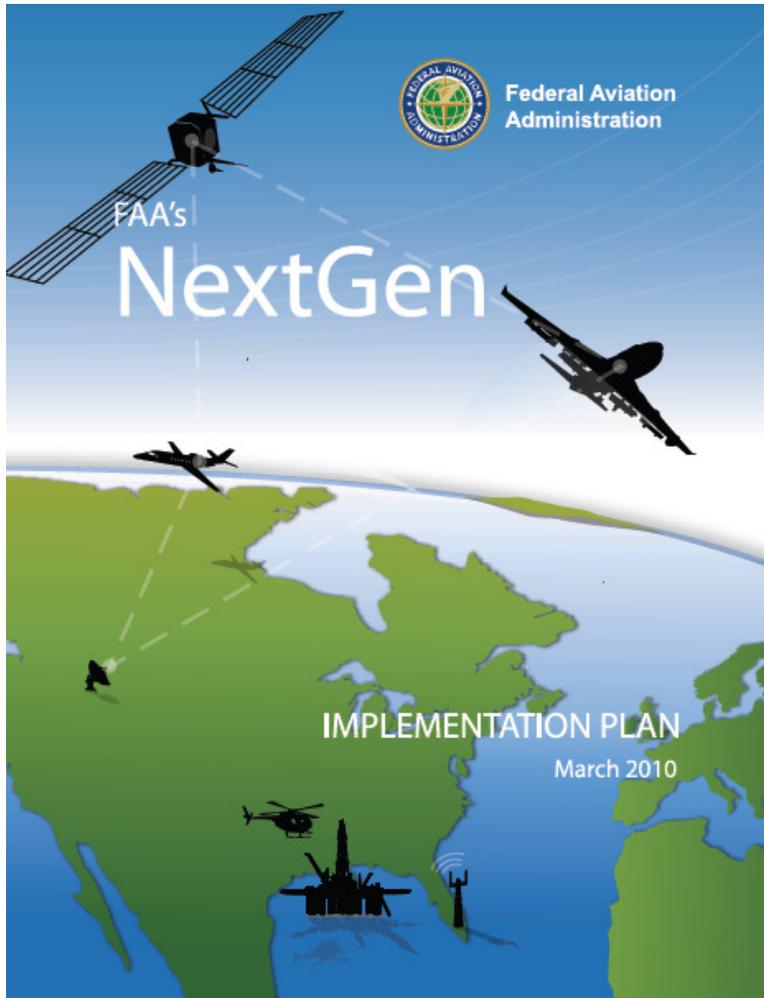




Aviation Augmentation Systems Update

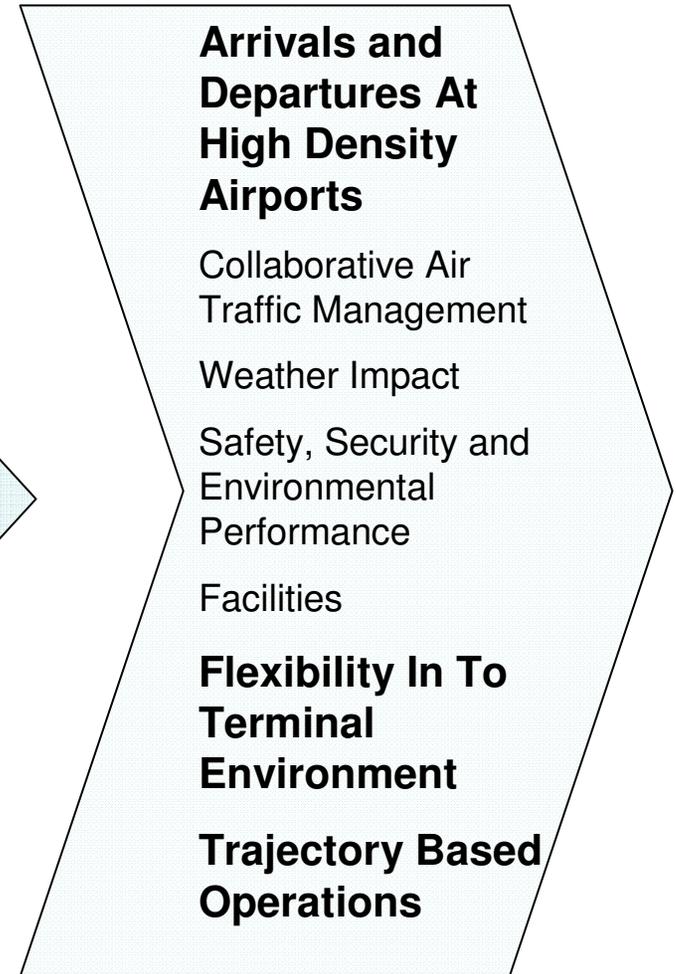


GNSS is a Key Enabler for NextGen



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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)			
LNAV	*0.3 nm	0.6 nm						
RNP (AR)	*0.1 nm	**0.1 nm						
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)			
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.

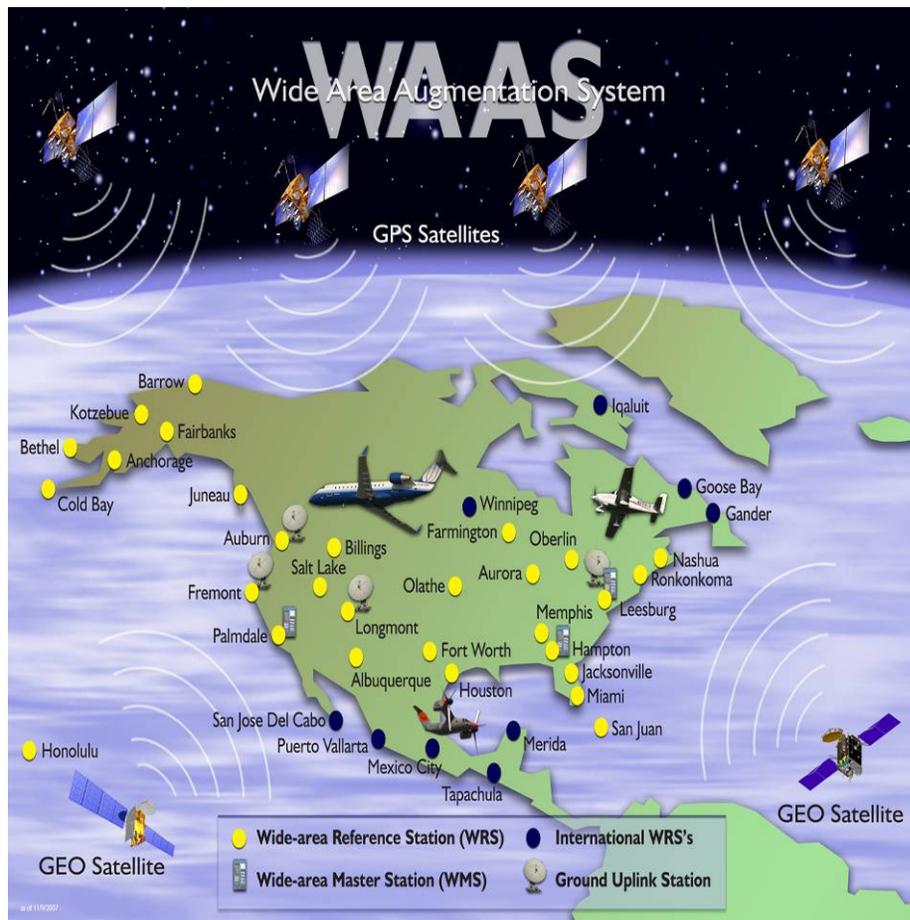
Dependent Parallel Approach (DPA)
Independent Parallel Approach (IPA)

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



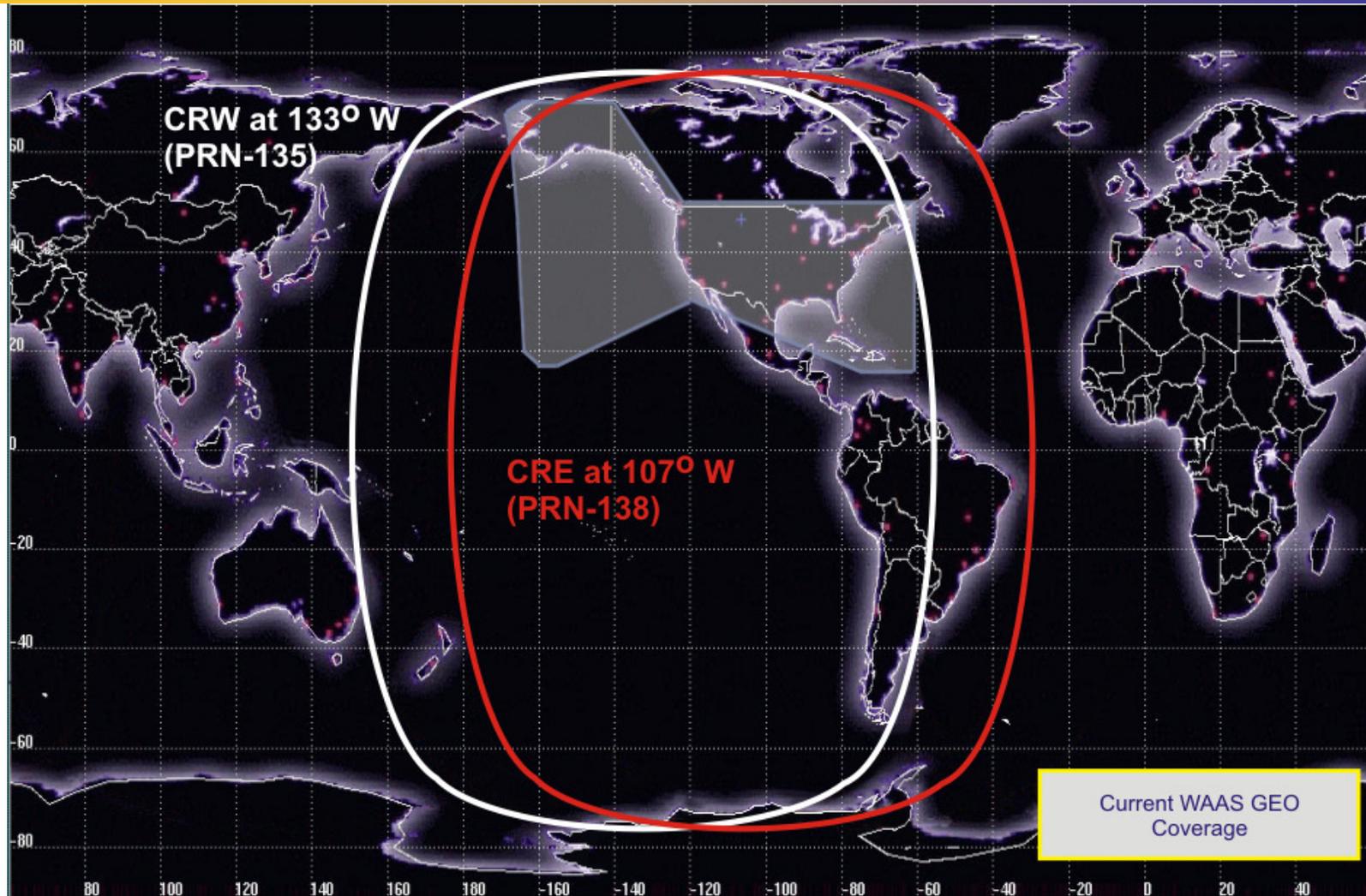
2 Operational Control Centers

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Current WAAS GEOs

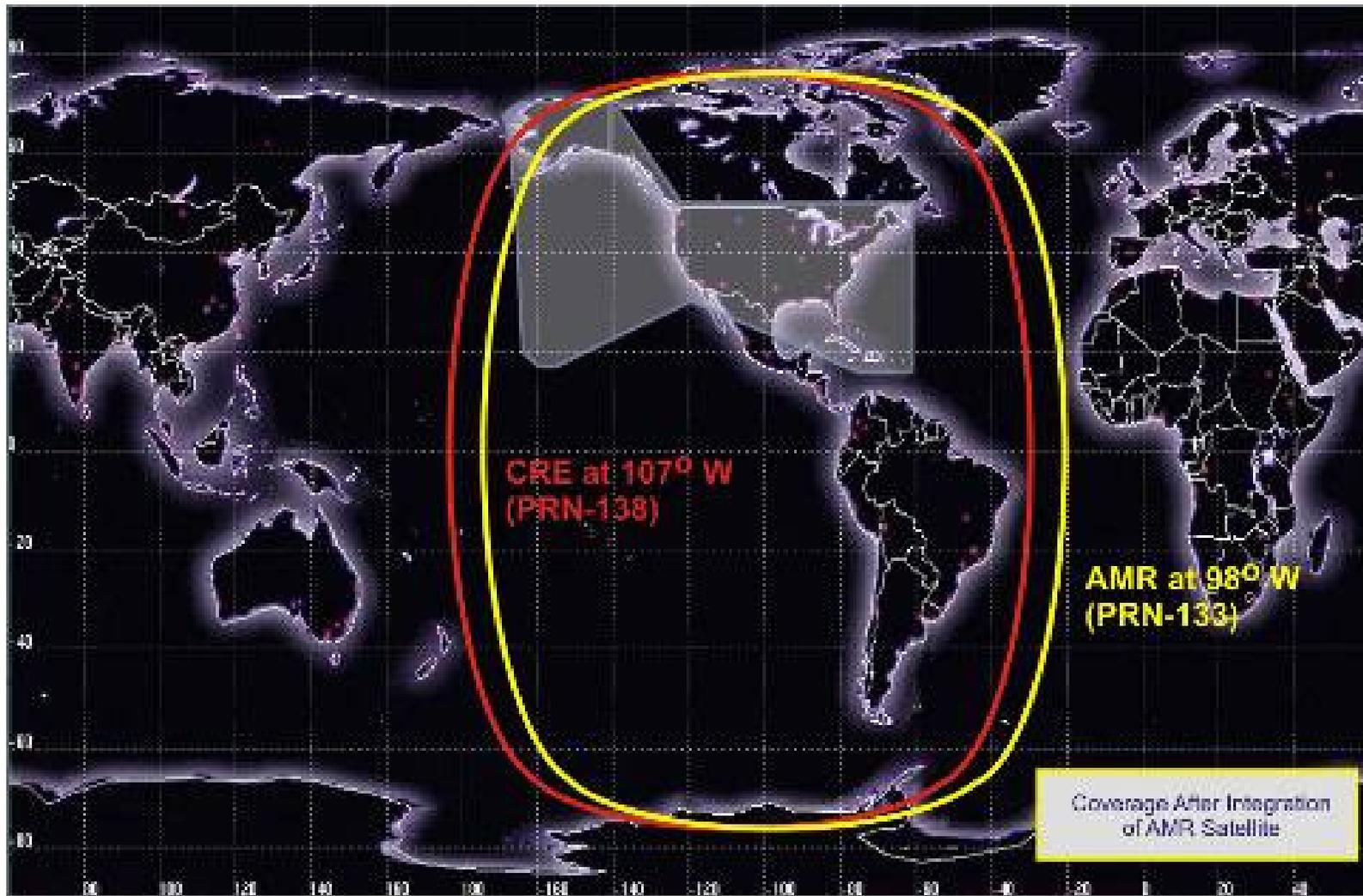


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Gap Filler GEO

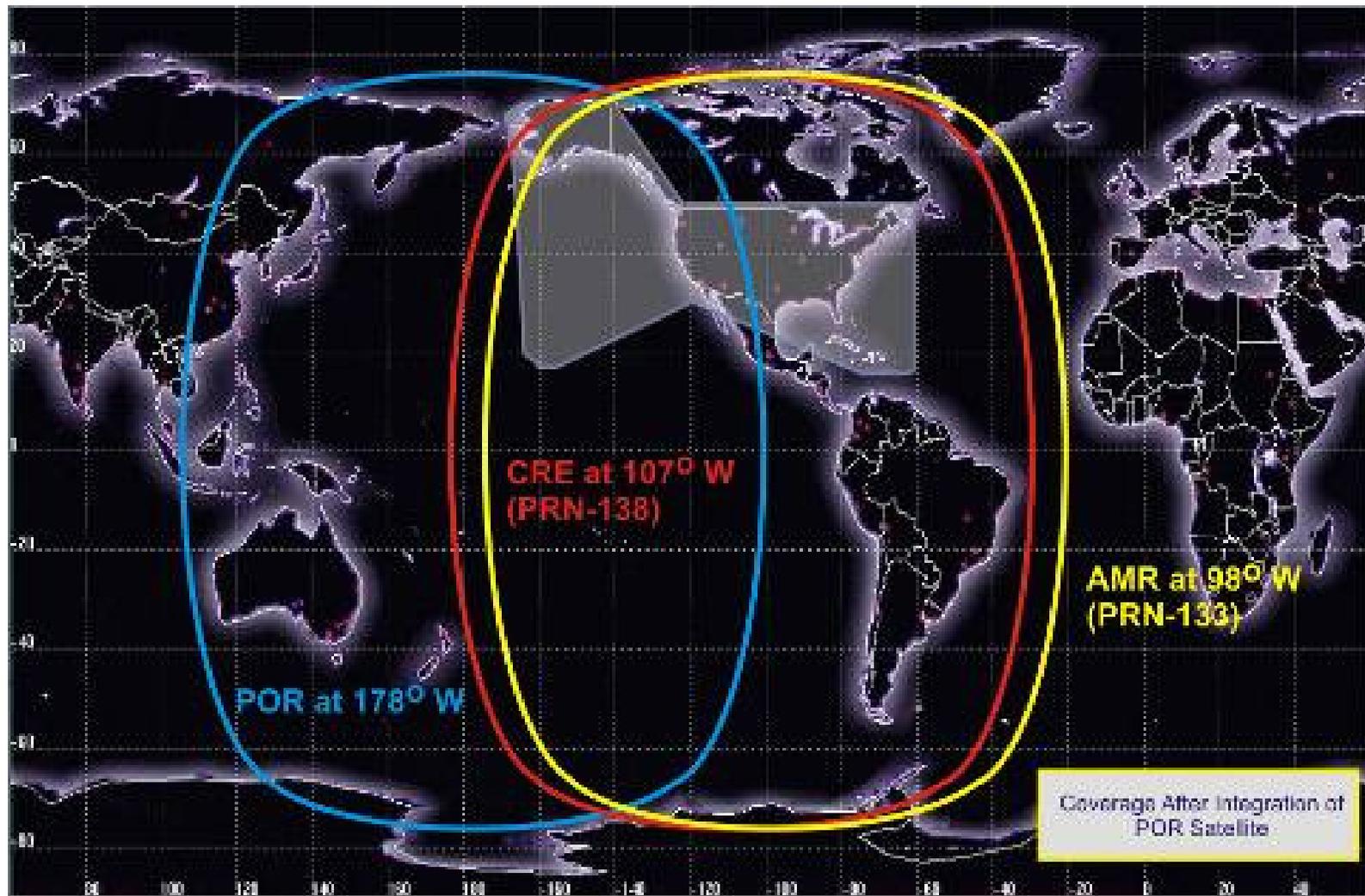


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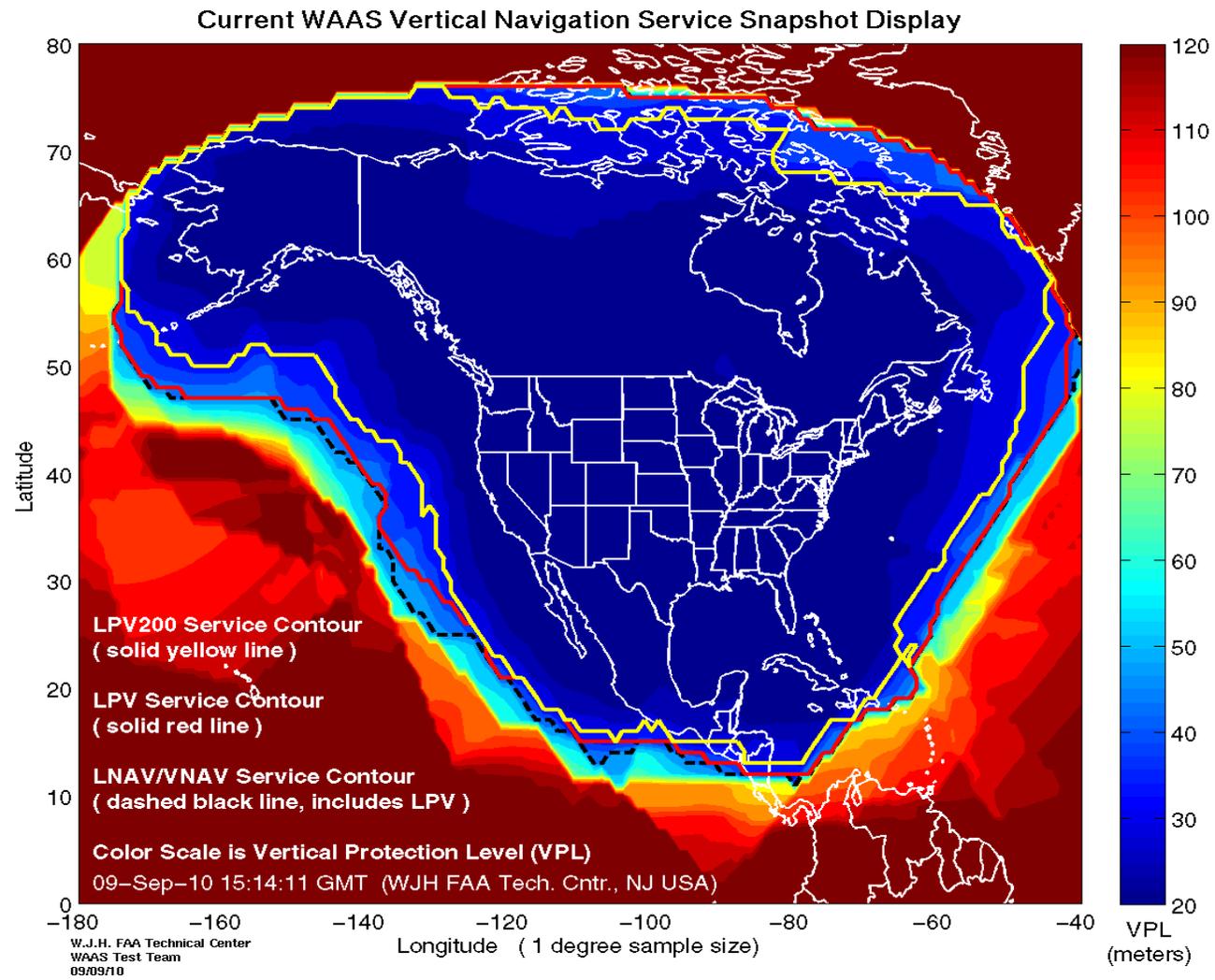


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Current WAAS LPV Performance



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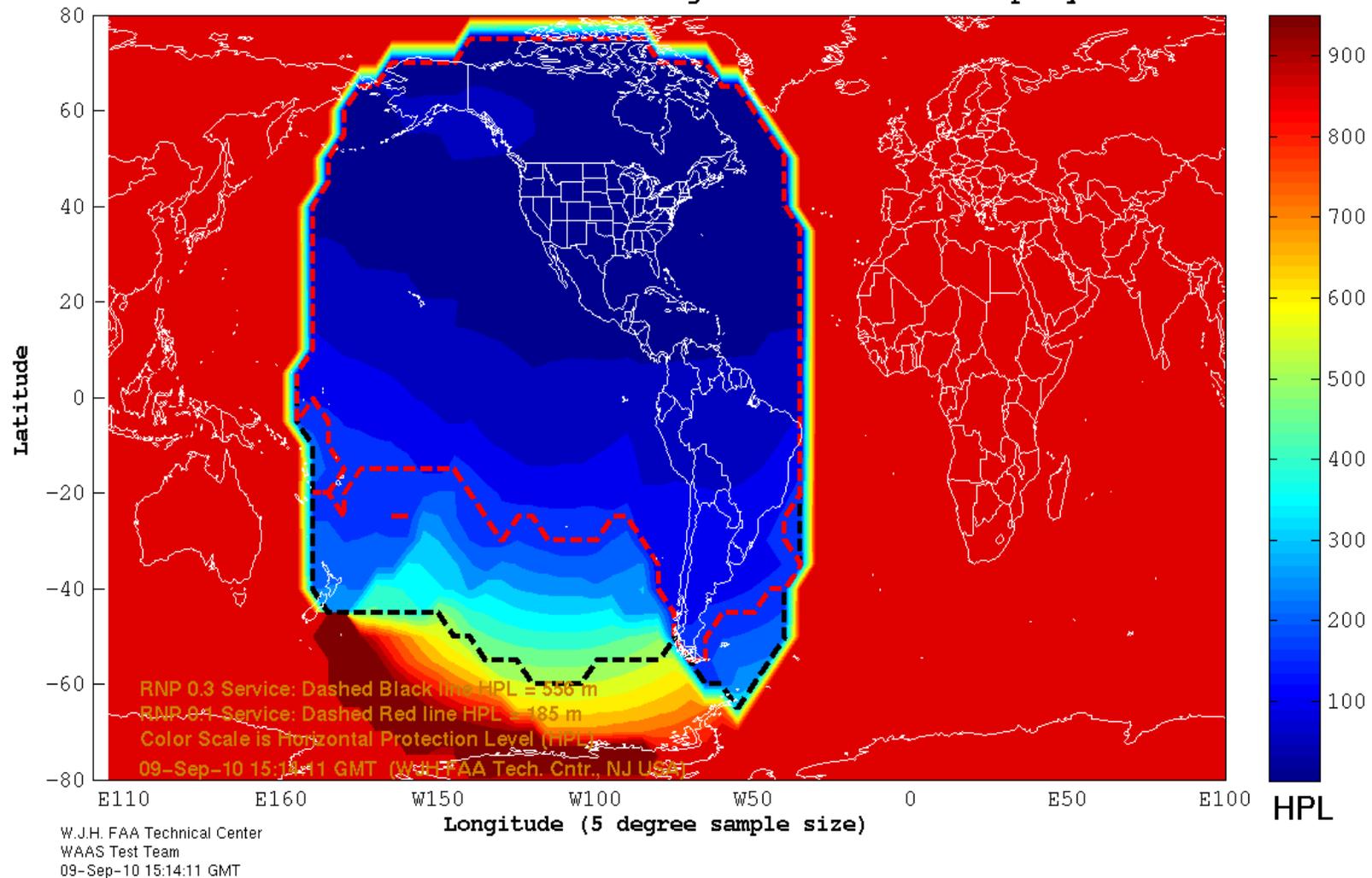
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Current WAAS RNP .3 Performance



Current WAAS RNP 0.3 Navigation Service Display

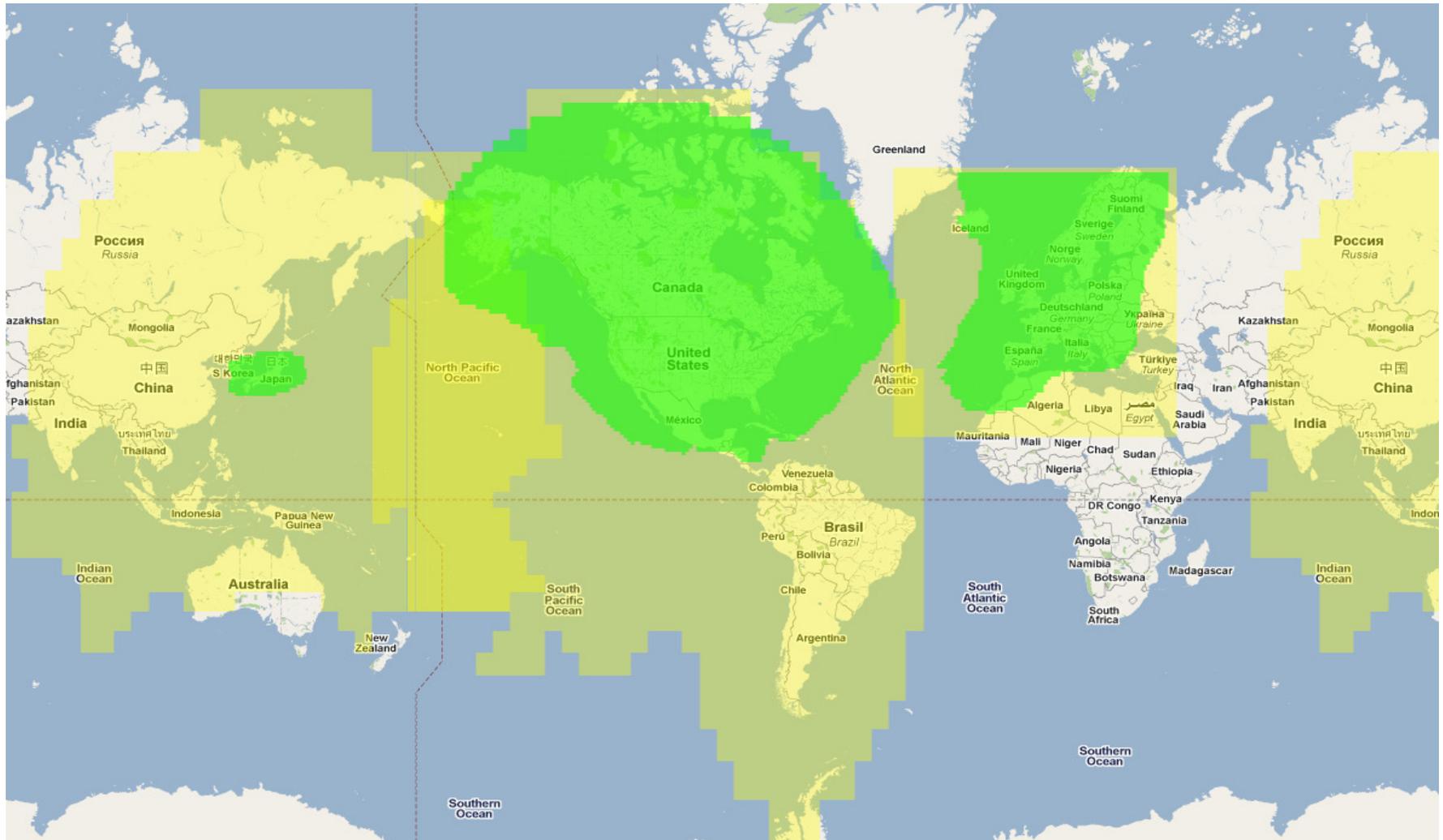


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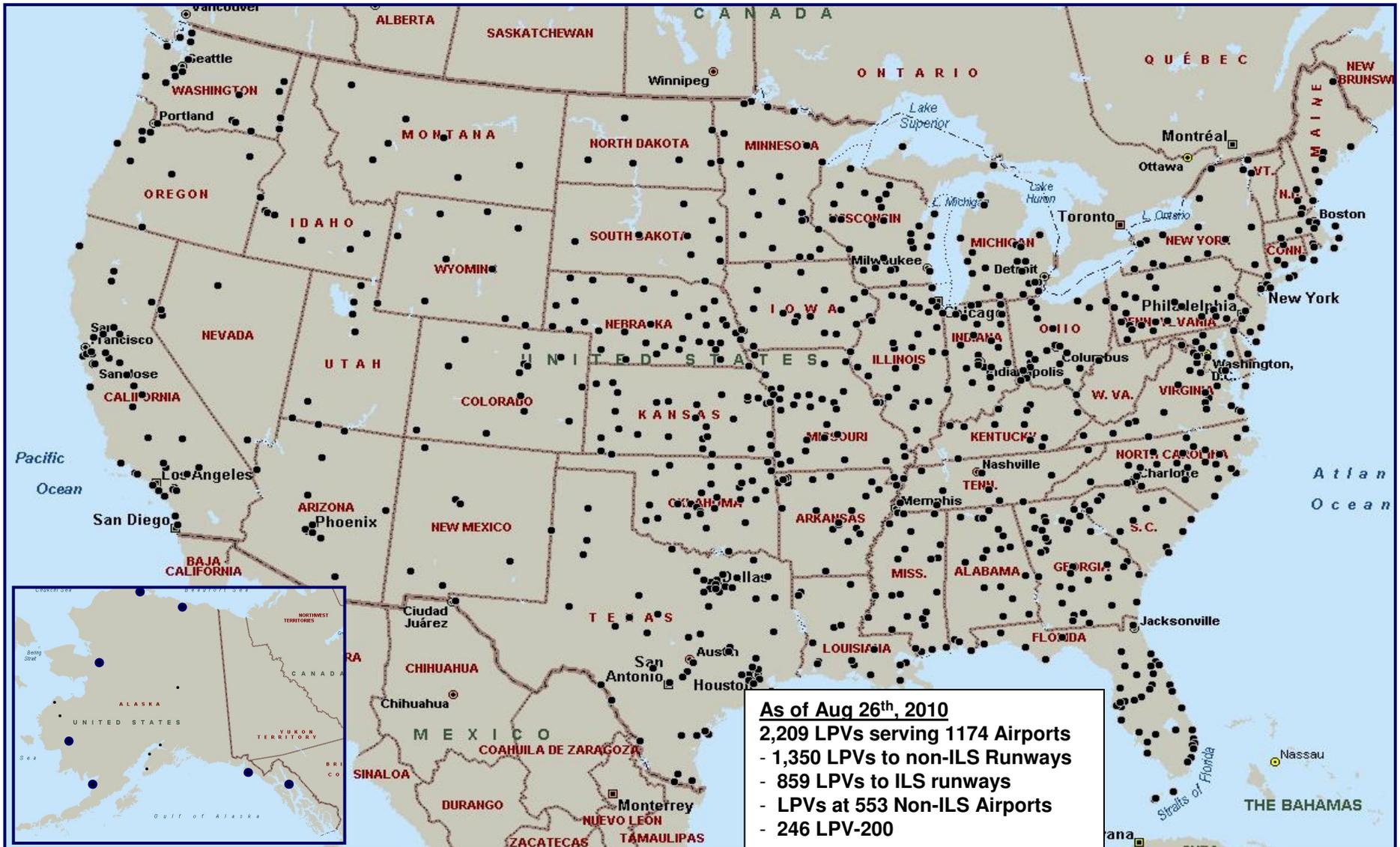
Combined SBAS Snapshot



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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:

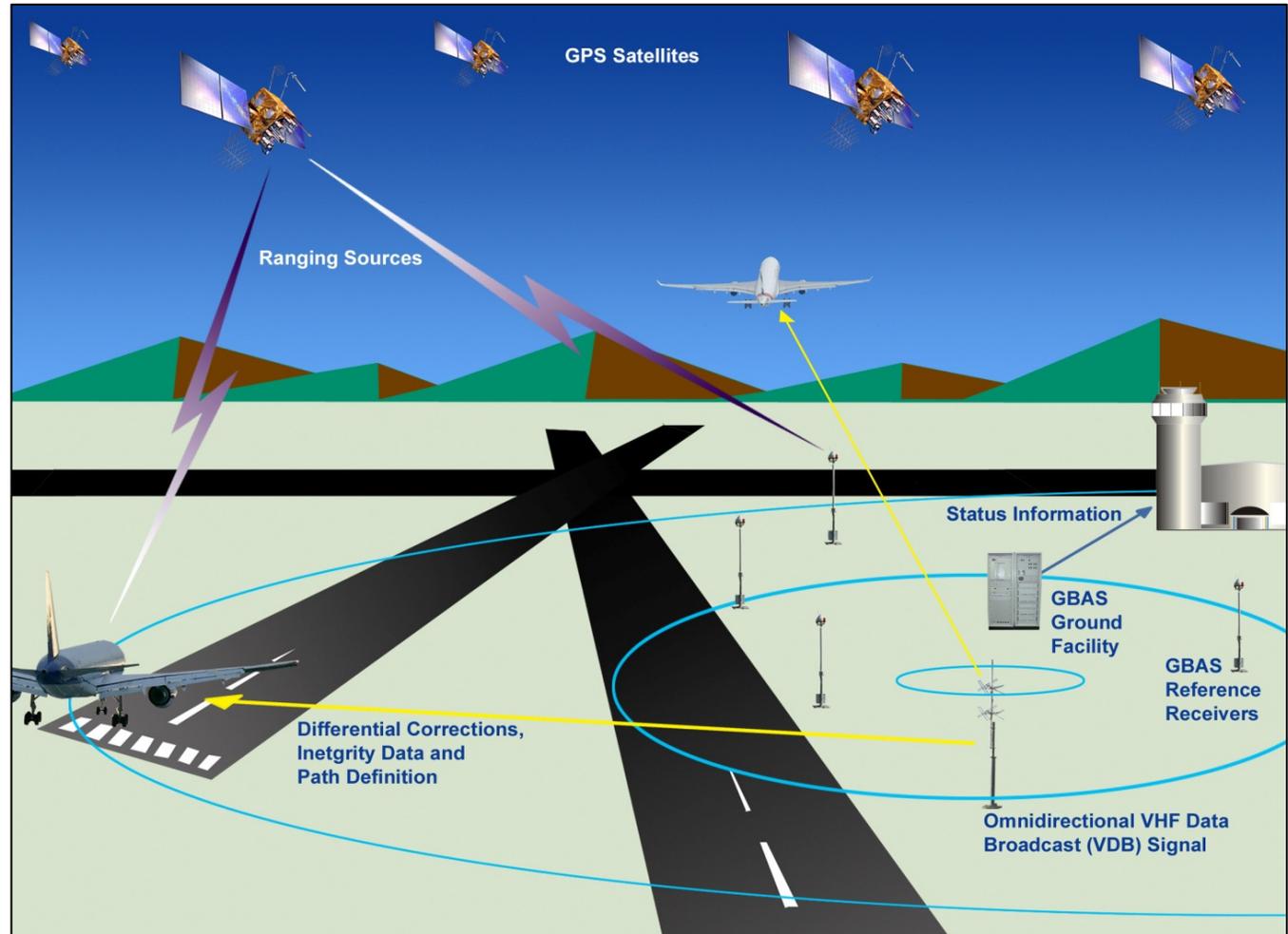
- **Gulfstream G-IV, G-V**
- **F-900B,-900EXC**
- **Challenger CL-601**
- **Hawker 800**
- **Citation X**
- **PC-12**
- **Viking**
- **Dassault EASy**
- **Cessna Sovereign**



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



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GBAS Pathway Forward



- Cat-I System Design Approval at Memphis – Complete
- Cat-III Validation by - 2010
- Cat-III Final Investment Decision by - 2012



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GBAS Facilities



- Current airlines GBAS equipped
 - Continental
 - Delta Airlines
 - Qantas
 - Air Berlin
 - TuiFly
 - Sonair
 - Air Vanatu
 - Emirates
- Over 15 countries have active GBAS programs





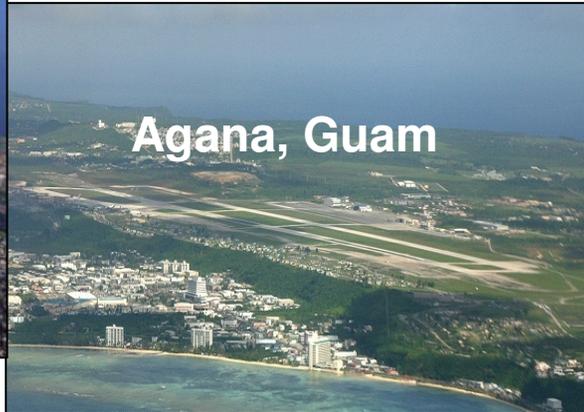
LAAS/GBAS International Efforts



Rio De Janeiro, Brazil



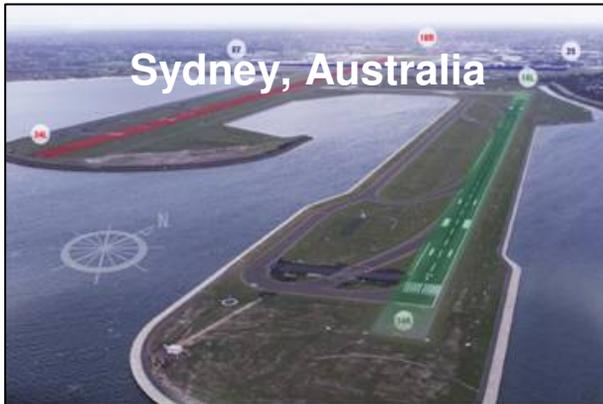
Agana, Guam



Malaga, Spain



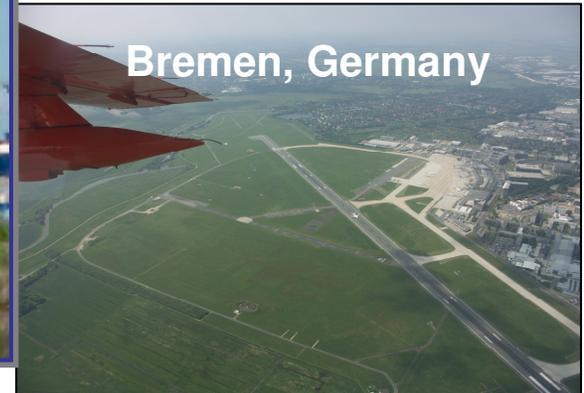
Sydney, Australia



Frankfurt, Germany



Bremen, Germany





Commercially Available GPS Jammer (so called “Personal Privacy Device”)

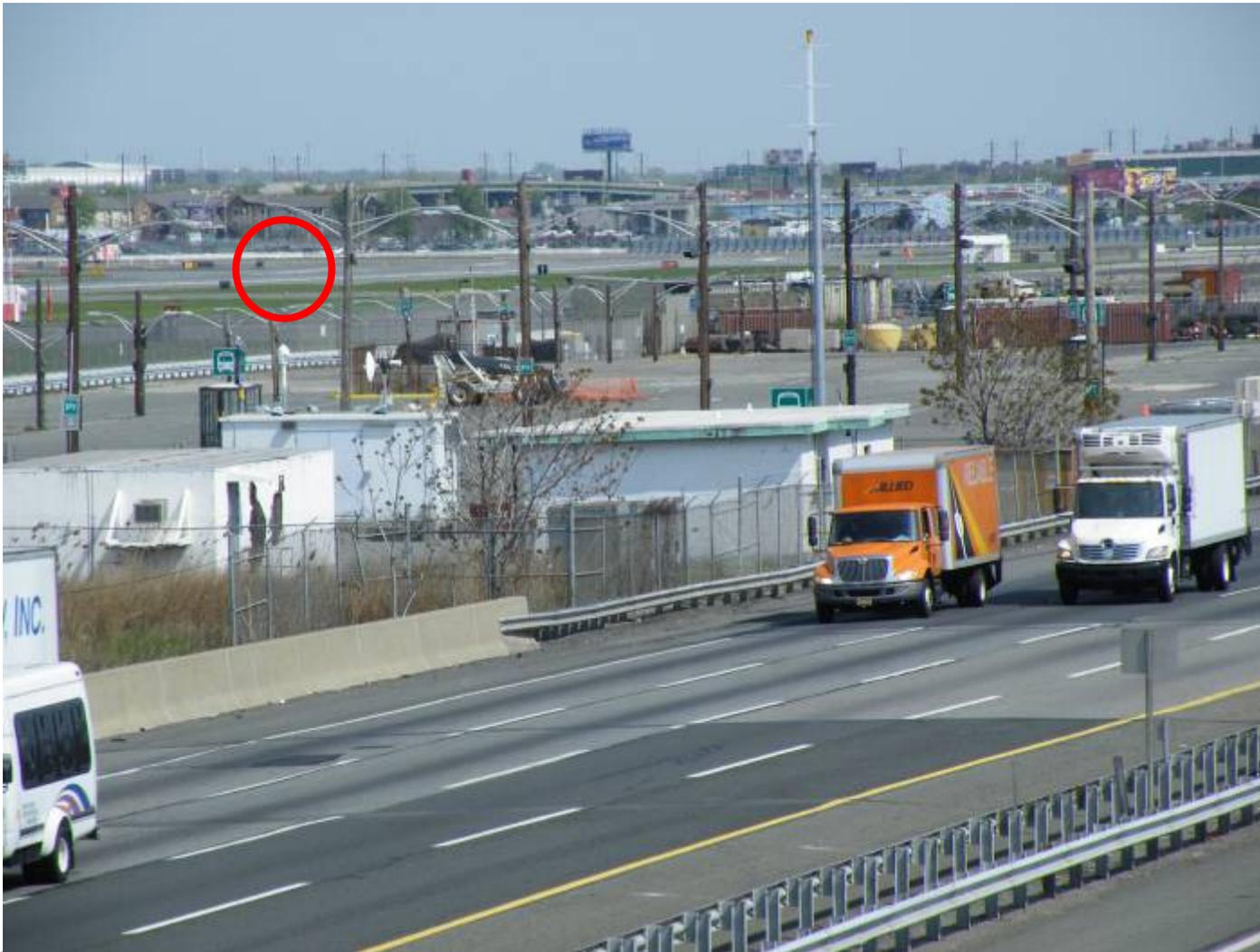


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LAAS Antenna Location

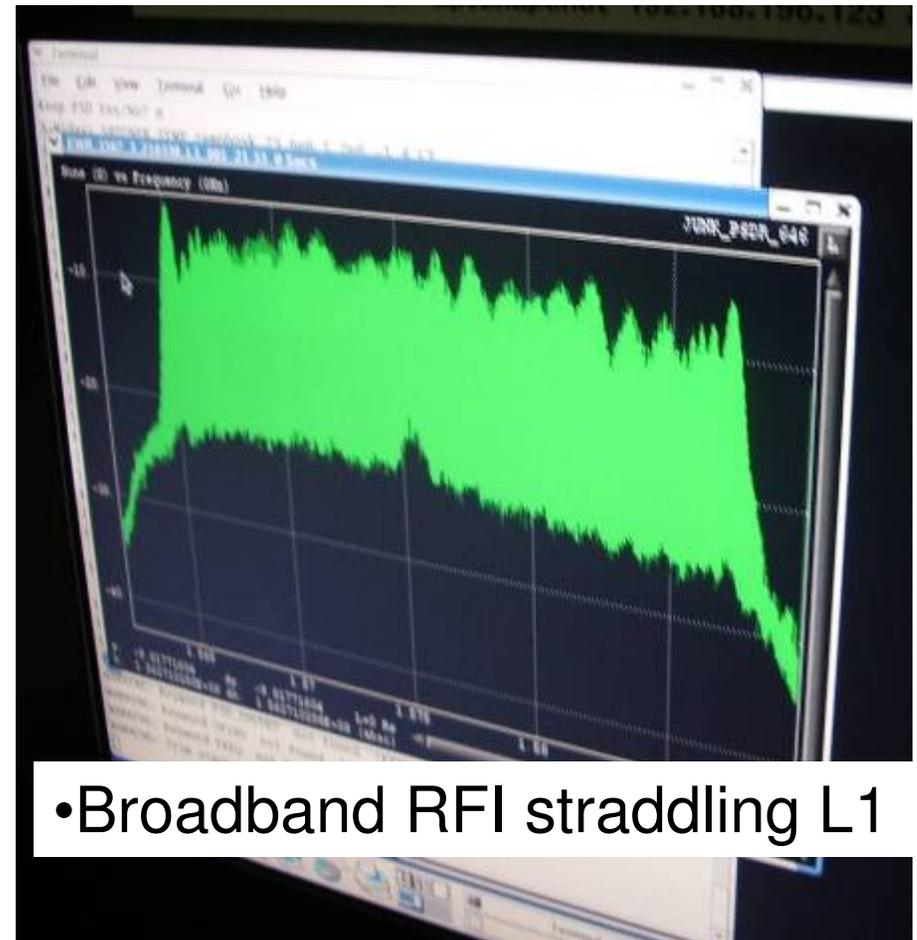
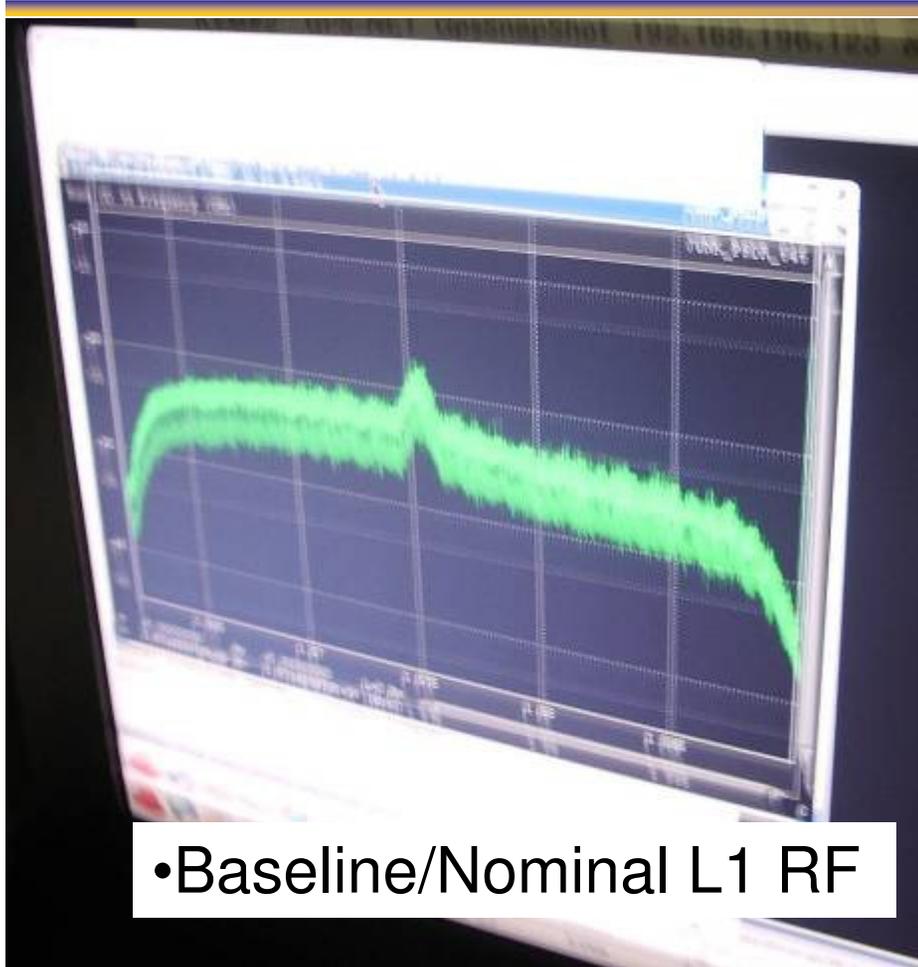


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Zeta “SnapShot” System Data





... 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



Questions

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NextGen
Operational Capabilities

NEXTGEN Domain



Navigation Services

PNT Systems

