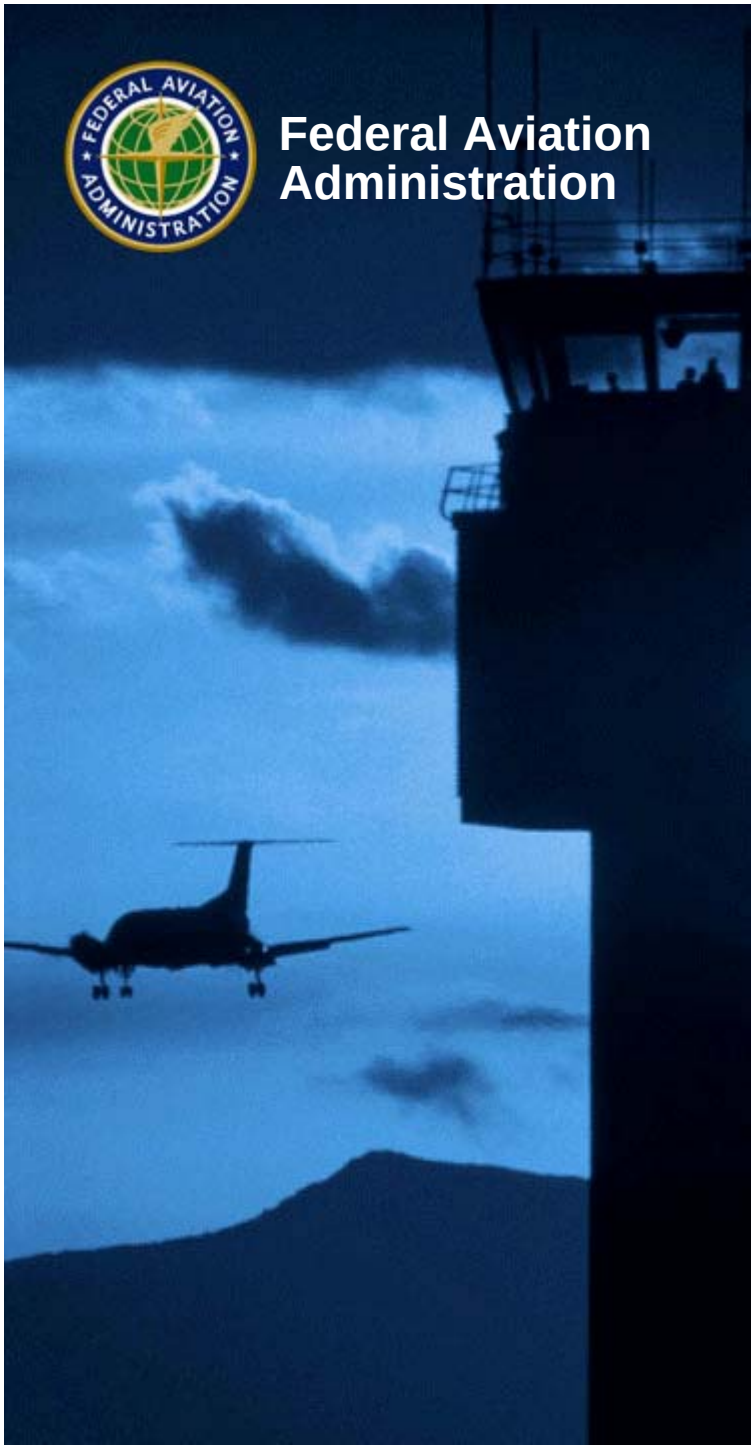
Wide Area Augmentation System (WAAS)



UN ICG Experts Meeting

July 15, 2008

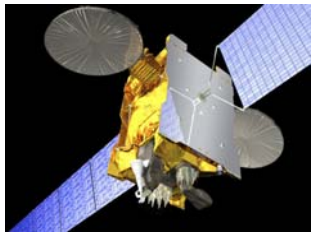
FAA Satellite Navigation Program

WAAS Architecture

38 Reference Stations

3 Master Stations

4 Ground Earth Stations



2 Geostationary Satellite Links

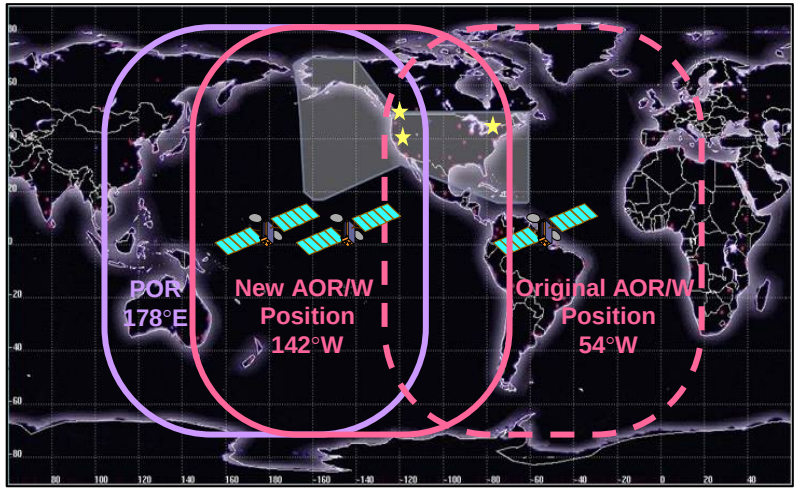
2 Operational Control Centers

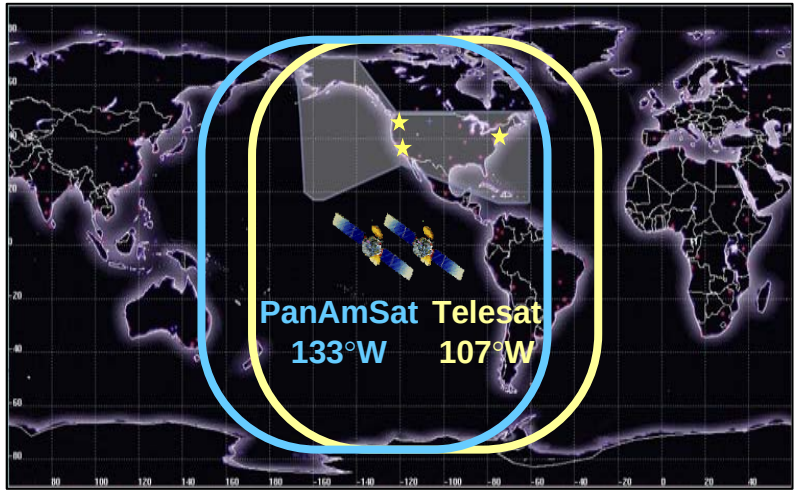
GEO Satellites

- **Phase I (IOC) – FY2003**
  - Inmarsat Satellites
    - AOR-W – 54W
    - POR – 178E
  - AOR-W Moved to 142W
  - Leases Expired July 2007

- **Phase II – FY2008**
  - New GEOs
    - Intelsat (Galaxy XV) – 133W
    - Telesat Canada (Anik F1R) – 107W
  - Operational July 2007
  - 10 Year Lease

- **Actively seeking third GEO ~ 125W**





WAAS Signals

- **Current:**
  - Center frequency: 1575.42 MHz (GPS L1)
  - Similar modulation as GPS C/A code signals, but with unique length-1023 Gold pseudorandom noise (PRN) sequences
  - 250 bit/s data (500 symbols/s with forward error correction)
  - Minimum received power level: -158.5 dBW
- **Future:**
  - Additional signal per GEO at 1176.45 MHz (GPS L5) planned
  - Envisioned design (subject to change):
    - Similar modulation as GPS L5 signals
    - Unique length-10230 PRN sequences from same code family
    - 250 bit/s data (500 symbols/s with forward error correction)
    - No pilot component
  - L5 signals are being broadcast by current WAAS GEOs, but for internal system use only

WAAS Network Time and Geodetic Reference Frame

- **WAAS has its own internal timescale, referred to as WAAS Network Time (WNT)**
  - Continually steered to within 50 ns of GPS time
- **World Geodetic System 1984 (WGS-84)**
  - Consistent with International Terrestrial Reference Frame (ITRF) 2000 to ~centimeter level

WAAS Accuracy Performance

	GPS Standard	GPS Actual	WAAS LPV-200 Standard	WAAS LPV-200 Actual
Horizontal 95%	36 m	2.74 m	16 m	1.08 m
Vertical 95%	77 m	*3.89 m	4 m	1.26 m

**** Use of GPS vertical not authorized for aviation without augmentation (SBAS or GBAS)***

WAAS Performance evaluated based on a total of 1,761 million samples (or 20,389 user days)

WAAS Phases

- **Phase I: Initial Operating Capability (July 2003)**
  - Provided LNAV/VNAV/Limited LPV Capability
- **Phase II: Full LPV (2003 – 2008)**
  - Improved LPV availability in CONUS and Alaska
  - Consists of additional WRS, hardware updates, software optimization, improved human factors, and GEO replacement
- **Phase III: Full LPV-200 (Cat I Equivalent) Performance (2009 – 2013)**
  - Development, modifications, and enhancements to include tech refresh
  - Steady state operations and maintenance
- **Phase IV: Dual Frequency Operations (2013 – 2028)**
  - Scheduled to align with GPS Modernization Program (L5)
  - Provide additional protection against unintentional GPS interference
  - Will significantly improve availability and continuity during severe solar activity
  - WAAS will continue to support single frequency users

Questions

http://gps.faa.gov

Instrument Approach Services