



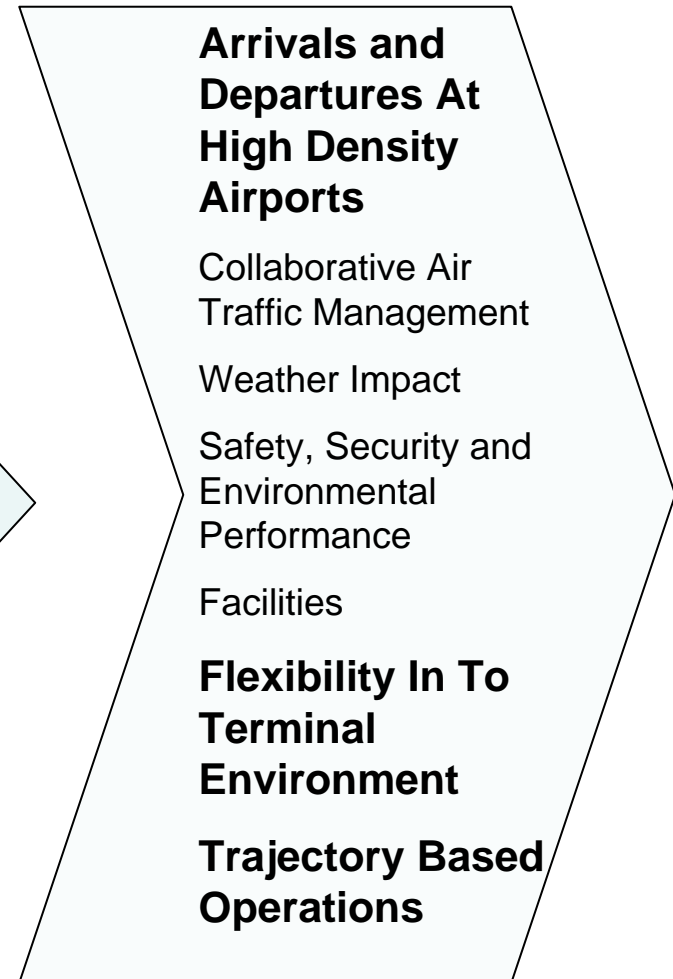
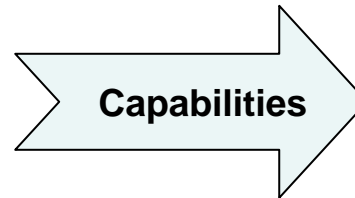
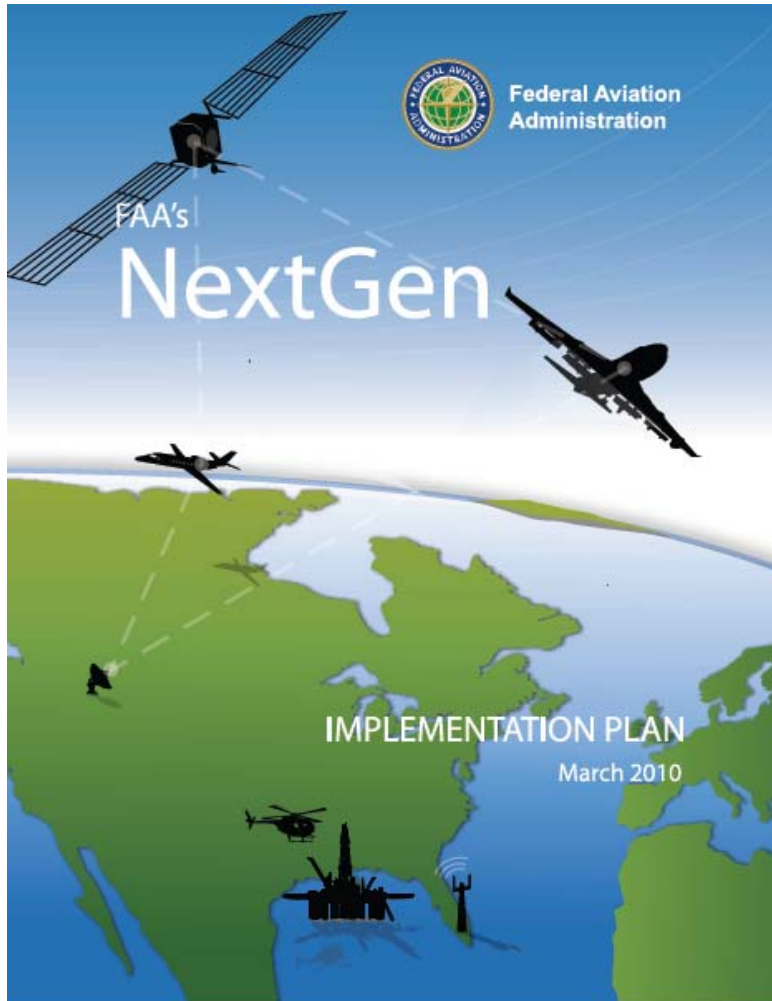
Aviation Augmentation Systems Update



ICG-5 Working Group B



GNSS is a Key Enabler for NextGen



RNP and ADS-B (RAD) Enabled with GNSS PNT

	Navigation (≥ 99.0% Availability)		Surveillance (≥99.9% Availability)			Positioning		
	Accuracy (95%)	Containment (10 ⁻⁷)	Separation	NACp (95%)	NIC (10 ⁻⁷)	GNSS PNT (99.0 – 99.999%)		
En Route	*10 nm	20 nm	5 nm	0.1 nm (7)	1 nm (5)	GPS		X
	*4 nm	8 nm						
	*2 nm	4 nm						
Terminal	*1 nm	2 nm	3 nm	0.05 nm (8)	0.6 nm (6)	SBAS		
LNAV	*0.3 nm	0.6 nm						
RNP (AR)	*0.1 nm	**0.1 nm						2.5 nm DPA
LPV	16m/4m	40m/50m	2.5 nm DPA	0.05 nm (8)	0.2 nm (7)			
LPV-200	16m/4m	40m/35m						
GLS Cat-I	16m/4m	40m/10m	2.0 nm IPA	121 m (8)	0.2 nm (7)			GBAS
GLS Cat-III	16m/2m	40m/10m						

*Operational requirements are defined for total system accuracy, which is dominated by flight 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.

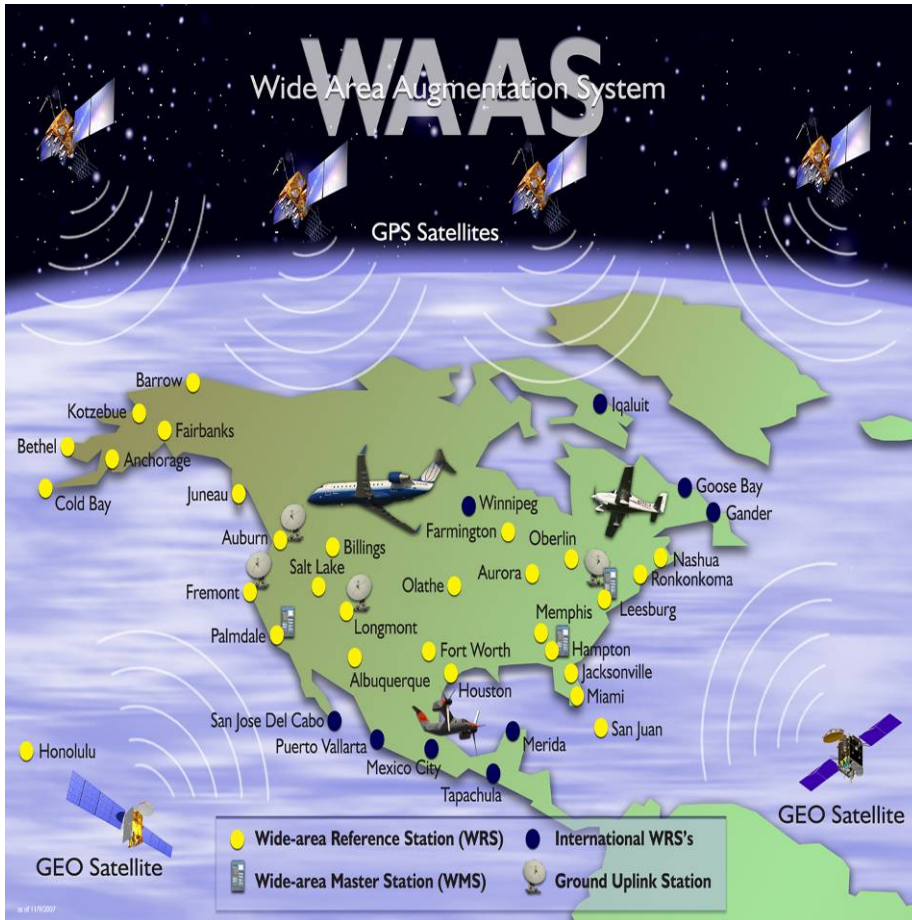
Dependent Parallel Approach (DPA)
Independent Parallel Approach (IPA)

Surveillance Integrity Level (SIL)
Navigation Integrity Category (NIC)

Navigation Accuracy Category
for Position (NACp)



Wide Area Augmentation System (WAAS)



38 Reference Stations



3 Master Stations



4 Ground Earth Stations



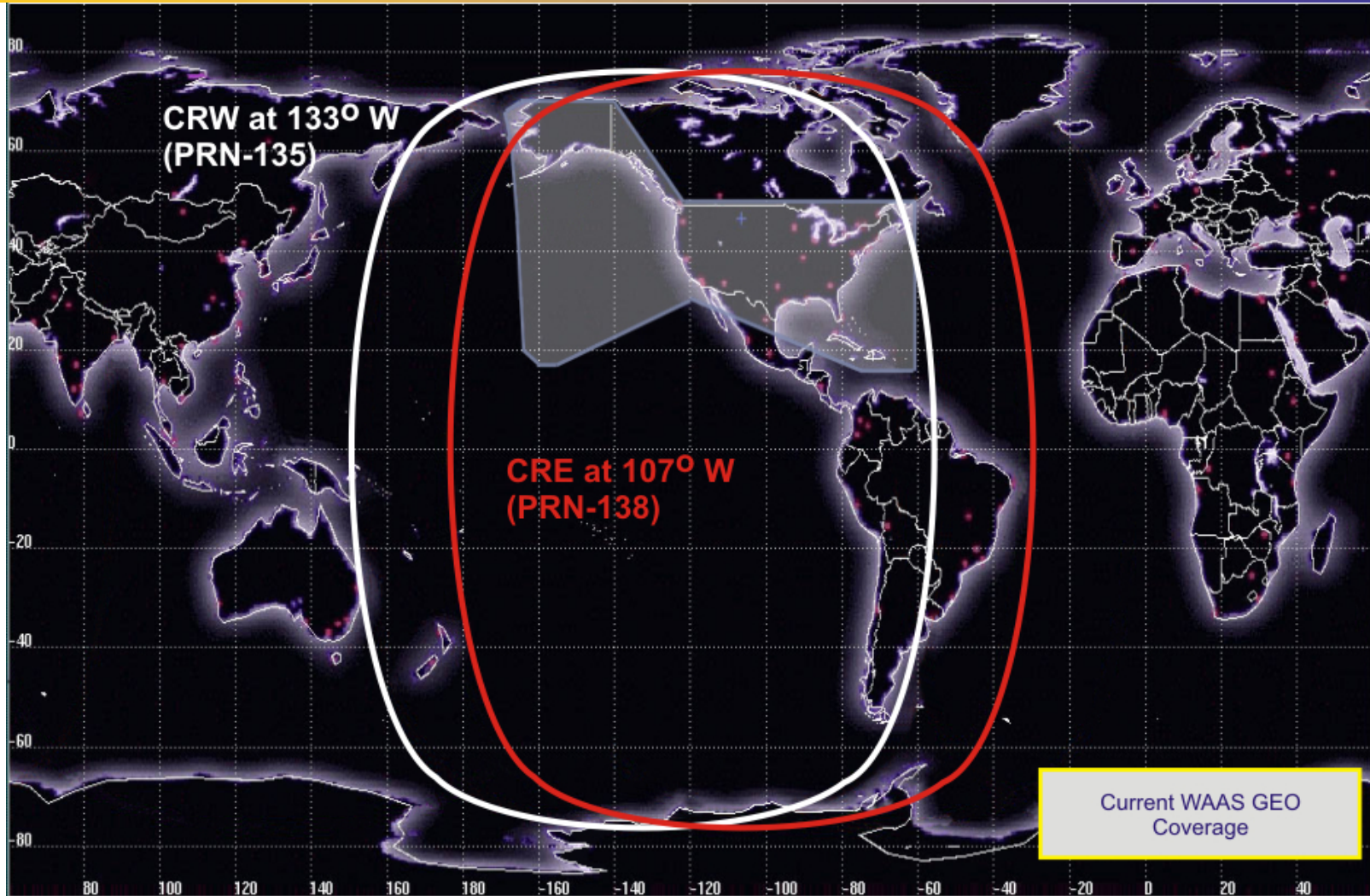
2 Geostationary Satellite Links



2 Operational Control Centers

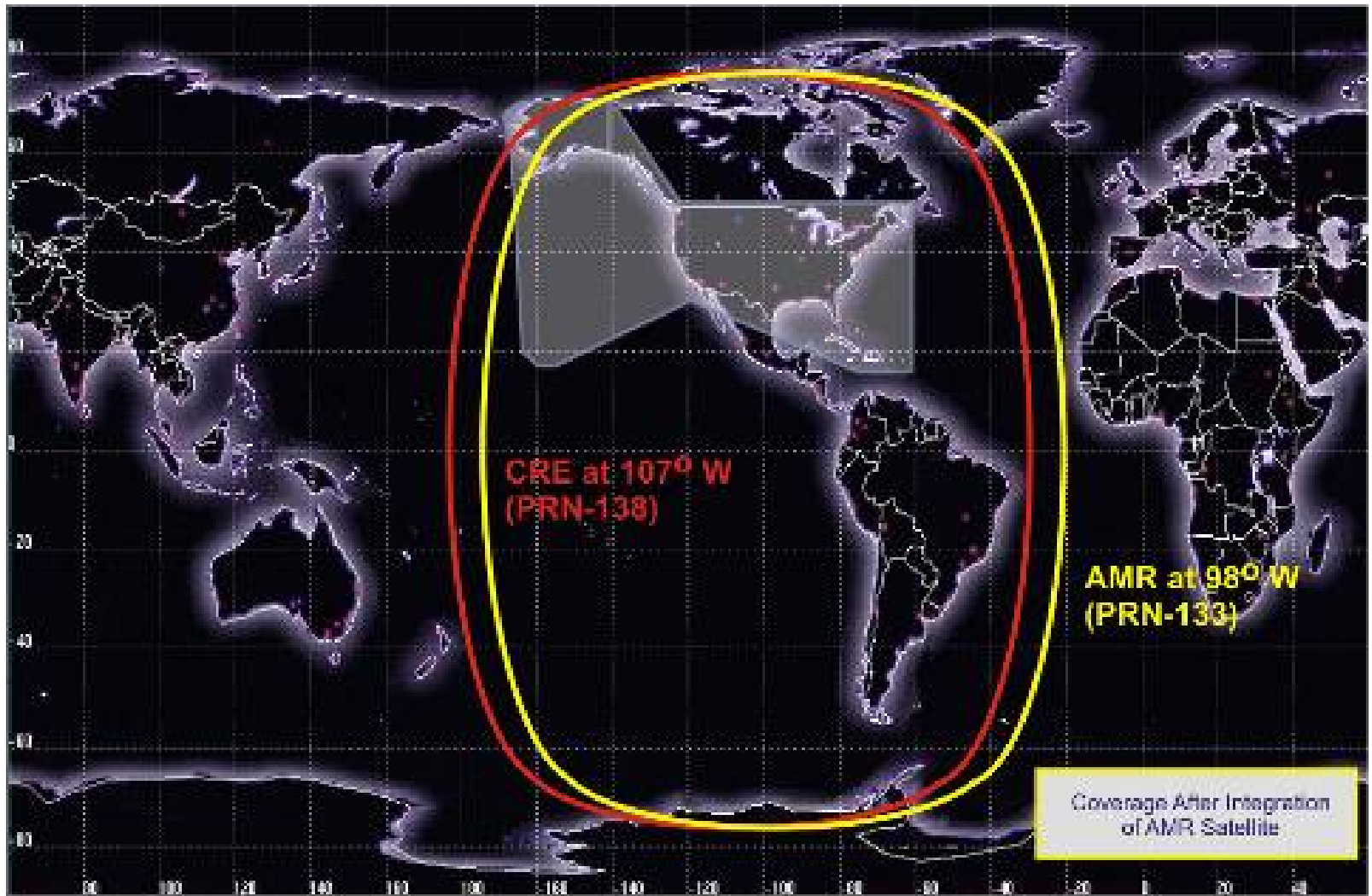


Current WAAS GEOs



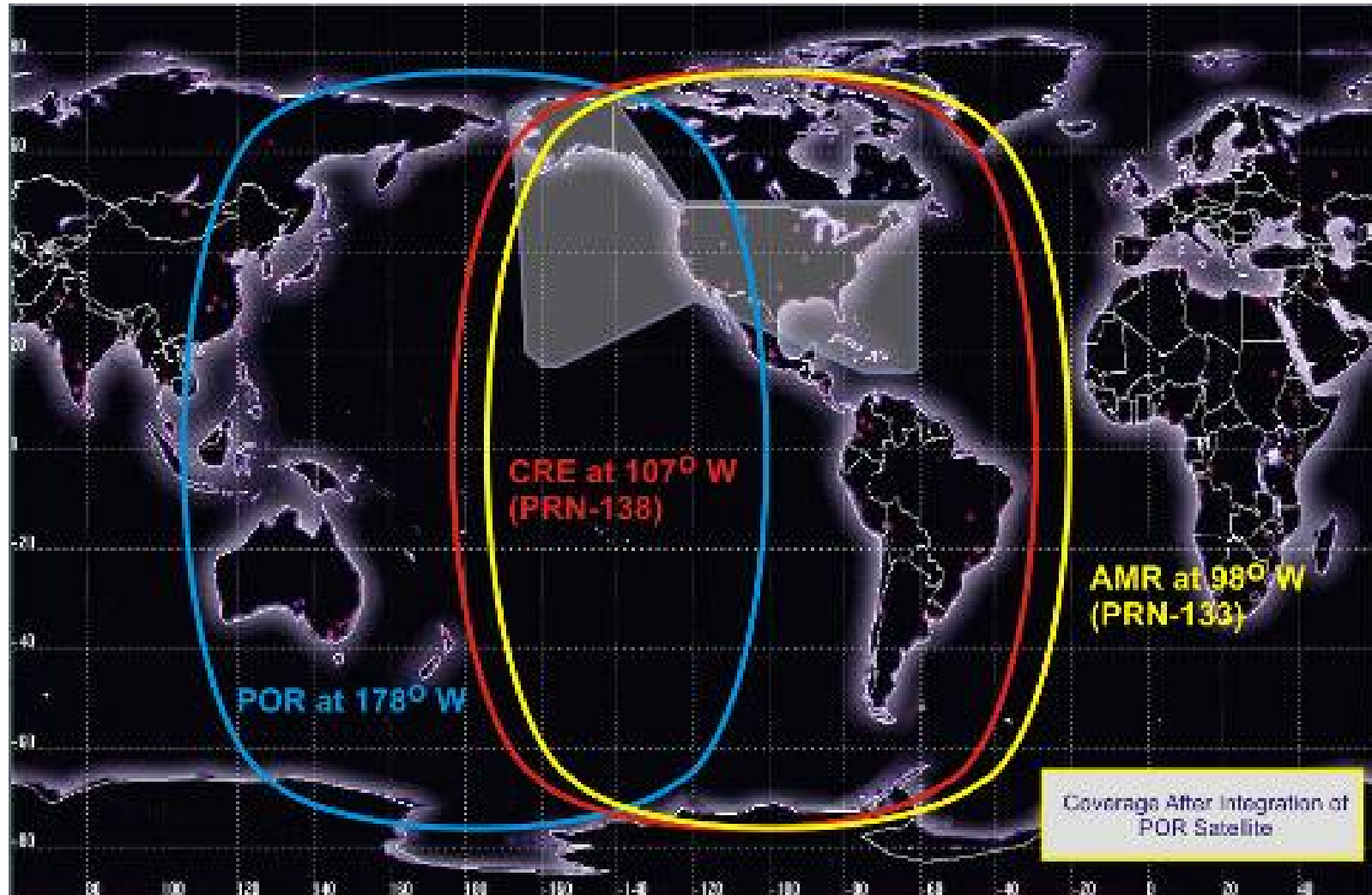


Gap Filler GEO



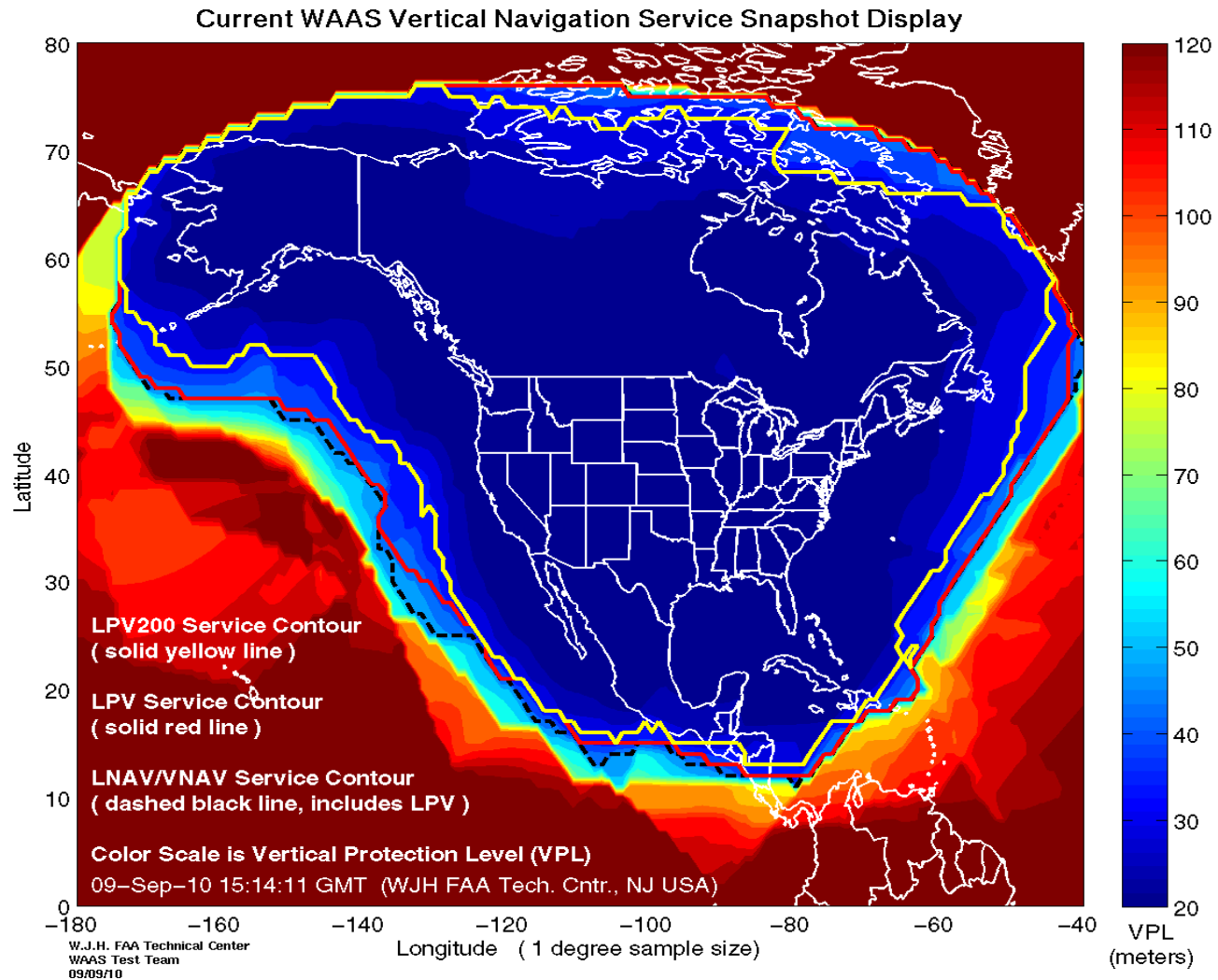


Pacific Ocean Region (POR) Inmarsat GEO





Current WAAS LPV Coverage

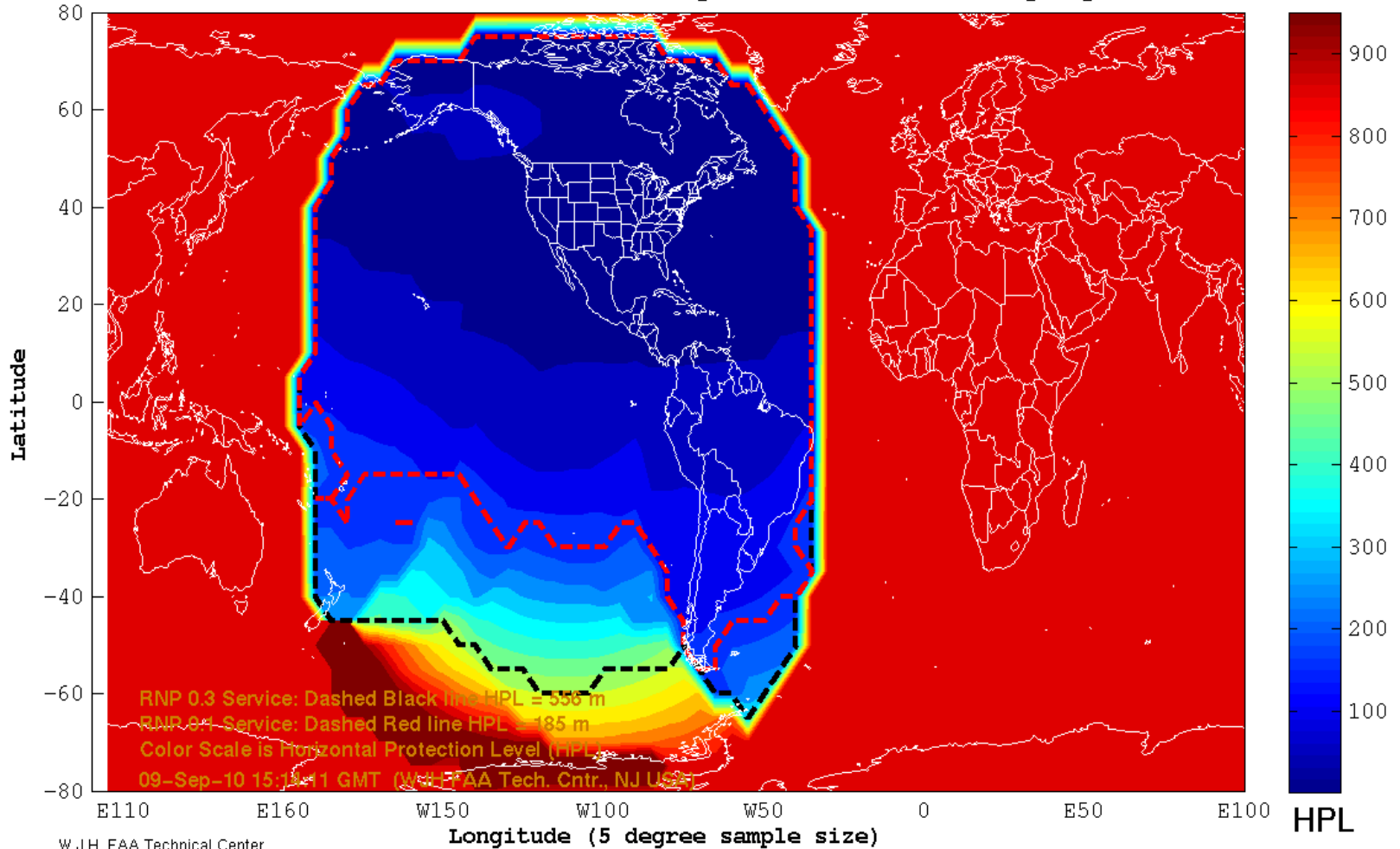




Current WAAS RNP 0.3 Performance



Current WAAS RNP 0.3 Navigation Service Display



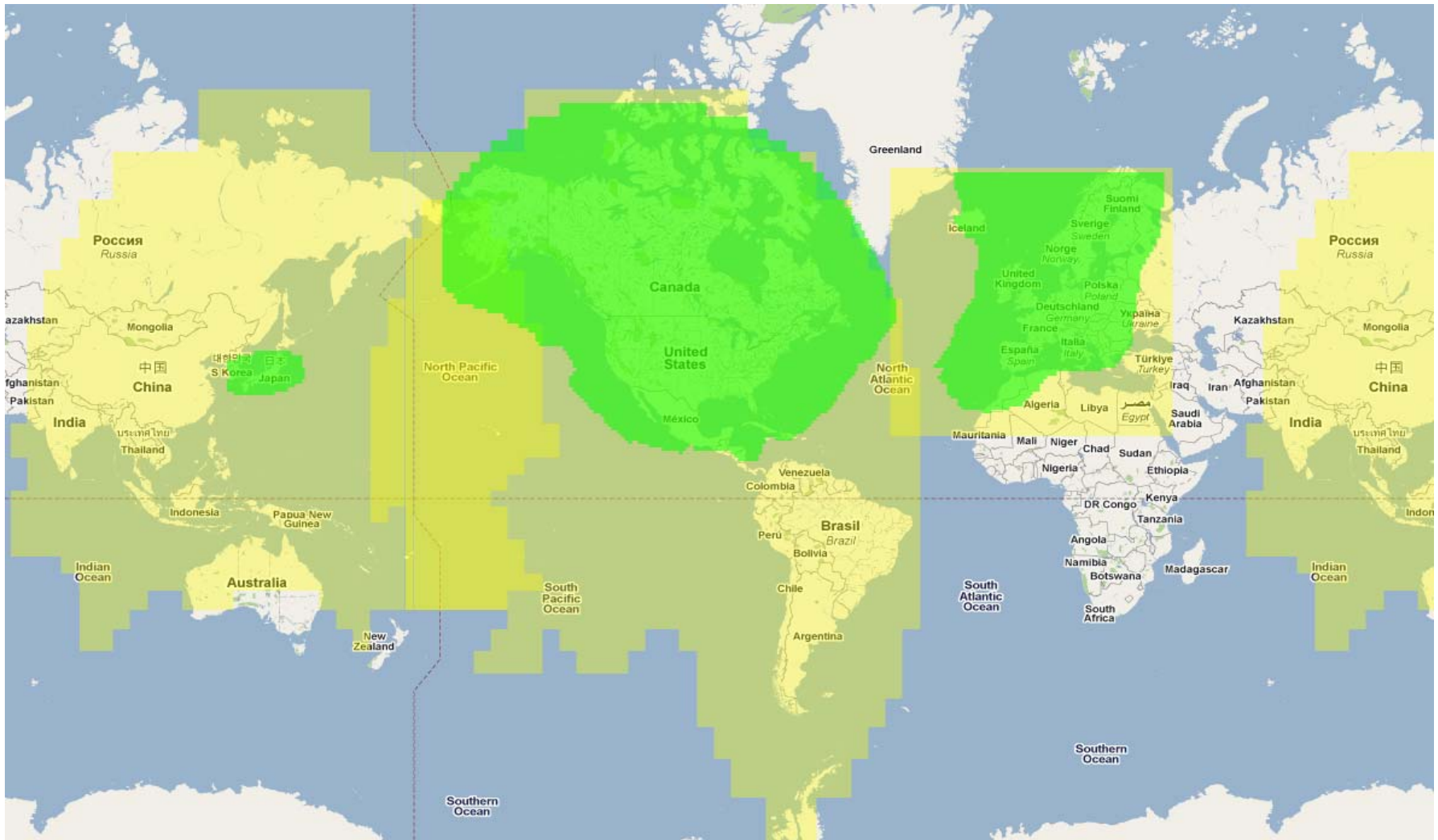
W.J.H. FAA Technical Center
WAAS Test Team
09-Sep-10 15:14:11 GMT

International Committee on GNSS (ICG-G)

October 2010

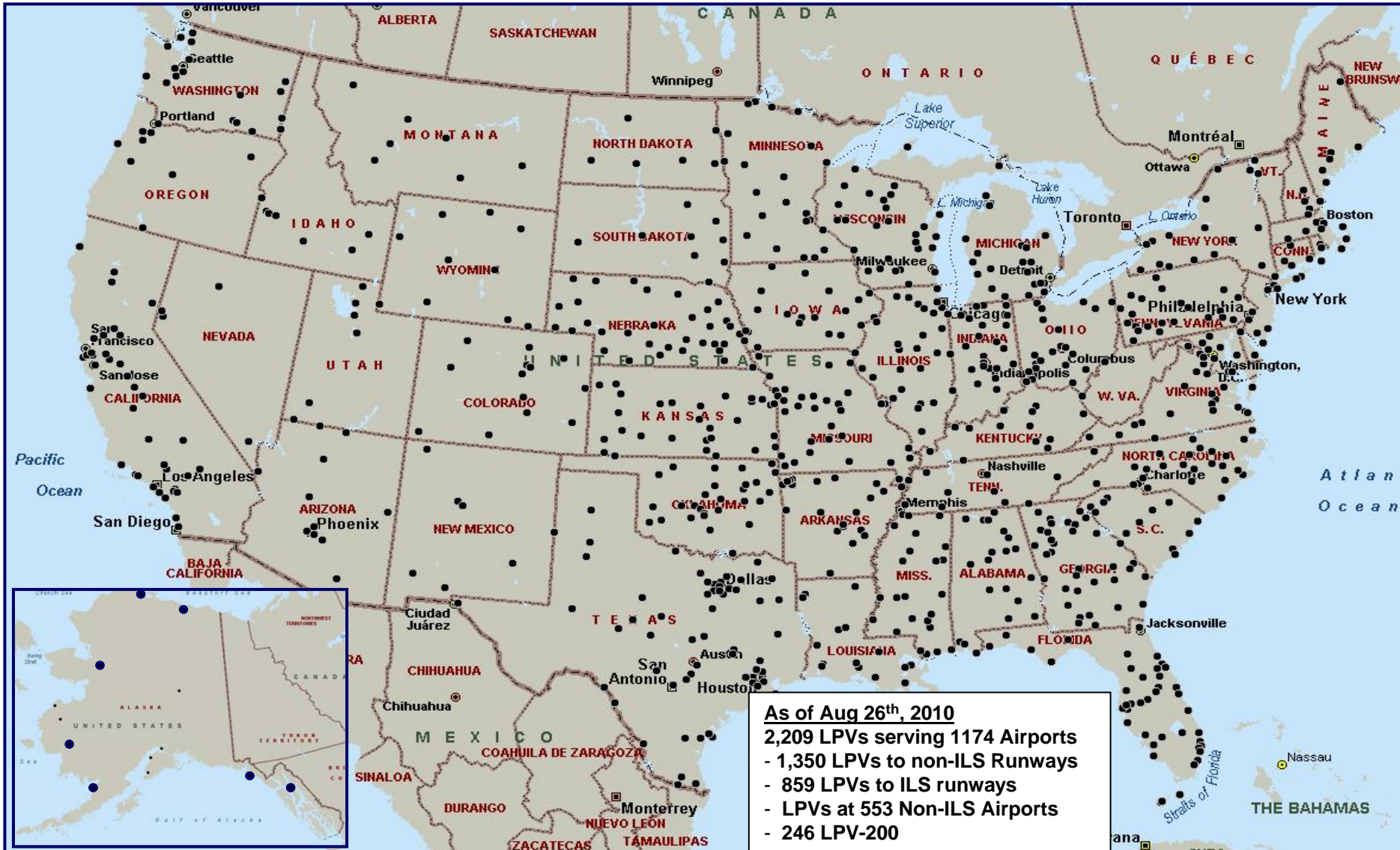


Combined SBAS Snapshot



International Committee on GNSS (ICG-5)
October 2010

WAAS Approach Procedures Today





Universal Navigation Systems (UNS)



Completed Aircraft Approvals

- **Astra 1125***
- **Beech 400***,
- **Boeing B-737-200, 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**



Rockwell-Collins



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:

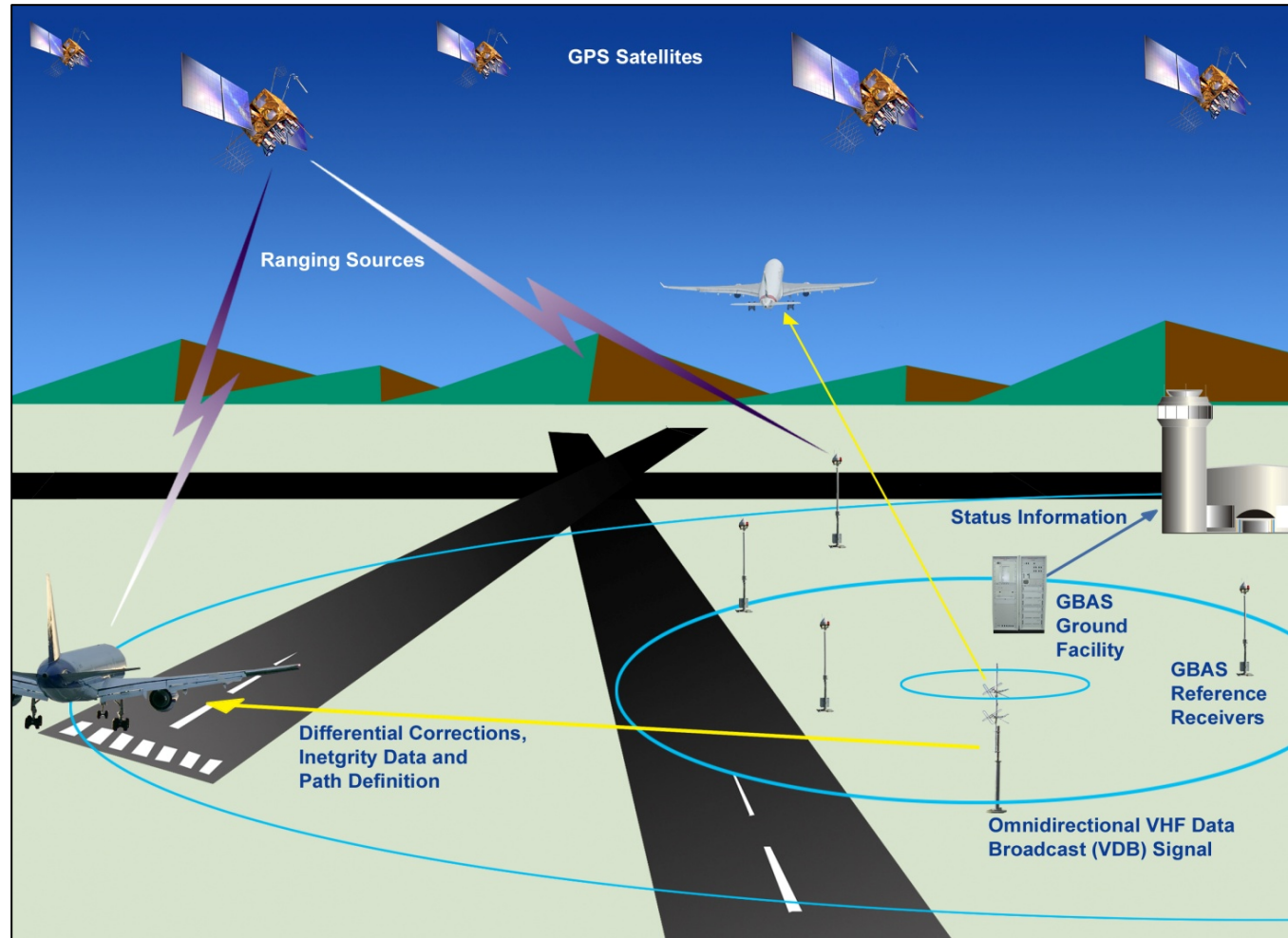
- **Gulfstream G-IV, G-V**
- **F-900B, -900EXC**
- **Challenger CL-601**
- **Hawker 800**
- **Citation X**
- **PC-12**
- **Viking**
- **Dassault EASy**
- **Cessna Sovereign**



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

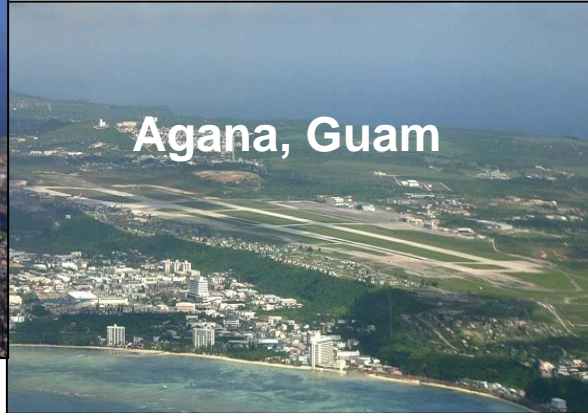




LAAS/GBAS International Efforts



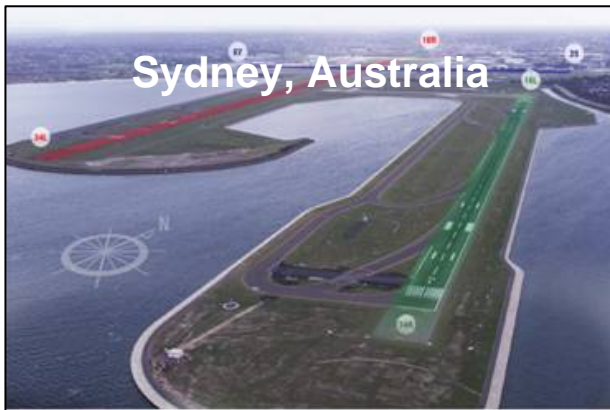
Rio De Janeiro, Brazil



Agana, Guam



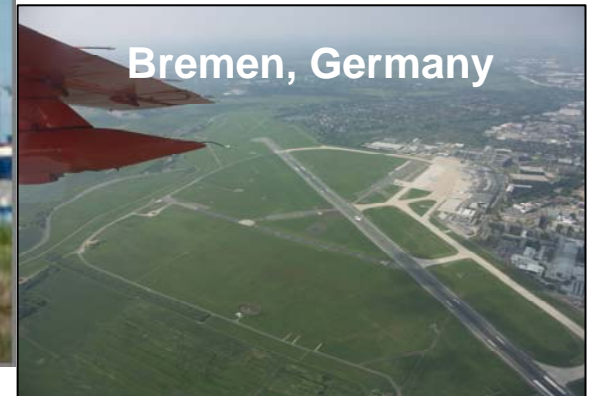
Malaga, Spain



Sydney, Australia



Frankfurt, Germany



Bremen, Germany



Commercially Available GPS Jammer (so called "Personal Privacy Device")





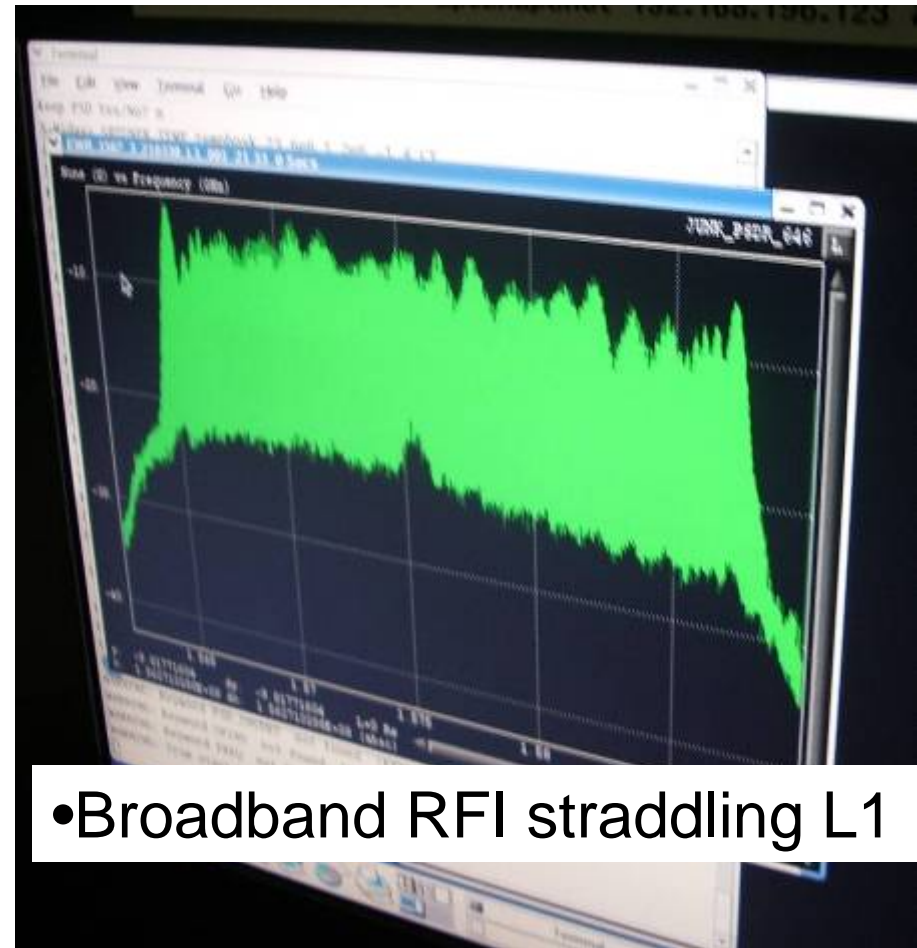
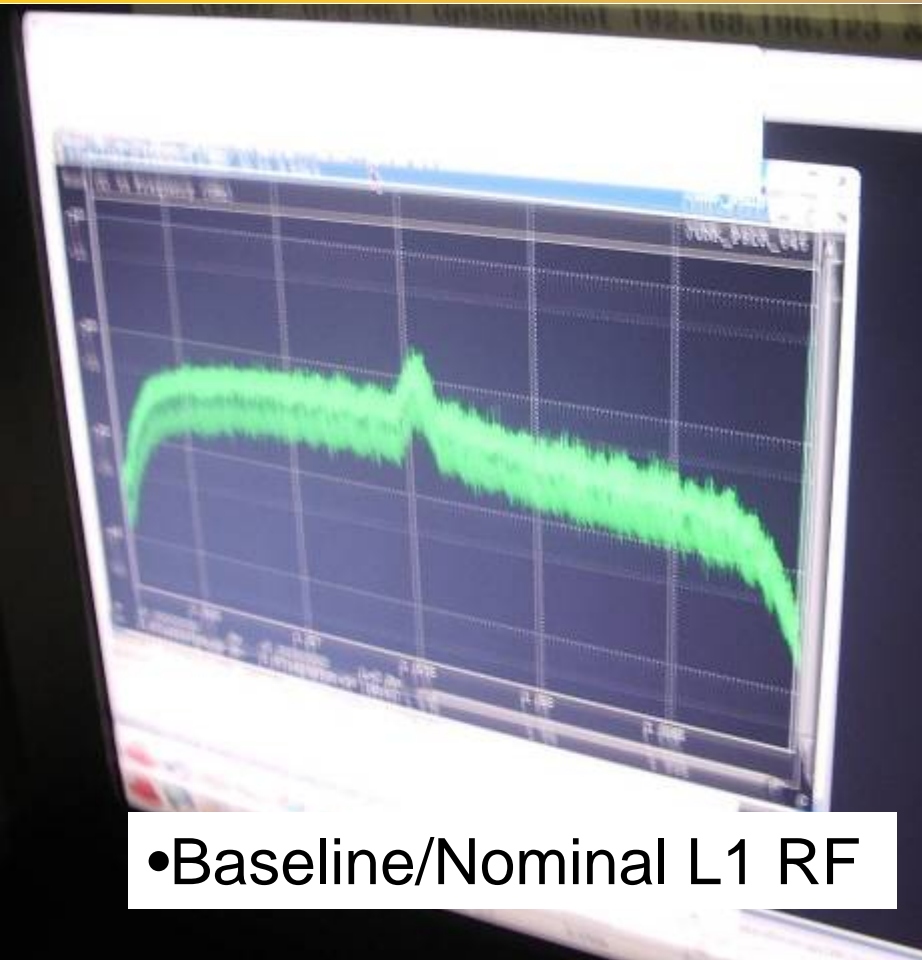
LAAS Antenna Location



International Committee on GNSS (ICG-5)
October 2010



Zeta "SnapShot" System Data





... 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 recent failures**
- **LAAS program activities underway for Cat-III**
- **RFI challenges being investigated**



Recommendations



- States and service providers should establish controls to mitigate impacts of privacy jammers
- Augmentation service providers should investigate establishing a cooperative global network of multi-constellation monitoring stations to support ARAIM



Questions