Navigation at the Crossroads

To: Stanford 2010 PNT Symposium
By: Leo Eldredge
    GNSS Program Manager
Date: November 9, 2010
Peak Aircraft Traffic Over The US

- 5000 aircraft
- 689 M passengers
- 36 B pounds cargo
If We Do Nothing…  \textit{Delays Increase}\ *

Delays projected using ATO Network Forecasts
Assumes weather in 2012 and 2016 the same as 2006
* Projections assume no capacity improvements
The Journey…

Procedural Based Control: 
*Control on Where We Think the Aircraft Is*

Surveillance Based Control: 
*Control on Where We Know the Aircraft Is*

Trajectory Based Control: 
*Control on Where We Know the Aircraft Will Be*

- Landmark Navigation
- Radio Beacons
- Position Reports

- VOR/DME
- RADAR

- Performance Based Navigation
- Aircraft Position Information
Performance Based Navigation

Area Navigation (RNAV): Satellite based navigation

Required Navigation Performance (RNP): Satellite navigation with onboard alerting

- Aircraft fly shorter, more efficient flight paths
- Increases capacity of runways and in the airspace
- Reduces delays, fuel burn, and aircraft noise
NextGen Assumptions for 2025

- ATC system cannot be scaled up to handle 2X traffic
- 2X traffic is more than a controller can handle
- Automation separates aircraft based on their trajectory
- Controllers manage demand and airspace
- Controllers intercede to provide “control by exception”
- Conformance to a trajectory is a requirement
NextGen – GPS dependency:

- RNAV/RNP - GPS
- VNAV - GPS
- EFB - GPS
- FANS/Data Communications - GPS
- GBAS/LAAS - GPS
- WAAS - GPS
- ADS-B - GPS
- CDTI - GPS
- Curved Path – Approaches - GPS
- Surface Traffic Applications - GPS
  – ASDE-X, RAAS, TIS
WAAS Architecture

38 Reference Stations
3 Master Stations
4 Ground Earth Stations
2 Geostationary Satellite Links
2 Operational Control Centers
Current WAAS LPV Coverage

Color Scale is Vertical Protection Level (VPL)
09-Nov-10 14:29:11 GMT (WJH FAA Tech. Cntr., NJ USA)
Airports with WAAS LPV Instrument Approaches

As of Oct 21st, 2010
- 2,327 LPVs serving 1227 Airports
- 1,437 LPVs to non-ILS Runways
- 890 LPVs to ILS runways
- 937 LPVs to Non-ILS Airports
- 396 LPVs to 200 DA

Navigation at the Crossroads
November 9, 2010
Ground Based Augmentation System (GBAS)

- One GBAS covers multiple runway ends
- GBAS eliminates ILS critical areas
- Supports offset landing thresholds and flexible glide-path to mitigate wake turbulence
- Contributing technology for high precision navigation services for
  - Closely Spaced Parallel Approach
  - Simultaneous Independent Approach
- Enabling precise positioning for terminal area navigation RNAV and RNP
VHF Omni-Directional Radio (VOR)

- VOR’s do not support performance based navigation (PBN)
- VOR drawdown being planned
- Critical VOR’s retained for minimum operational network (MON)
Distance Measuring Equipment (DME)

- 1151 DMEs
- DME service continues well into the future
- Sustainment effort replacing obsolete systems
- Optimizing network to support enroute and terminal solutions
Instrument Landing System (ILS)

- Currently 1,228 Active ILS
  - 57% beyond 20 year service life, in 10 years over 73%
- ILS will eventually be reduced as user support for GNSS-based solutions increases
Navigation Services Evolution

Current

Point-to-Point
Jet / Victor Routes
SIDs / STARs, ILS

Primary
VOR/DME
NDB, VORTAC
TACAN

Alternate/
Substitute
GPS, WAAS

2025
NextGen

Q / T Routes
Direct TBO Routes
RNAV SIDs / STARs
RNAV(GPS)
RNAV(RNP)

GPS, DDI
WAAS, LAAS
Other GNSS ?

DD w/o I ?
APNT ?

PBN
TRANSITION
Summary

• Transition of the US National Airspace System to the Next Generation Air Transportation System (NextGen) is underway
• NextGen operational capabilities are dependent on PNT services enabled by GPS
• GPS, SBAS, and GBAS enable NextGen operational improvements
• A portion of legacy navigation systems will be retained to support alternative PNT
• FAA investigating other alternate PNT services to support NextGen
Questions
http://gps.faa.gov