WAAS and LAAS Program Status

CGSIC
20 September

Leo Eldredge
GNSS Program Manager
FAA Navigation Services
Performance Based Navigation is a Key Enabler for NextGen Services

Arrivals and Departures At High Density Airports
- Collaborative Air Traffic Management
- Weather Impact
- Safety, Security and Environmental Performance
- Facilities

Flexibility In To Terminal Environment

Trajectory Based Operations

Performance Based Navigation is a Key Enabler for NextGen Services
# RNP and ADS-B (RAD) Enabled with GNSS PNT

<table>
<thead>
<tr>
<th></th>
<th>Navigation (≥ 99.0% Availability)</th>
<th>Surveillance (≥99.9% Availability)</th>
<th>Positioning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accuracy (95%)</td>
<td>Containment (10⁻⁷)</td>
<td>GNSS PNT (99.0 – 99.999%)</td>
</tr>
<tr>
<td>En Route</td>
<td>*10 nm</td>
<td>20 nm</td>
<td>GPS</td>
</tr>
<tr>
<td></td>
<td>*4 nm</td>
<td>8 nm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*2 nm</td>
<td>4 nm</td>
<td></td>
</tr>
<tr>
<td>Terminal</td>
<td>*1 nm</td>
<td>2 nm</td>
<td></td>
</tr>
<tr>
<td>LNAV</td>
<td>*0.3 nm</td>
<td>0.6 nm</td>
<td></td>
</tr>
<tr>
<td>RNP (AR)</td>
<td>*0.1 nm</td>
<td>**0.1 nm</td>
<td>SBAS</td>
</tr>
<tr>
<td></td>
<td>DPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPV</td>
<td>16m/4m</td>
<td>40m/50m</td>
<td></td>
</tr>
<tr>
<td>LPV-200</td>
<td>16m/4m</td>
<td>40m/35m</td>
<td></td>
</tr>
<tr>
<td>GLS Cat-I</td>
<td>16m/4m</td>
<td>40m/10m</td>
<td>GBAS</td>
</tr>
<tr>
<td>GLS Cat-III</td>
<td>16m/2m</td>
<td>40m/10m</td>
<td></td>
</tr>
</tbody>
</table>

*Operational requirements are defined for total system accuracy, which is dominated by fight technical error. Position accuracy for these operations is negligible.

**Containment for RNP AR is specified as a total system requirement; value representative of current approvals.

Dependent Parallel Approach (DPA)  Surveillance Integrity Level (SIL)  Navigation Accuracy Category
Independent Parallel Approach (IPA)  Navigation Integrity Category (NIC)  for Position (NACp)
Wide Area Augmentation System (WAAS) Architecture

38 Reference Stations
3 Master Stations
4 Ground Earth Stations

2 Geostationary Satellite Links
2 Operational Control Centers
Current WAAS LPV Performance
Current WAAS RNP .3 Performance

Current WAAS RNP 0.3 Navigation Service Display

- RNP 0.3 Service: Dashed Black line, HPL = 100 m
- RNP 0.3 Service: Dashed Red line, HPL = 485 m
- Color Scale is Horizontal Protection Level (HPL)

09-Sep-10 15:41 GMT, RNP FAA Tech. Ctr., NJ USA

W.J.H. FAA Technical Center
WAAS Test Team
09-Sep-10 15:41 GMT
Current WAAS GEOs

CRW at 133° W (PRN-135)

CRE at 107° W (PRN-138)
CRW Failure Pending
Alaskan Airports Impacted

- Adak
- Atqasuk Edward Burnell Sr. Memorial
- Bob Baker Memorial
- Deering
- Gambell
- Kivalina
- Nome
- Point Hope
- Point Lay LRRS
- Ralph Wien Memorial
- Savoonga
- Shishmaref
- Teller
- Wainright
- Wales
- Wiley Post
Gap Filler GEO

Coverage After Integration of AMR Satellite

CRE at 107° W (PRN-138)

AMR at 98° W (PRN-133)
As of Aug 26th, 2010
2,209 LPVs serving 1174 Airports
- 1,350 LPVs to non-ILS Runways
- 859 LPVs to ILS runways
- LPVs at 553 Non-ILS Airports
- 246 LPV-200
Universal Navigation Systems (UNS)

Completed Aircraft Approvals

- Astra 1125*
- Beech 400*, Beech 400 C&F, B-727-200, B-737
- Bombardier Q-series, Q-300, Q-400
- Bombardier CL-600/60
- Bombardier DHC-8-400 series ‘Q-400’
- Citation 550 Bravo Series,
- Citation V 560 Series, & XL, , 525*, Fleet
- DeHaviland ‘Dash-8’
- Falcon 10, 20D, 50, 50*
- Gulfstream G-II*
- KingAir 200*, 350
- LEAR 31A, 35, 35A,
- LEAR 40, 40XR, 45, 45XR, 60
- MD-87
- S-76, S-76B, S-76C++
- Sabre 65

Projected Aircraft Approvals

- ATR-42
- Beech Be-200, -300
- Boeing B-727-200 C&F, B-737
- Bell 412
- Cessna Citation II
- Cessna Citation 560XL/XLS, 650
- Cessna Citation VII, Encore
- C-9
- Northrop Grumman T-38
- Gulfstream G-II, G-III
- Falcon 20, 2000
- Hawker 125-700B
- King Air 300, RC-12, US Army
- PC-12
- Embraer NB-145
completed Aircraft LPV STCs:

- Bombardier Challenger CL-604
- Bombardier CRJ-200
- Cessna Citation Jet CJ-1+, 2+, 3
- King Air-300
- Hawker 800XP
- Cessna Citation Encore+

Aircraft LPV STCs in work:

Estimate completion w/in 6 months:

- Bombardier CRJ-700/900
- Beechcraft Premier 1 & 1A
- Beechcraft King Air 200,200GT,300,350,C90GTi
- Hawker 400XP, 750, 850/XP, 900XP
- Beechjet 400A (est. 30 Sep for STC)

Estimate completion w/in 12 months:

- Dassault Falcon 20, 50/EX, 2000/EX
- Piaggio P-180
- Gulfstream G-150, G-200
- Bombardier Lear 60XR

Estimate Completion w/in 18 months:

- Bombardier Challenger CL-300, CL-605
Honeywell/CMC

Approved Avionics LPV TSOs:
- Primus Epic FMS

Pending Avionics LPV TSOs:
- Primus 2000 (NZ-2000)
- APEX
- EPIC (in other airframes)
- KSN 770 (for GA aircraft)

Approved Aircraft LPV STCs:
- Gulfstream G-450 & -550

Pending LPV STC Approvals:
- Gulfstream G-IV, G-V
- F-900B,-900EXC
- Challenger CL-601
- Hawker 800
- Citation X
- PC-12
- Viking
- Dassault EASy
- Cessna Sovereign
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
GBAS Facilities

- **Current airlines GBAS equipped**
  - Continental
  - Delta Airlines
  - Qantas
  - Air Berlin
  - TuiFly
  - Sonair
  - Air Vanatu
  - Emirates

- **Over 15 countries have active GBAS programs**
LAAS/GBAS International Efforts

- Agana, Guam
- Malaga, Spain
- Frankfurt, Germany
- Bremen, Germany
- Rio De Janeiro, Brazil
- Sydney, Australia
Commercially Available GPS Jammer (so called “Personal Privacy Device”)

![Image of a GPS Jammer](image-url)
LAAS Antenna Location
... and a few more “Personal Privacy Devices”

$110 Ebay

$335 Ebay

$92 Ebay

$40 GPS&GSM
www.chinavasion.com

$55 Ebay

$83 GPS&GSM
www.Tayx.co.uk

$152 Ebay
Summary

• WAAS implementation progressing on track
• Geostationary satellite procurement activities underway to mitigate failures
• LAAS program activities underway for Cat-III
• RFI challenges being investigated
Questions