

# WAAS and LAAS Program Status

**CGSIC**  
**20 September**

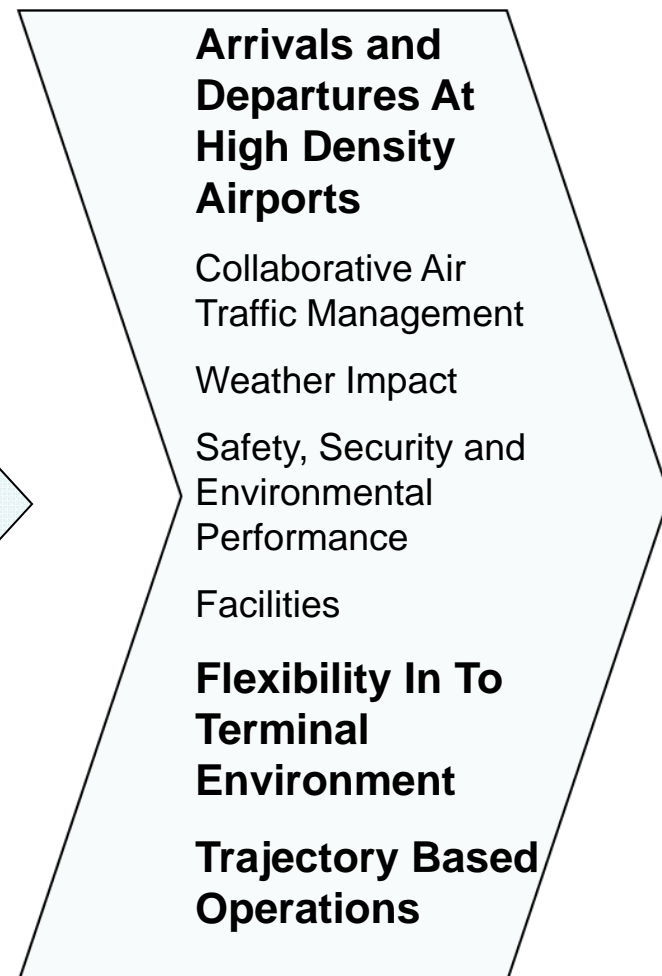
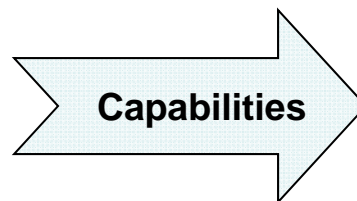
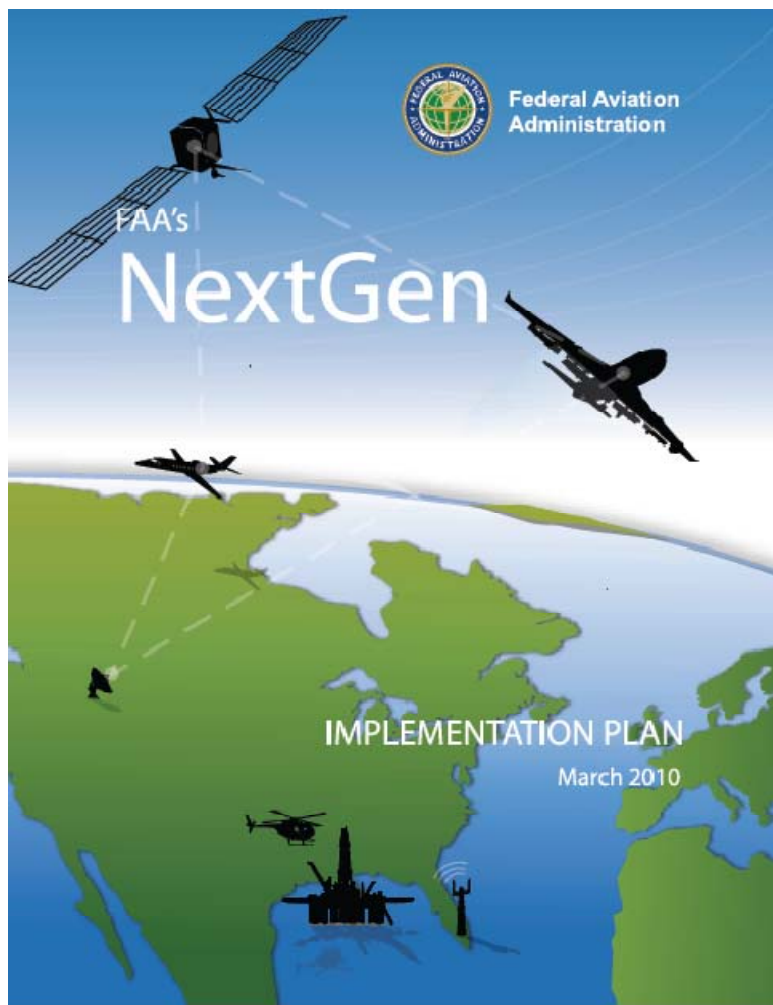
**Leo Eldredge**  
**GNSS Program Manager**  
**FAA Navigation Services**



**Federal Aviation  
Administration**



# Performance Based Navigation is a Key Enabler for NextGen Services



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

	Navigation (≥ 99.0% Availability)		Surveillance (≥99.9% Availability)			Positioning		
	Accuracy (95%)	Containment (10 <sup>-7</sup> )	Separation	NACp (95%)	NIC (10 <sup>-7</sup> )	GNSS PNT (99.0 – 99.999%)		
En Route	*10 nm	20 nm	5 nm	0.1 nm (7)	1 nm (5)	GPS		
	*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						
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.

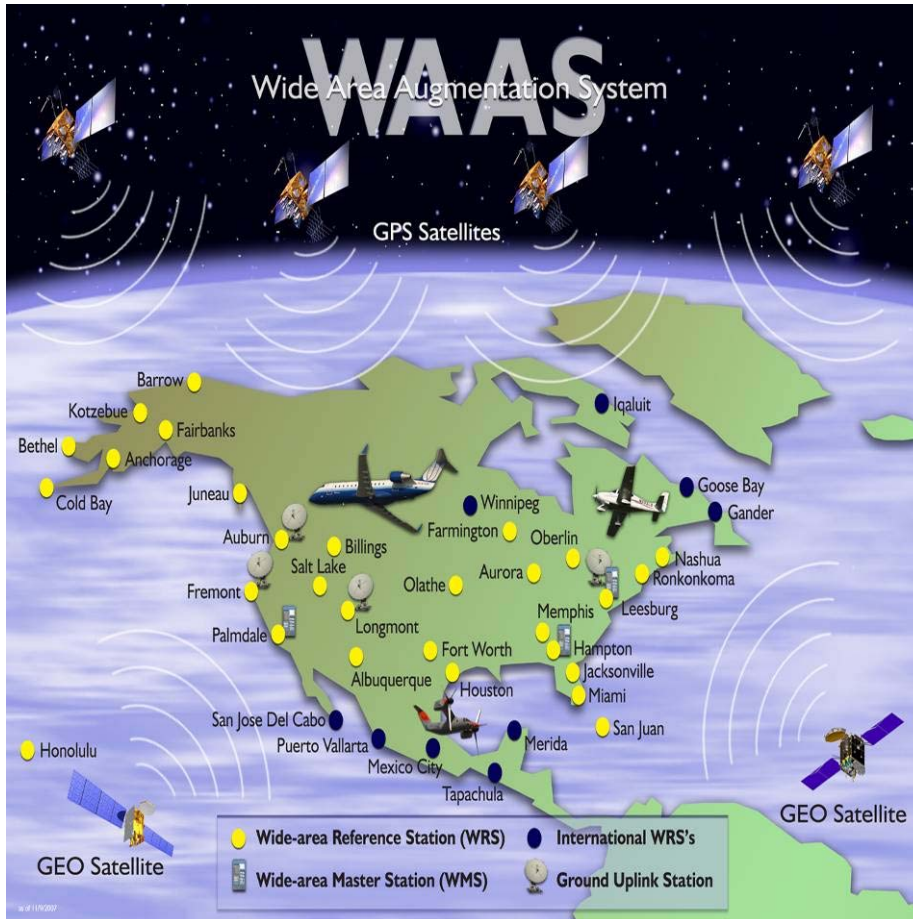
\*\* Containment for RNP AR is specified as a total system requirement; value representative of current approvals.

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) Architecture



38 Reference Stations



3 Master Stations



4 Ground Earth Stations

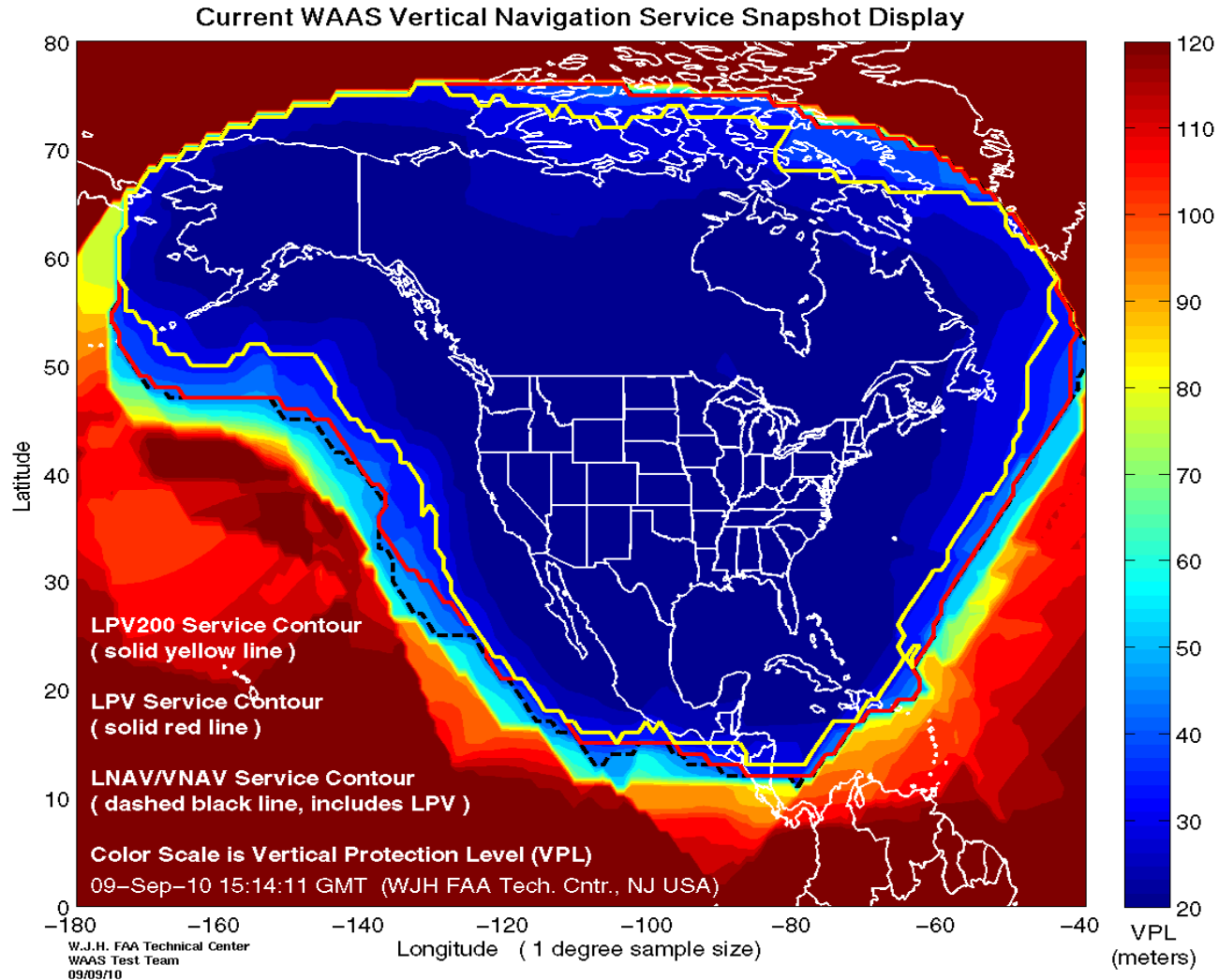


2 Geostationary Satellite Links



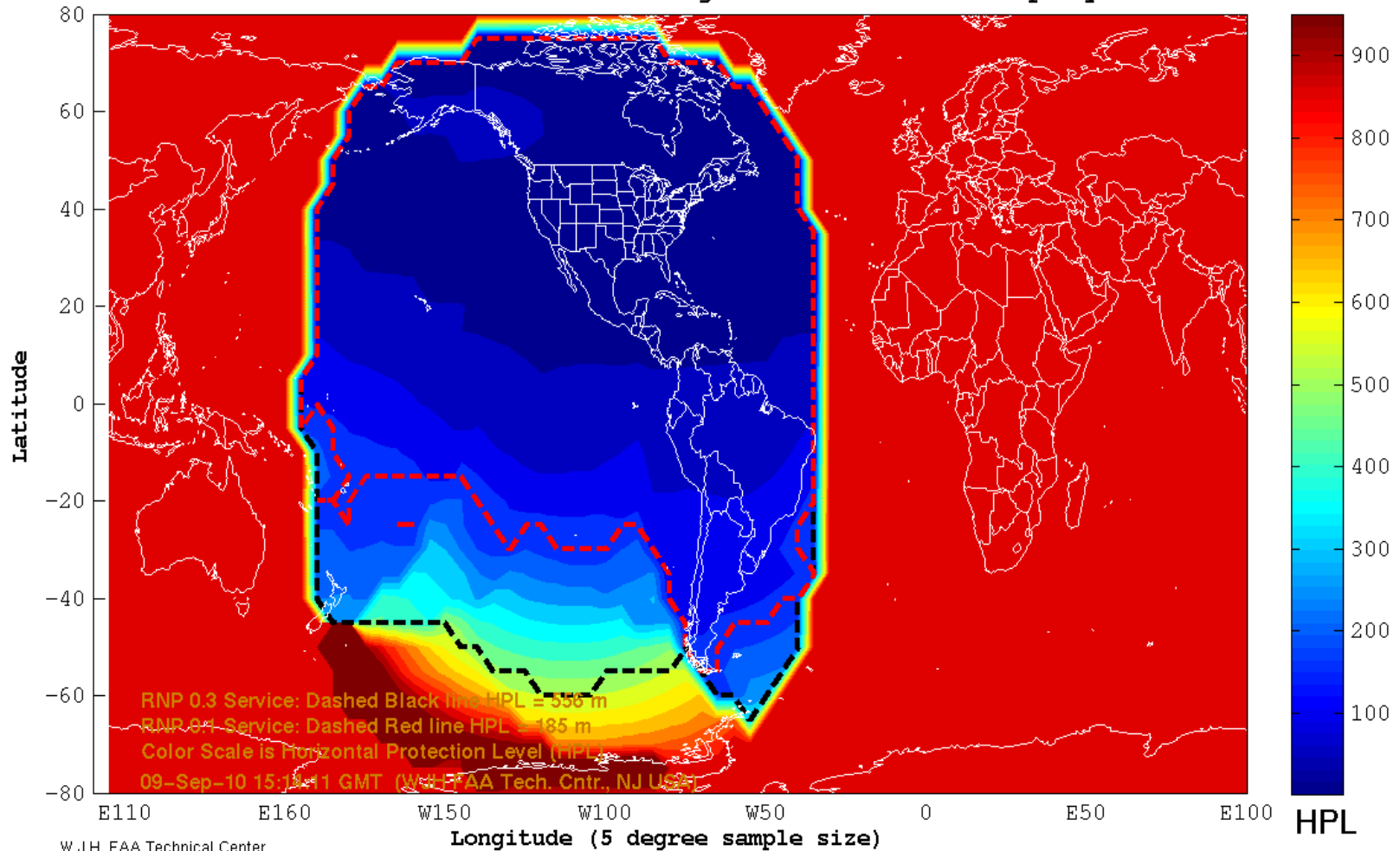
2 Operational Control Centers

# Current WAAS LPV Performance



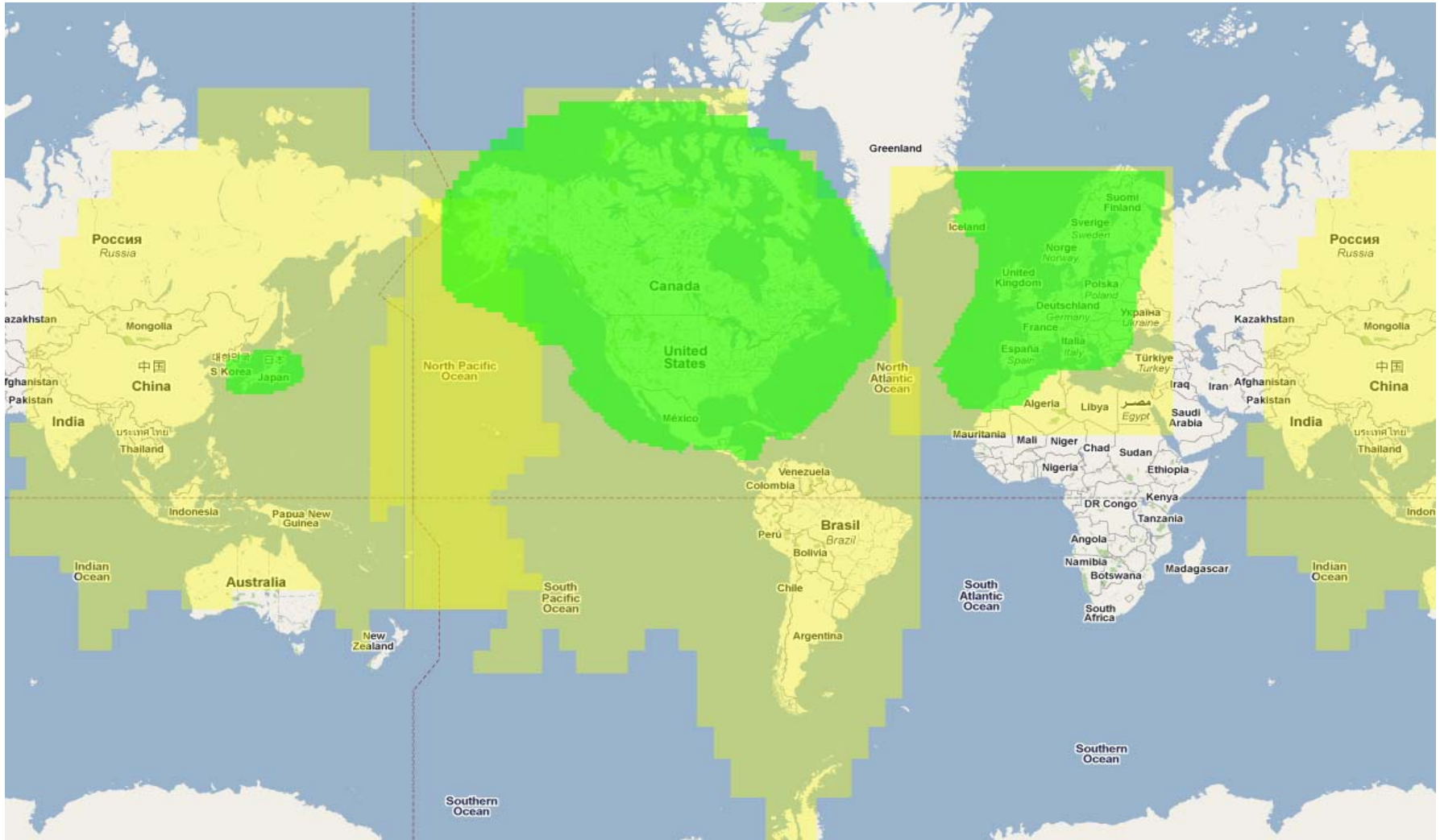
# Current WAAS RNP .3 Performance

Current WAAS RNP 0.3 Navigation Service Display

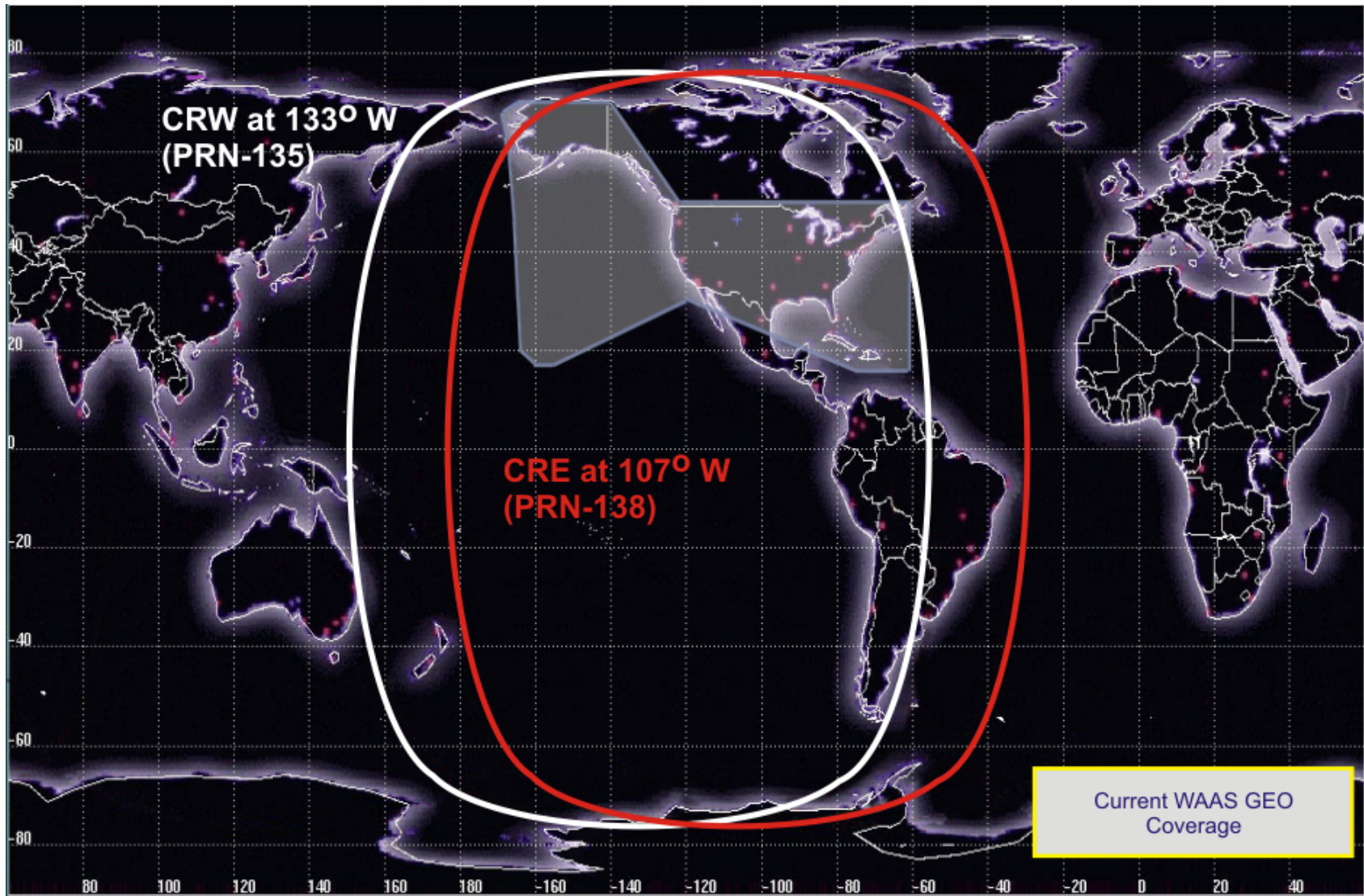


W.J.H. FAA Technical Center  
WAAS Test Team  
09-Sep-10 15:14:11 GMT

# Combined SBAS Snapshot

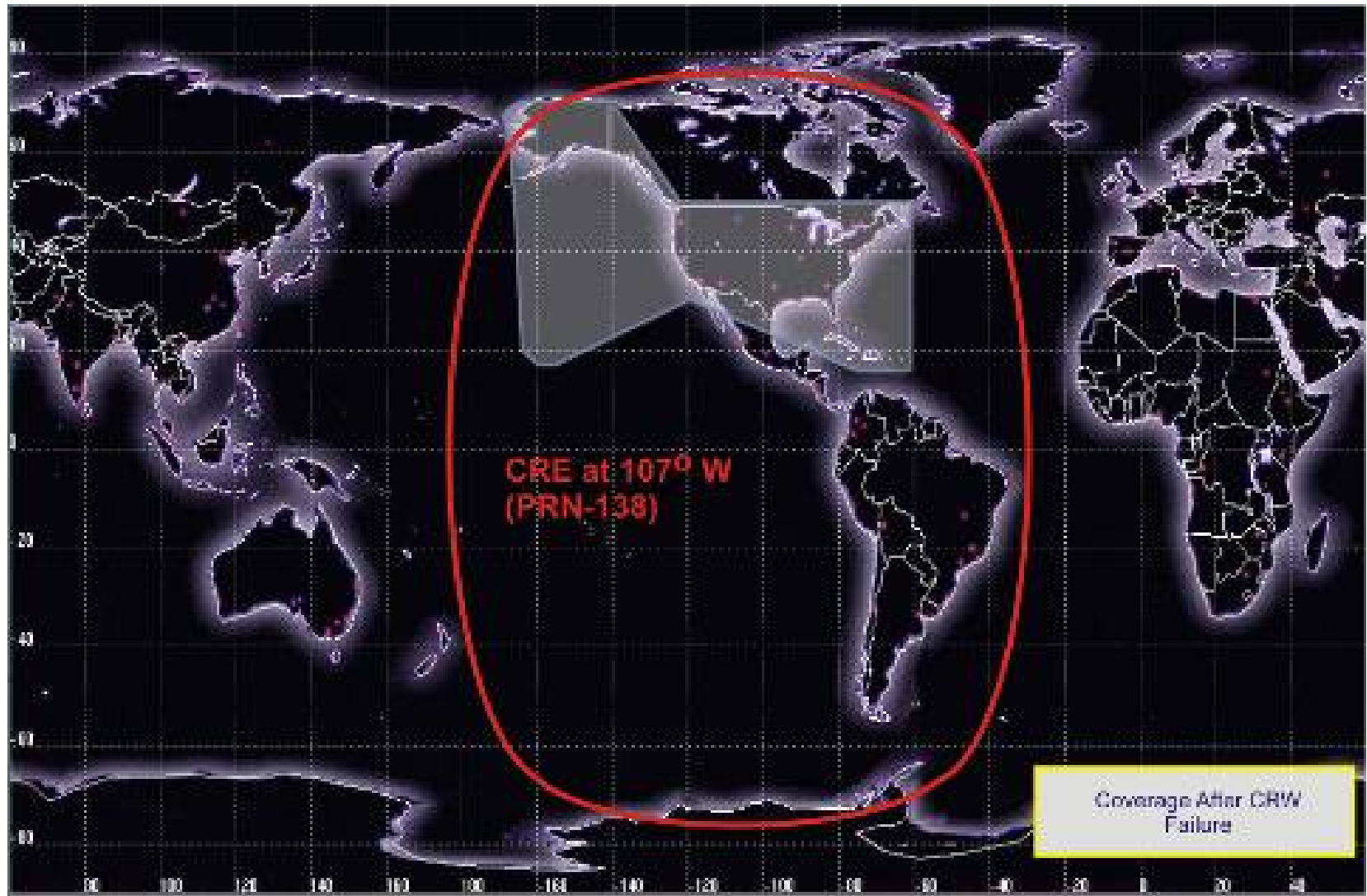


# Current WAAS GEOs



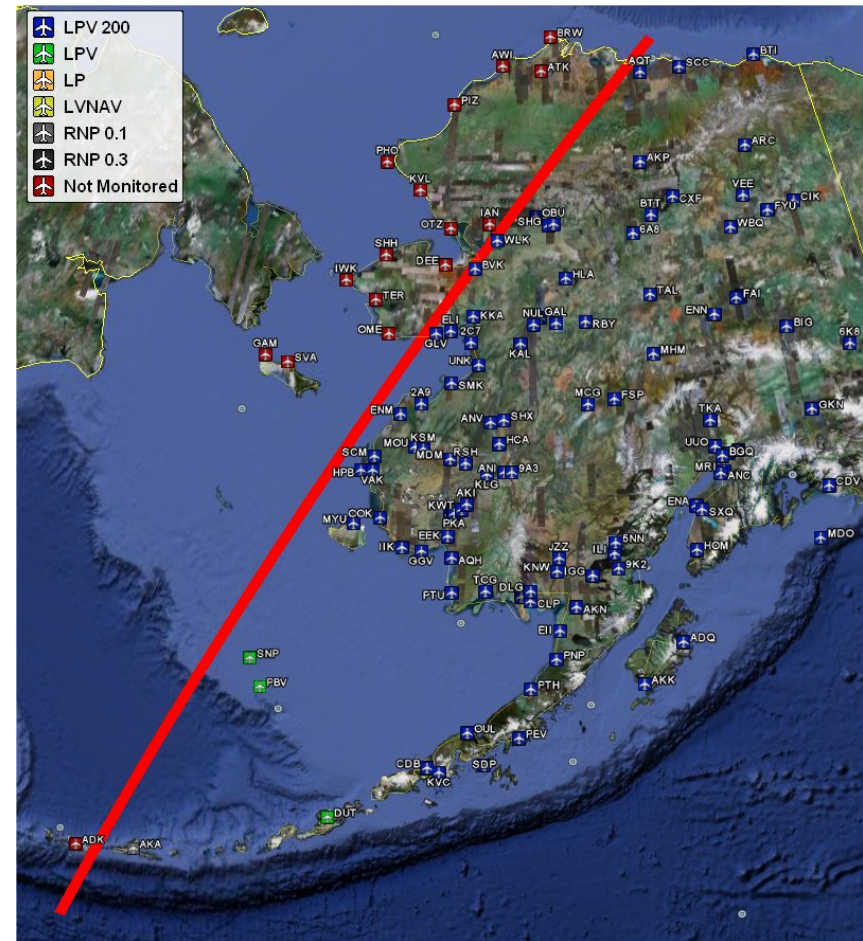


# CRW Failure Pending



# Alaskan Airports Impacted

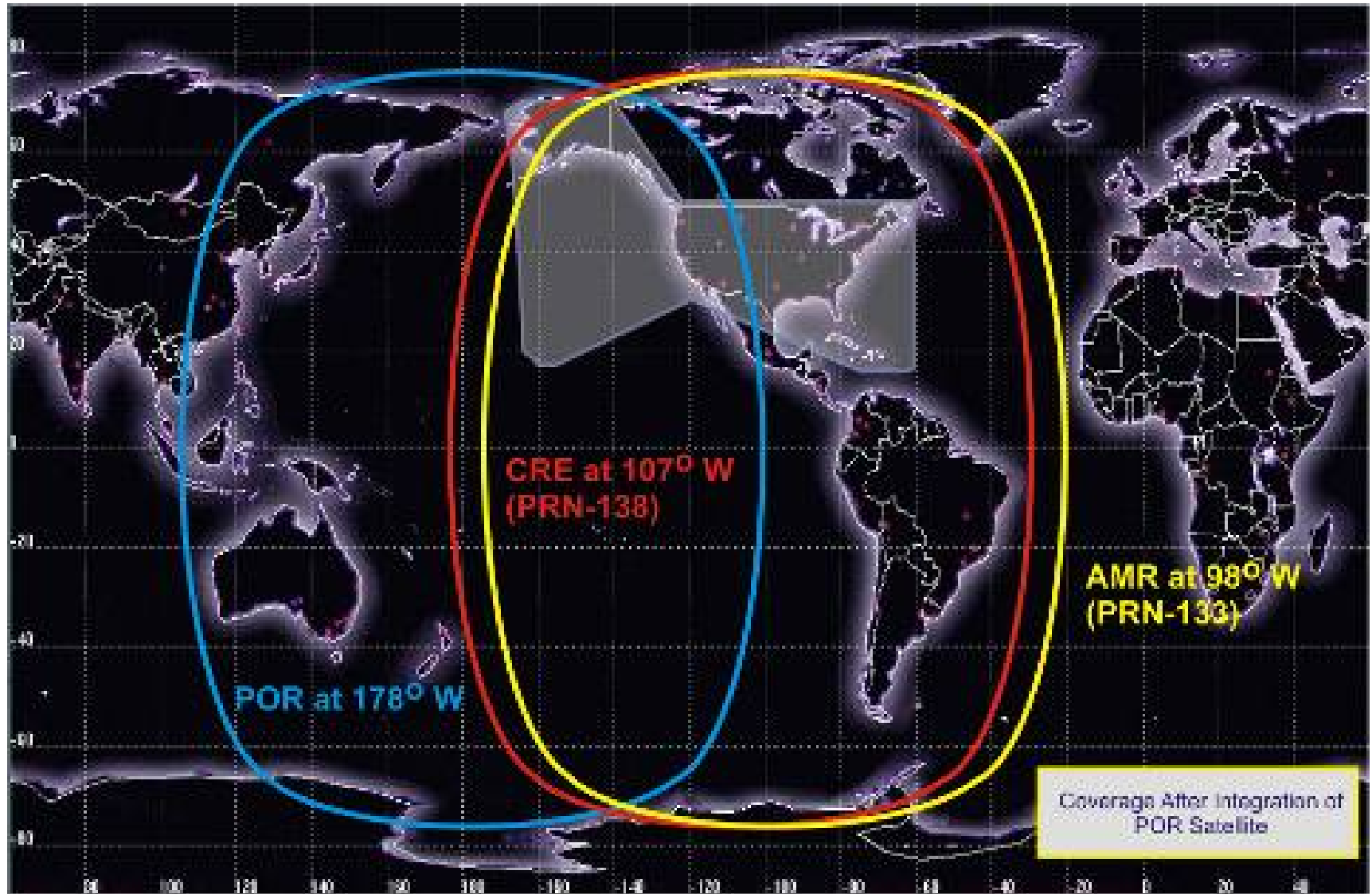
- Adak
- Atqasuk Edward Burnell Sr. Memorial
- Bob Baker Memorial
- Deering
- Gambell
- Kivalina
- Nome
- Point Hope
- Point Lay LRRS
- Ralph Wien Memorial
- Savoonga
- Shishmaref
- Teller
- Wainright
- Wales
- Wiley Post



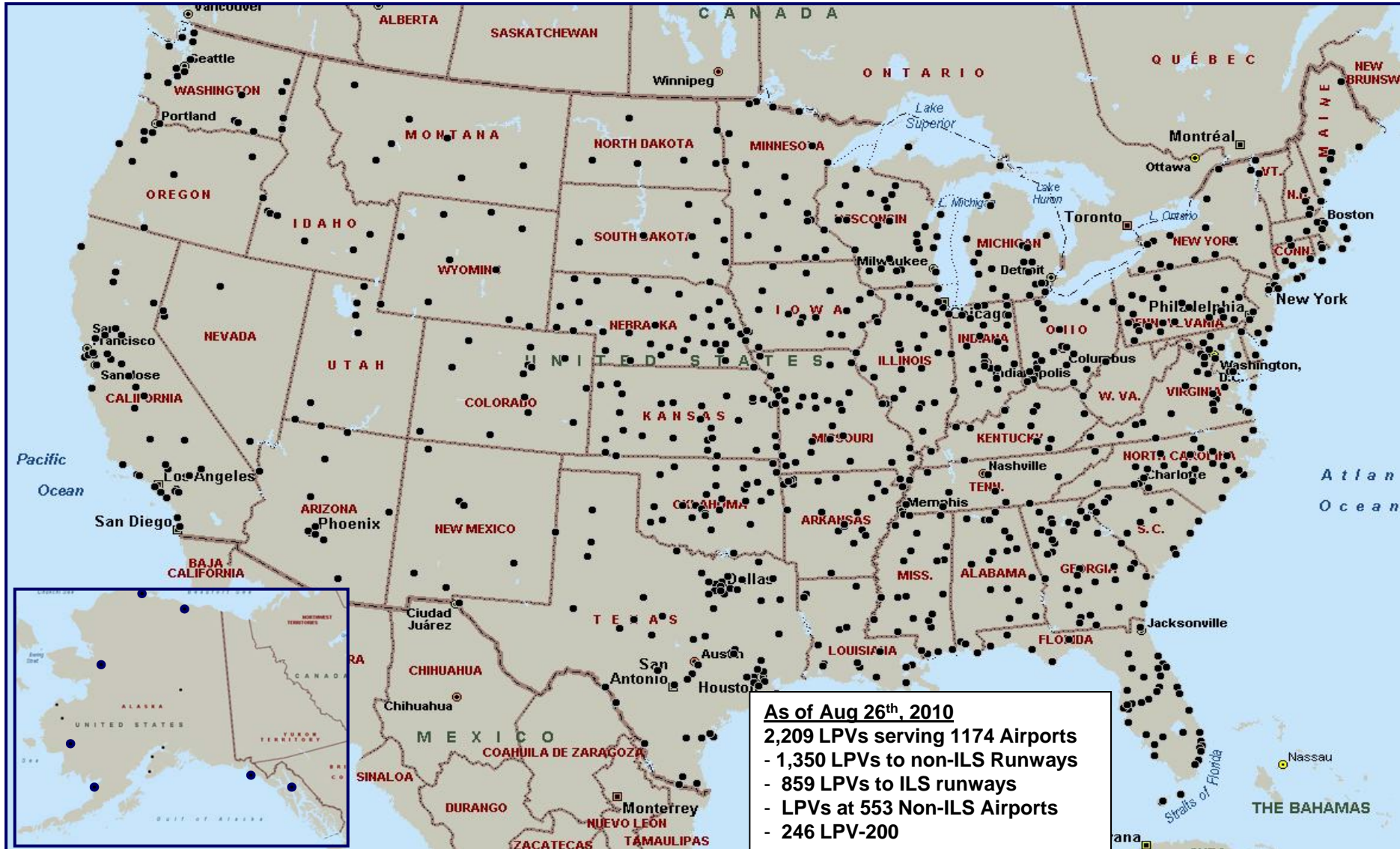
# Gap Filler GEO



# POR



# 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

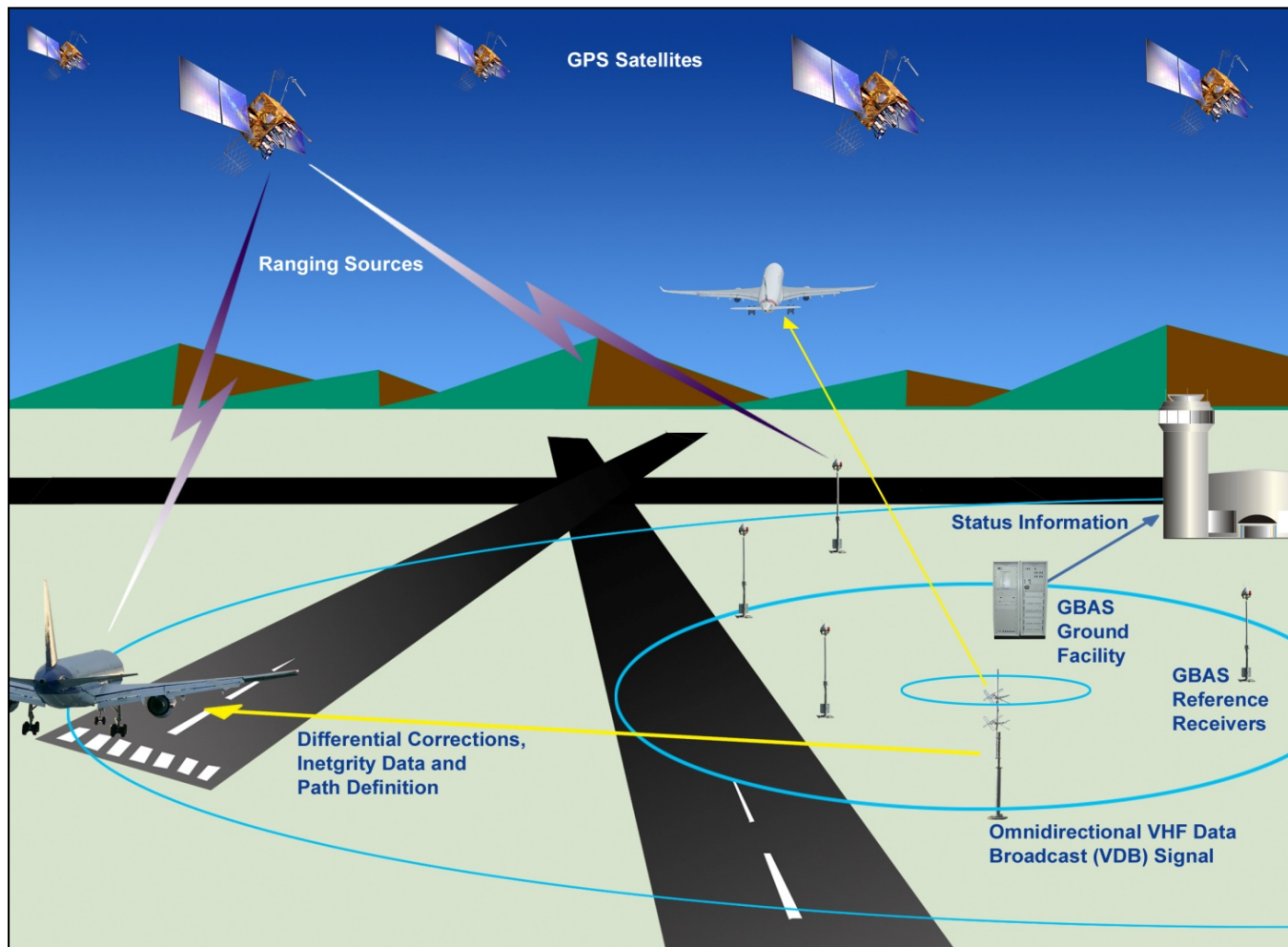
## Pending LPV STC Approvals:

- 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

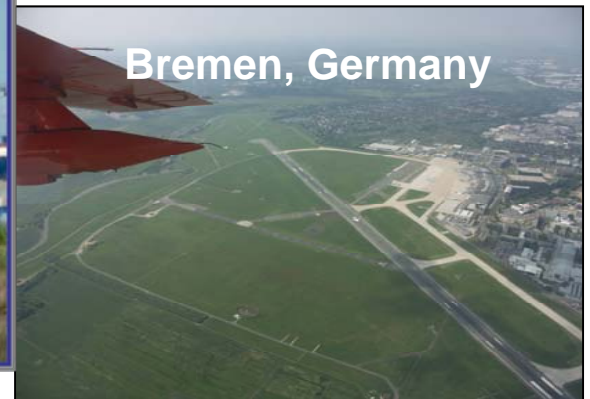
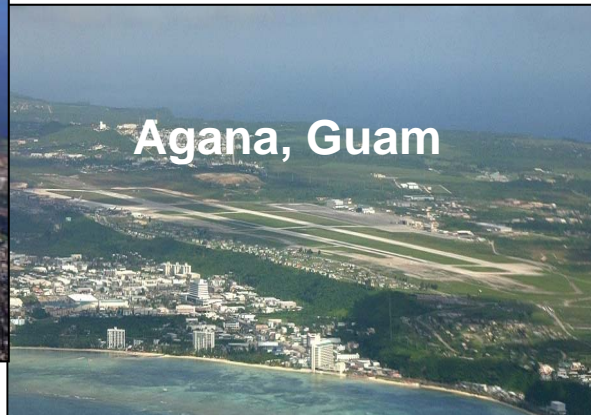
- **Current airlines GBAS equipped**

- Continental
- Delta Airlines
- Qantas
- Air Berlin
- TuiFly
- Sonair
- Air Vanatu
- Emirates

- **Over 15 countries have active GBAS programs**



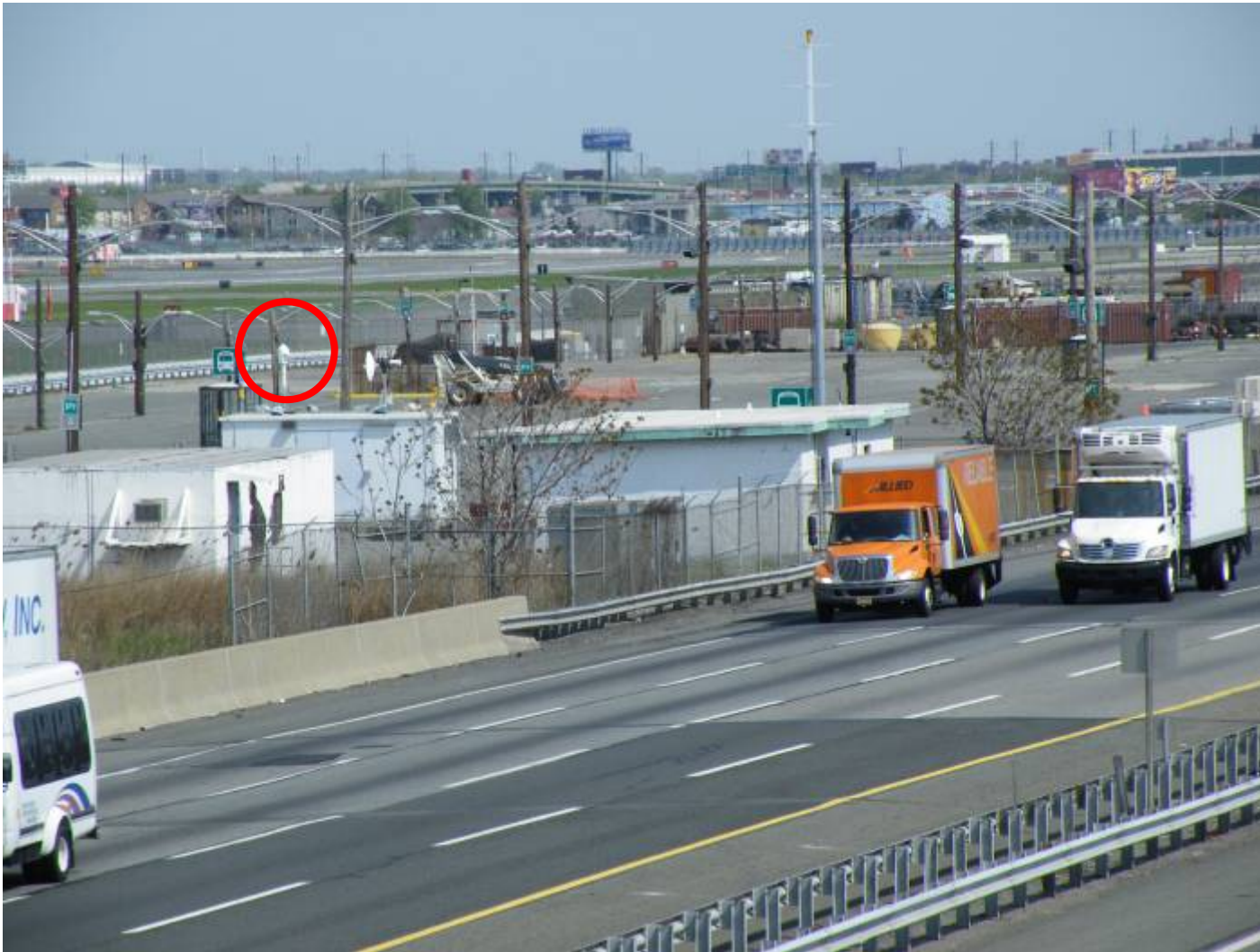
# LAAS/GBAS International Efforts



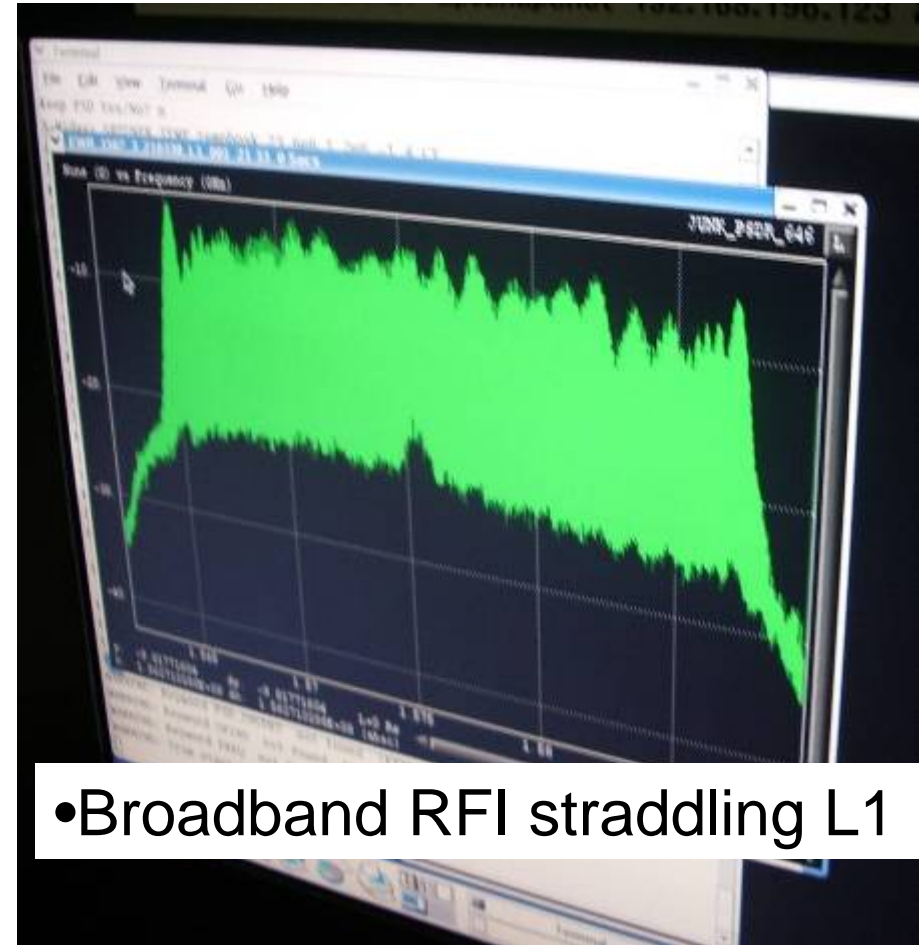
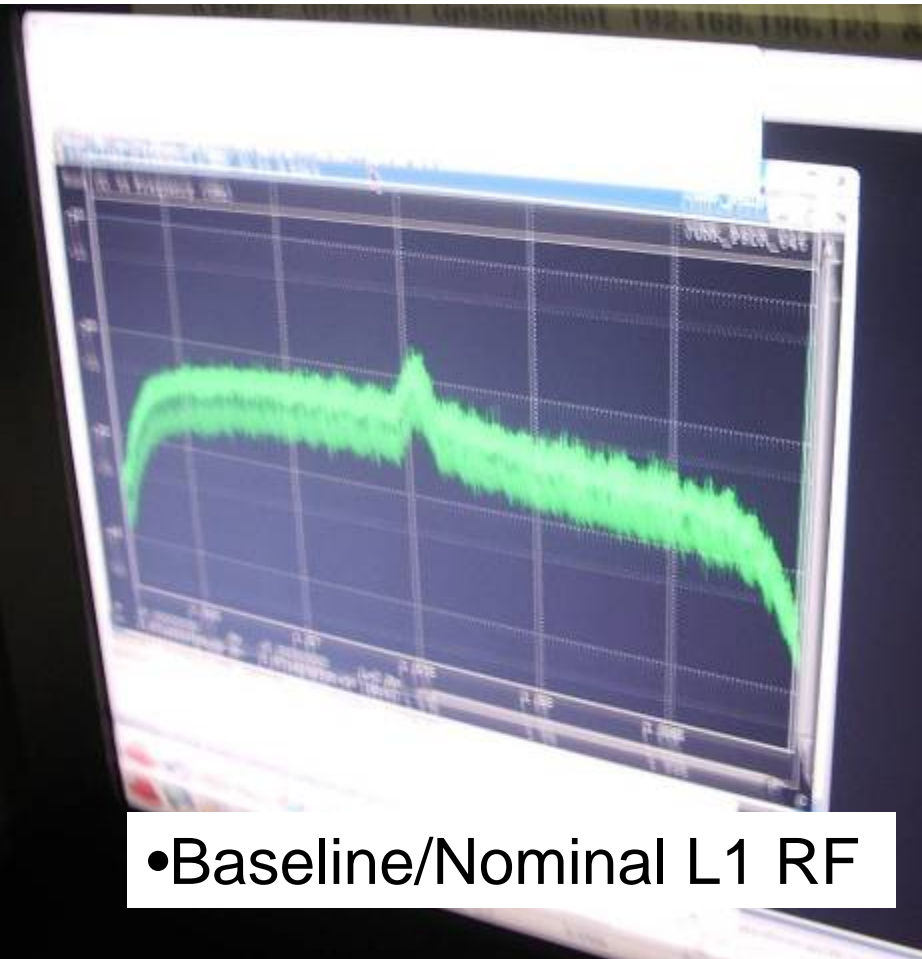
# Commercially Available GPS Jammer (so called “Personal Privacy Device”)



# LAAS Antenna Location



# Zeta “SnapShot” System Data



# ... and a few more “Personal Privacy Devices”



\$110 Ebay



\$335 Ebay



\$92 Ebay



\$40 GPS&GSM  
[www.chinavasion.com](http://www.chinavasion.com)



\$55 Ebay



\$83 GPS&GSM  
[www.Tayx.co.uk](http://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

