Navigation in the US National Airspace System

Where are we now? ... Where are we going?

Royal Institute of Navigation International Loran Association London, UK 28 October 2008

> Mitchell J. Narins Chief Systems Engineer Federal Aviation Administration Navigation Services



Federal Aviation Administration

Overview

- Wide Area Augmentation System (WAAS) Status
- Local Area Augmentation System (LAAS) Status
- Automated Dependent Surveillance Broadcast (ADS-B) Status
- eLoran







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

Royal Institute of Navigation International Loran Association 28 October 2008



Navigation Services Vision

 Provide safe, cost effective position, navigation, and timing services (PNT) to meet the operational needs of aviation customers.





The US is responsible for a substantial portion of the world's airspace



U.S. Assigned Airspace Equals ~77 Million Square Kilometers





Navigation Services Roadmap (1 of 2)

 2008
 2019
 2011
 2012
 2013
 2014
 2015
 2016
 2017
 2018
 2019
 2020
 2021
 2023
 2024
 2024
 2025
 2026





Navigation Services Roadmap (2 of 2)

 2008
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Ground-Based Navigation Aides





Localizer (Lateral Guidance - VHF Frequencies)





Distance Measuring Equipment (Slant Range - UHF Frequencies)



VHF Omnidirectional Radio



- Existing Procedures (as of 2/14/08 publication cycle):
 - 4,411 GPS NPA (LNAV)
 - 1,251 LNAV/VNAV
 - 1,333 LPVs (14 of which are below 250')



FAA Satellite Navigation Program









WAAS Architecture





38 Reference Stations

3 Master Stations



4 Ground Earth Stations



2 Geostationary Satellite Links



2 Operational Control Centers



Geostationary Satellites (GEO)





Localizer Performance Vertical (LPV) Coverage





Near Real-Time WAAS Information

http://www.nstb.tc.faa.gov

GNSS Program Information

http://gps.faa.gov



WAAS Avionics Status

General Aviation

- Over 37,000 Units Sold
- Increasing at ~1000 Units Per Month
- New Products Coming to Market in Late 2008

Business & Regional Aircraft

- Over 500 Units Sold Since 2007
- Two Additional Products Coming to Market in Late 2008
- Cessna CJs Delivering with WAAS Avionics in 2009
- Acceptance Rates Should Increase Significantly in 2009

Air Carrier & Cargo Aircraft

- Southwest Airlines Equipping 200 Boeing 737s
- Federal Express Has Equipped 253 Caravan Aircraft
- Horizon Airlines Equipping 48 Bombardier Aircraft
- Helicopter Aircraft Implementing WAAS
 - Significant Growth Projected for First Responders
- WAAS Avionics are Interoperable with Other SBASs









WAAS Approach Procedures

- Exceeded Instrument Landing Systems (ILS) - September 2008



WAAS Procedures to be Published to All Instrument Runways in the US NAS by 2018



WAAS Enterprise Schedule



Long Term Schedule



Future Considerations



Galileo (EU)







GLONASS



Other?

GPS



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 Early 2009
- Cat-III Prototype Validation by 2010
- Cat-III System Design Approval by 2012
- Evaluating Potential to Leverage Resources with DoD Joint Precision Approach Landing System (JPALS)





LAAS/GBAS International Efforts





Automatic Dependent Surveillance - Broadcast (ADS-B)

• Automatic

 Periodically transmits information with no pilot or operator input required

Dependent

Position and velocity vector are derived from the Global Positioning System (GPS)

• Surveillance

- A method of determining position of aircraft, vehicles, or other asset
- Broadcast
 - Transmitted information available to anyone with the appropriate receiving equipment





Notice of Proposed Rulemaking (NPRM)

Aviation Rulemaking Committee (ARC)

- ARC is considering 36 summary recommendations
 - 26 recommendations will be resolved before any rule is adopted
 - ADS-B Link Strategy
 - ADS-B Program and Business Case
 - Performance Requirements
 - Required Equipment
 - Communication, Navigation and Surveillance Equipment
 - 10 recommendations for future consideration
 - ADS-B Program and Business Case
 - Required Equipment
 - Communication, Navigation and Surveillance Equipment
 - Security, Privacy, and Malicious Use
- 4 recommendations have PNT considerations



Summary of Recommendations for Final Rule

Recommendation #	Summary	
Performance Requirements		
Recommendation #14	Performance Requirements per domain	
Recommendation #15	Latency recommendations	
Recommendation #16	Not apply vertical position accuracy in NAC 9	
Recommendation #17	Allow for foreign satellite constellations	
Recommendation #18	Non-Diversity Antenna	
Recommendation #19	Use DO-289 MASPS to define SIL	
Recommendation #20	Broadcast message element recommendations	
Recommendation #21	Calculate/report continuity of RNP parameters	
Recommendation #22	Specify continuity requirement	
Recommendation #23	Specify 2 continuity requirements for ASSA and FAROA	



Summary of Longer Term Recommendations

Recommendation #	Summary	
ADS-B Program and Business Case		
Recommendation #27	Define strategy for ADS-B In	
Recommendation #28	Fuse data in automation to accommodate lack of Mode 3/A Code	
Recommendation #29	3nm en route separation	
Required Equipment		
Recommendation #30	Implement transponder removal for low altitude operators not equipped with ACAS	
Recommendation #31	Enhance ELT with tracking service	
Recommendation #32	Replace ELTs	
Communication, Navigation, and Surveillance Equipment		
Recommendation #33	Integrated CNS strategy to deal with GNSS outages	
Security, Privacy and Malicious Use		
Recommendation #34	ICAO codes treated under privacy laws	
Recommendation #35	Use Anonymity for UAT, develop a feature for it on 1090 MHz	
Recommendation #36	Assign ICAO codes so they don't correlate with tail numbers	



Rulemaking: Next Steps

Milestone	Planned Date of Completion
ARC Recommendations finalized and submitted to the FAA	September 26, 2008
Internal Stakeholders Meeting	October 30, 2008
Comment period on ARC recommendations closes	November 3, 2008
Internal Stakeholders Meeting (ISD Focus)	November 20, 2008
FAA Rulemaking Team finalizes RPR Phase 3	November 30, 2008
RPR Phase 3 Approval (Director and Associate Level)	December 8, 2008
Internal Stakeholders Meeting	December 18, 2008 (Tentative)
RPR Phase 3 Approval (Associate Administrator / COO / AGC-1)	December 19, 2008
RPR Phase 3 Submitted to ARM	December 30, 2008
Rulemaking Council Approval of RPR	January 27, 2009







Status of eLoran

- The PNT Executive Committee will discuss *eLoran* at their 5 November meeting
- 2008 Federal Radionavigation Plan will address eLoran
- US Coast Guard will continue to operate the system through FY 2009



Summary

- The WAAS Program Has Matured Through Development and is Rapidly Progressing Through Operational Implementation
- The First Certified LAAS is Expected In Early 2009
- LAAS is Expected to Achieve Category-III By 2012
- ADS-B Program Progressing On Track

