



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

4th International Committee on GNSS

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Space-Based Positioning, Navigation, and
Timing***



Overview



U.S. Space-Based PNT Policy

Robert Hessin

**Global Positioning System
Description**

David Buckman

GPS Augmentations

Leo Eldredge

Summary



Introduction



- Over the past decade, GPS has grown into a global utility providing space-based positioning, navigation and timing (PNT)
 - Consistent, predictable, dependable policy and performance
 - Augmentations improve performance even further



- Like the Internet, GPS has become a critical component of the global information infrastructure
 - Scalable applications enabling broad new capabilities
 - Facilitating innovations in efficiency, safety, environmental, public security, and science



U.S. Space-Based PNT Policy



GOAL: Ensure the U.S. maintains space-based PNT services, augmentation, back-up, and service denial capabilities that...

- Provide uninterrupted availability of PNT services
- Meet growing national, homeland, economic security, and civil requirements, and scientific and commercial demands
- Remain the pre-eminent military space-based PNT service
- Continue to provide civil services that exceed or are competitive with foreign civil space-based PNT services and augmentation systems
- Remain essential components of internationally accepted PNT services
- Promote U.S. technological leadership in applications involving space-based PNT services



U.S. Policy/Law Promotes Commercial Markets/Applications Growth

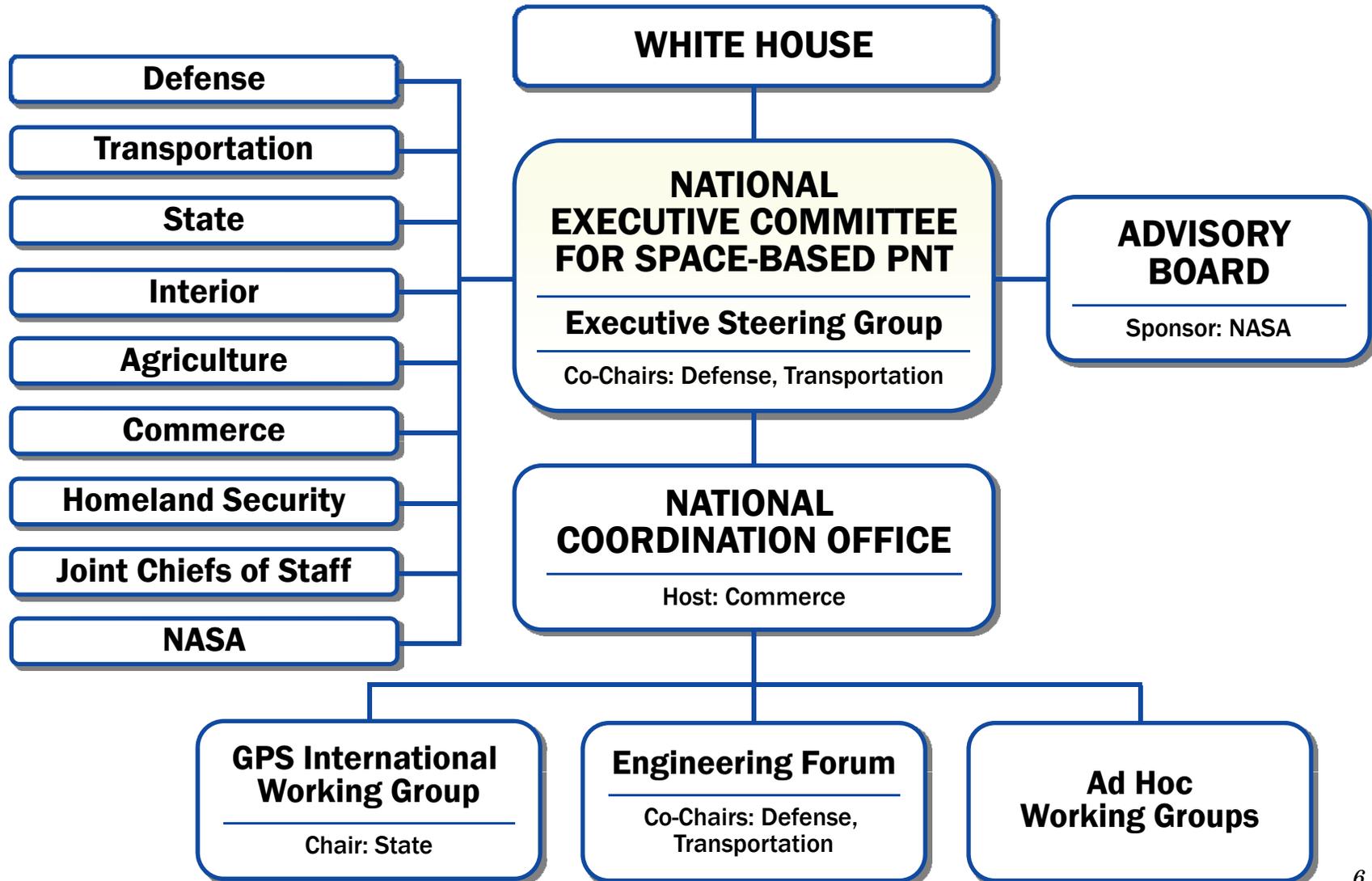


- Provide civil PNT services through GPS and augmentations **free of direct user fees** on a continuous, worldwide basis
- Provide open, **public access to information** needed to use these services
- **Improve performance** of GPS and augmentations
- Seek to ensure that international space-based PNT systems are **interoperable** with civil GPS and augmentations or, at a minimum, are compatible

Policy stability and transparency improve industry confidence and investment



U.S. Space-Based PNT Organizational Structure





U.S. Policy Promotes Global Use of GPS Technology



- **No direct user fees for civil GPS services**
 - Provided on a continuous, worldwide basis
 - Including both current and future civil GPS services
- **Open, public signal structures for all civil services**
 - Promotes equal access for user equipment manufacturing, applications development, and value-added services
 - Encourages open, market-driven competition
- **Service improvements for civil, commercial, and scientific users worldwide**
- **Protection of radionavigation spectrum from disruption and interference**
- **Global compatibility and interoperability with GPS**



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

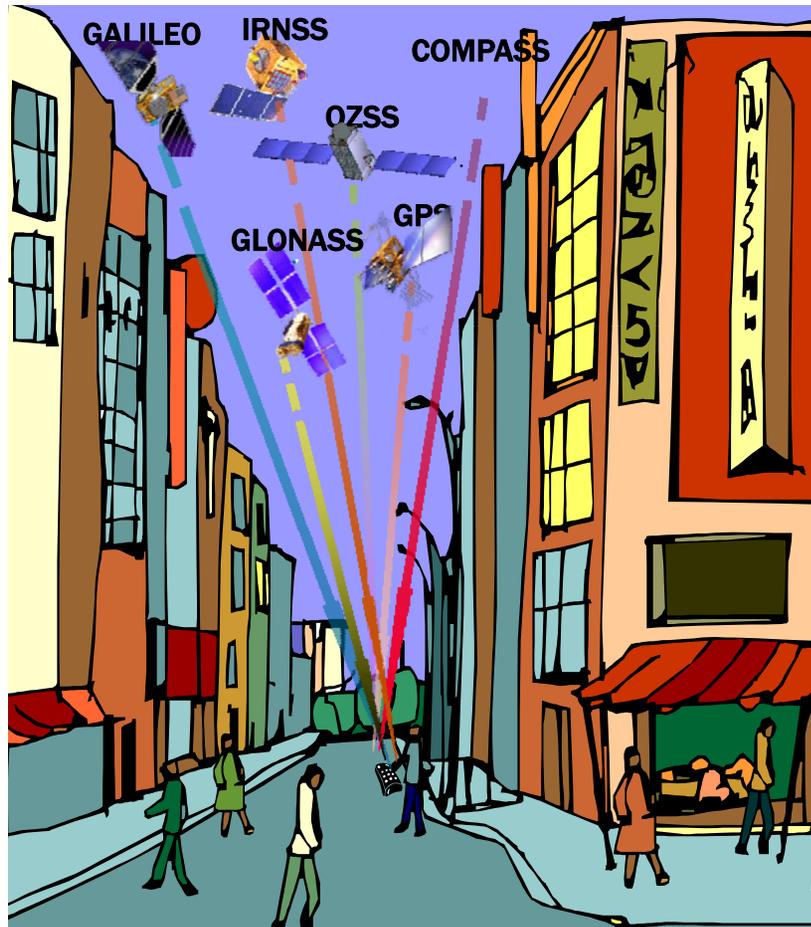


- Ensure **compatibility** – ability of U.S. and non-U.S. space-based PNT services to be used separately or together without interfering with each individual service or signal
 - Radio frequency compatibility
 - Spectral separation between M-code and other signals
- Achieve **interoperability** – ability 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



The Goal of GNSS Civil Interoperability



- **Compatibility**
 - Do no harm
- **Interoperability** provides users a PNT solution using signals from different GNSS systems:
 - No additional receiver cost or complexity
 - No degradation in performance

Interoperable = Better Together than Separate



Summary



- The U.S. supports free access to civilian GNSS signals with public domain documentation necessary to develop user equipment
- 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 Air Force on behalf of the USG
- The U.S. policy promotes open competition and market growth for commercial GNSS

GPS is a Global Public Service providing consistent, predictable, dependable performance



GPS Status and Modernization

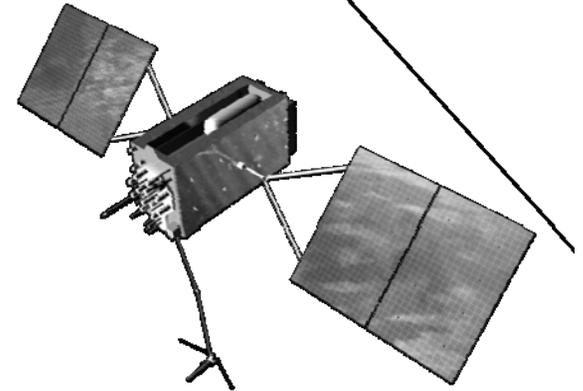
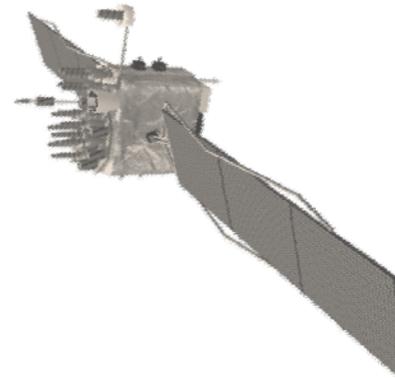
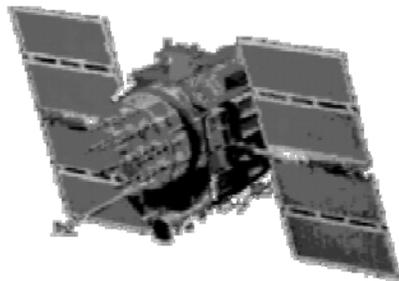
David Buckman
Positioning, Navigation and Timing Command Lead
Air Force Space Command



Overview



- GPS Today
- GPS Tomorrow
- Recent Topics
- Summary





...GPS Today...

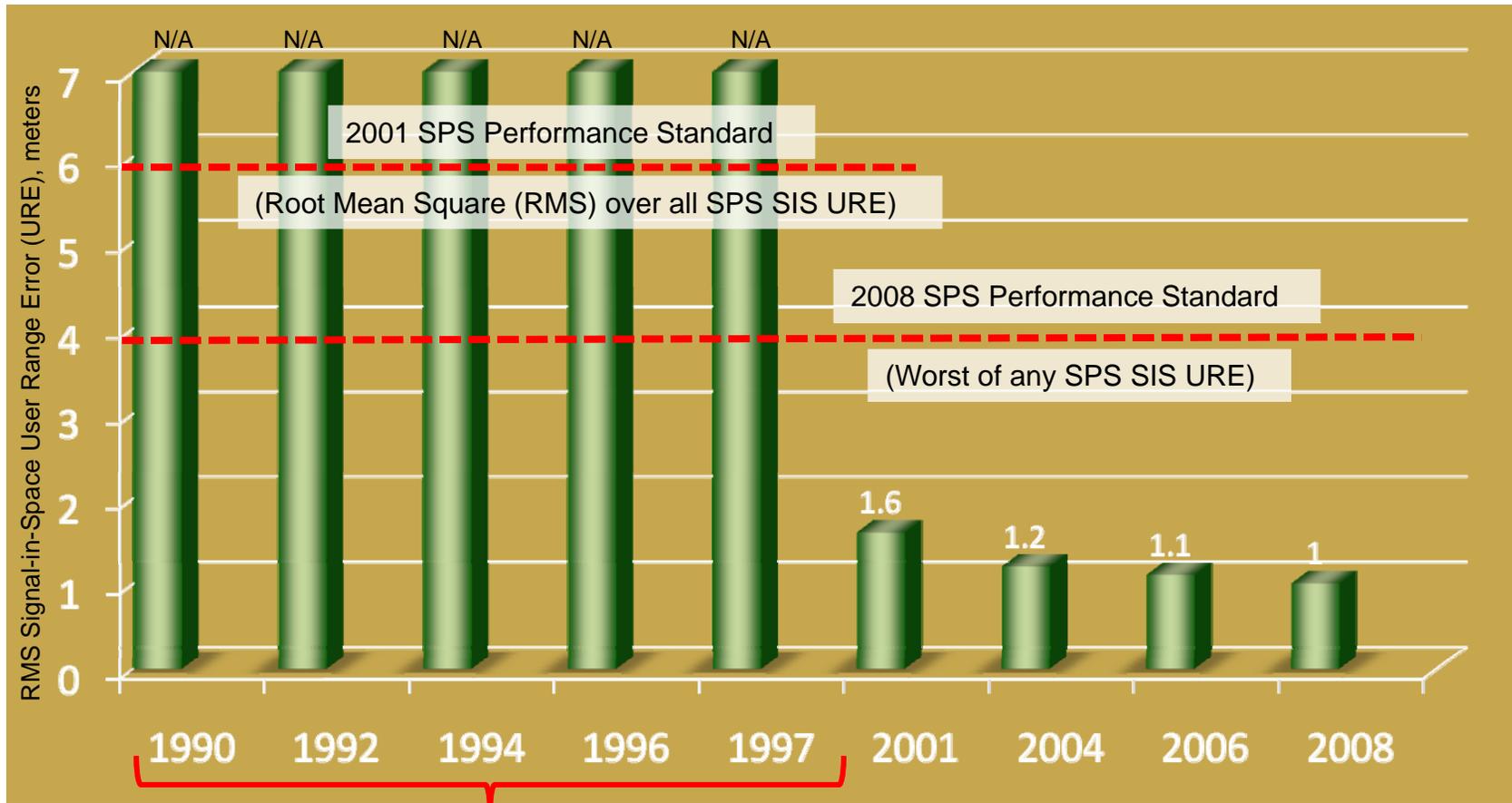


- Operated by Space Professionals in 2nd Space Operations Squadron at Schriever AFB, CO
- Largest Ever Constellation
 - 11 Block IIA
 - 12 Block IIR
 - 7 Block IIR-M + 1 in on-orbit test
- Residual Satellites
 - 4 Block IIA
- Most Recent Launch
 - IIR-21(M) – 8th & Final IIR(M)
 - Launched 17 Aug 09
 - SVN 50
 - Last Delta II Booster for GPS Launch
- Next Launches
 - IIF-1 – CY10





...GPS Today... SPS Signal in Space Performance

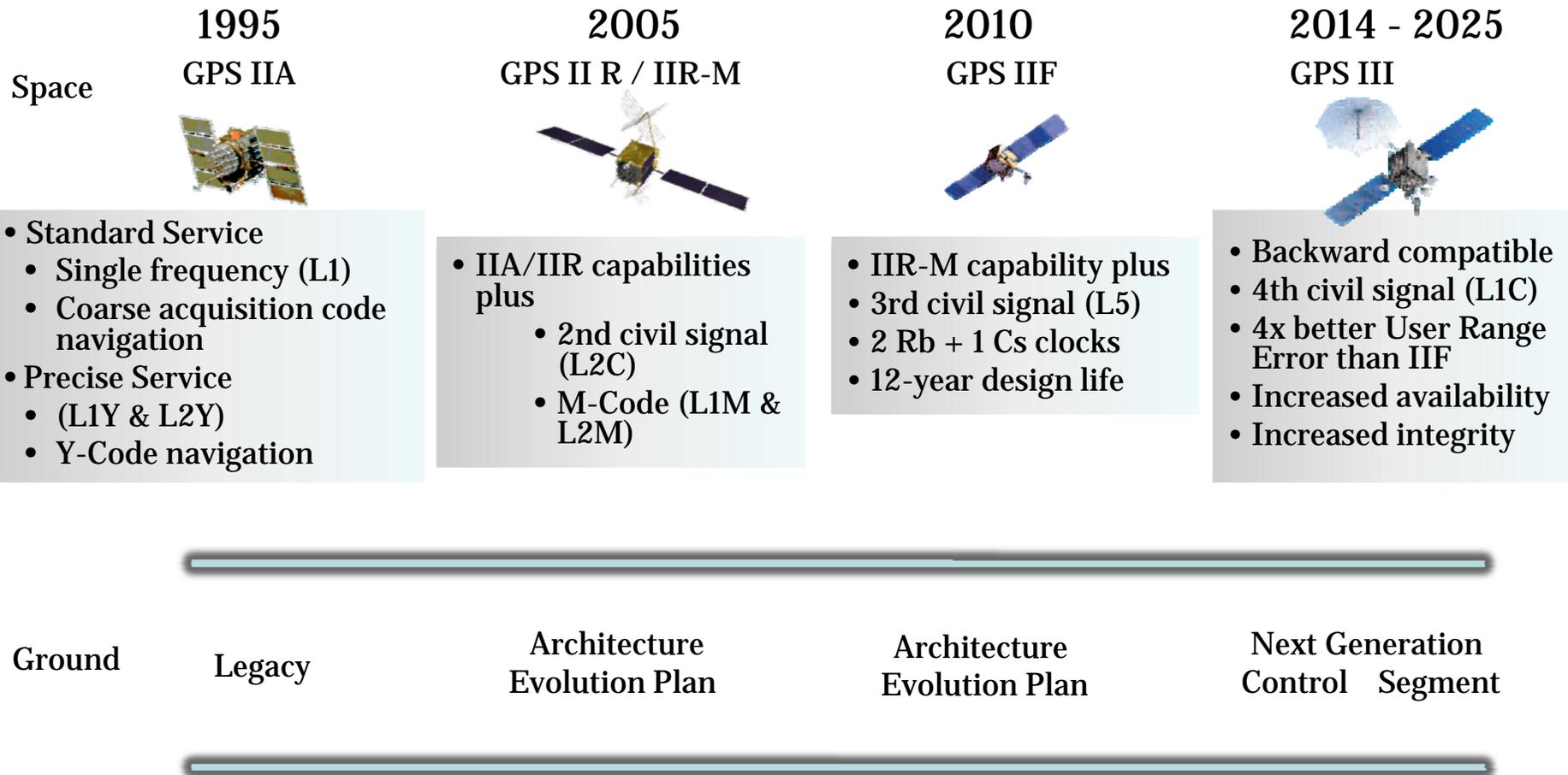


Selective Availability

System accuracy exceeds published standard



...GPS Tomorrow...





...GPS Tomorrow... New Signals



- **L2C**
 - Provides high-performance Civilian Navigation Message (CNAV) and ionospheric correction for civil users with L1C/A
 - Transmissions began 2005 on IIR-M vehicles
 - Currently, 7 IIR-Ms transmitting L2C dataless
 - “Type 0” CNAV messages will begin Fall 2009
 - Allows UE manufacturers to begin developmental testing with ICD-compliant L2C broadcasts
 - Full CNAV implementation on IIR-M, IIF and III with OCX
- **L5**
 - Provides safety-of-life applications, is open to all users, and protected in Aeronautical Radionavigation Service band
 - On-orbit broadcast 10 Apr 2009 secured ITU frequency filing with dataless broadcast on IIR-M (20)
 - Full CNAV implementation on IIF and III with OCX



...GPS Tomorrow... Semi-codeless Transition



- GPS receivers attain very high accuracy by using "codeless" or "semi-codeless" techniques that exploit the encrypted military GPS signals without actually decoding them
- Techniques will no longer be necessary once the new civil GPS signals are fully operational
- US government published a notice for users to transition to GPS civil-coded signals by December 31, 2020
 - Provided time for an orderly and systematic transition
 - Based on launch schedule and projected budget
- US government led community-wide collaboration on this transition plan
- US is committed to continually improving GPS services as users complete a timely transition to dual-coded civil GPS equipment
 - Example of successful communication and collaboration...win-win situation



...GPS Tomorrow... New Control Segment



- Architecture Evolution Plan (AEP)
 - Transitioned in 2007
 - Modern distributed system replaced 1970's era mainframe
 - Increased capacity for monitoring of GPS signals to 100% worldwide coverage (was 96.4%) and have 99.8% of world double covered
 - Increased worldwide commanding capability from 92.7% to 94.5% while providing nearly double the backup capability
- Next Generation Control Segment (OCX)
 - Commands & monitors all GPS signals
 - Including modernized signals (L2C, L5, L1C, M-code)
 - Two development contracts awarded – Nov 07
 - Down select of contract in 2009
 - Net-centric architecture
 - Enhanced security



Recent Topics



- GAO stated concern in an the April 2009 report regarding AF “ability to acquire new satellites in time to maintain current GPS service without interruption.”
- Air Force testified before Congress on 7 May 2009 on constellation sustainment strategy
 - Timely acquisition supported by mission assurance practices incorporating lessons learned from IIF program
 - Robust risk mitigation methods including use of residual satellites, power management , and launch schedule adjustment
- US Air Force
 - Committed to meeting or exceeding our performance commitments to worldwide users...as we have for 14 years!



Summary



- GPS is healthy – largest constellation ever, producing best signals ever
 - Tremendous accomplishments in the last year
- GPS moving forward with development and deployment of new civil signals -- improving navigation accuracy and robustness
- Each segment modernizing with ‘reduced–risk’ steps
- International cooperation critical to future successes

GPS -- Serving the World



GPS Augmentation Systems

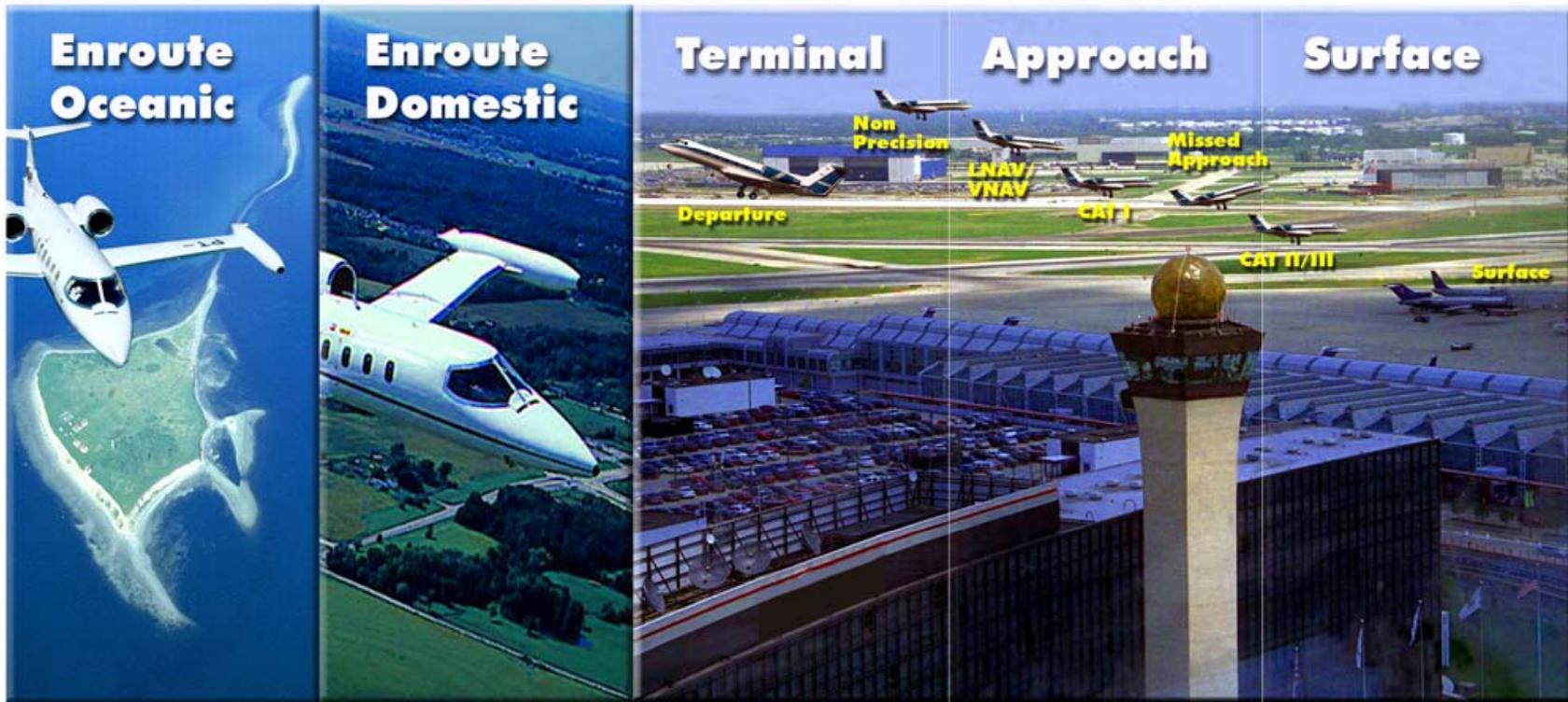
*Leo Eldredge
GNSS Group
Federal Aviation Administration*



FAA GPS Augmentation Programs



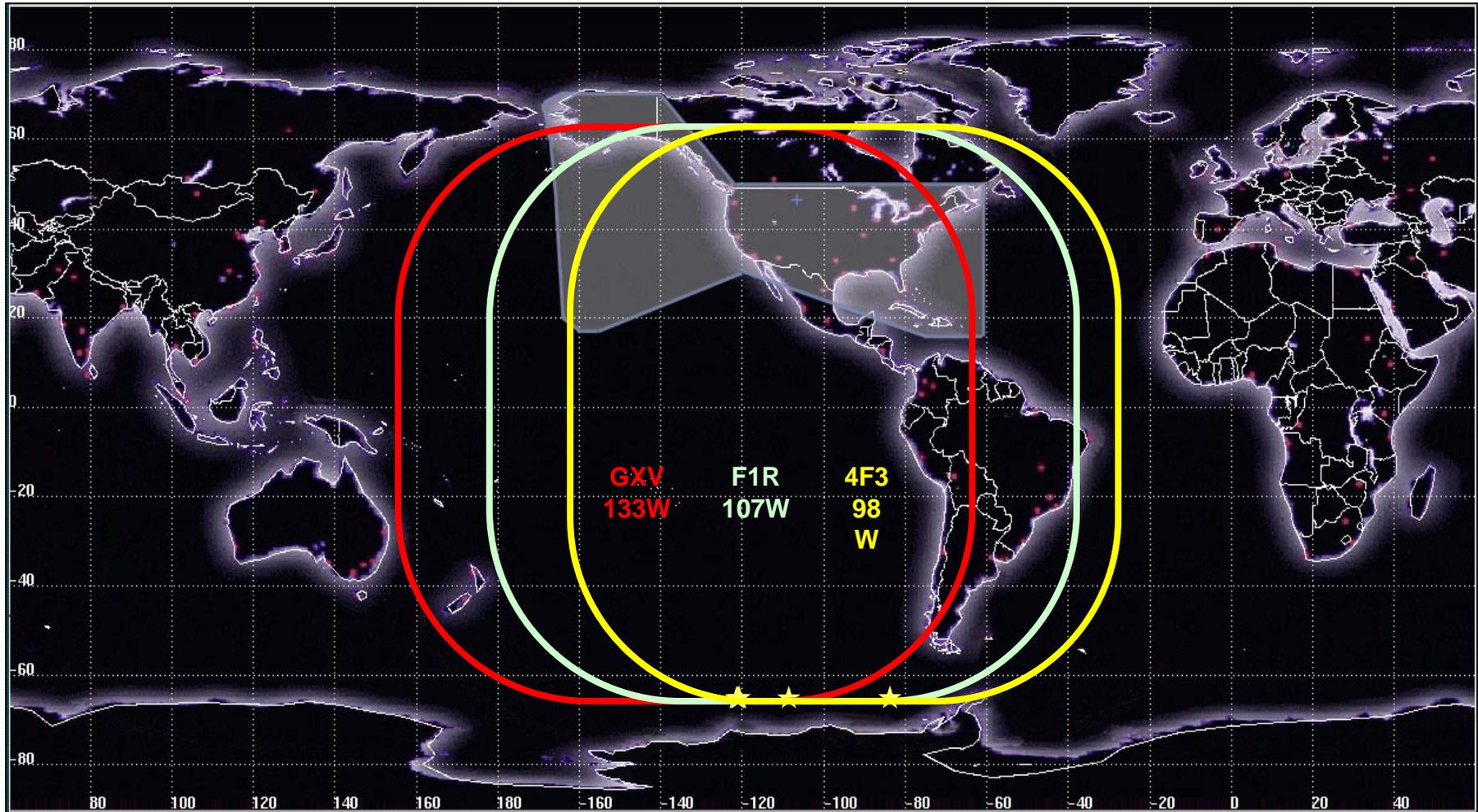
WAAS



LAAS

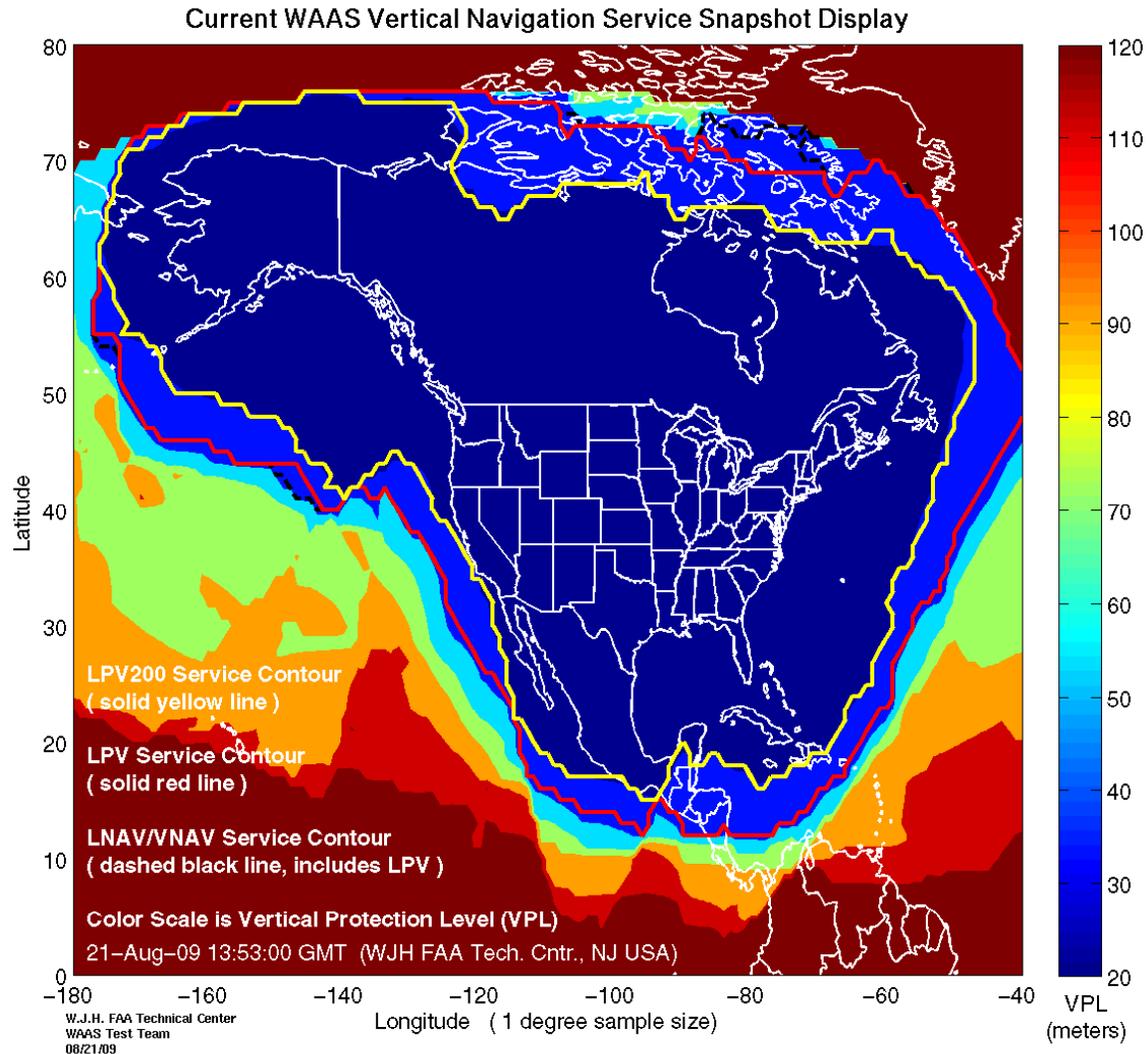


GEO Satellite Coverage Plot



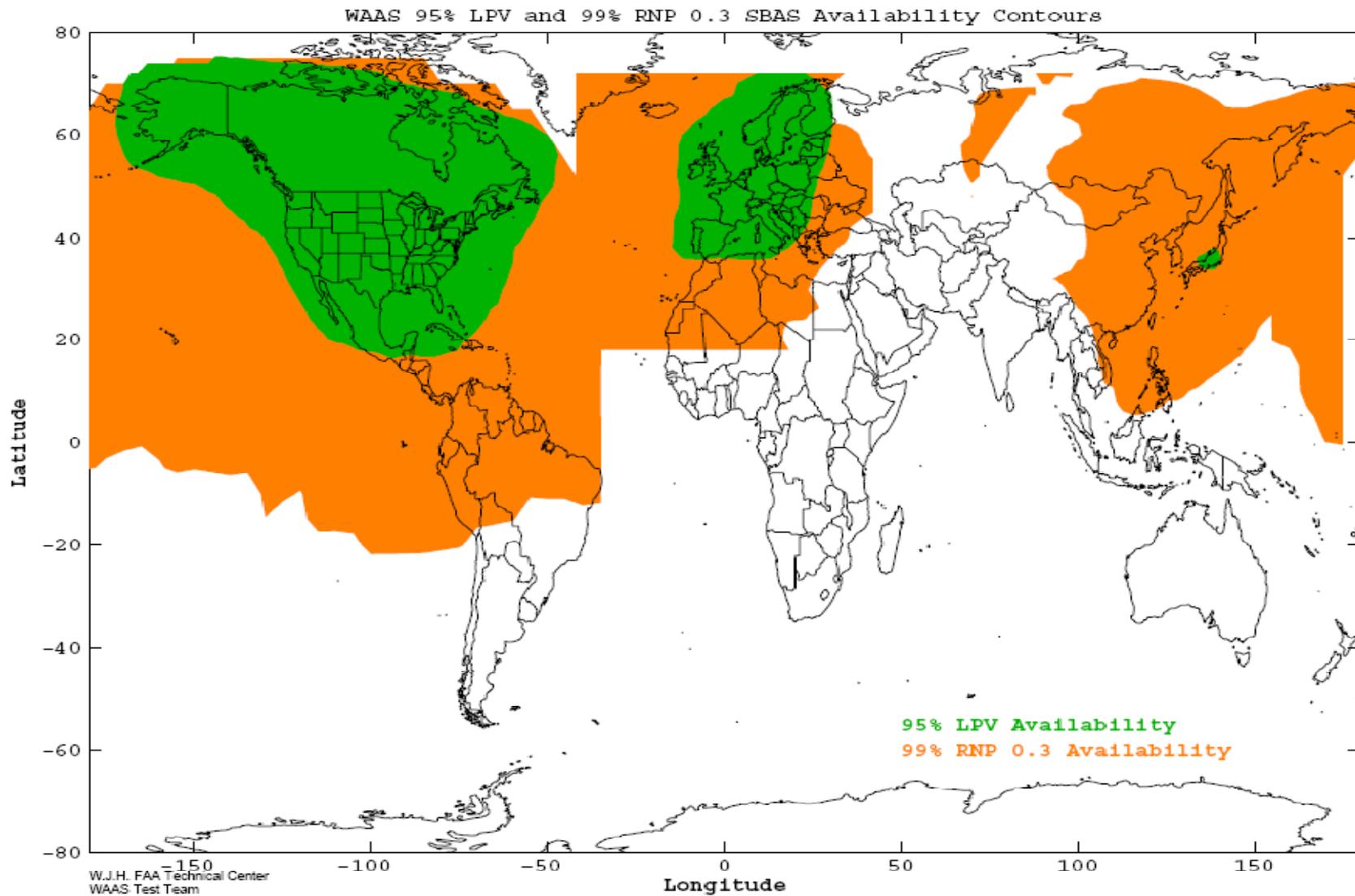


Localizer Performance Vertical (LPV)



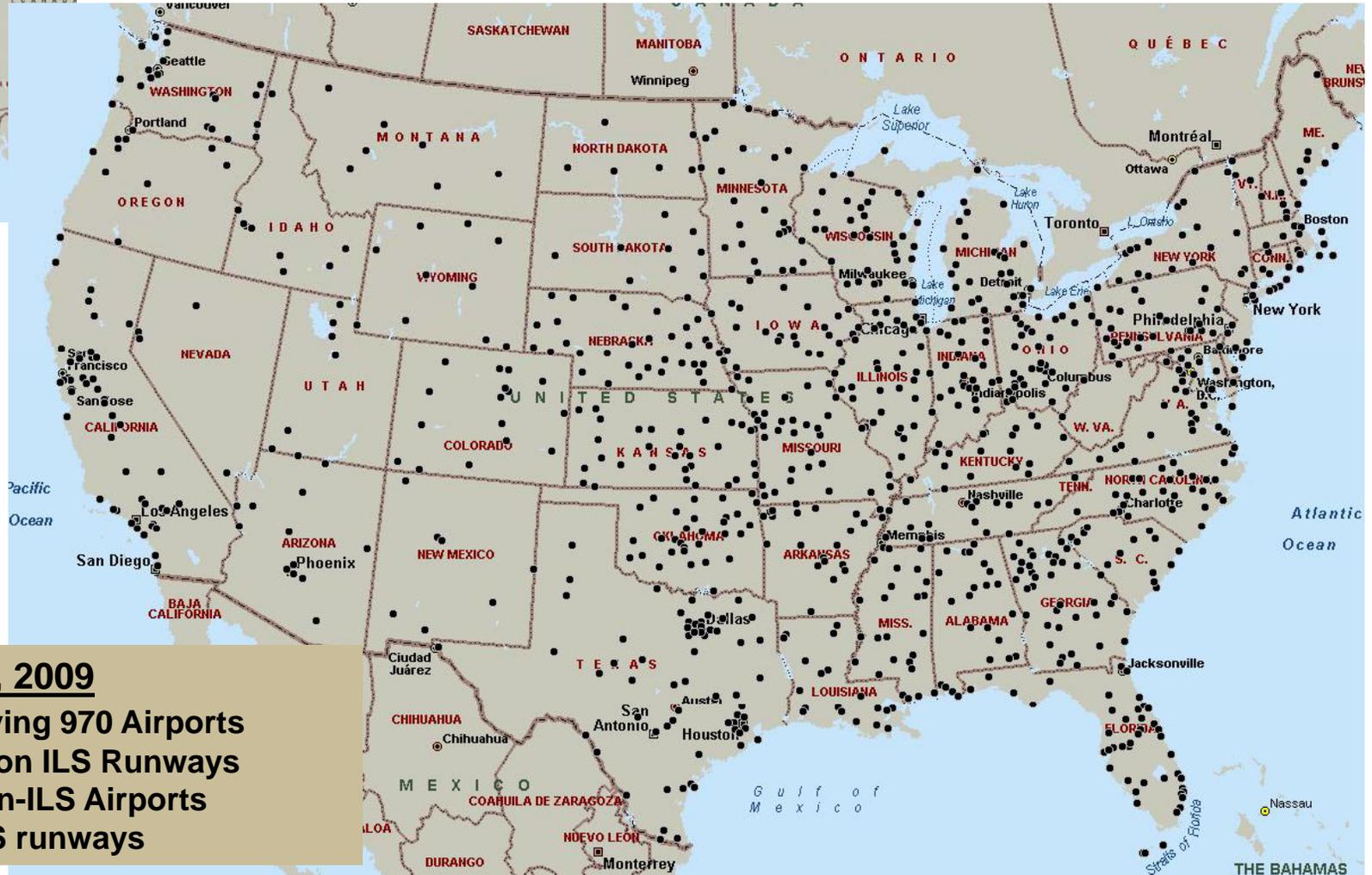


Global SBAS Coverage





Airports with WAAS Supported Instrument Approaches with Vertical Guidance



As of Aug 27th, 2009

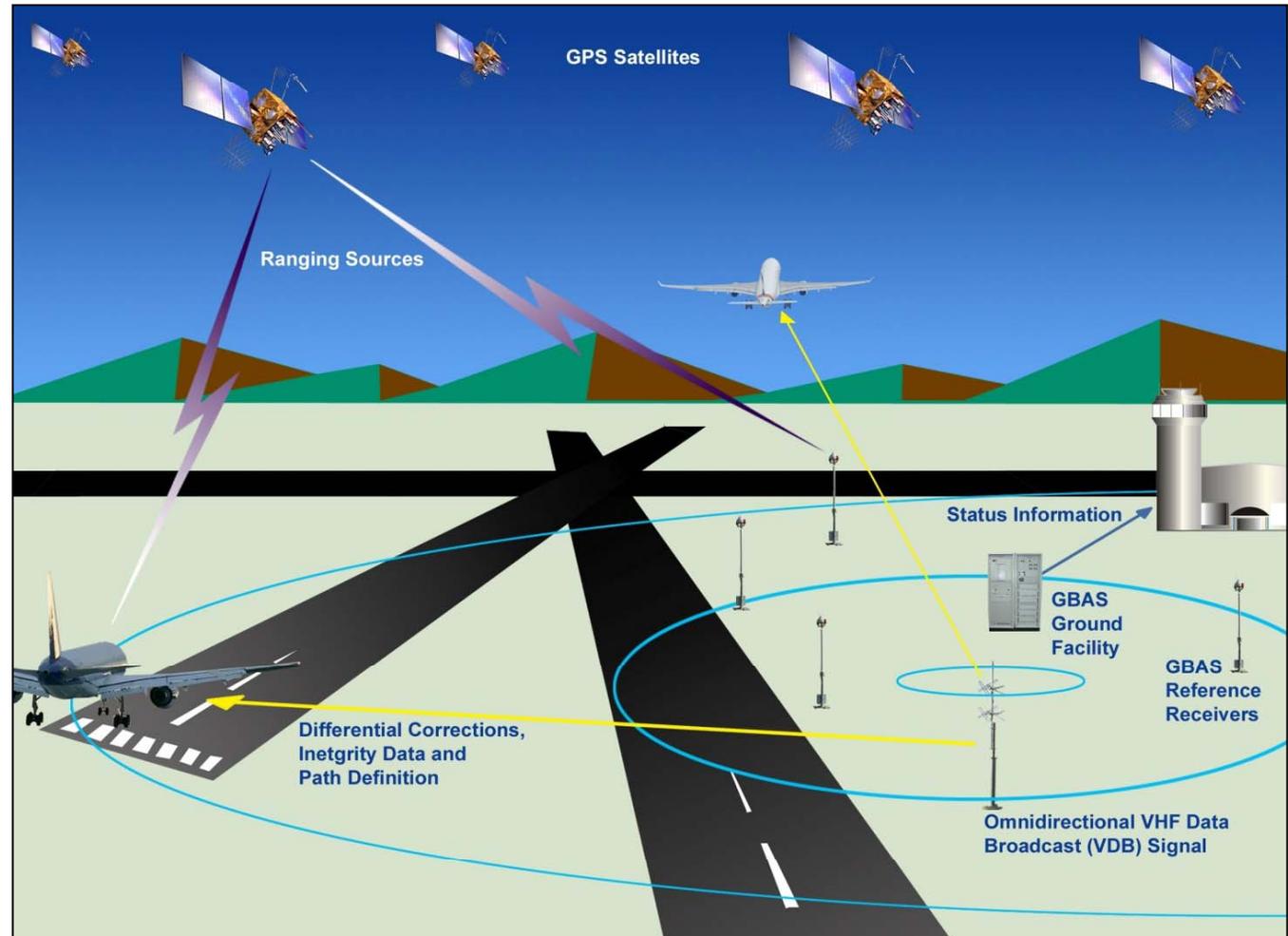
- 1,822 LPVs serving 970 Airports
- 1049 LPVs to non ILS Runways
- LPVs to 678 non-ILS Airports
- 773 LPVs to ILS runways



Local Area Augmentation System (LAAS)



- Precision Approach For CAT- I, II, III
- Multiple Runway Coverage At An Airport
- 3D RNP Procedures (RTA), CDAs
- Navigation for Closely Spaced Parallels
- Super Density Operations





GBAS Pathway Forward

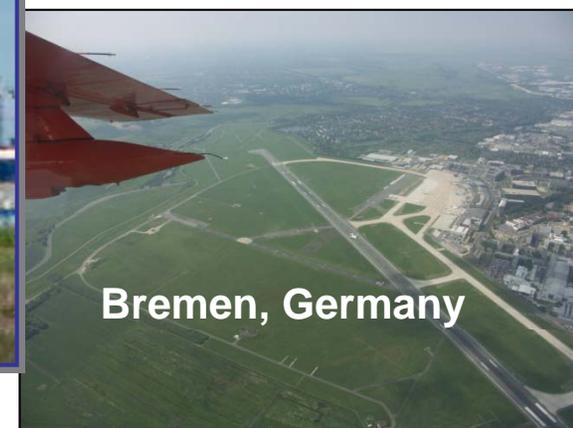
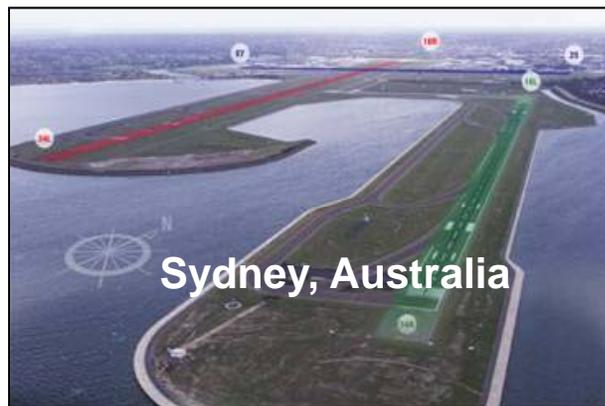
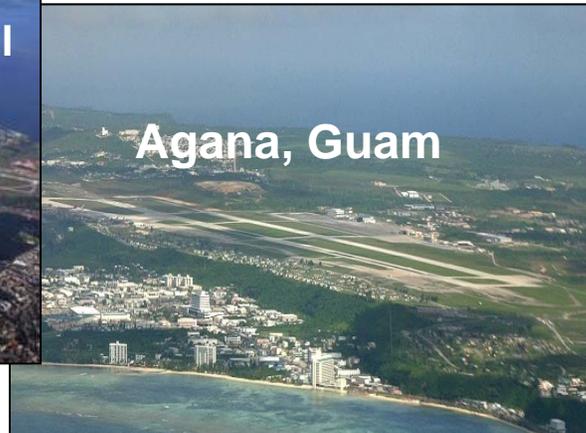


- Cat-I System Design Approval at Memphis – Complete
- Cat-III Validation by - 2010
- Cat-III Final Investment Decision by - 2012





LAAS/GBAS International Efforts





Nationwide Differential GPS (NDGPS)



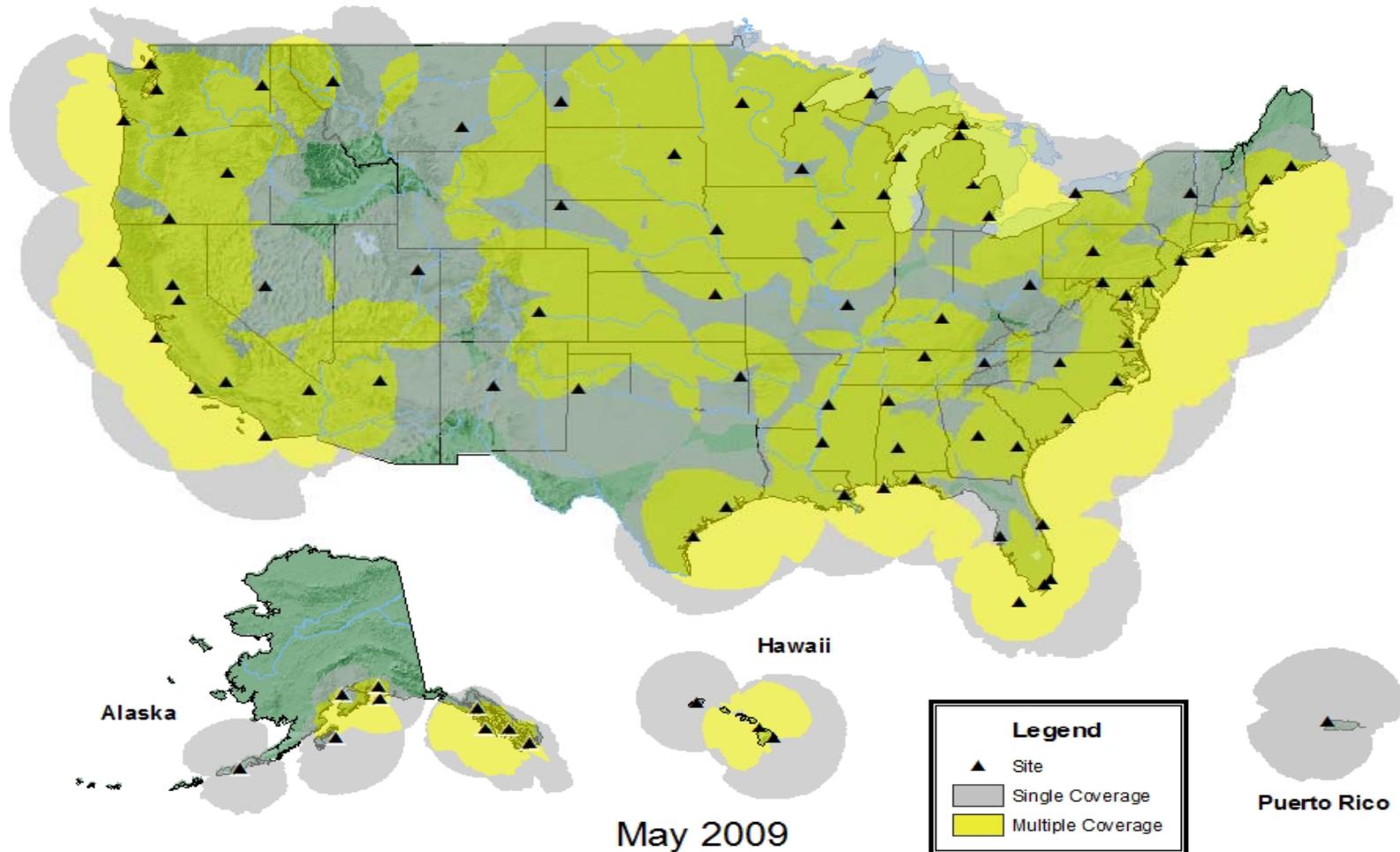
- **NDGPS is a National PNT Utility**
 - Operated/managed by U.S. Coast Guard as a Combined NDGPS (50 Maritime sites + 29 DOT [“inland”] + 9 Corps of Engineers [“waterway”] sites)
- **Single coverage terrestrial over 92% of CONUS; double coverage over 65% of CONUS**
- **Serving multiple user communities**
 - Surface/Maritime Transportation
 - Agriculture
 - Environmental and Natural Resources Management
 - Weather Forecasting
 - Precision Positioning (CORS)



Nationwide Differential GPS (NDGPS)



Nationwide DGPS Coverage





Summary



- **WAAS currently providing service to aviation in the U.S. National Airspace System**
- **LAAS system design approval for Category-I completing in September**
- **LAAS activity to continue to Category-II/III**
- **NDGPS covering 92% of CONUS and serving multiple user communities**



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