



The Past, Present, and Future of LAAS

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Outline

- **Purpose**
- **Background**
- **Ground Based NAVAIDS**
- **GPS/SBAS/GBAS**
- **LAAS**
 - Present (CAT I Contract)
 - Future (CAT II/III)
- **Transition to SATNAV**
- **Summary**



Purpose

- **The Purpose Of This Paper Is To Show The FAA's Transition From Ground Based NAVAIDS To LAAS Satellite Based Navigation And The Obstacles And Challenges Encountered Along That Path.**





Background

- **Origins of Satellite Navigation Began More Than 25 Years Ago.**
- **FAA's National Airspace System (NAS) was strictly ground-based:**
 - Instrument Landing System (ILS) and VHF Omni-Directional Range (VOR), and Non-Directional Beacons (NDB)
- **FAA's Movement Toward Satellite Navigation Started In The Early 1990's.**



Why not retain ILS

- **ILS is Expensive.**
 - FAA Maintains Thousands of Aging NAVAIDS
 - Estimated Annual Maintenance Costs Exceed \$100m.
- **Requires a Large Obstacle Free Zones and Reduces Capacity in IFR Conditions.**
- **Buildings and Other Structures Create Multipath That Complicates ILS Installations.**
- **Limited to Inflexible, Long, Straight in Approaches.**





Microwave Landing System

- **Solved Many of the Problems Associated with ILS:**
 - Frequency Congestion, Critical Areas, Multipath, and Inflexibility
- **FAA did Considerable Work on MLS Standards and Equipment Development**
- **Canceled in Favor of the More Promising Satellite Navigation Technology.**





Basic GPS

- **Great Capability**
 - Common to Everyday Users
 - Augmentation Needed for Safety of Life Applications





GPS and Augmentation

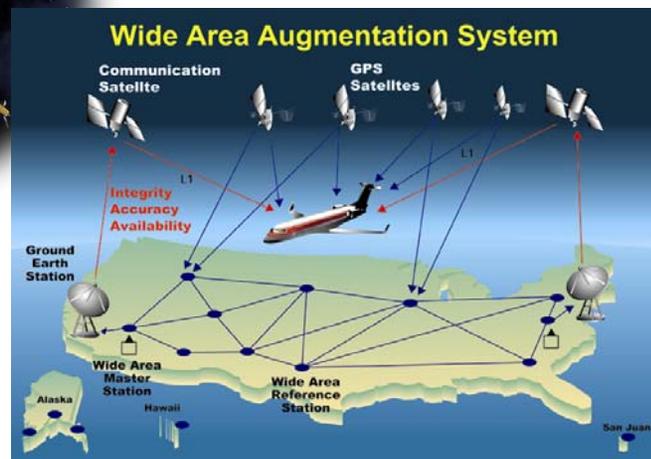
GPS

Enroute/Non-Precision



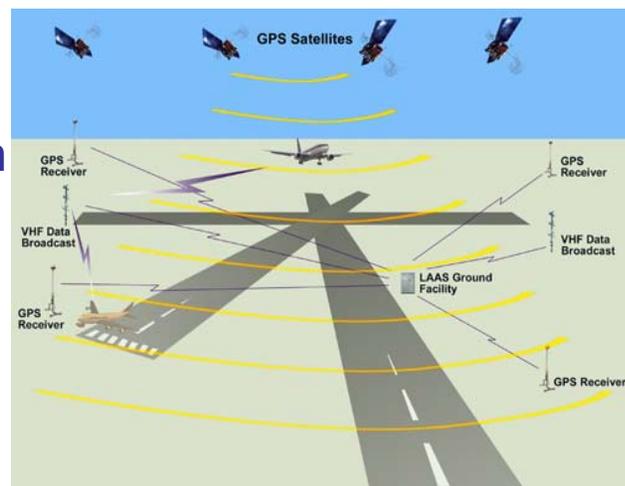
SBAS (WAAS)

Enroute/Terminal/LPV



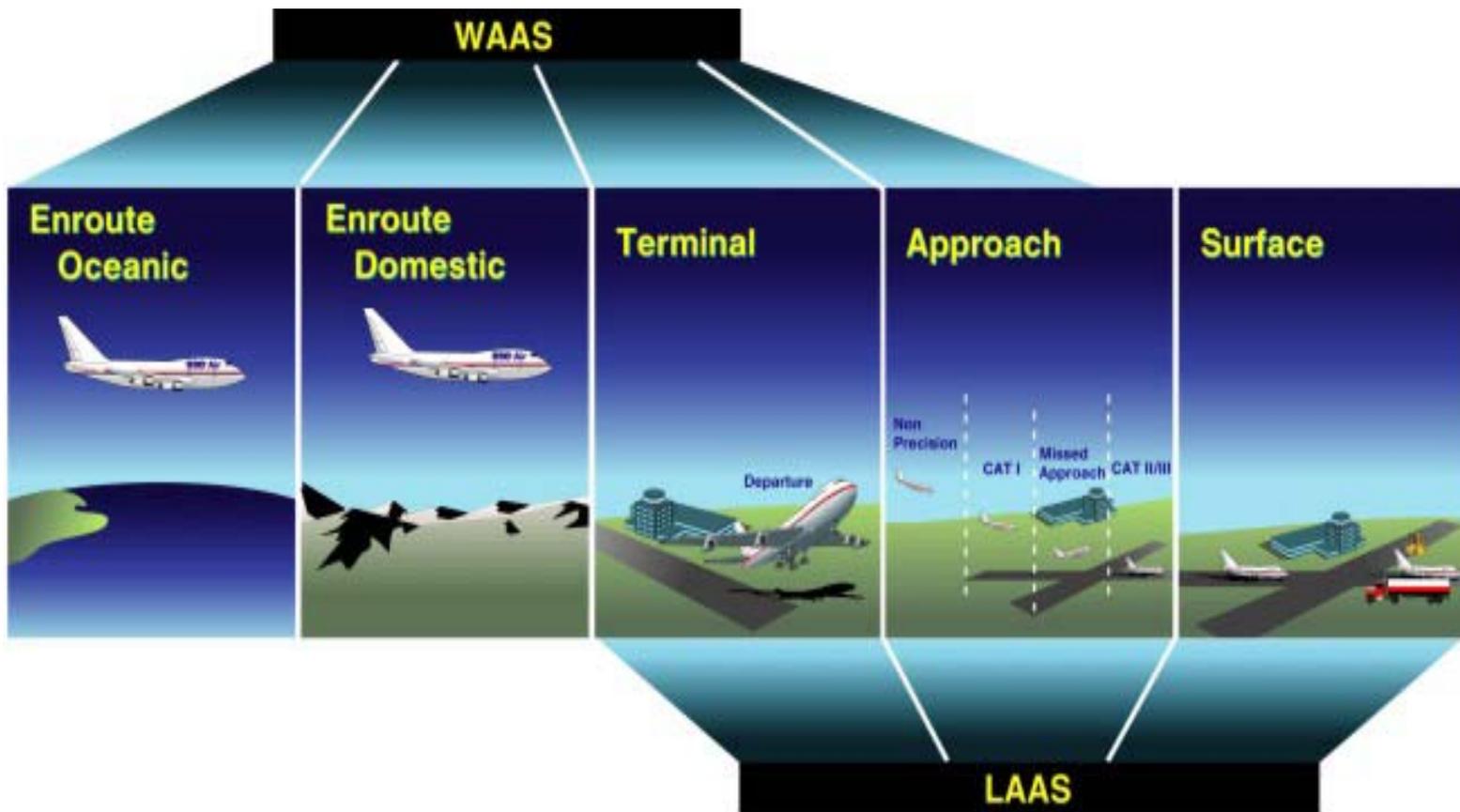
GBAS (LAAS)

Terminal/Low Precision Approach





WAAS/LAAS are Complementary





LAAS

Program Description

- **Local Area Augmentation System (LAAS) Provides a Differential GPS Augmentation Navigation Capability Within the Terminal Area**
- **Capabilities May Include:**
 - Precision Approach to CAT III Minimums
 - Complex Procedures
 - Guided Missed Approaches
 - Departure Procedures
 - Surface Movement Navigation



Typical LAAS Equipment

REFERENCE RECEIVER AND ANTENNA



04	09
06L	06R
30L	30R
15	
15	



REFERENCE RECEIVER AND ANTENNA



MDT

PRIMARY EQUIPMENT

SHELTER

- " TRANSMITTER
- " MONITOR
- " POWER AMP
- " POWER SUPPLIES

REFERENCE RECEIVER AND ANTENNA



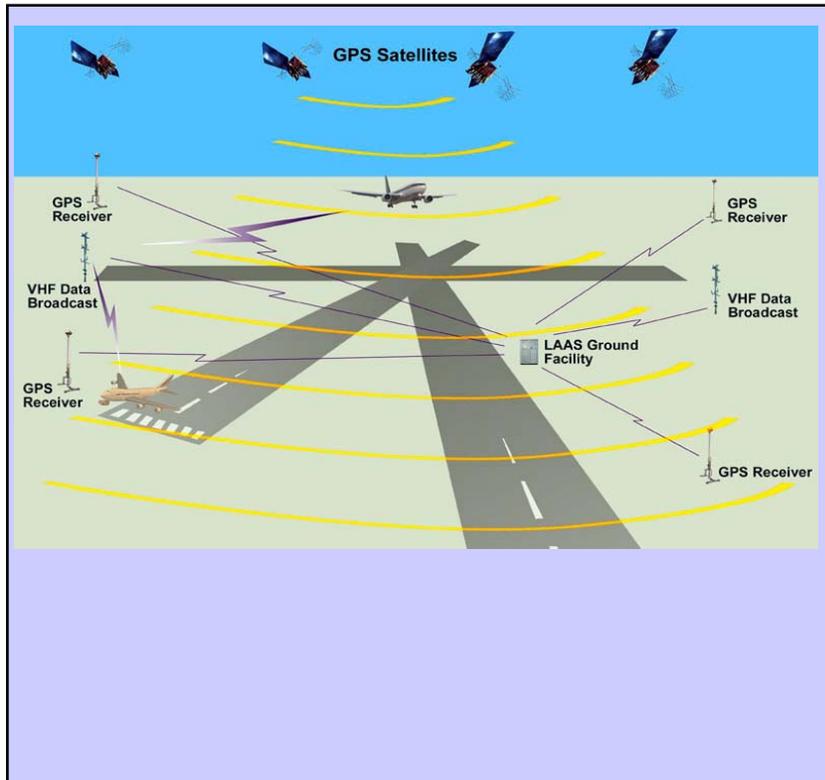
OPTIONAL
2 VDB

REFERENCE RECEIVER AND ANTENNA





LAAS versus ILS



One LAAS/per airport
4 Reference Receivers/antenna
1 VDB antenna



ILS /per Runway End

- **Localizer**
- **Glide Slope**
- **Marker Beacons**





LAAS Cat I Contract

- **Awarded April 30, 2003 to Honeywell International, Inc.**
 - Phase I – \$16.7M for Software and Hardware Design
 - 18 months
 - Focus on Integrity Design Report
 - Documents contractor's progress to satisfy integrity risks
 - Phase II – Development Option
 - 19 months
 - Limited Rate Production Systems and Installation at Selected Airports
 - Phase III – Production Option
 - For up to 200 production systems if required





LAAS Business Case

- **LAAS Requires Considerable Investment By The Users.**
- **FAA Needs Assurance That The Users Will Equip.**
- **FAA working with IBM Global Services to complete a “LAAS Benefit Assessment”**
 - Estimated Completion - Sept 04
 - Establish Navigation Capabilities Baseline
 - Establish LAAS Incremental Benefits
 - Provide Information for FAA and Industry LAAS Decision Makers
 - Efficiency Benefits (Airline & Airport)
 - Safety Benefits
 - Benefits of LAAS as an Enabling Technology





Enabling Technology

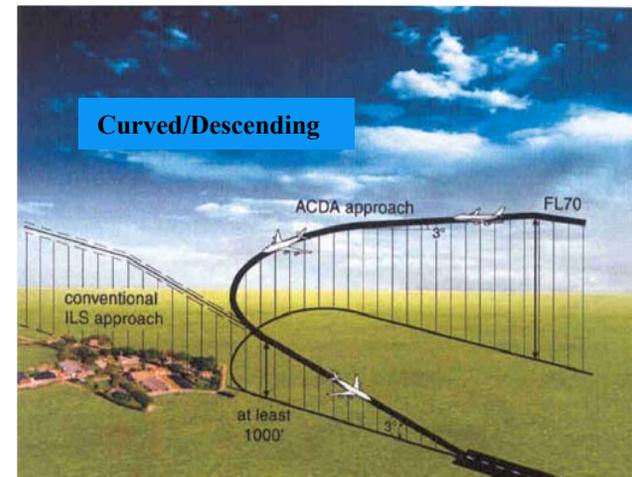
- Support Runway Incursion Avoidance Systems
- Support Improved Terminal Area Surveillance Through Improved Navigation Accuracies
- Support Adjacent Airport Operations
- Support Surface Movement Applications
- Support Advanced/Complex Terminal Operations





LAAS Complex Procedures

- **LAAS Avionics Activities**
 - **Basic LAAS MMR Integration**
 - Awarded to Rockwell Collins – FY99
 - Acquisition and Engineering Support for LAAS Flight Testing, Flight Inspection and Commissioning
 - **Complex Procedure Integration**
 - Awarded to Rockwell Collins - 3/10/2003
 - Modification of the MMR to Support Complex Procedures Up-linked via the VDB

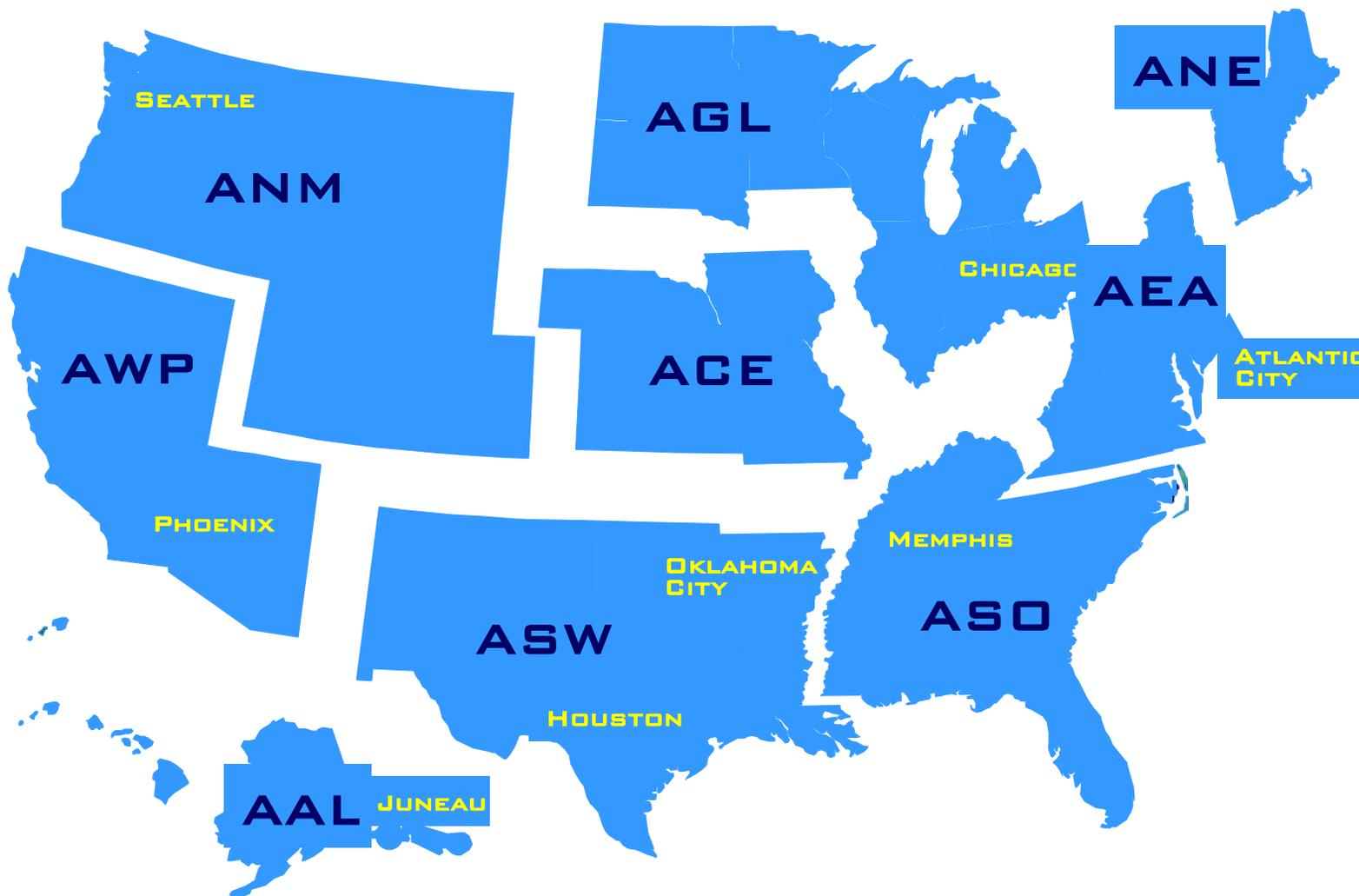




Initial LAAS Sites

Planned LAAS Sites (Alphabetical Order)

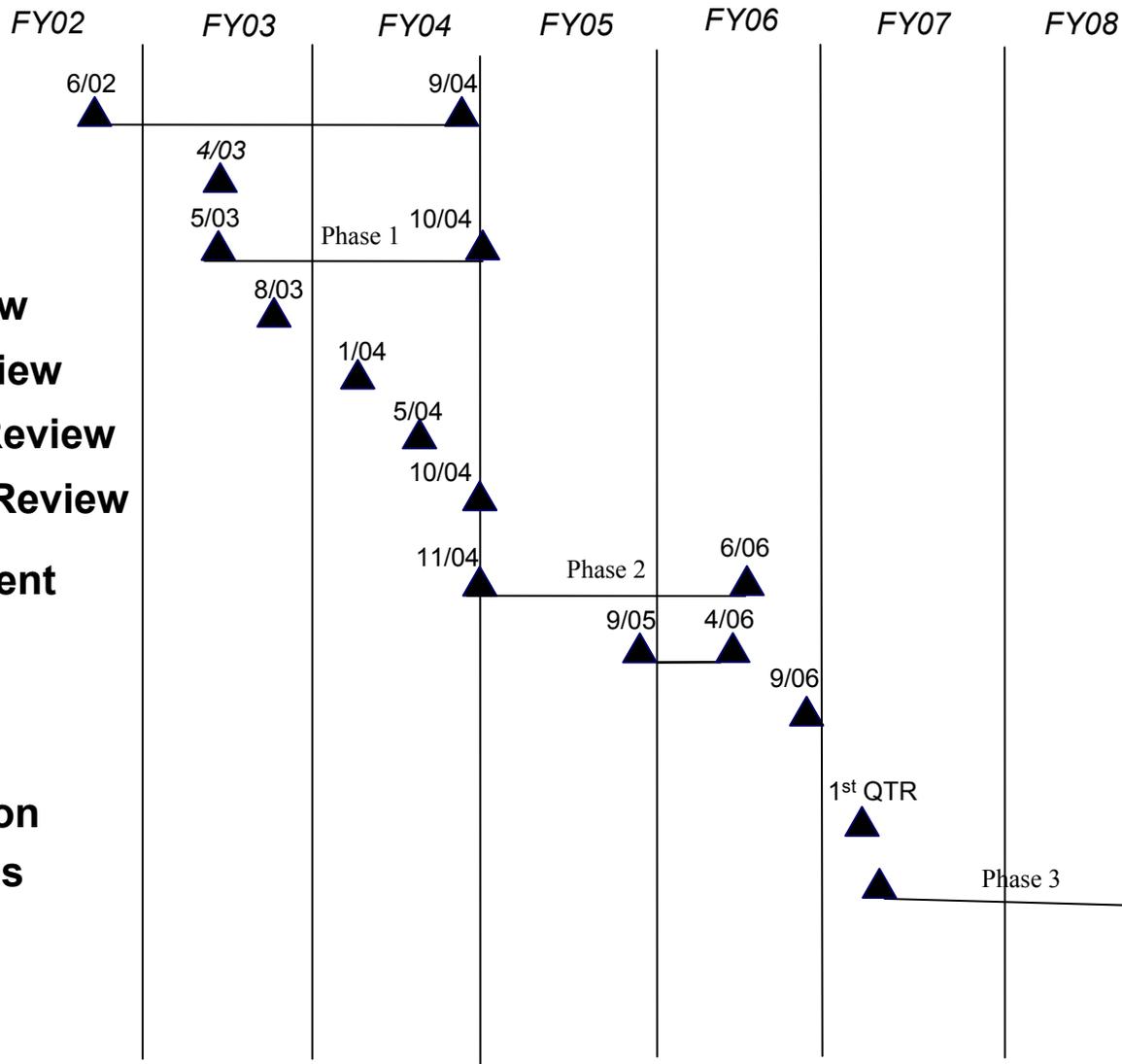
Chicago, Houston, Juneau, Memphis, Phoenix, Seattle





Contract Schedule

- **Benefits Analysis**
- **Contract Award**
- **System Design**
 - **Sys Req't Review**
 - **Sys Design Review**
 - **Prelim Design Review**
 - **Critical Design Review**
- **System Development**
- **LRIP Deliveries**
- **Initial Operational Capability**
- **Production Decision**
- **Production Options**





Challenges

- **The Most Challenging Requirement For GPS Augmentation Is Integrity**
- **Integrity Is The Assurance That An Occurrence Of Hazardously Misleading Information (HMI) Provided To The Aircraft Is Rare**
- **2×10^{-7} For CAT I And 10^{-9} For CAT III Respectively**
- **Can Not Be Validated Through Tests, Must Be Validated Through Analysis**





LAAS Category III

- **CAT II/III R&D Efforts**
 - **Technical Design and Schedule Mitigation Efforts to be Completed Over Next 2-3 Years**
 - **Opportunities Being Considered to Accelerate CAT II/III Activities**
 - **Present Activities with Boeing on Airborne Multipath Flight Tests (B 777)**
 - **Joint Resources Council (JRC) Decision for Full-Scale Development 2005**





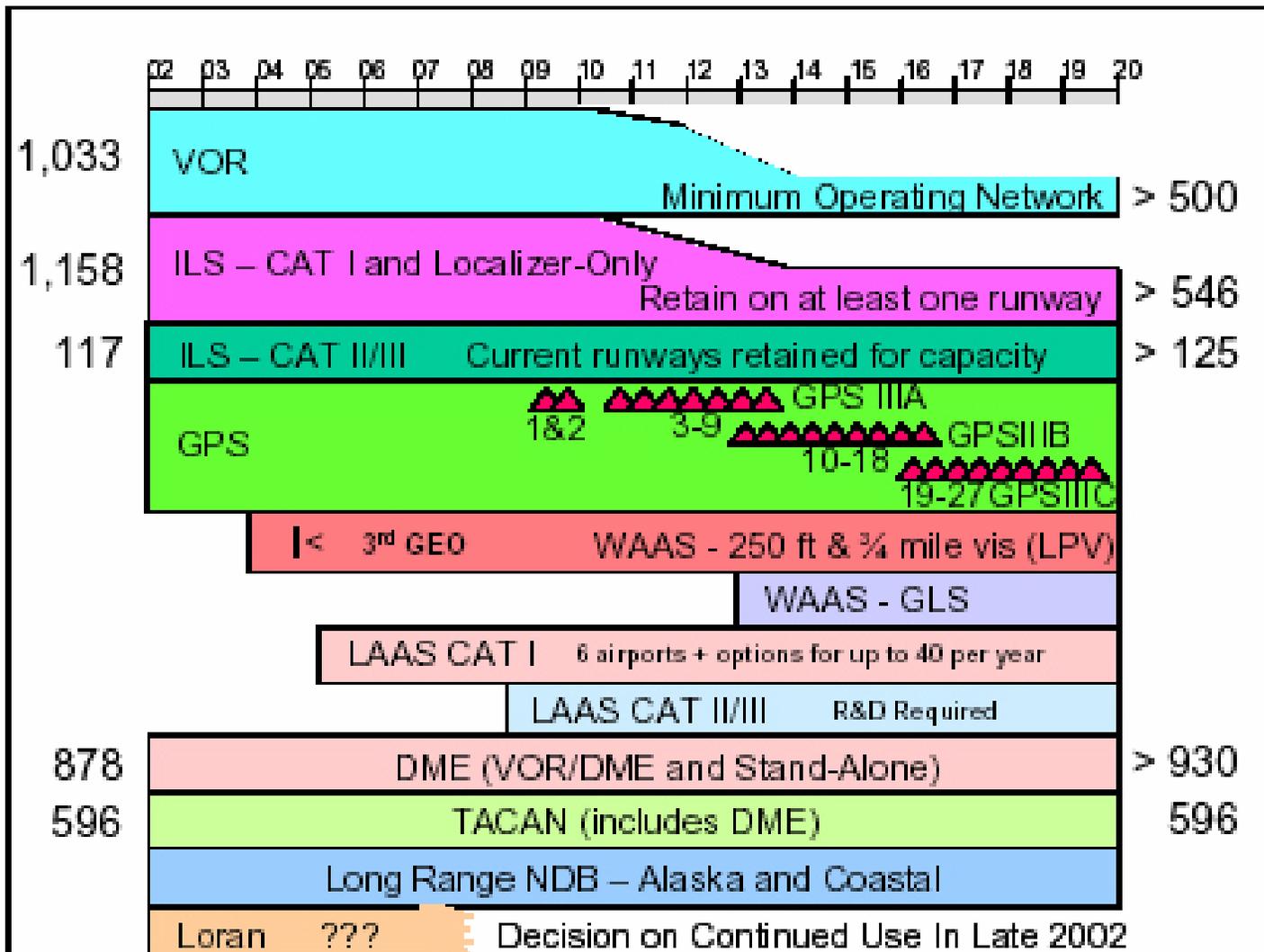
Transition/LAAS

- **The FAA is Conservatively Entering Into A Satellite Navigation Based Infrastructure.**
 - For The Foreseeable Future A Significant Number Of Ground-based NAVAIDS Will Be Retained As Backup And To Provide A Robust And Redundant Navigational Capability.
 - Full Economic Benefits Of Eliminating Ground Based Navigation Aids Cannot Be Realized Yet.





Navigation & Landing Timeline





Summary

- **Satellite-based navigation is a quantum leap in aviation technology.**
- **GPS capabilities are being exploited to improve safety and efficiency.**
- **The business cases for both the users and the FAA are being structured and refined.**
- **Research and development is moving the technology to bring LAAS into reality.**
- **WAAS and LAAS are complementary systems that will make up the corner stone of aviation navigation well into the 21st century.**



<http://gps.faa.gov>



- 🌐 **CAT I/II/III**
- 🌐 **Tailored Approaches**
- 🌐 **Surface Navigation**
- 🌐 **Remote Coverage**
- 🌐 **Multiple Runway Coverage**

