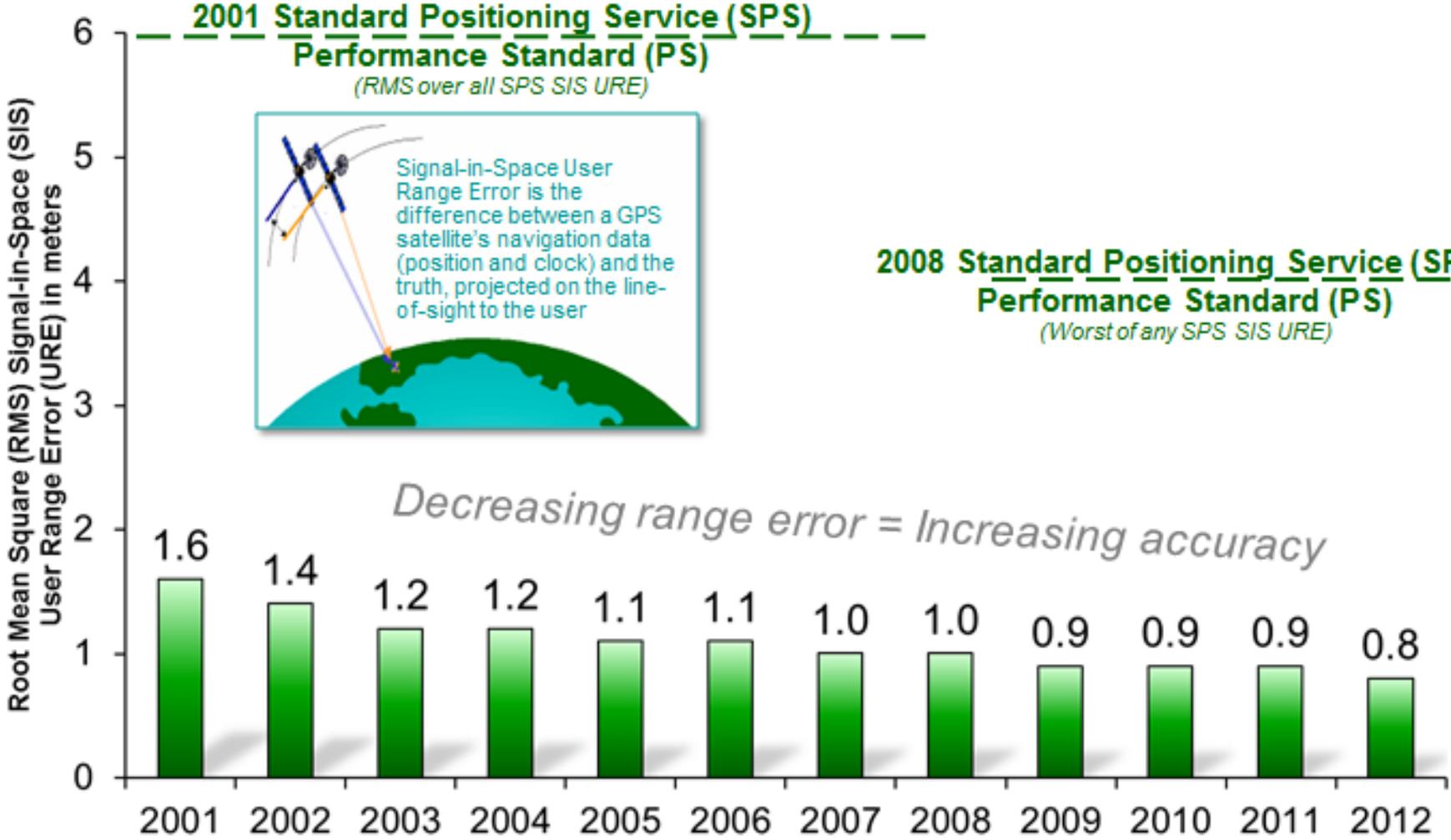
# Standard Positioning Service (SPS) Signal-in-Space Performance



**2001 Standard Positioning Service (SPS)  
Performance Standard (PS)**  
*(RMS over all SPS SIS URE)*



**2008 Standard Positioning Service (SPS)  
Performance Standard (PS)**  
*(Worst of any SPS SIS URE)*



**System accuracy exceeds published standard**



# GPS Modernization Program



## Legacy Block IIA/IIR

- Single Frequency (L1)
- Coarse acquisition (C/A) code
- Y-Code (L1Y & L2Y)

## Block IIR-M

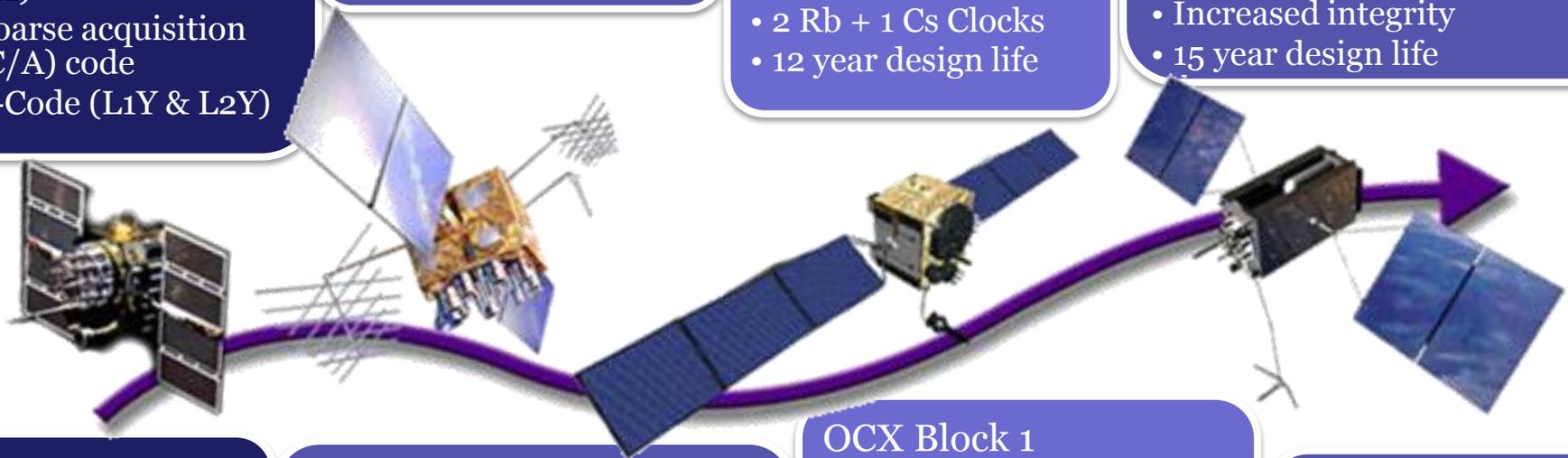
- 2<sup>nd</sup> Civil Signal (L2C)
- M-Code (L1M & L2M)

## Block IIF

- 3<sup>rd</sup> civil signal (L5)
- 2 Rb + 1 Cs Clocks
- 12 year design life

## Block III

- 4<sup>th</sup> civil signal (L1C)
- 4x better User Range Error than IIF
- Increased availability
- Increased integrity
- 15 year design life



## Legacy OCS

- Mainframe system
- Command & Control
- Signal monitoring

## AEP

- Distributed architecture
- Increased signal monitoring
- Security
- Accuracy
- Launch and disposal operations

## OCX Block 1

- Fly constellation + GPS III
- Control L2C and L5 signals
- Upgraded information assurance

## OCX Block 2

- Control L1C signal
- Capability On-Ramps
- GPS III evolution

**Increasing System Capabilities - Increasing User Benefit**



# Modernized Civil GPS Capabilities



- Second civil signal “L2C”
  - Designed to meet commercial needs
  - Available since 2005 without data message
  - Currently 11 satellites broadcasting L2c



## Third civil signal “L5”

- Designed to meet transportation safety of life requirements
- Uses Aeronautical Radio Navigation Service band
- Currently 4 satellites broadcasting L5



- Fourth civil signal “L1C”
  - Designed for GNSS interoperability
  - Specification developed in cooperation with industry
  - Launches with GPS III in 2015
  - Improved tracking performance



*Urban Canyons*

Improved  
performance in  
challenged  
environments

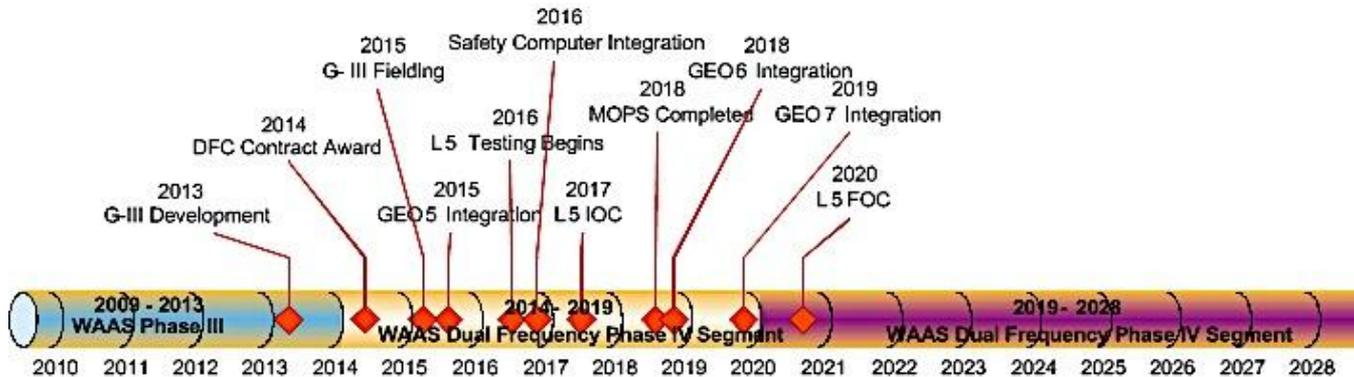




# WAAS Transition Strategy



- Implement 2<sup>nd</sup> Civil Signal L5
- Integrate 5<sup>th</sup> & 6<sup>th</sup> GEOs
- Develop Dual Frequency MOPs
- Evaluate Multi-Constellation



- 1 Wide-area Master Station
- 38 Wide-area Reference Station
- 6 Ground Uplink Station
- 2 O&M Console

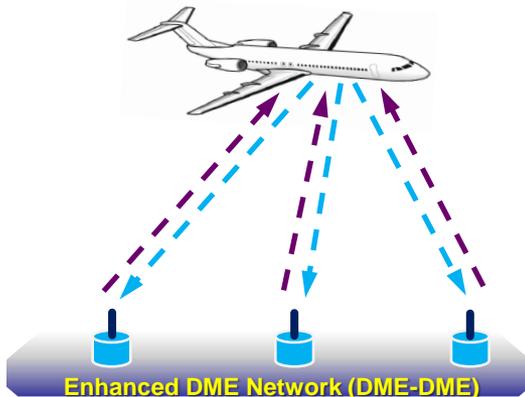


# Alternative Positioning, Navigation & Timing (APNT)

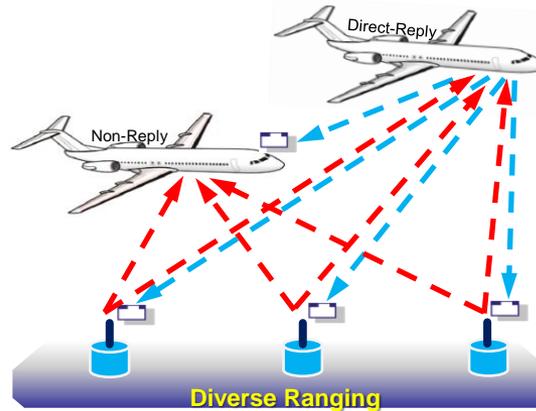


- National Policy requires FAA to provide a backup in the event of GPS interference or outage
- Today's legacy systems will not support the NextGen operational improvements, provides limited function for Area Navigation (RNAV), and no function for Required Navigation Performance (RNP) or Trajectory Based Operations (TBOs)
- The FAA is in the process of designing an APNT system, various alternatives are being discussed

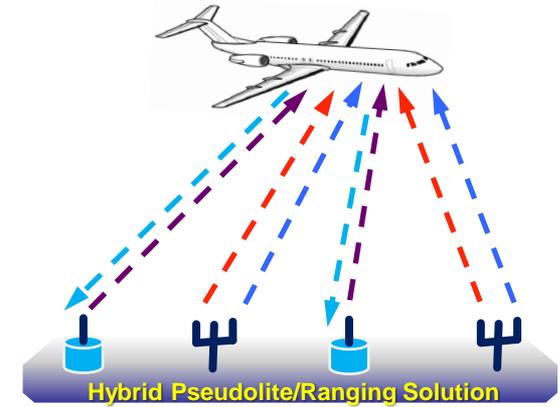
## Alternatives under evaluation



- Leverages Existing DME/DME Technology
- RNAV Today; Impacts to Avionics to realize RNP
- Evaluating means to support both IRU and non-IRU aircraft



- New Concept
- Uses Ground and Aircraft-based emitters for coverage
- Leverages Planned and Existing ADS-B Technology and Air/Ground Infrastructure
- Provides precise time to aircraft
- Has an impact to Avionics



- New Concept
- Leverages DME/GBT Infrastructure
- Provides precise time to aircraft
- Has an impact to Avionics

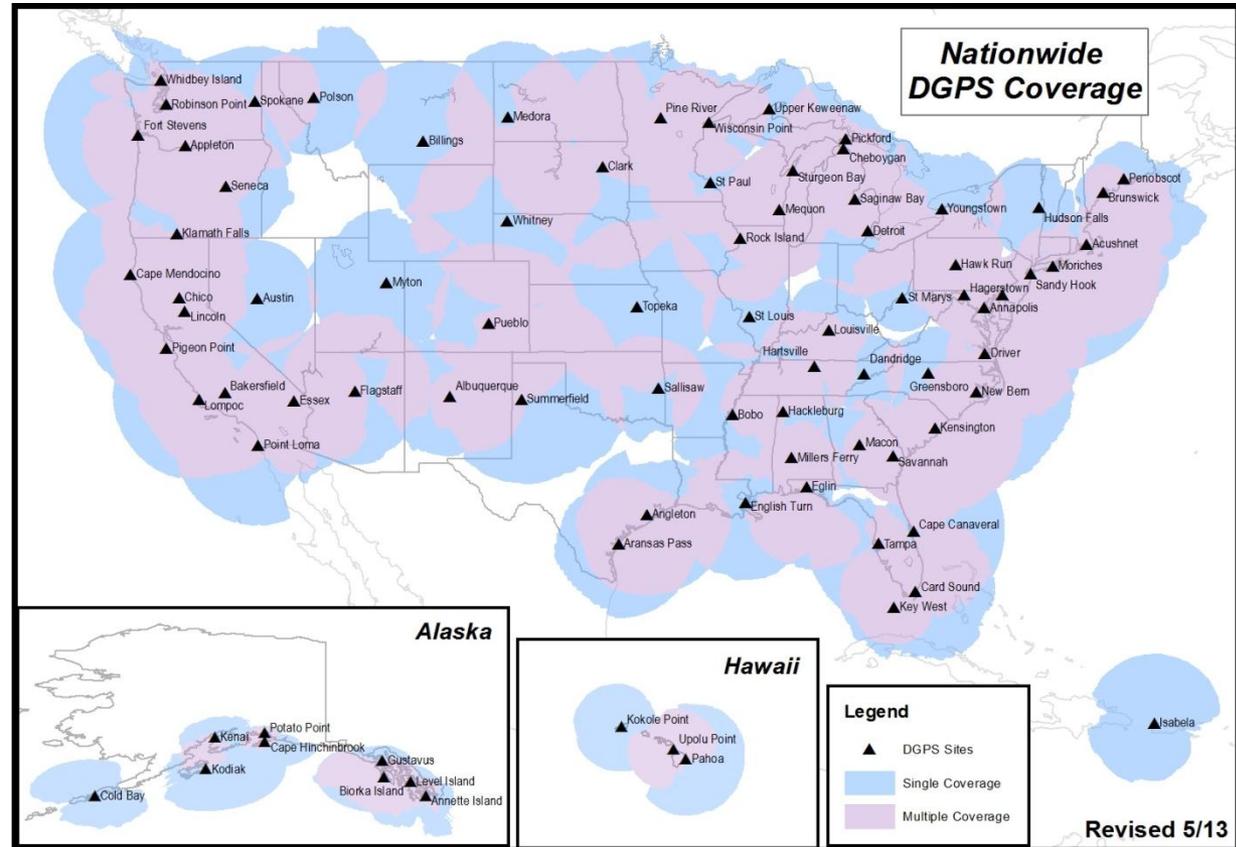


# Nationwide Differential GPS (NDGPS)



Sponsors: U.S.  
Coast Guard &  
Department of  
Transportation

- 80+ sites
- Broadcasts  
GPS correction  
signals
- Improved  
accuracy &  
integrity





# *Assessment of Future of NDGPS*



- Joint U.S. Coast Guard & Department of Transportation Federal Register Notice 16 April 2013
  - Assessment driven by many factors: from policy to technology
  - Asked how NDGPS is used, impact/alternatives if discontinued
  - Few comments received; Docket still open for additional comments
- Next Steps: Identify and assess alternatives
  - Continuation/partial decommission/transfer/hybrid
- Decision timeline: No earlier than summer 2014
  - Supports investment decisions in 2016
- Continue uninterrupted NDGPS service to users as currently provided until future decision reached
- Public/user community information/ involvement in decision processes and next steps

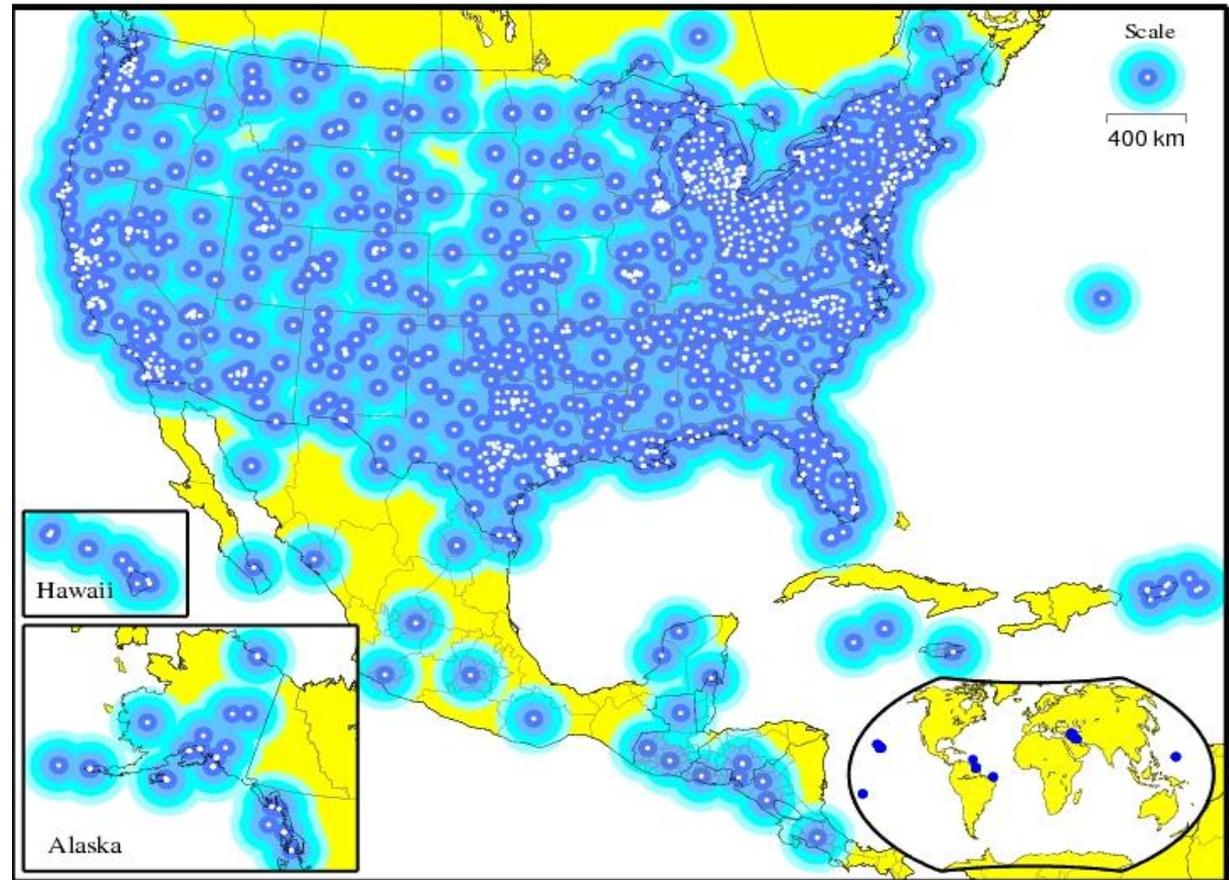


# *National Continuously Operating Reference Stations (CORS)*



Sponsor: National Oceanic and Atmospheric Administration

- 1,900+ sites
- Operated by 200+ academic organizations
- Enables highly accurate, 3-D positioning





# Summary

- The U.S. supports free access to civilian GNSS signals and all necessary public domain documentation
  - GPS.gov -- official public resource for U.S. Government (USG) information about GPS and related topics
- GPS is a critical component of the global information infrastructure
  - Compatible with other satellite navigation systems and interoperable at the user level
  - Guided at a national level as multi-use asset
  - Acquired and operated by the Air Force on behalf of the USG
- The U.S. policy promotes open competition and market growth for commercial GNSS

*GPS continues to provide  
consistent, predictable, dependable performance*



*Thank You !*

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