

Performance Based Navigation: Area Navigation (RNAV) and Required Navigation Performance (RNP)

Presented to: EWG Ops SC

By: Jim Arrighi
FAA RNAV/RNP Group

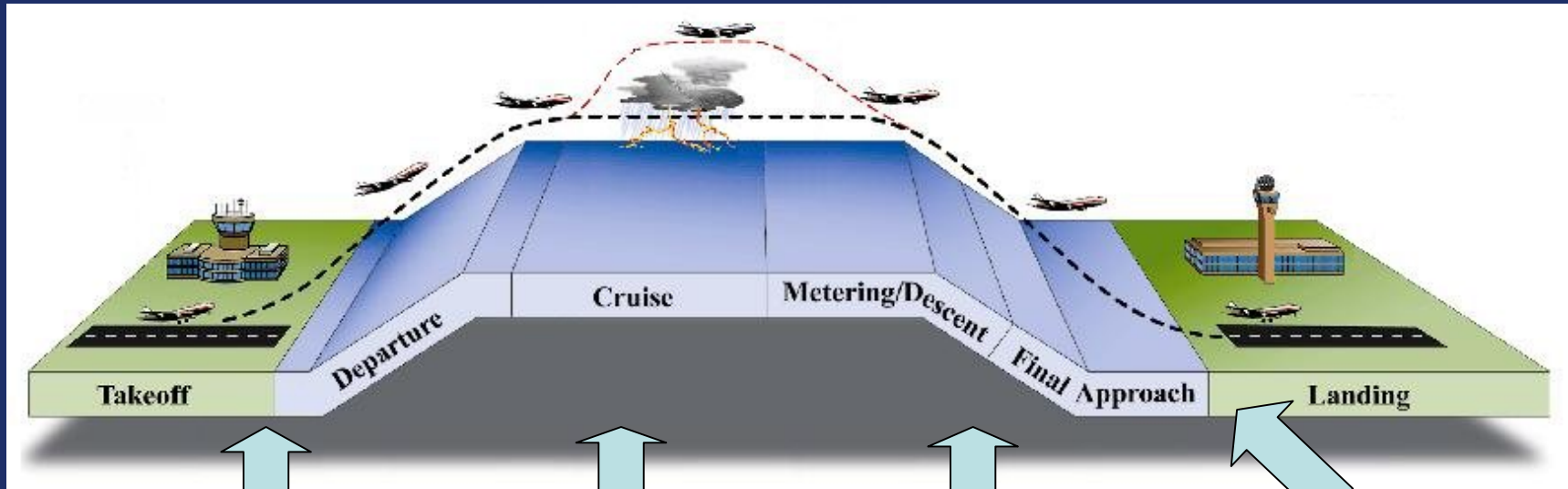
Date: November 17,2008



Federal Aviation
Administration



Current PBN Implementation in NAS



RNAV 1
SIDs

RNAV 2
Q Routes &
T Routes

RNAV 1
STARs

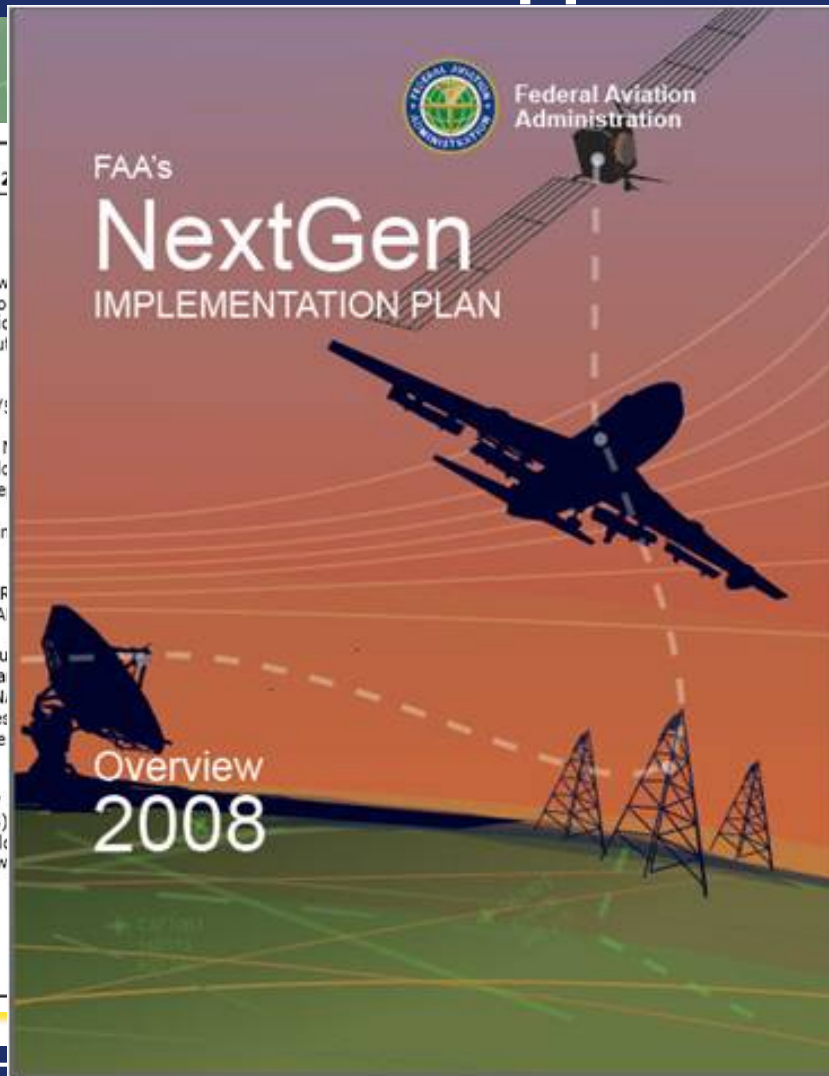
RNAV (GPS)
Approaches
~ ICAO RNP APCH
and
RNP SAAAR
= ICAO RNP AR APCH

RNAV/RNP Accomplishments and Plans

Description	FY05-07	FY08	FY09 Projected
RNAV T/Q-Routes and GPS MEAs	69	49	12
RNAV SIDs/STARs	172	78	50
RNP SAAAR	75	63	50
Helicopter RNAV (GPS)	5	-	TBD
Total	321	190	112



FAA's Detailed Evolution Plans for Specific Capabilities and Applications



- FAA and industry collaborative initiative
- Signed July 2006
- Sets implementation goals for near, mid and far term
- Integral part of NextGen
- Key of PBN
 - Area Navigation (RNAV)
 - Required Navigation Performance (RNP)

Near Term (2008-2011)

En Route

- ☐ RNAV Q routes
- ☐ RNP-2 routes
- ☐ T routes and low
- ☐ Requirements to aircraft navigating into en route au

Oceanic

- ☐ RNP-10 and 50/100 Pacific
- ☐ RNP-10 and 60/100 Pacific
- ☐ Expand 30 NM lateral separation in the Pacific
- ☐ Explore RNP-4 in

Terminal

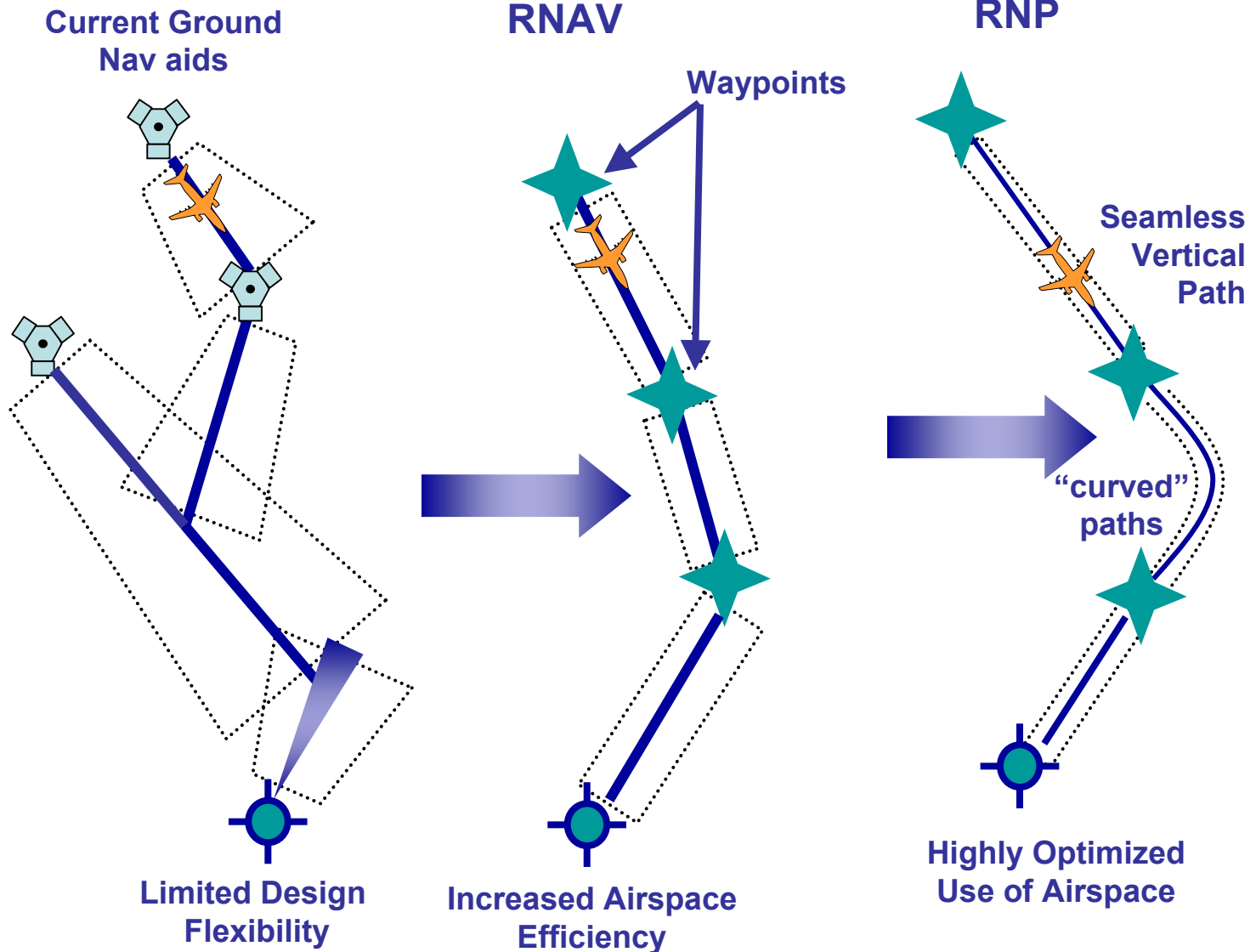
- ☐ RNAV SIDs/STARs
- ☐ RNP-1 SIDs/STARs
- ☐ Automation requirements for merging RNAV and RNP
- ☐ Concepts for RNAV 3D, constant descent (CDA), and time

Approach

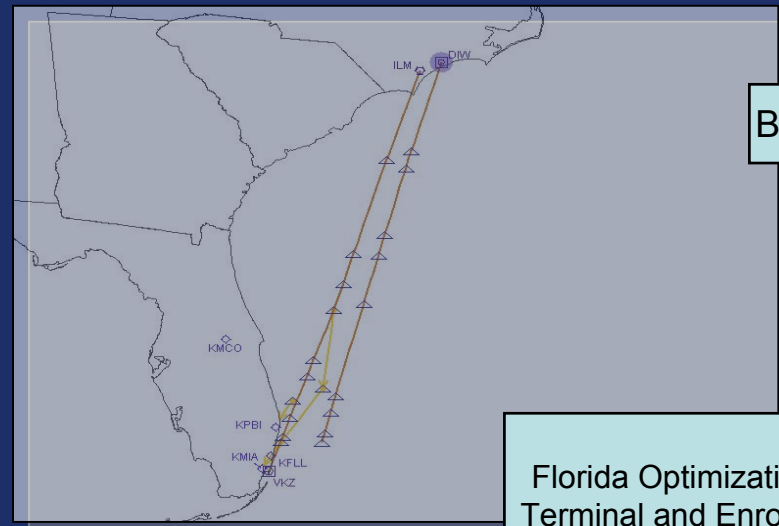
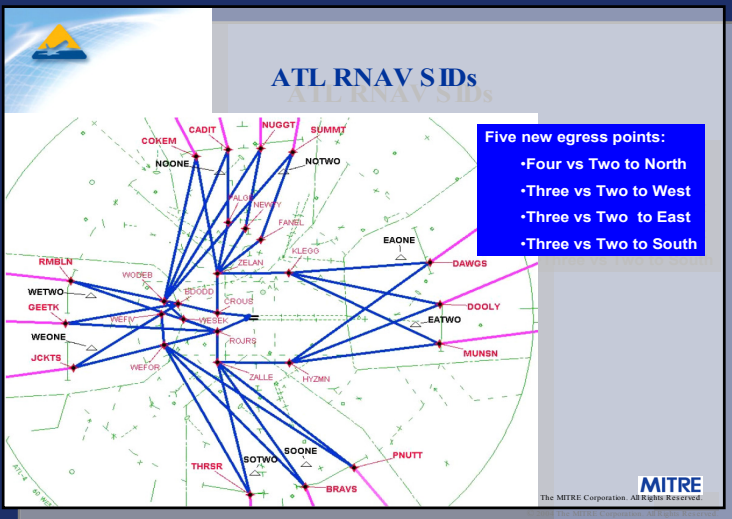
- ☐ At least 25 RNP
- ☐ 300 RNAV (GPS)
- ☐ Standards for converging runways based on RNP

Performance Based Navigation

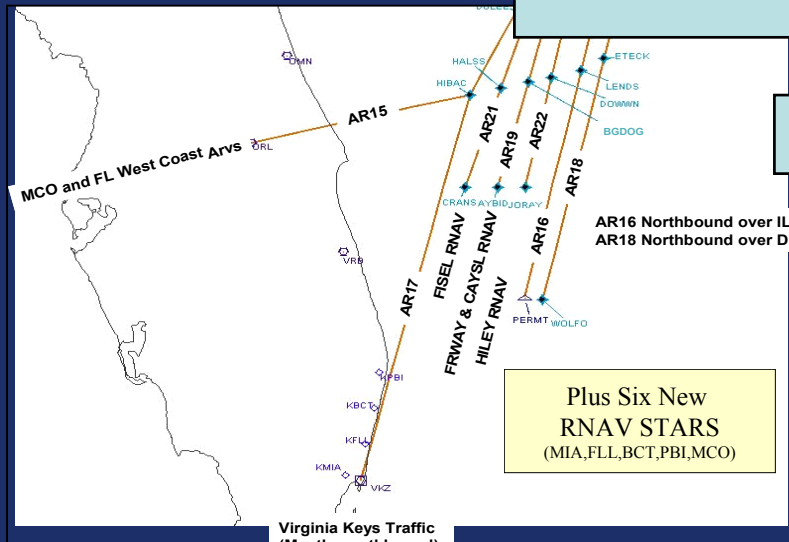
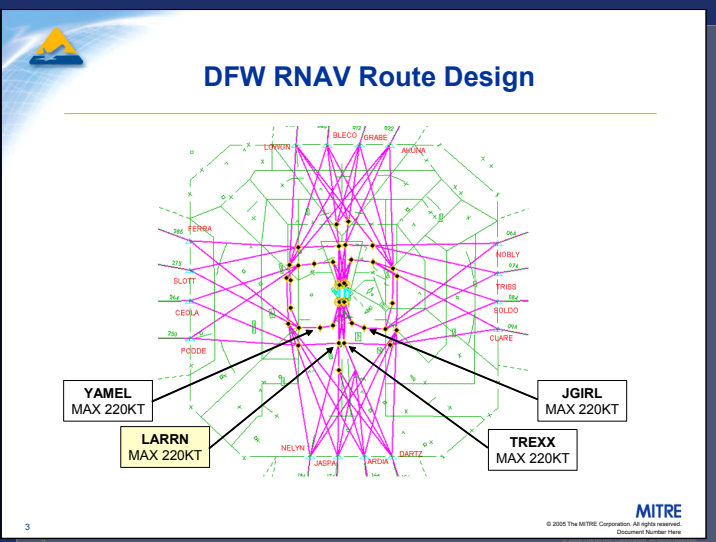
All Flight Domains



Terminal and En Route Applications



Florida Optimization Terminal and Enroute

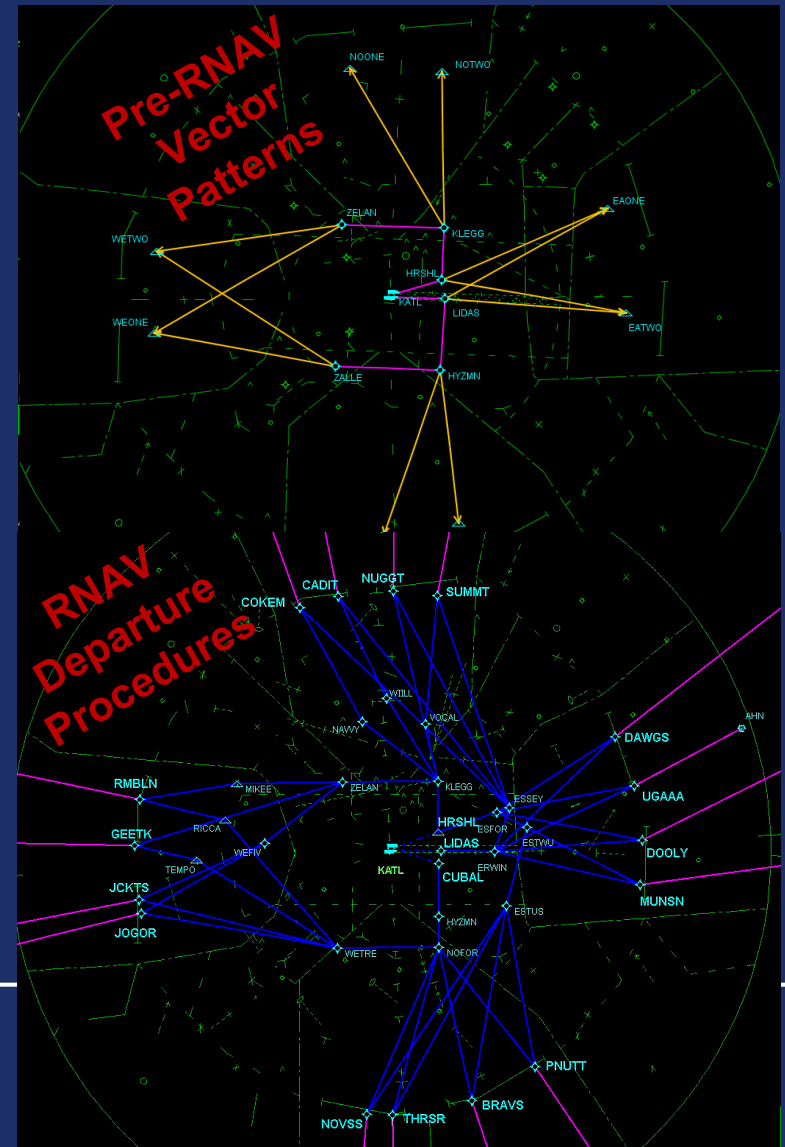
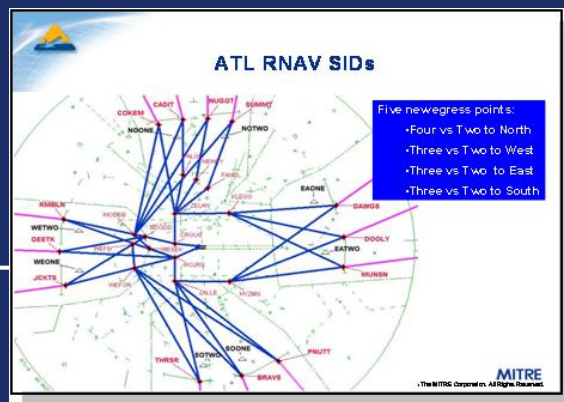


After



Example 1: Atlanta Departure Procedures Before and After

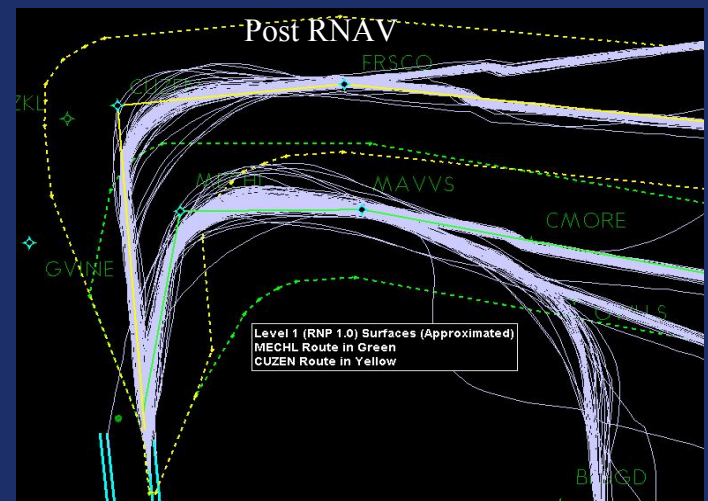
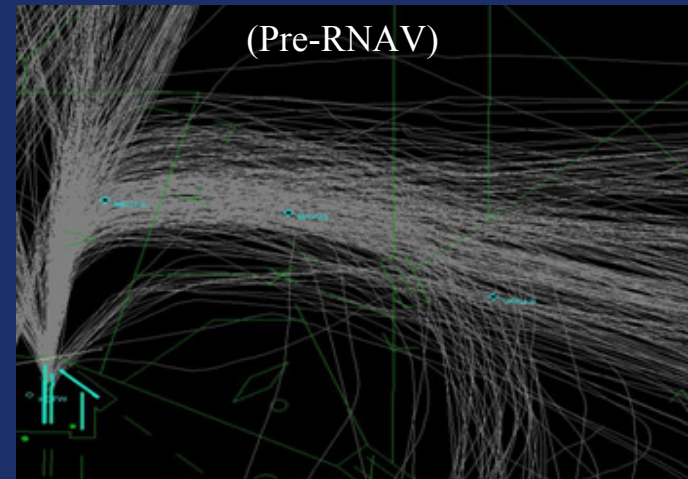
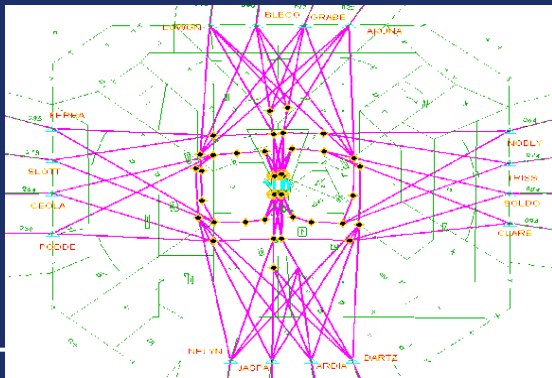
- Approx 94% of daily departures are RNAV capable
- More departure lanes and exit points to the en route airspace
- Repeatable and predictable paths
- Benefits
 - Taxi times
 - Departure Delays
 - Improved flight profiles
 - Reduced Distances



Example 1: Cont.

Dallas Fort Worth Departure Procedures Before and After

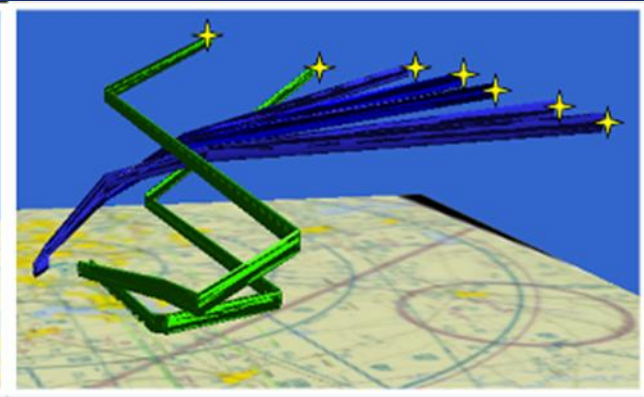
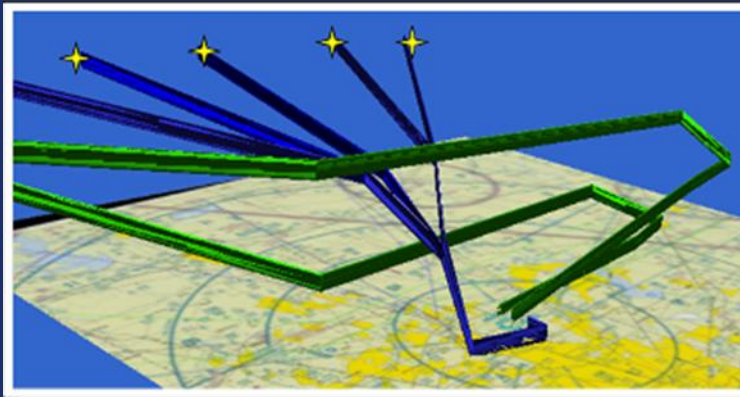
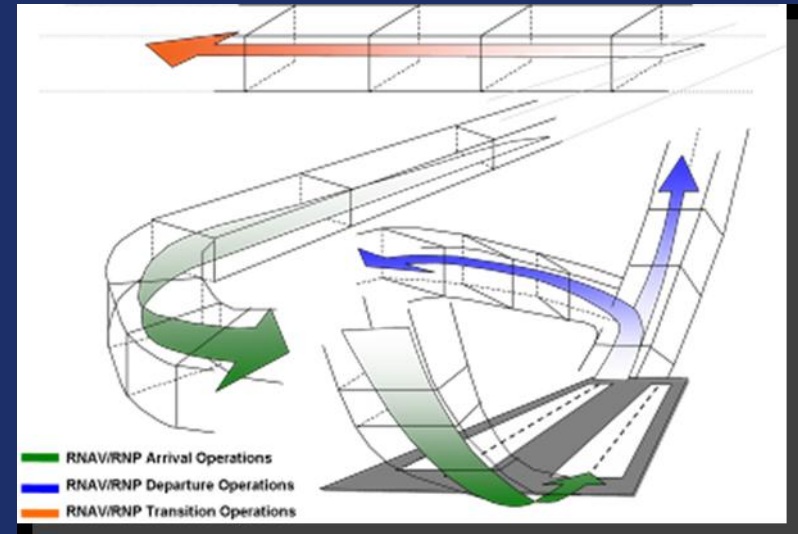
- Approx 90% IFR departures are RNAV capable
- Improved “fanning”
- Benefits
 - Taxi times
 - Departure Delays
 - Improved flight profiles
 - Reduced Distances



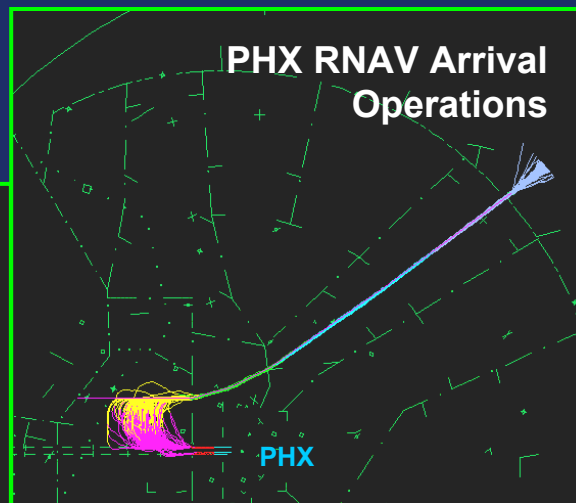
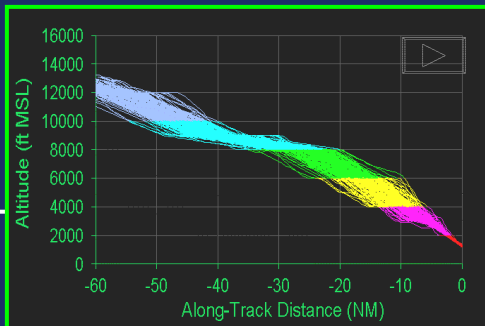
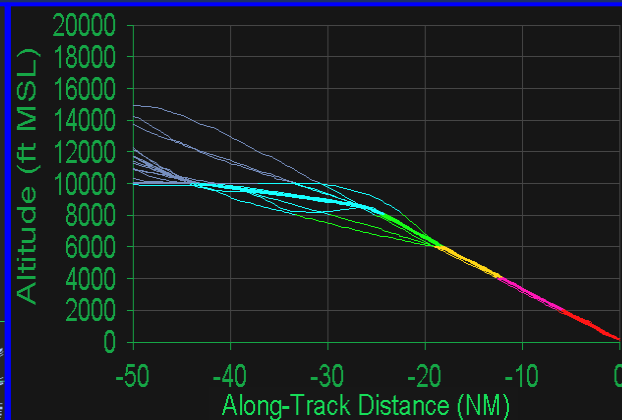
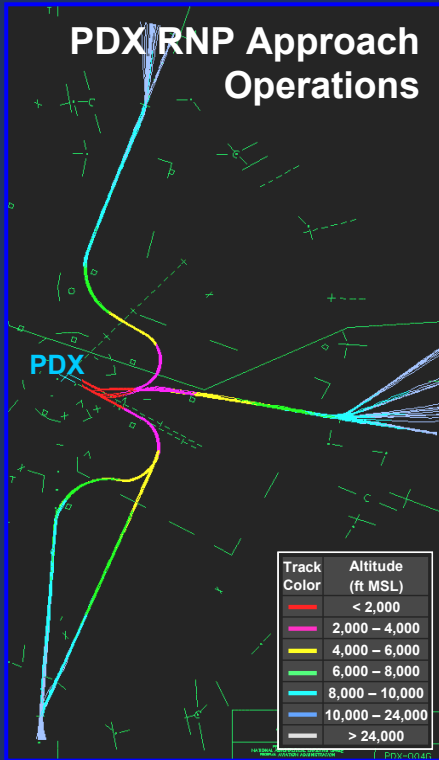
Example 2: PBN “Network of Procedures”

Applications for De-confliction, Optimization and Benefits

- Network of procedures to segregate traffic flows
 - Between arrival/departure and transitions operations
 - Between primary and satellite airport operations
 - Between City Pairs



Example 3: Procedures with Vertical Guidance



- RNAV and RNP arrival procedures with vertical guidance can provide
 - Fewer level flight segments
 - More time in reduced or idle-power descent
- Fuel burn savings to operators
- Lower aircraft emissions
- Enhanced via data analysis capabilities
 - Ongoing analysis for procedure design, modeling, and reporting for optimization and issues identification and resolution



Example 4: Implementing “Green” Procedures



- Atlantic Interoperability Initiative to Reduce Emissions (AIRE)
- Signed by FAA and EC – June 08
- Reduce aviation’s environmental footprint
- All flight segments (gate-to-gate)
 - Surface, Oceanic, Arrival
- Near term goals
 - Optimized Profile Descents (OPD)
 - Demonstration flights
 - Completed May 2008
 - Atlanta and Miami
 - Savings: Fuel (48-52 gals/ft.), CO2 (460-497 kg/ft.)

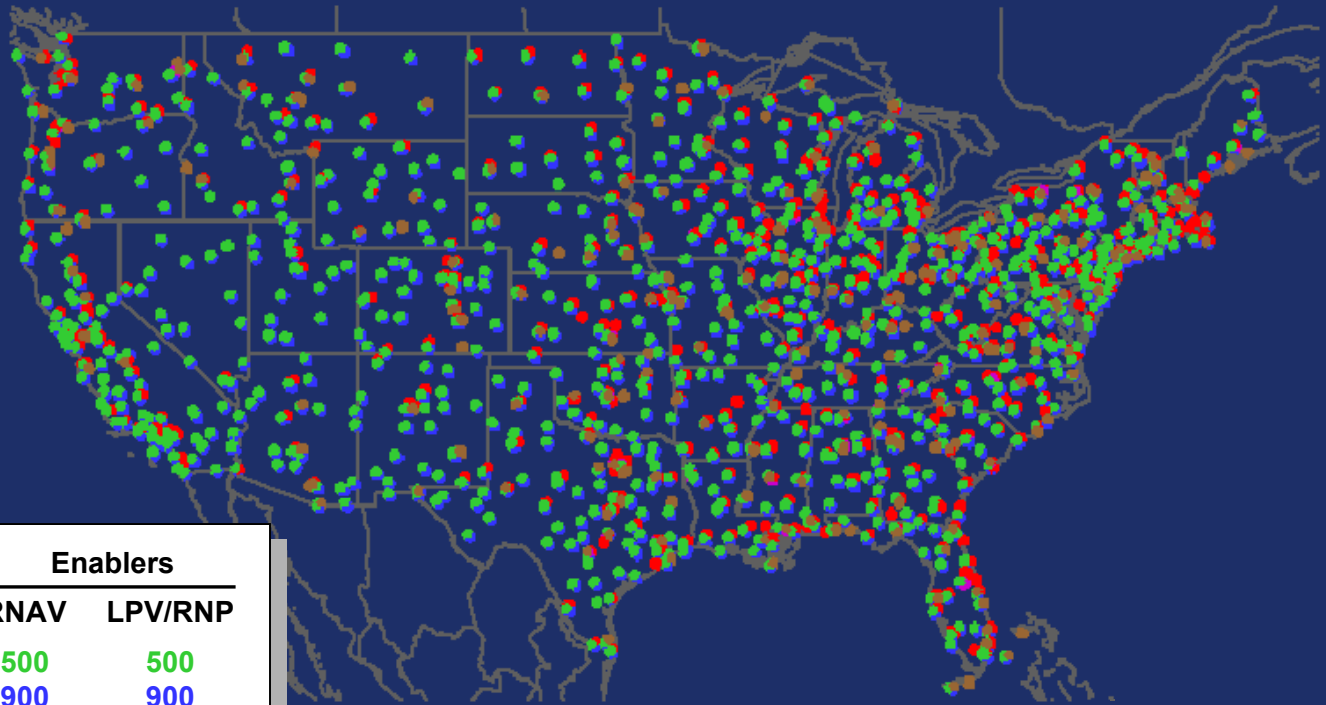


Example 5:

Infrastructure Benefits

reduced NAVAIDS and unneeded procedures

NAVAID Divestment



Locations indicate existing navigation aids, not those proposed for divestment

	Today	Enablers	
		RNAV	LPV/RNP
VOR	1,000	500	500
DME	900	900	900
NDB	600	0	0
ILS I	1,000	1,000	500
ILS II	20	20	20
ILS III	70	70	70
MB	1,500	0	0

Number of navigation aids is approximate

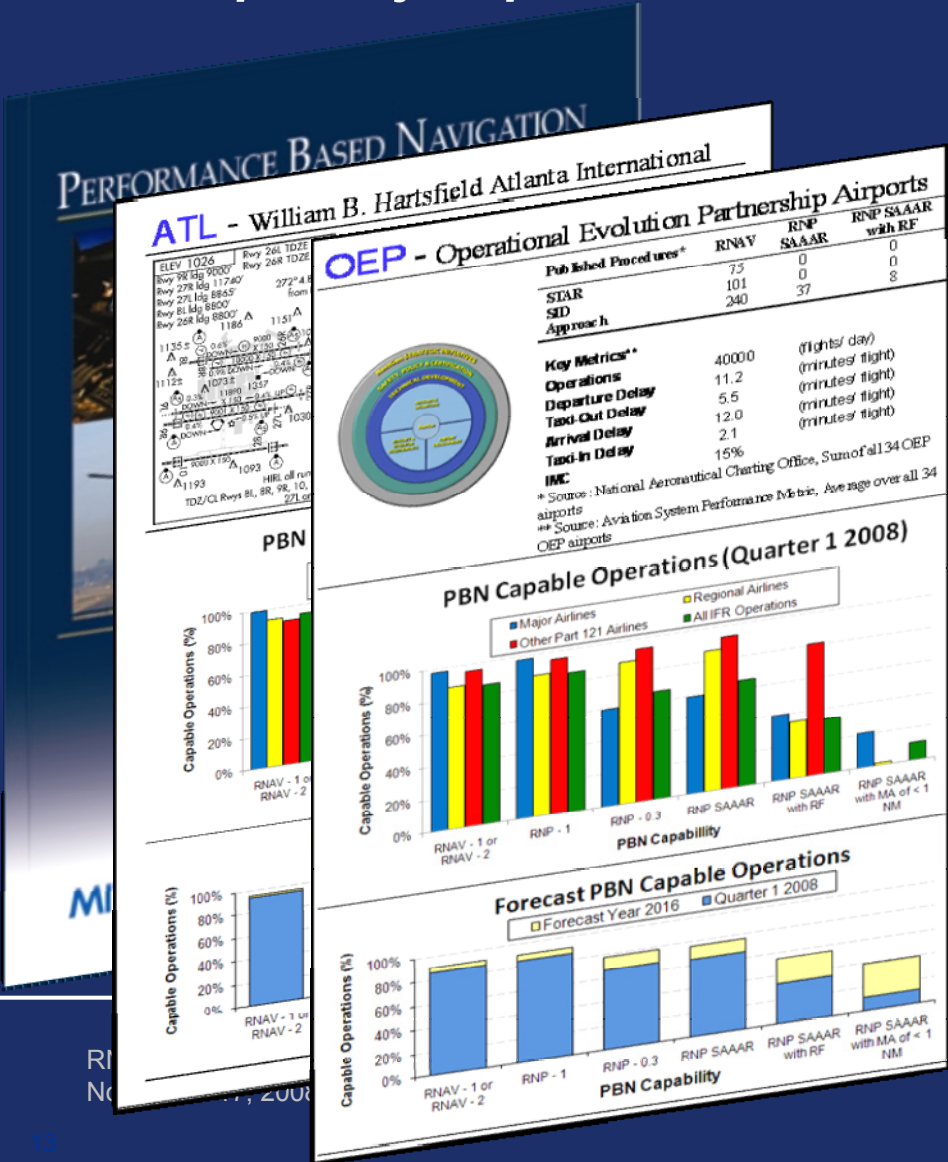


Assessing Fleet Readiness for PBN

Analysis of Equipage for PBN Procedures: 2008

Capability Report

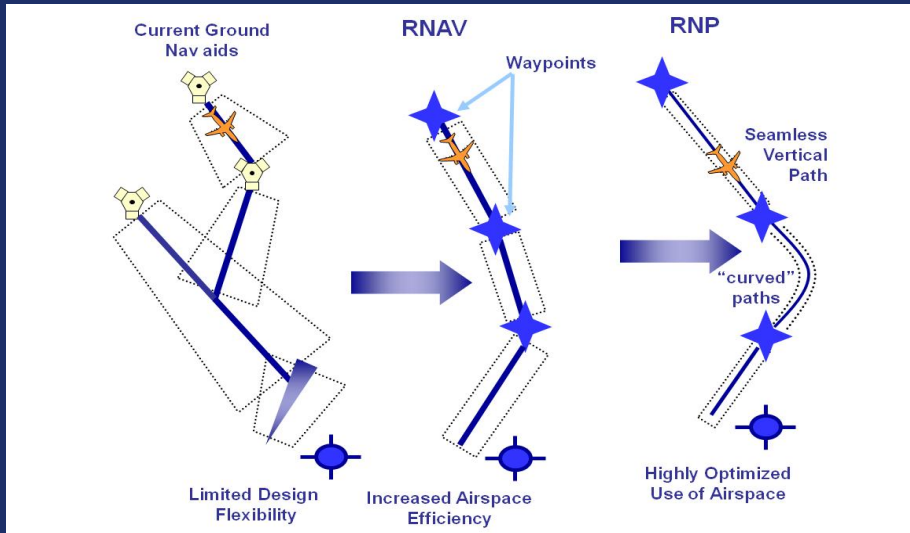
PBN



- Current capability
 - Proprietary inventory of fleet equipage for RNAV and RNP
 - Knowledge of flight crew abilities
 - Analysis capabilities:
 - Airport-specific (OEP airports)
 - NAS-wide
- FAA – Now doing this for “NextGen”
- Future capability development in FY09
 - All aircraft capabilities required for NextGen.



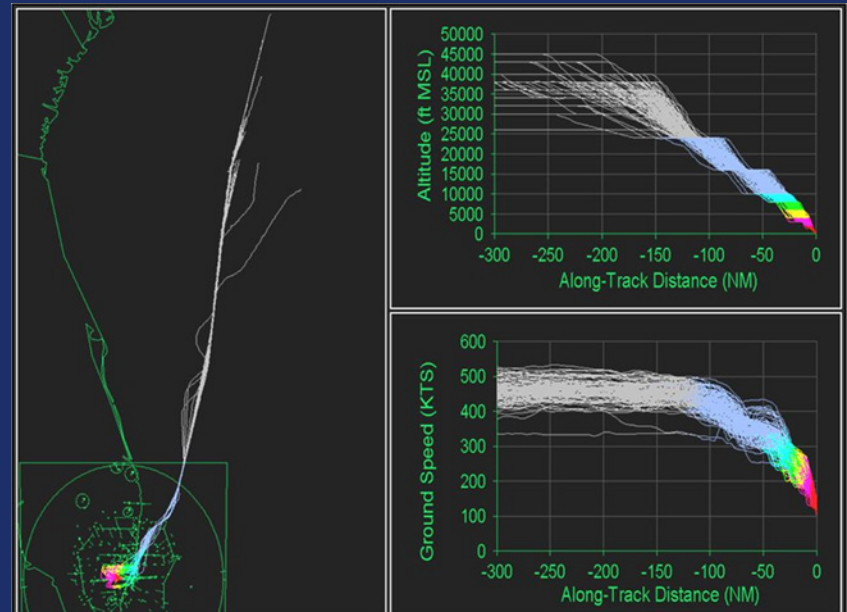
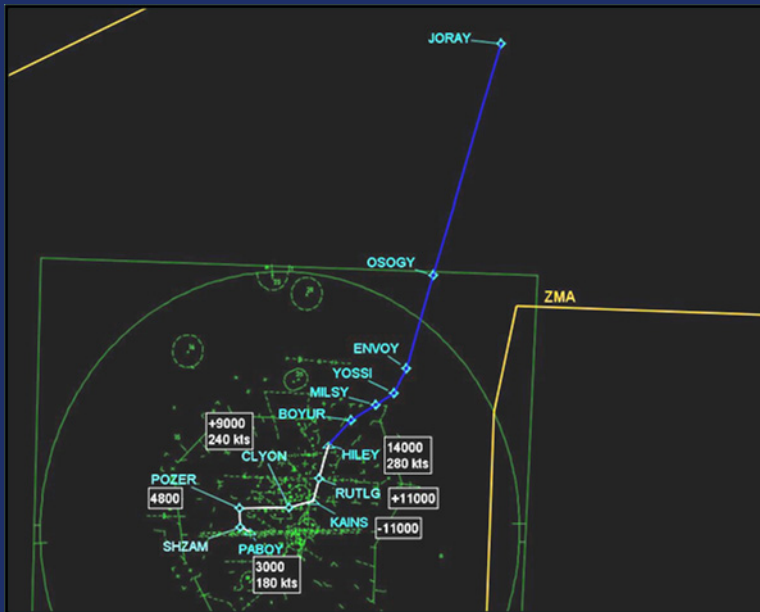
Summary



- RNAV and RNP key building blocks of NextGen
- Addresses
 - Capacity, safety, environment, fuel, and includes infrastructure cost savings
 - Over \$130M cumulative savings to operators since 2006
- Ongoing technical and operational analysis (includes propriety data), complex modeling, prototyping, and concepts development that contribute to standards development, procedures implementation, and benefits

Network of Procedures with De-confliction	Reduced Lateral and Vertical Track Spacing	Efficiency and Throughput	Delay and Environment

Standard Terminal Arrival (STAR) Optimized Profile Descent (OPD) Effort



FY 09 Prioritize Implementation Sites

- **Extensive operational analysis of IFR airports due 2/09**
- **The site specific methodology will account for airport and airspace complexities, aircraft equipage, operational benefits and environmental “hot spot” factors**
- **Develop site selection list and coordinate with industry partners**
- **Initiate new Procedure Design Activity**



Existing OPD Examples

- **Published Procedures:**

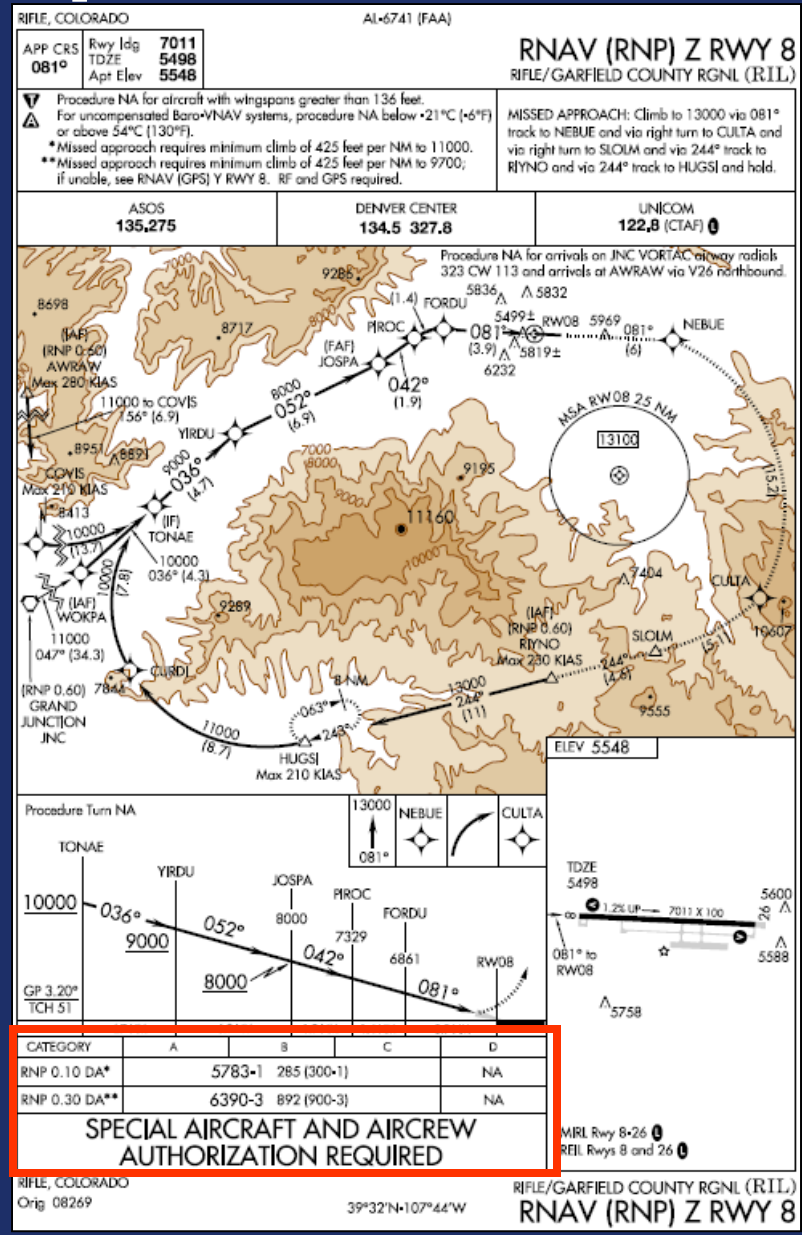
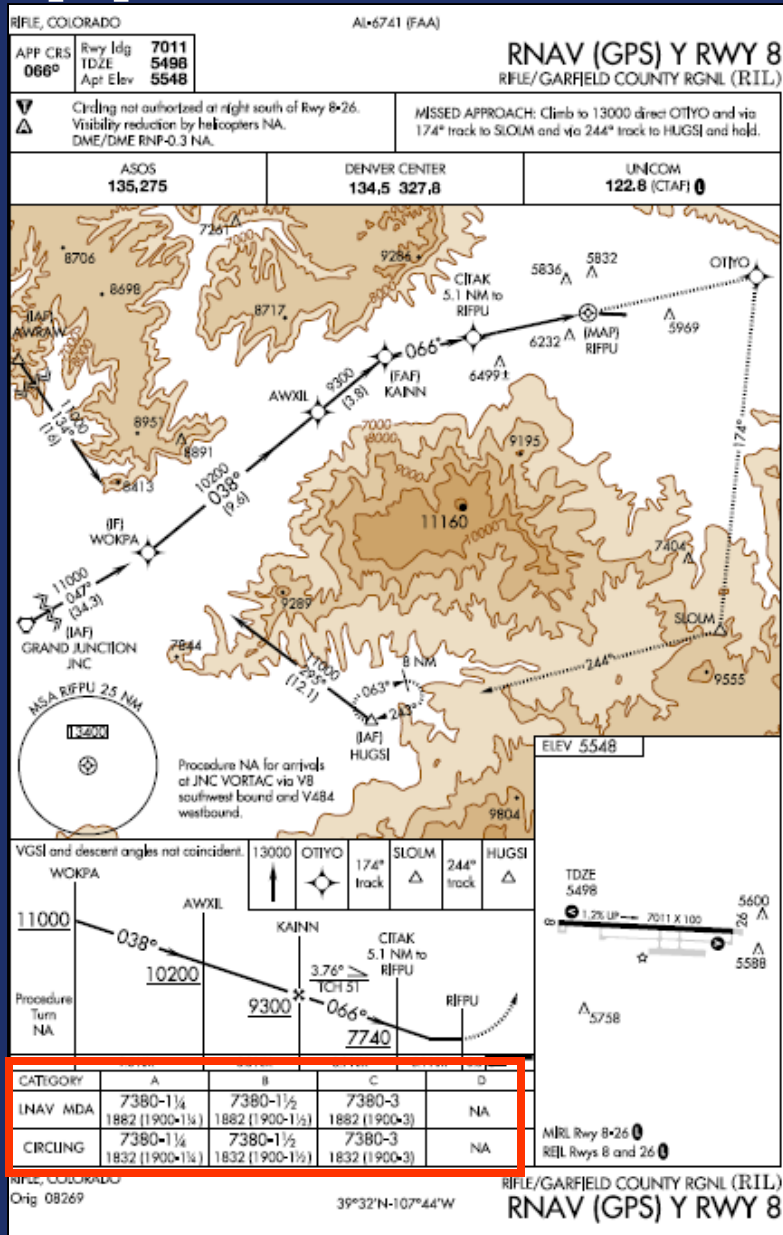
- Los Angeles (LAX) - September 08: 3 procedures provide OPD for approximately 50% of LAX traffic. Benefits analysis ongoing
- Phoenix - 4 published RNAV STARs
 - Evaluation of 'descend via' from FL400 1 corner post commenced 9/22
- Atlanta RNAV STAR OPD 90-day demo commenced in August
 - Incorporates an optimized profile on an existing RNAV STAR to enable a CDA from the en route (FL350)
 - Development of a published procedure will be pursued after the demo

- **Under Development:**

- **Charleston - Kickoff meeting July 15-17. Designed 4 OPD RNAV STARs**

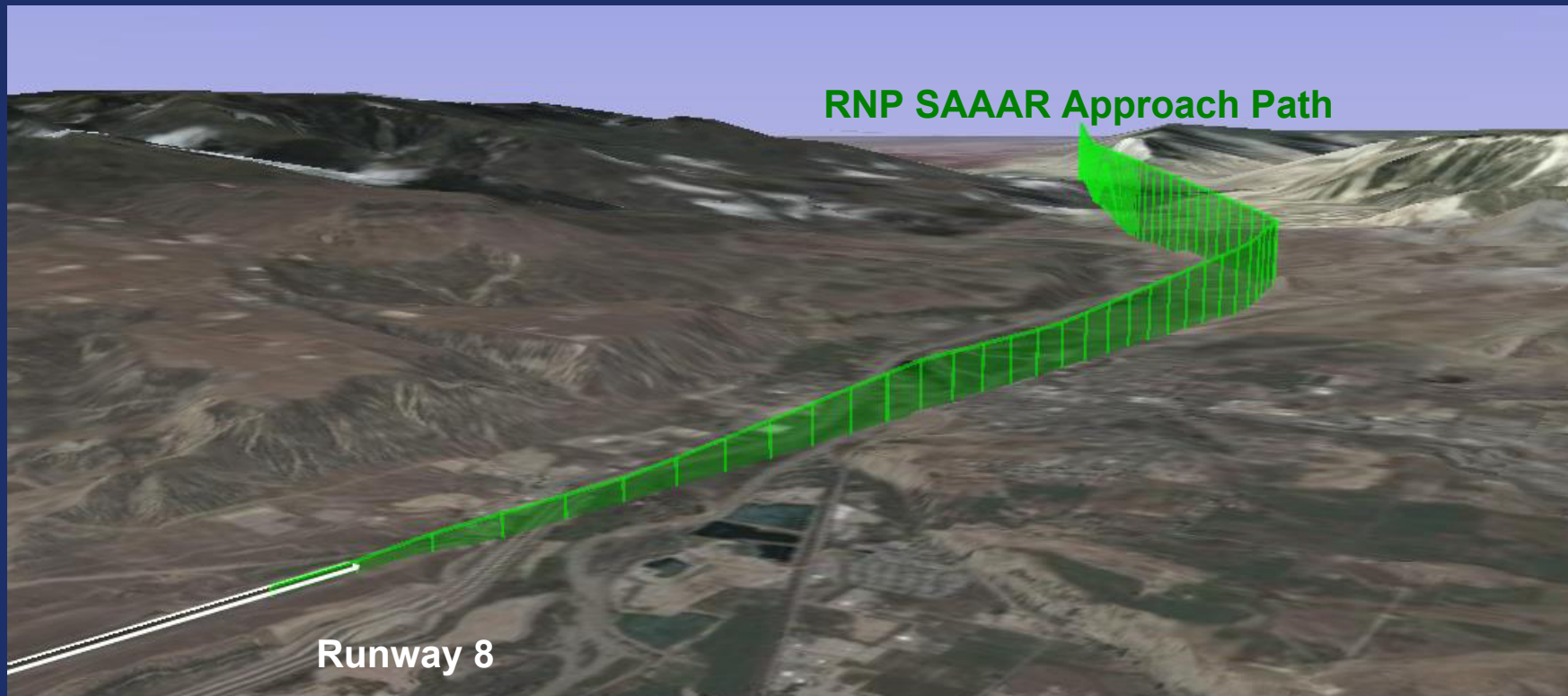
- Collaborative effort with AJP-67 (AIRE) and USAF (C-17)
- Louisville-Standiford - Kickoff meeting June 17-18
 - Designed 7 OPD RNAV STARs

Approach Chart Comparison



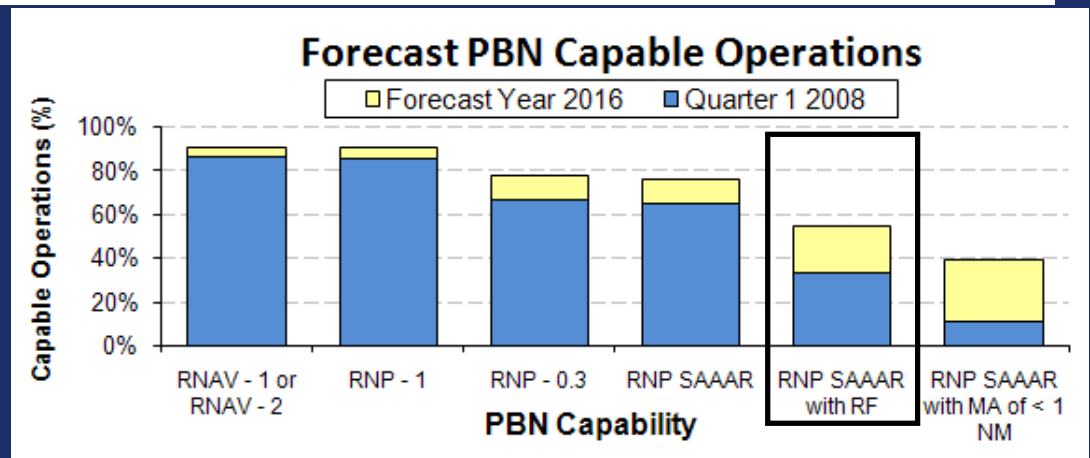
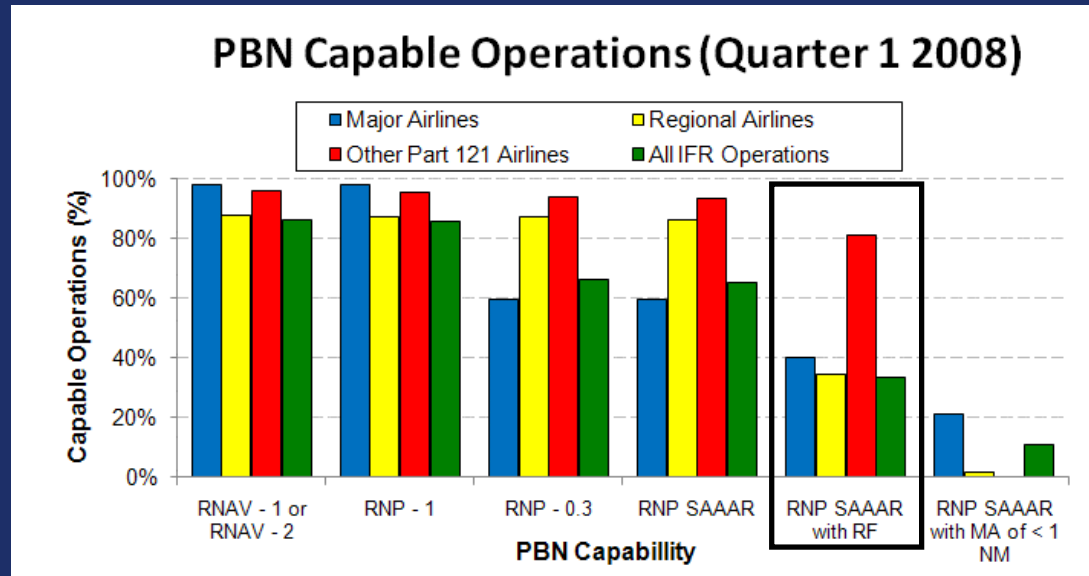
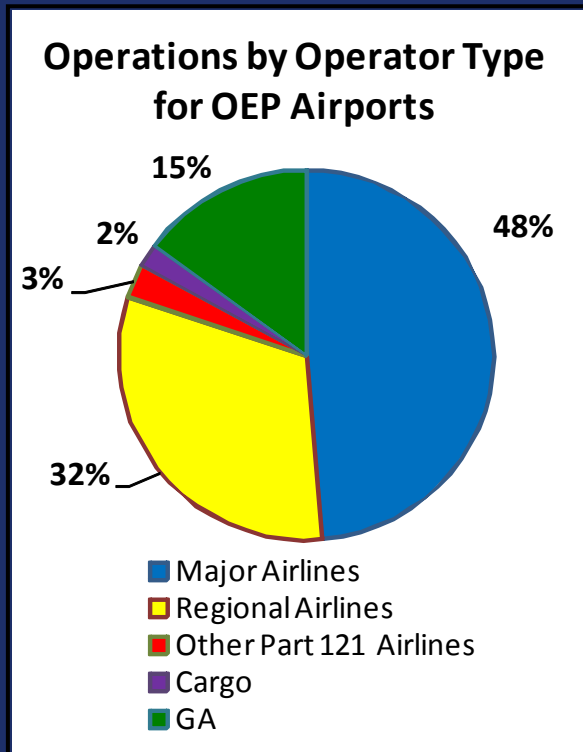
Rifle, Colorado

Benefits of RNP SAAAR



- High terrain on both sides of approach path to Runway 8
- RNP SAAAR enables stabilized vertically guided approaches
- Reduces landing minima from 1900 ft / 3 miles to as low as 300 ft / 1 mile

NAS-Wide OEP Airport PBN Capability



Questions?

