GPS Augmentation Systems Status

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Federal Aviation Administration (FAA)
September 2009
FAA GPS Augmentation Programs
WAAS Architecture

38 Reference Stations
3 Master Stations
4 Ground Earth Stations
2 Geostationary Satellite Links
2 Operational Control Centers
Localizer Performance Vertical (LPV)

Current WAAS Vertical Navigation Service Snapshot Display

Color Scale is Vertical Protection Level (VPL)
21-Aug-09 13:53:00 GMT (WJH FAA Tech. Cntr., NJ USA)

LPV200 Service Contour (solid yellow line)
LPV Service Contour (solid red line)
LNAV/VNAV Service Contour (dashed black line, includes LPV)

VPL (meters)
Global SBAS Coverage

WAAS 95% LPV and 99% RNP 0.3 SBAS Availability Contours

95% LPV Availability
99% RNP 0.3 Availability
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

CGSIC
September 2009
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

- Rio De Janeiro, Brazil
- Agana, Guam
- Malaga, Spain
- Sydney, Australia
- Frankfurt, Germany
- Bremen, Germany
Future Considerations

Galileo (EU)

GLONASS

COMPASS

GPS
Two Civil Frequencies

• The ionosphere creates the largest source of uncertainty affecting today’s use of GPS for aviation
• When GPS L5 becomes widely available it will be possible for the user receivers to directly remove the ionosphere delay errors
• However, the two frequency combination amplifies the effects of other error sources
  – More satellites tend to reduce the magnitude of the errors
WAAS Dual Frequency User Potential
(No “RDM Constraint”)

38 US WRS IFOR Threshold

38 US WRS
13 SA WRS IFOR Threshold
Current International Signal Plans

- **GPS** (US)
- **GLONASS** (Russia)
- **Galileo** (Europe)
- **COMPASS** (China)
- **IRNSS** (India)
- **QZSS** (Japan)
- **SBAS** (US Europe India Japan)

Future CDMA signal

Compass & IRNSS in S-band
ARAIM Results for 30 SVs & URA = .5 m

For VAL = 35m, NDP & Acc: 97.77% coverage at 99.5% availability

ARAIM currently predicated upon a user update rate of ~ 1 hour
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
• Dual Frequency GNSS Offers Significant Potential for Aviation