

Navigation Services and the U.S. National Airspace System

By: Leo Eldredge, Global Navigation Satellite
Systems Group Program Manager

Date: May 5, 2008



Federal Aviation
Administration





Federal Aviation Administration

Vision: To improve the safety and efficiency of aviation, while being responsive to our customers and accountable to the public

Air Traffic Organization

Safety. Service. Value.

**Leading Aviation Services
into the Future**



Navigation Services Vision

Provide safe, cost effective *position, navigation, and timing* services to meet operational needs of aviation customers

Note – Navigation services vision serves the FAA Mission and ATO Corporate Principles



Positioning, Navigation and Timing (PNT)

- **Positioning**

- The ability to accurately and precisely determine one's location and orientation two dimensionally (or three dimensionally when required) referenced to a standard geodetic system (such as World Geodetic System 1984, or WGS84);

- **Navigation**

- The ability to determine current and desired position (relative or absolute) and apply corrections to course, orientation, and speed to attain a desired position anywhere around the world, from sub-surface to surface and from surface to space; and

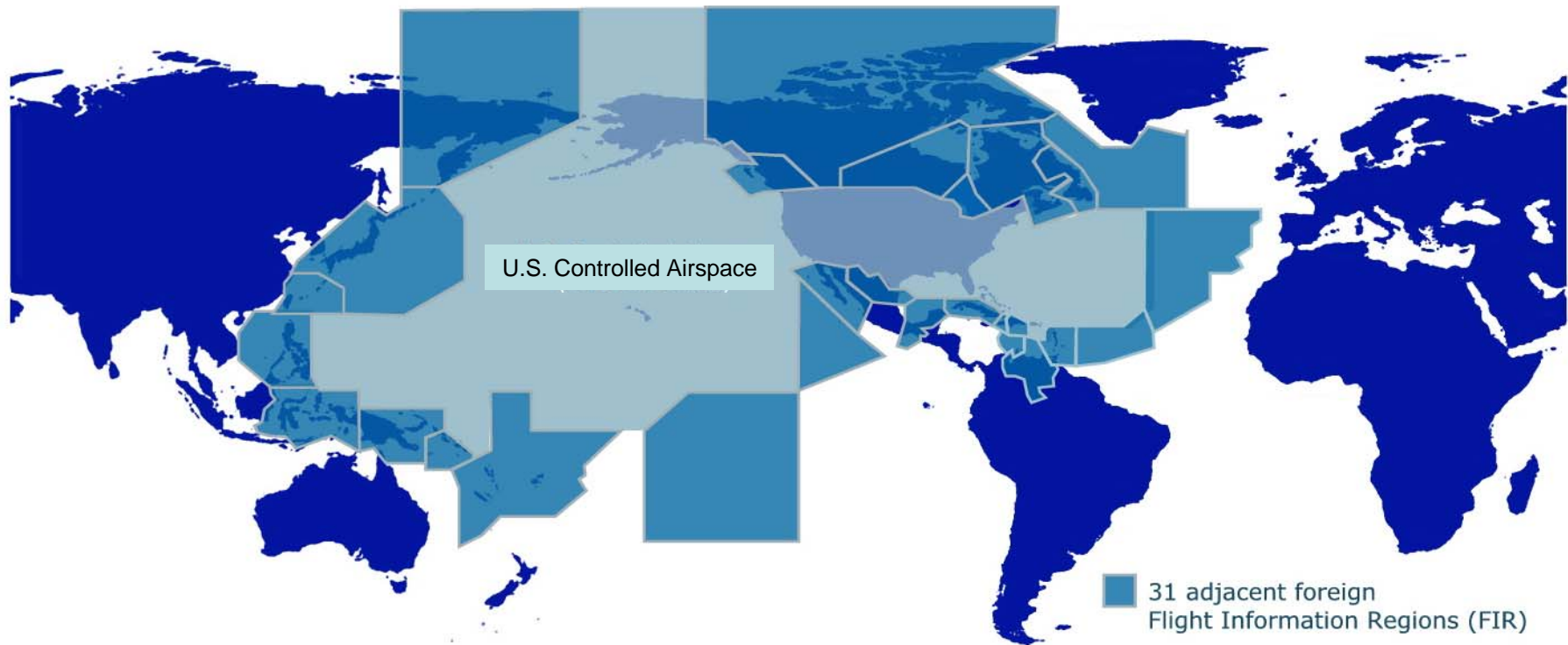
- **Timing**

- The ability to acquire and maintain accurate and precise time from a standard (Coordinated Universal Time, or UTC), anywhere in the world and within user-defined timeliness parameters. Timing includes time transfer.

National Space Based PNT Policy December 2004

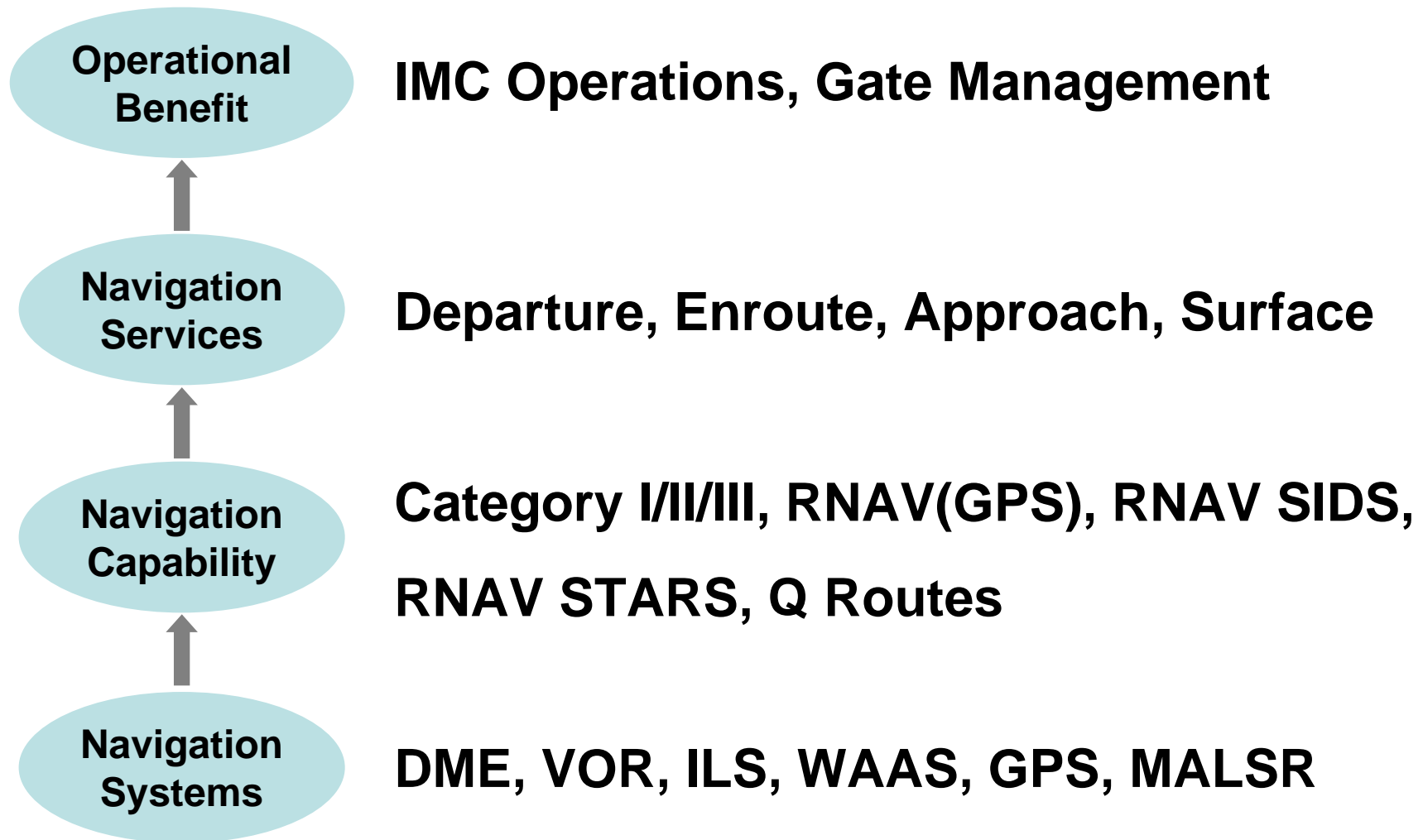


Int'l Cooperation... A Necessity

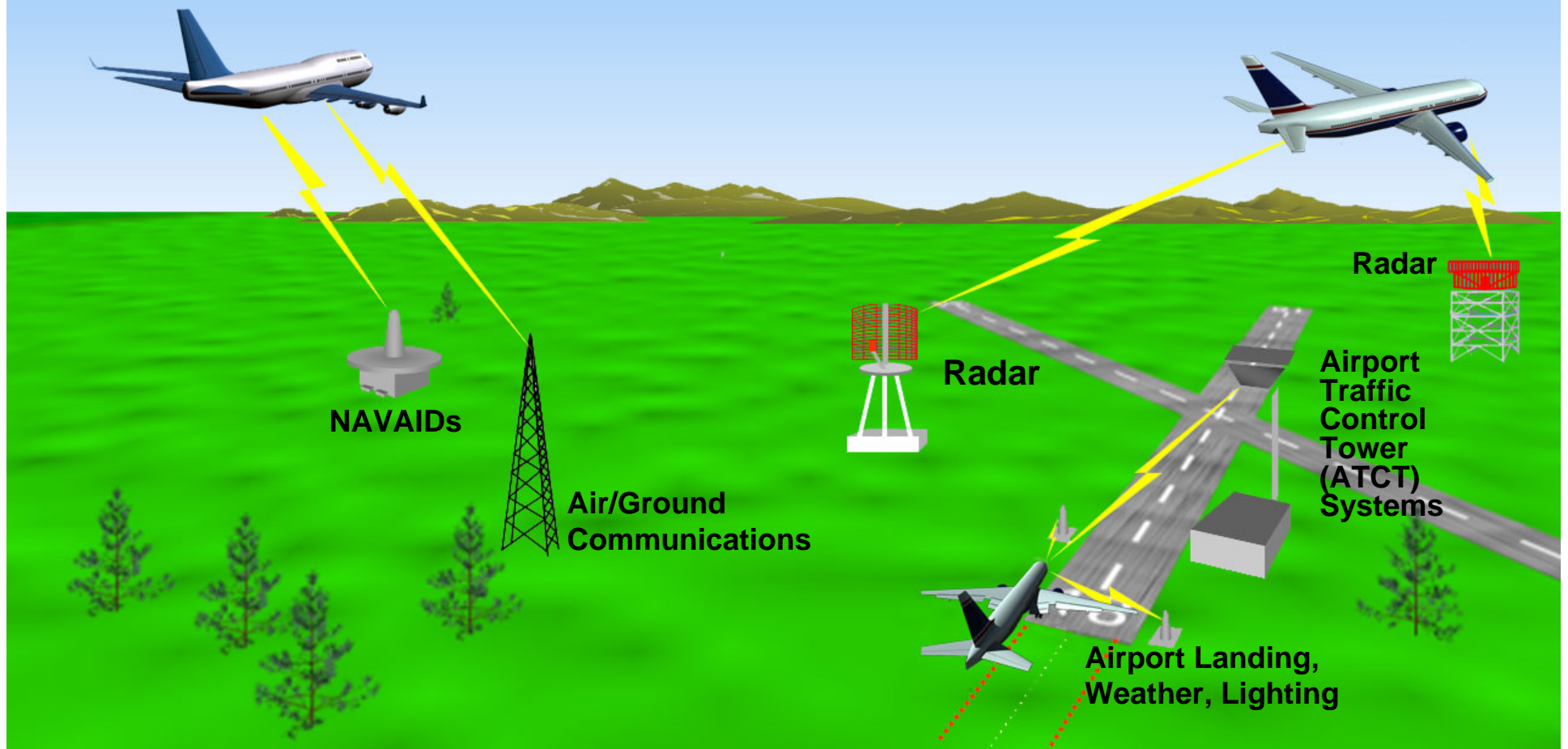


- **U.S. Assigned Airspace Equals 77 Million Square Kilometers**

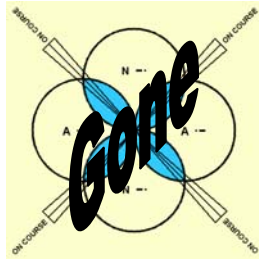
Navigation Operational Benefits Hierarchy



Today's *ground based, human-centered* Air Transportation System is reaching its technological and capacity limits



Evolution of Navigation Systems



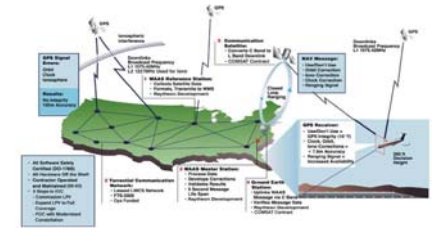
Four-course range



VOR, DME, Tacan



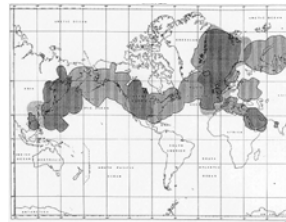
Omega Aerial System Circa 1982



WAAS



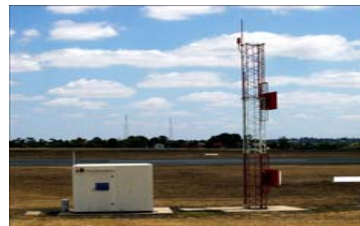
NDB



Loran C



GPS



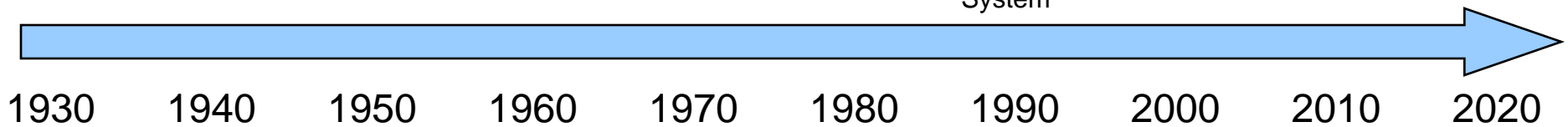
Instrument Landing System



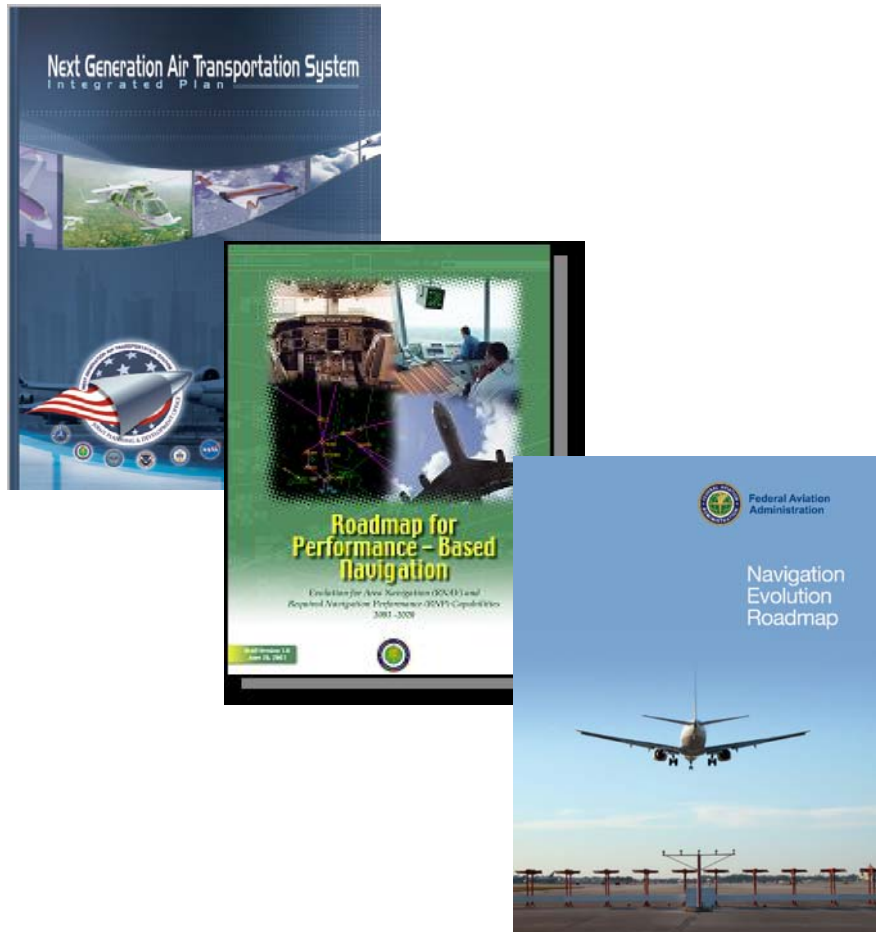
Microwave Landing System



LAAS

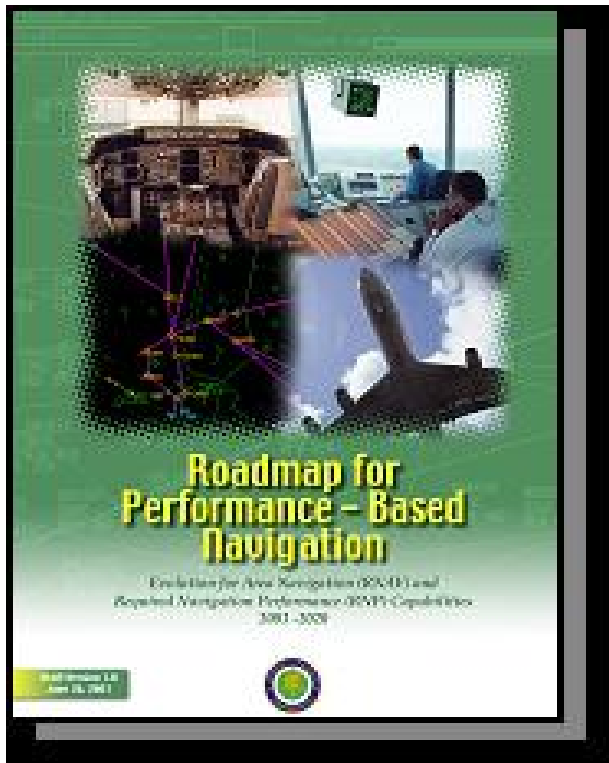


Path to Performance-based NAS



- **The Next Generation Air Transportation System (NextGen) Integrated Work Plan (IWP) Defines A System To Meet Demands For The 21st Century**
 - PNT Enablers – Section 9
- **The Roadmap for Performance-Based Navigation v2 was published in 2006**
- **FAA Navigation Services has developed the Navigation Evolution Roadmap that defines the infrastructure now and in the future for implementation of RNAV, RNP and NextGen**

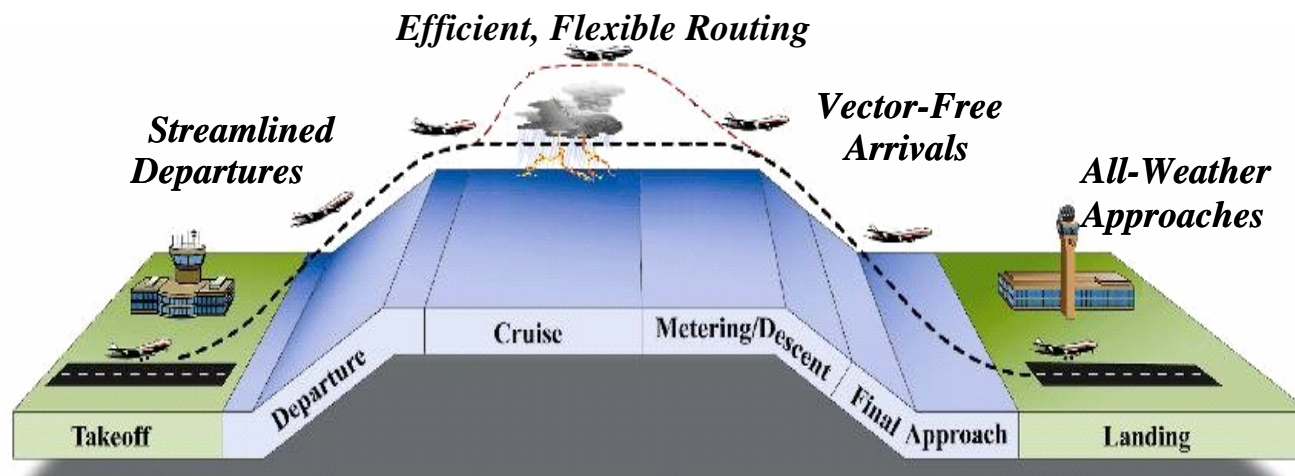
What Is “Performance-Based” Navigation?



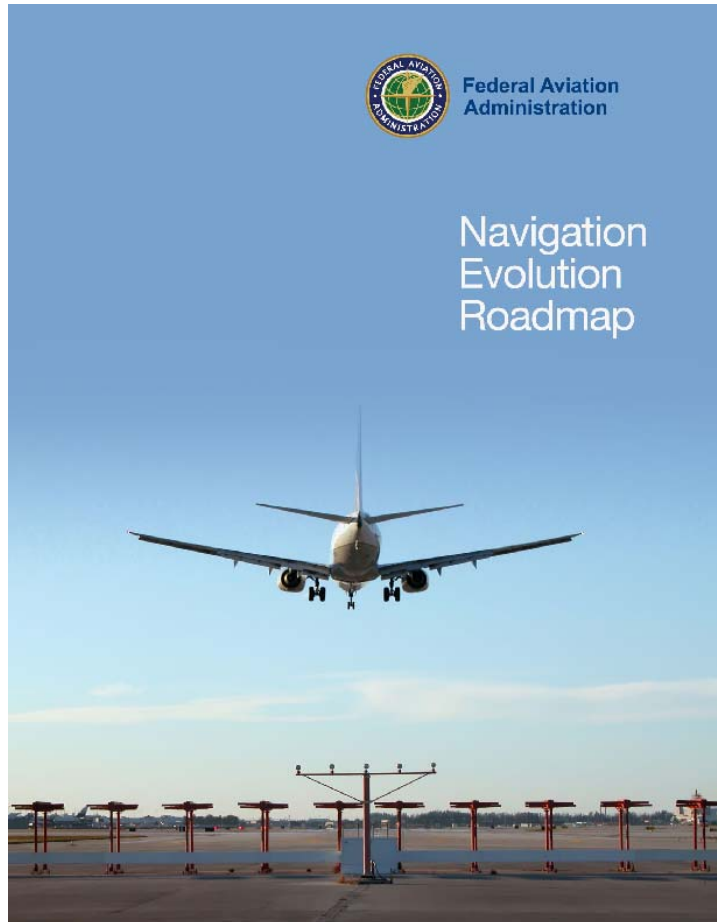
- **An End-to-End Air Transportation System Based On Performance Standards Rather Than Specific Technologies Or Equipment**
 - Area Navigation (RNAV)
 - Required Navigation Performance (RNP)
- **Recognizes The Ability Of Modern Aircraft To Operate Safely And Efficiently Using A Variety Of On-Board Systems and External Signals**

Performance-Based Navigation in the United States

- Complete Transition By 2025
- Consistent With ICAO Global Vision
- Operational Capability Enabled By GPS And Augmentations
- Enhance Safety, Capacity, Efficiency
- Reduce Cost For Legacy Navigation Systems

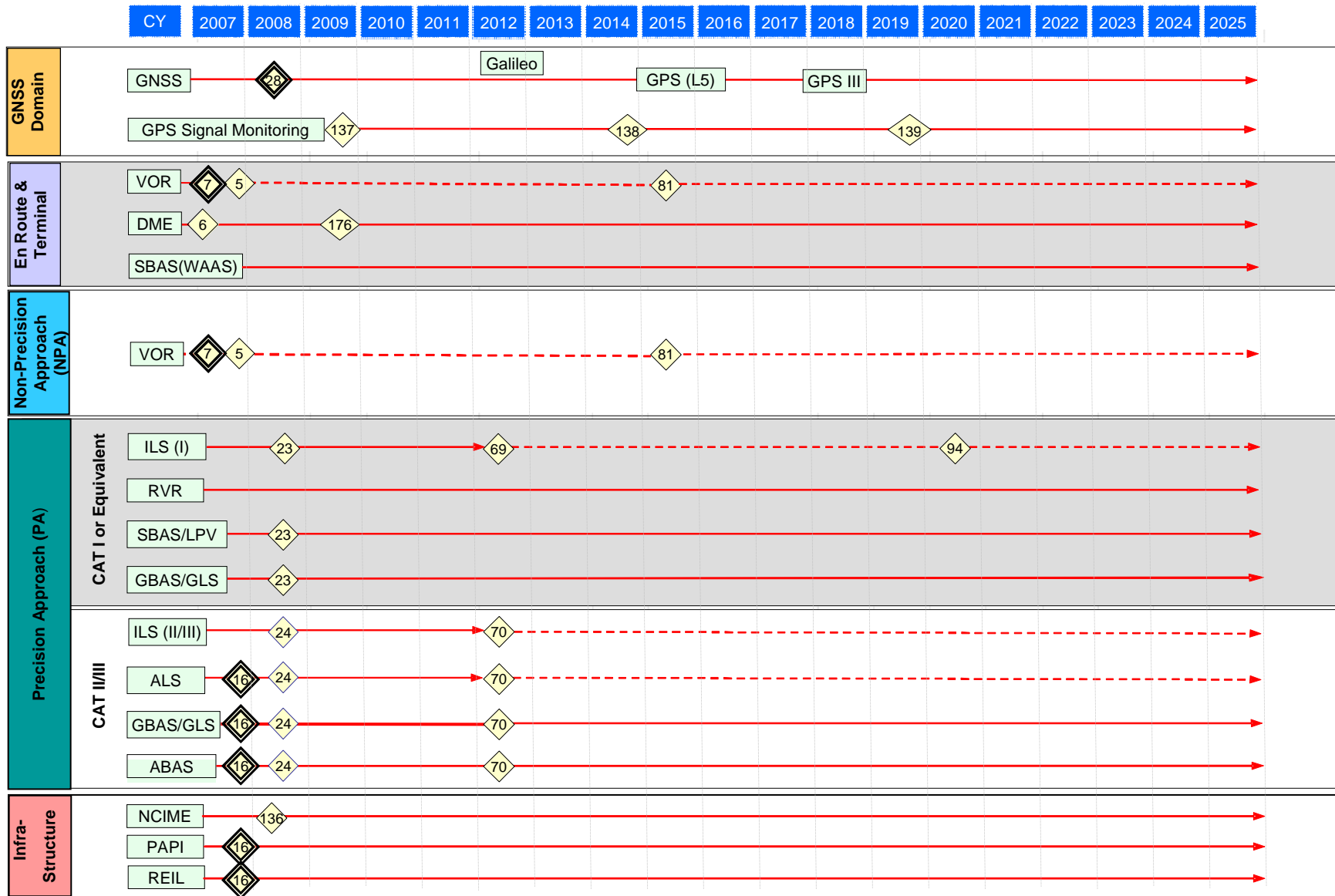


Navigation Evolution Roadmap

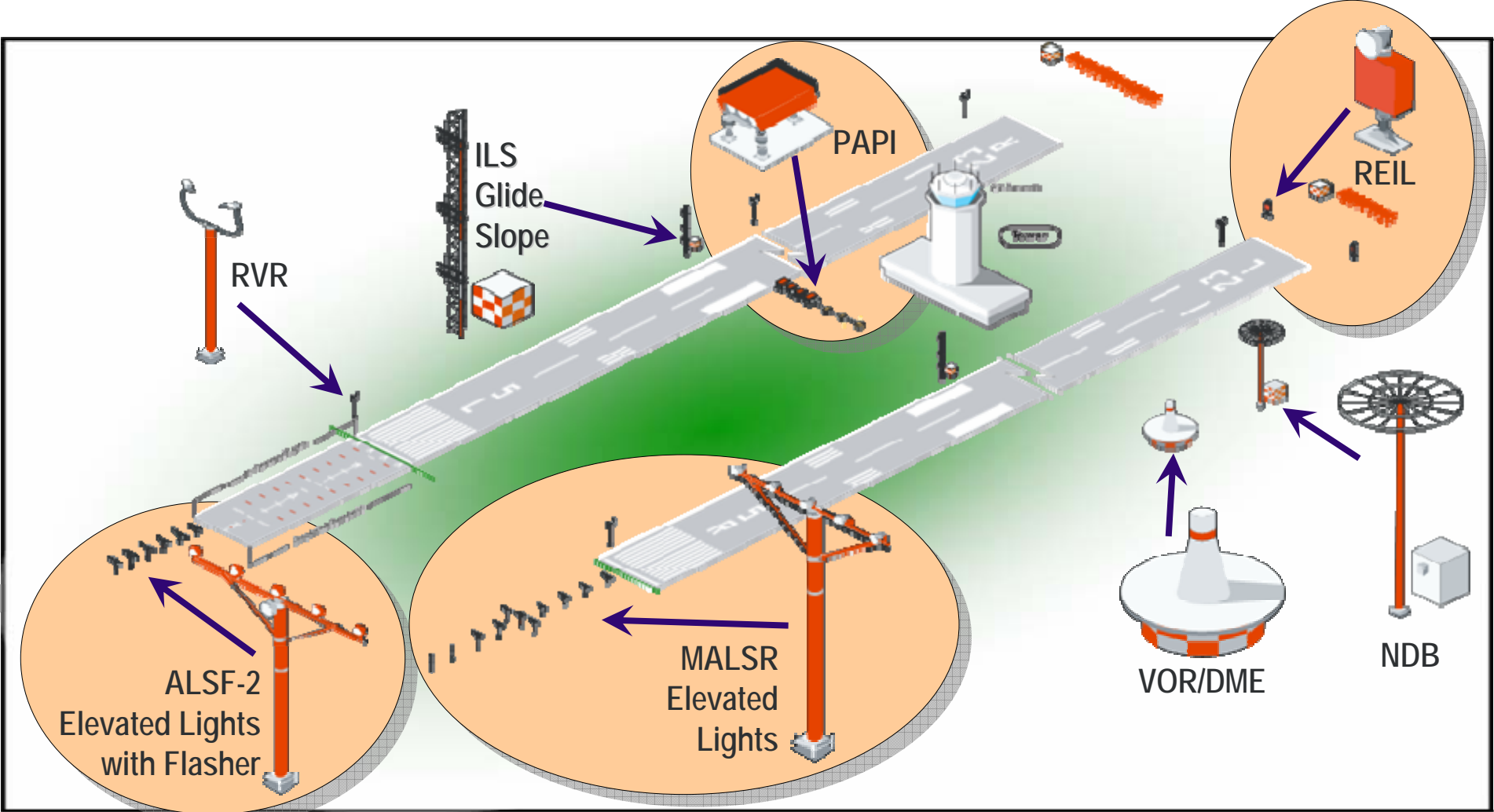


- **In Final Coordination For Signature By FAA Administrator**
- **High-level Framework For Transition To Performance-Based Navigation From Traditional Station-Referenced Terrestrial Systems**
- **Collaborative Effort With Aviation Community**
 - Navigation Evolution Customer Council (NECC)
- **Companion Business Plan**

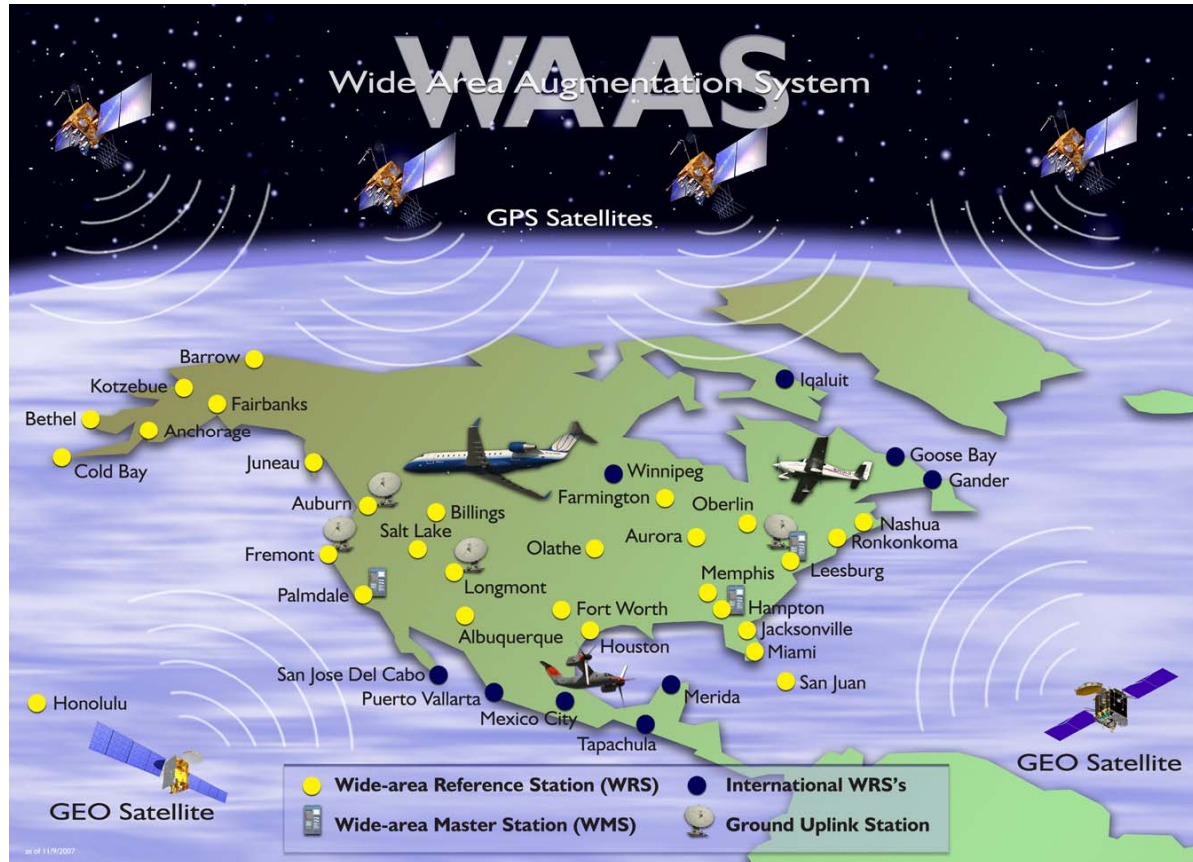
Navigation Roadmap



Terrestrial-Based Facilities



Satellite Systems



2 Geostationary Satellite Links



3 Master Stations

4 Signal Generator System/ Ground Earth Stations

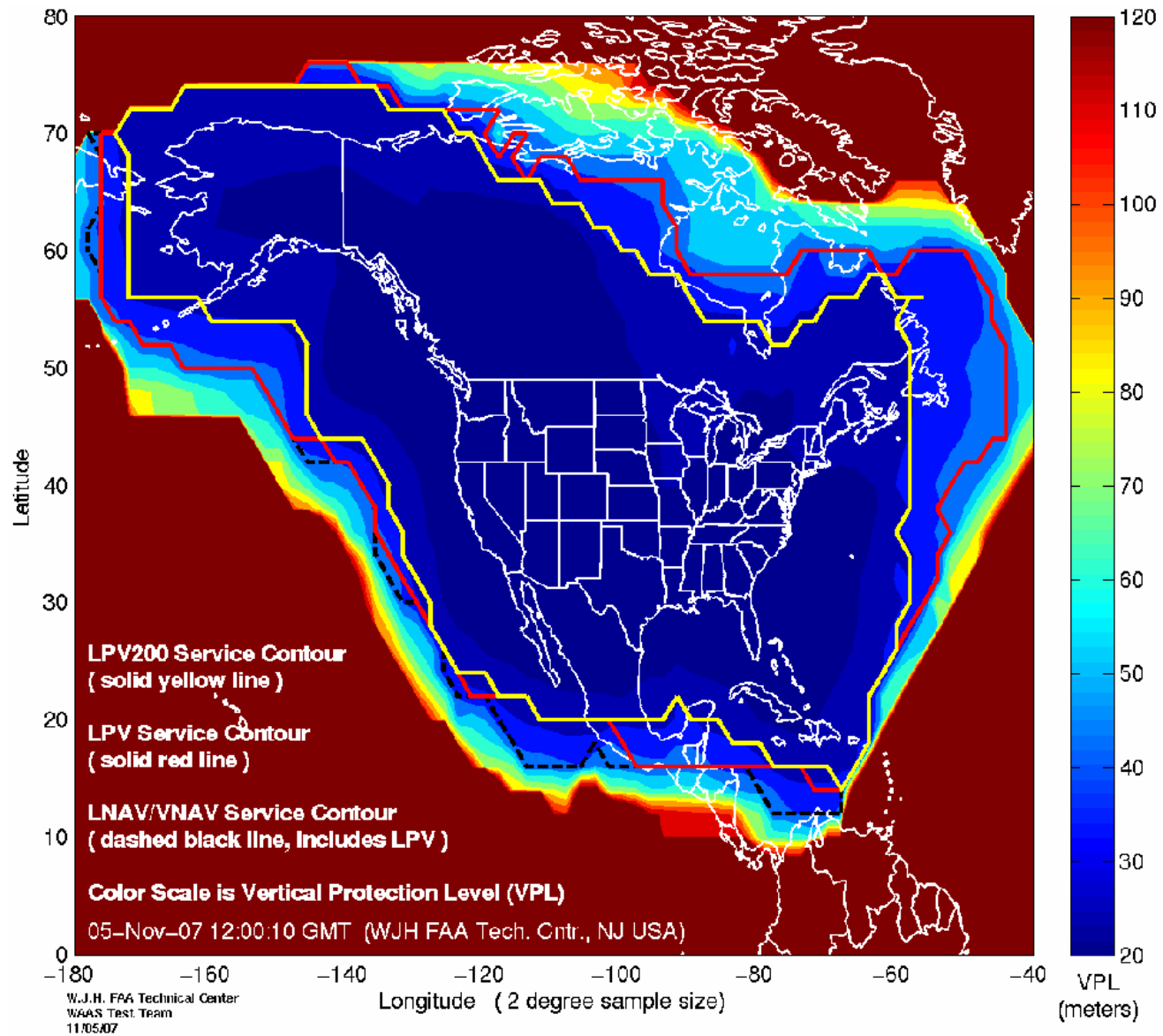


2 Operational Control Centers

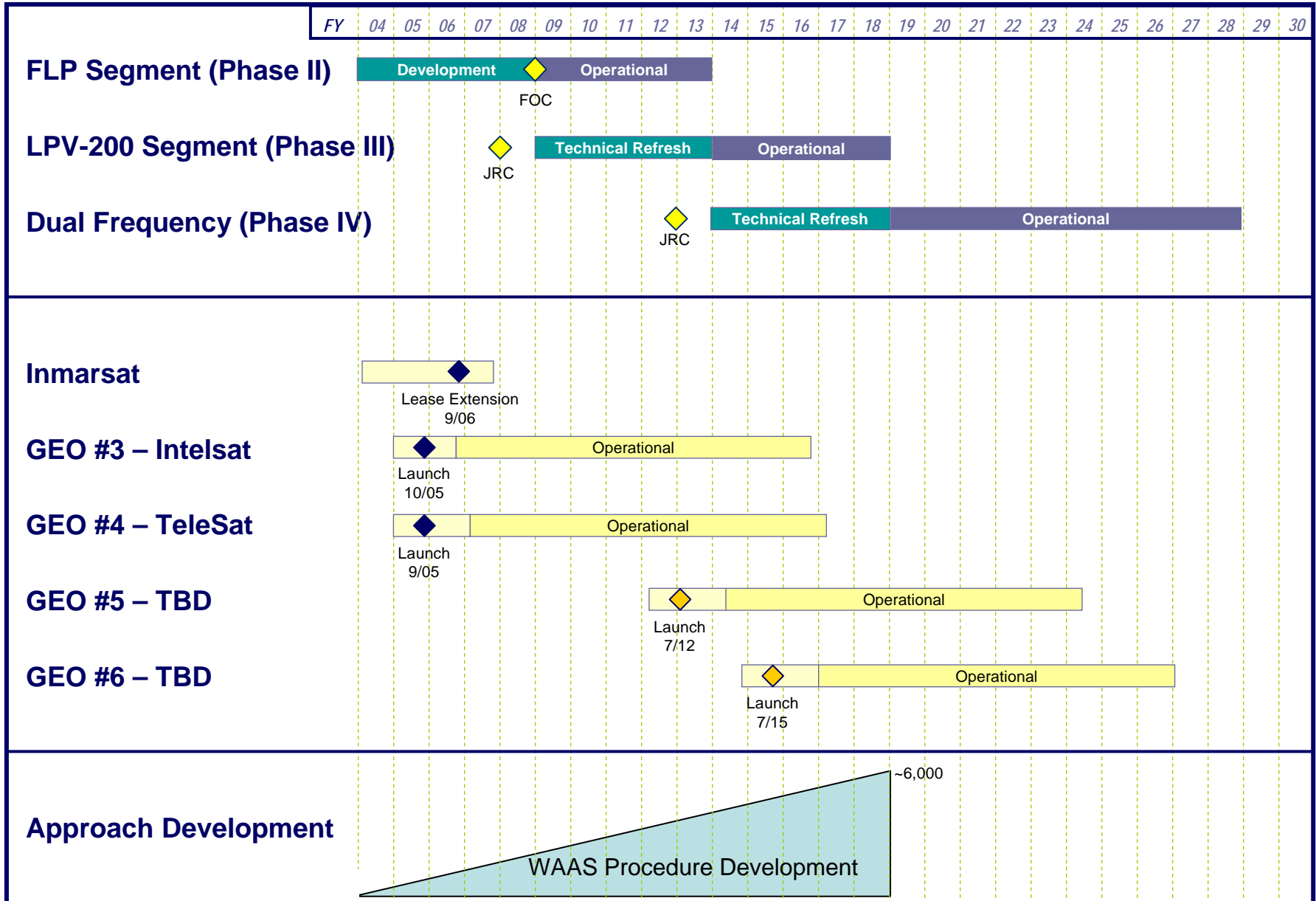


38 Reference Stations

WAAS Coverage

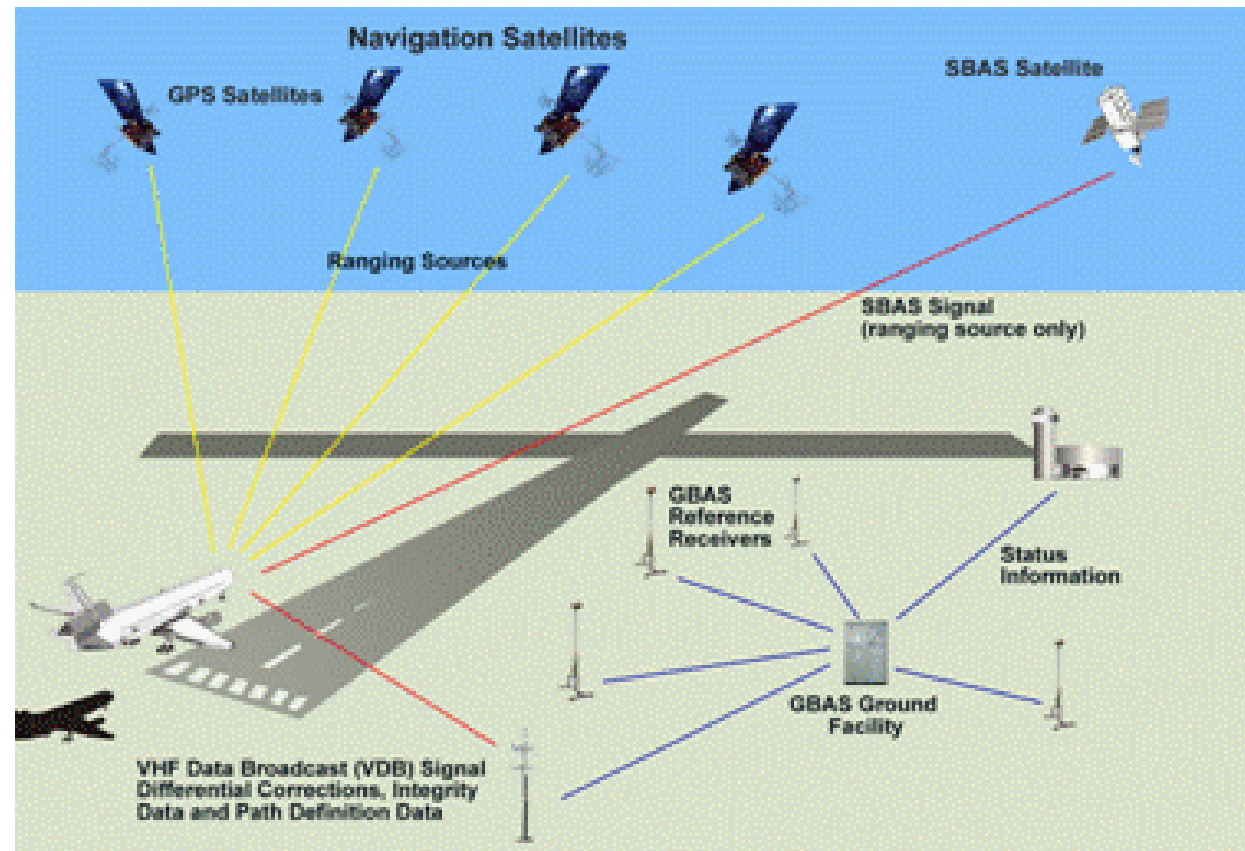


WAAS Enterprise Schedule

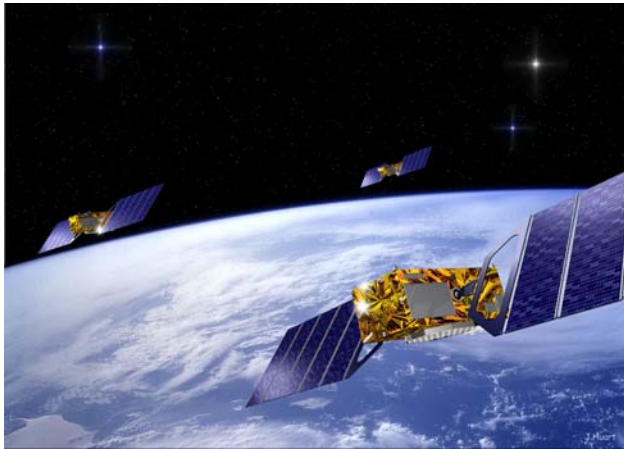


Local Area Augmentation System (LAAS)

- Precision Approach For CAT- I, II, III
- Multiple Runway Coverage At An Airport
- Terminal Area Procedures for Arrival and Departure



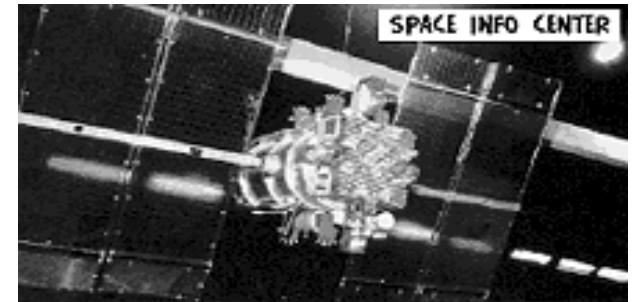
Future Considerations



Galileo (EU)



COMPASS (China)



GLONASS



GPS

Summary

- **The U.S. Is Transitioning To A Performance Based Aviation System**
- **GNSS is a Critical Enabler of NextGen Technology**
- **SBAS (WAAS) Will Provide RNAV(GPS) Approach Services To All Instrument Runways By 2018**
- **GBAS (LAAS) Will Complete Cat-I System Design Approval In Late 2008**
- **The FAA Will Continue Its Multilateral And Bilateral Efforts to Facilitate Aviation Use of GNSS**

