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32<sup>nd</sup> Annual Forecast Conference  
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Airport Capacity & Planning

## Applying Advanced Technologies to Enhance Airport System Capacity

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# Applying Advanced Technologies to Enhance Airport System Capacity

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It wasn't always the primary strategy...

"Two miles of runways at the top 25 delay-prone airports would take care of virtually all of the delay in the system. The solution, therefore, is 50 miles of runways."

- Testimony to Senate Aviation Subcommittee  
March 29, 2001

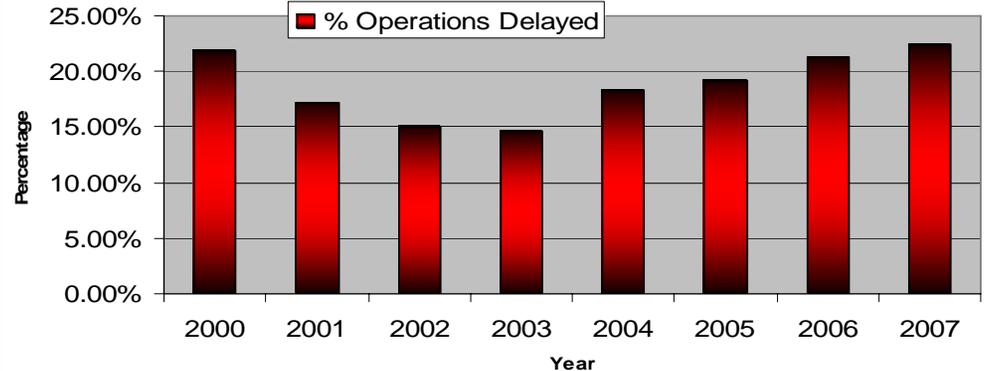
# Pavement alone hasn't been the solution ...

## Runways Constructed Since 2001

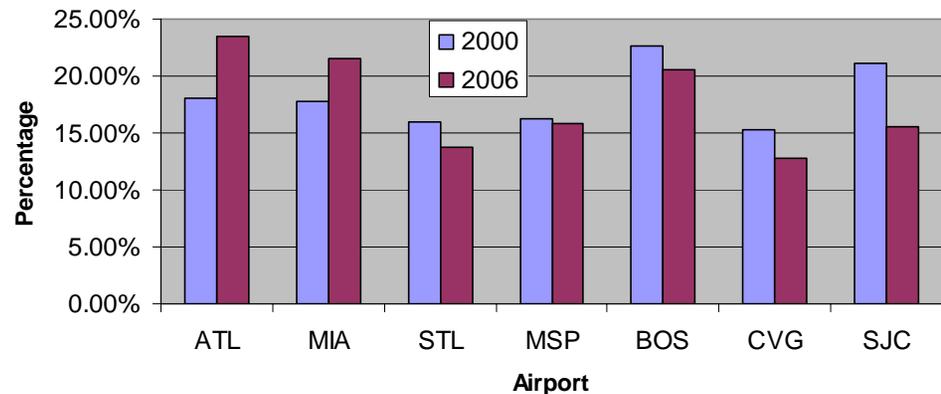
2001:	SJC	11,000 ft.
	DTW	10,000 ft.
2003:	MIA	9,000 ft.
	DEN	16,000 ft.
	MCO	9,000 ft.
	IAH	9,000 ft.
2004:	CLE	9,000 ft.
2005:	MSP	8,000 ft.
	CVG	8,000 ft.
2006:	ATL	9,000 ft.
	STL	9,000 ft.
	BOS	5,000 ft.

Total: 12 new runways  
21.78 miles

**Percentage of Air Carrier Operations Delayed  
All Airports 2000 - 2007 (YTD)**



**Percentage of Operations Delayed 2000 vs. 2006  
Airports with new runway construction**



Source: Bureau of Transportation Statistics

# Shift in focus from Pavement to Technology

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Hypotheses: Demand is increasing, but more uniformly distributed over time and among airports (commercial service and general aviation).

Bottleneck is not at the runway level but at the local airspace level.

Constraints to increased capacity: Weather Minima  
IFR Separation Requirements  
Airspace Routing Limitations

New Availability to increase capacity: Maturation of Technologies  
Reduced Costs of Implementation  
Acceptance by users

# Applying Advanced Technologies to Enhance Airport System Capacity

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**Area Navigation (RNAV)** -- Method of navigation that permits operation on any desired flight path, independent of ground-based navaid location

RNAV / RNP Technologies to:

Increase capacity on approach

Plus on-board technologies to:

Increase departure capacity

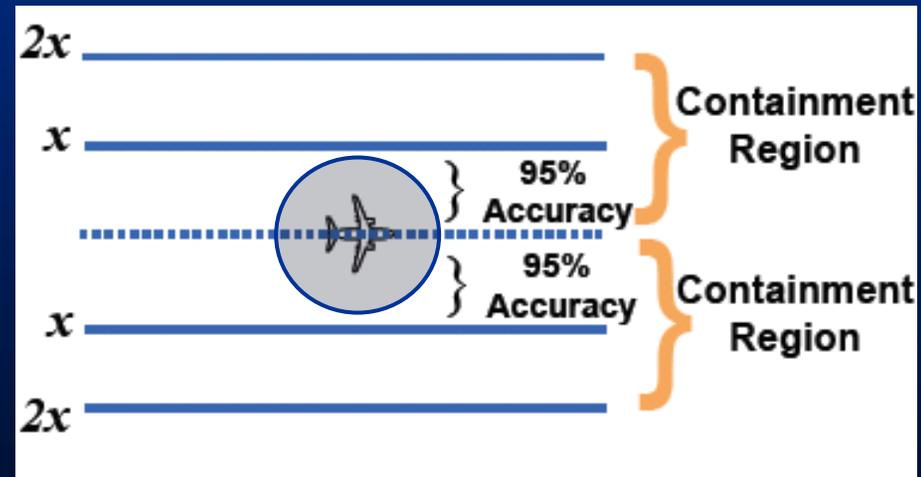
Open up capacity at additional airports

# Applying RNAV / RNP to Airport Approaches

## RNP Approach Procedures

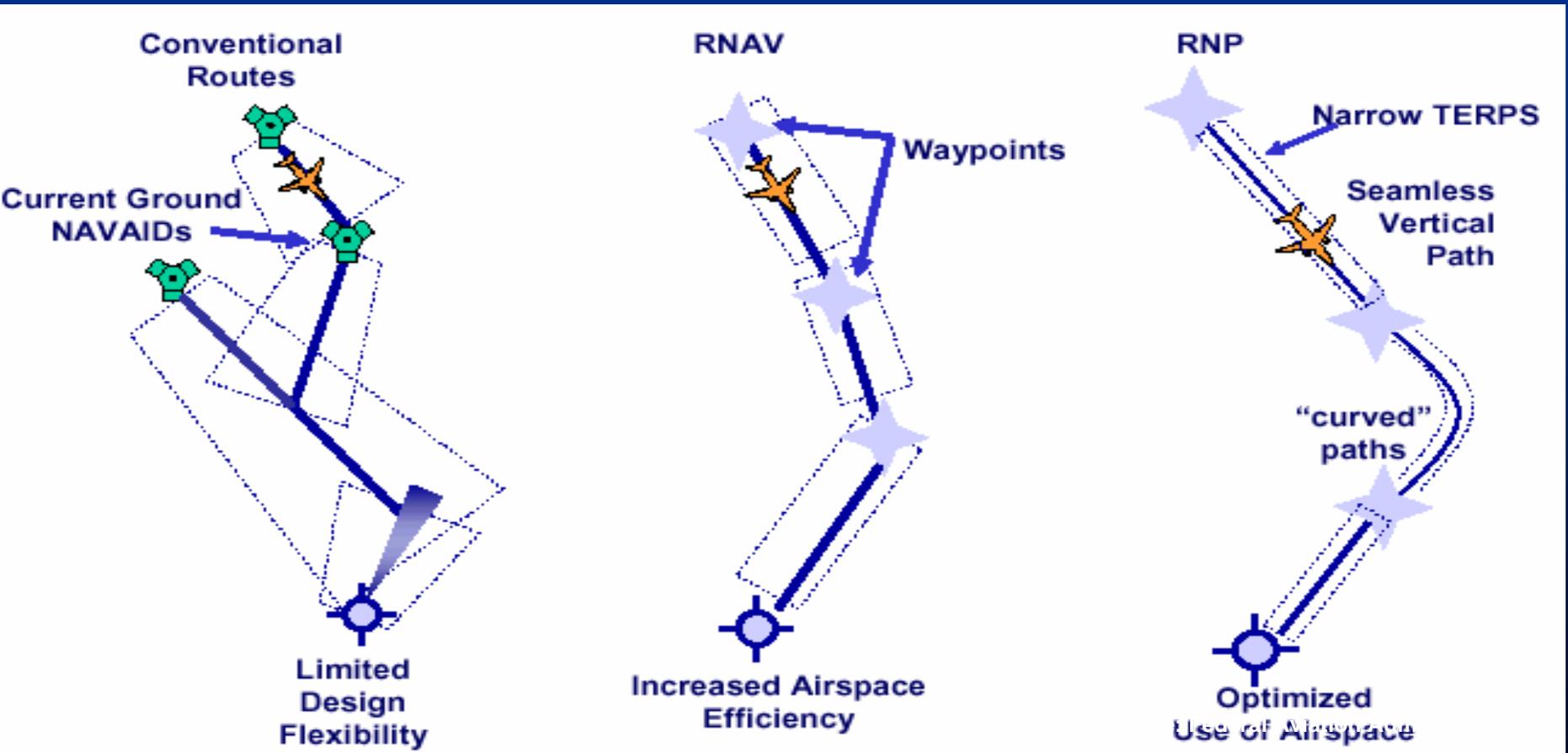
**Required Navigation Procedures (RNP)** – RNAV based approach procedures applicable to certain operators with special authorization and aircraft capabilities

- Onboard avionics keep aircraft within a tightly specified corridor
- RNP-x has accuracy of x (nm) or better, 95% of time
- 99.999% probability that aircraft is within containment region--an area  $\pm 2x$  wide



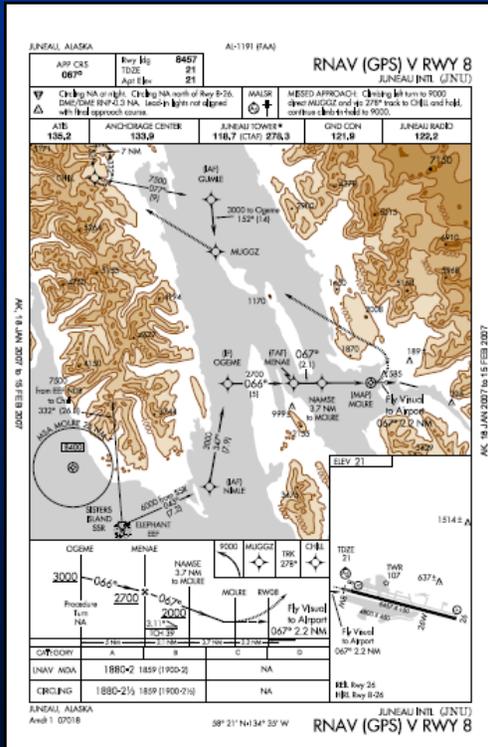
# Applying RNAV / RNP to Airport Approaches

Increases efficiency, flexibility and optimal use of airspace



# Applying RNAV / RNP to Airport Approaches

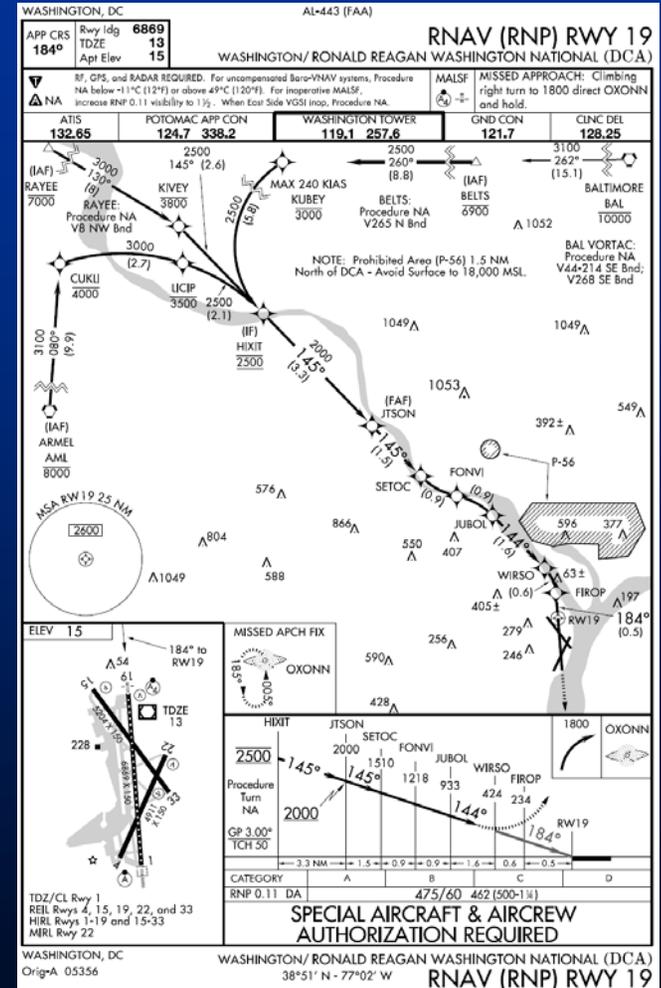
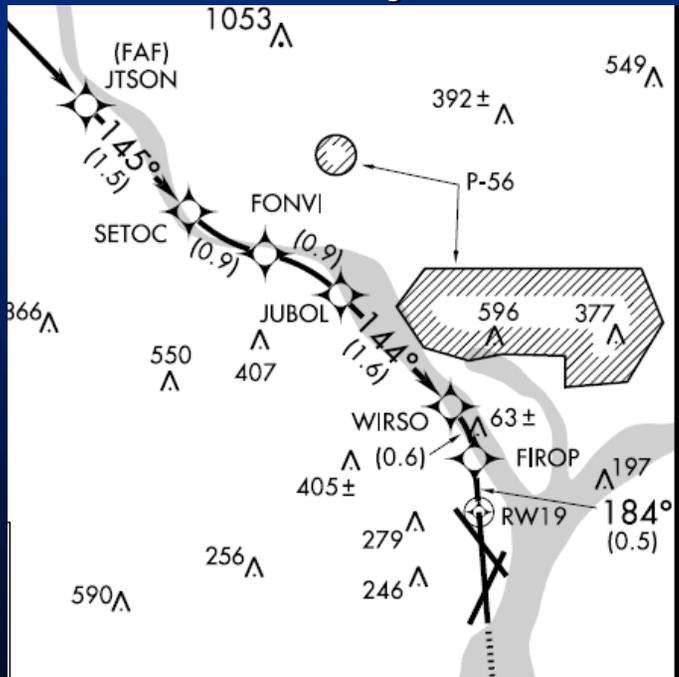
- Pioneered RNP in Alaska
  - To serve "terrain-challenged" airports (e.g., Juneau-Gastineau Channel)
  - Exploit advanced avionics on its B-737-400+'s



# Applying RNAV / RNP to Airport Approaches

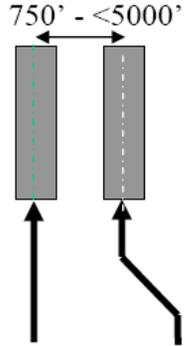
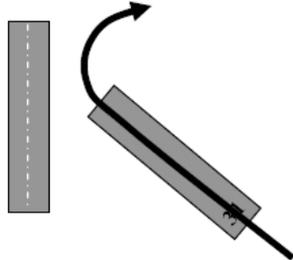
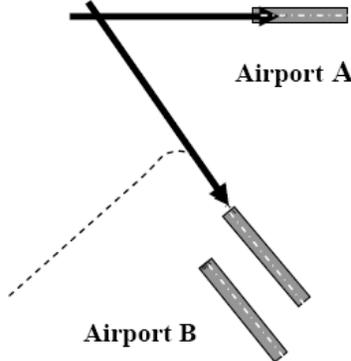
- Established 9/28/05, RNP 0.11
- Previous approach minimums: 720-foot decision altitude and 2 & 1/4 mi. visibility
- RNP approach minimums: 475-foot decision altitude and 1 & 1/4 mi. visibility

Source: RNAV/RNP Program Update, Federal Aviation Administration



# Applying RNAV / RNP to Airport Approaches

## Enhancing Capacity to Multiple Runway Configurations

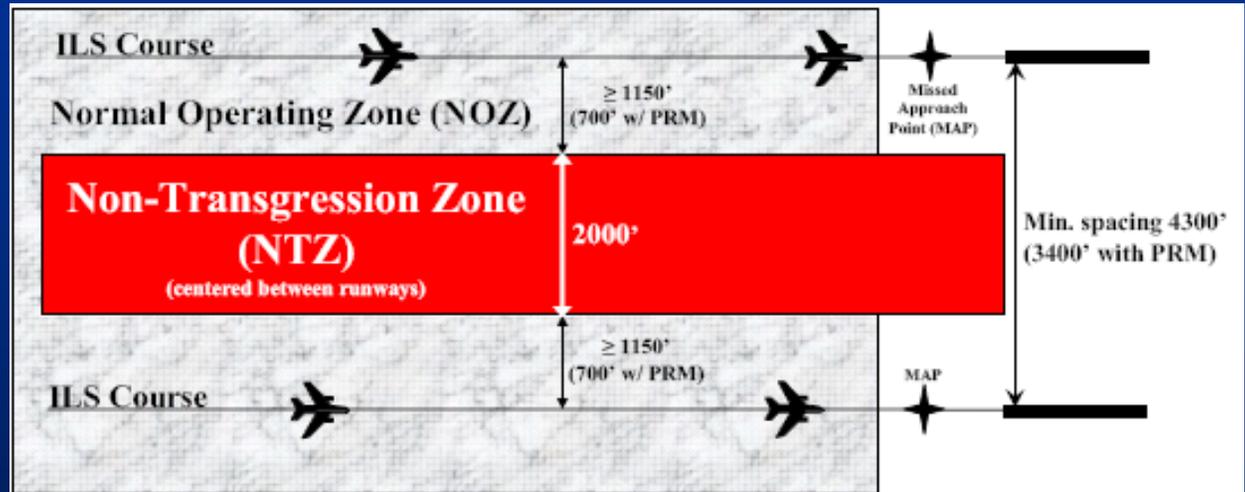
Parallel Operations	Converging Operations	Adjacent Airport Operations
 <p>750' - &lt;5000'</p>		 <p>Airport A</p> <p>Airport B</p>
10 to 15 Top Airports	15 to 20 Top Airports	10 to 15 Top Airports
Arrival capacity gains up to 60% over single runway operations	Arrival capacity gains up to 50% over single runway operations	Increased arrival and departure rates for adjacent airports involved

Source: Federal Aviation Administration

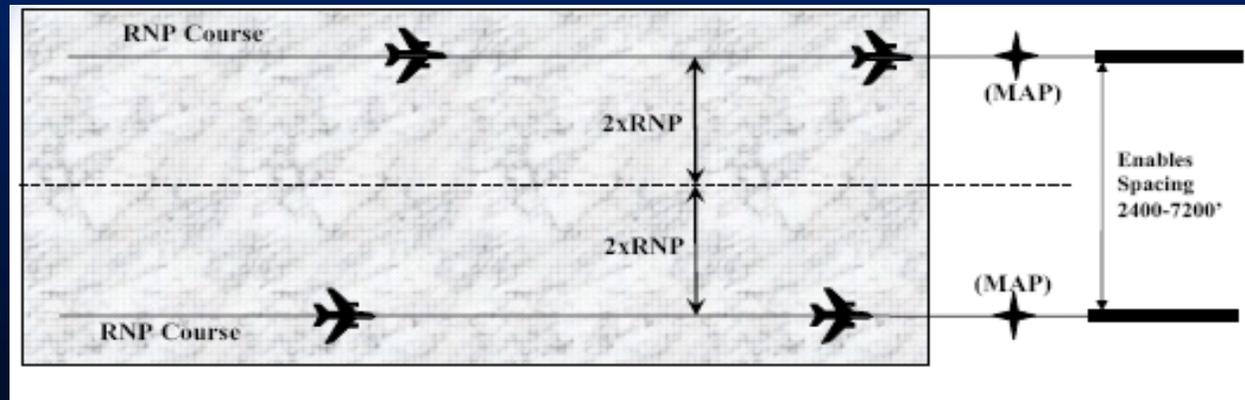
# Applying RNAV / RNP to Airport Approaches

Applying RNP Approaches to reduce parallel runway separation requirements

- Current Requirements for Simultaneous Independent ILS Approaches in IMC



- Future RPA Concept

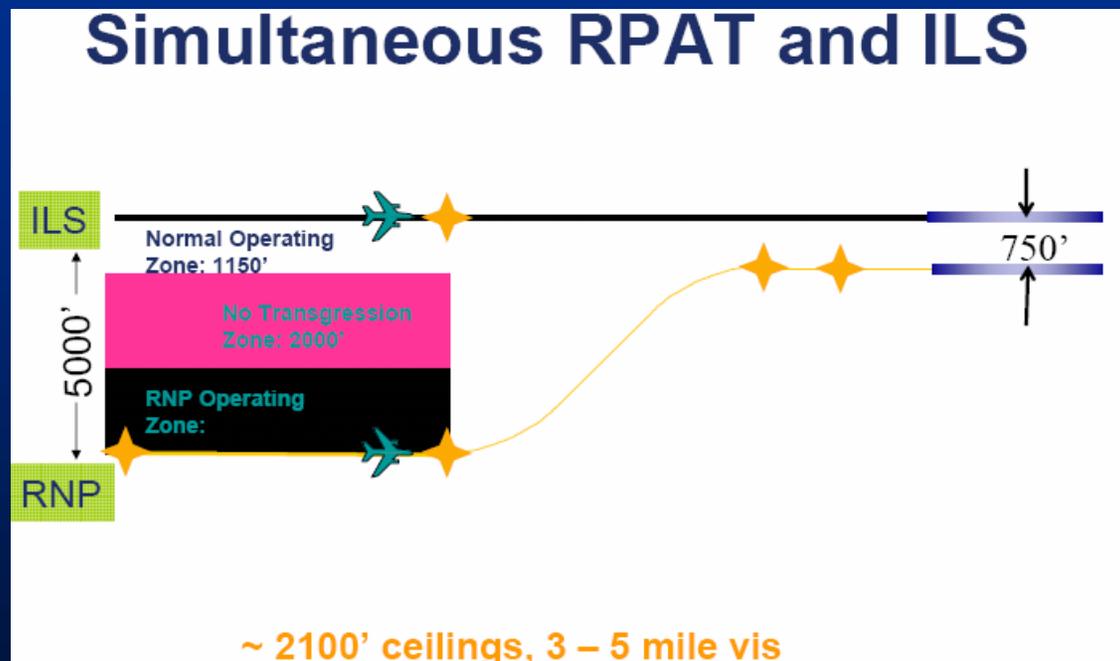


Source: RNAV/RNP Program Update, Federal Aviation Administration

# Applying RNAV / RNP to Airport Approaches

## Integrating RNP with ILS approaches to parallel runway environments

- Provides up to 60% greater capacity over single runway
  - Applicable to parallel runways spaced as close as 750 feet
  - Provides ILS approach to accommodate mixed equipage
  - Maintains second arrival stream if one ILS is out of service



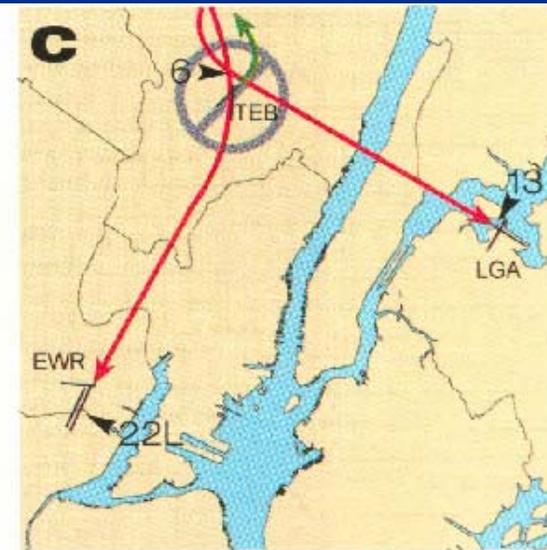
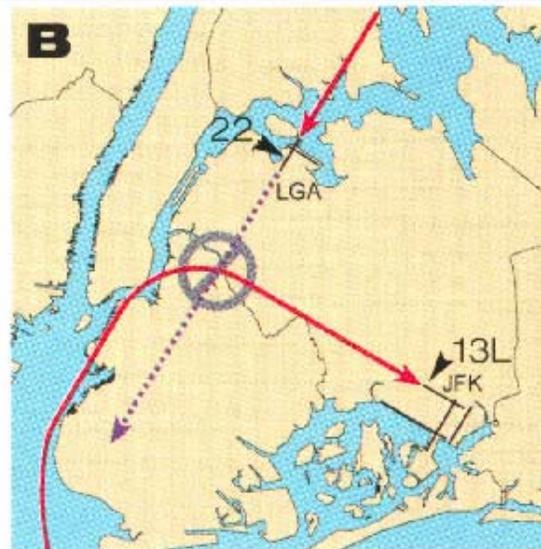
Source: FAA and MITRE CAASD

# Applying RNAV / RNP to Airport Approaches

## De-conflicting Approaches to Multiple Airports



BECAUSE OF the potential interactions between JFK runway 13L ILS approaches and LGA runway 4 ILS approaches (panel A) or runway 22 missed approaches (panel B), LGA approaches must use runway 13 ILS, which in turn conflicts with runway 22L approaches at EWR and runway 6 departures at TEB (panel C).



### Legend

-  Arrivals
-  Departures
-  Missed approach
-  Points of potential interactions

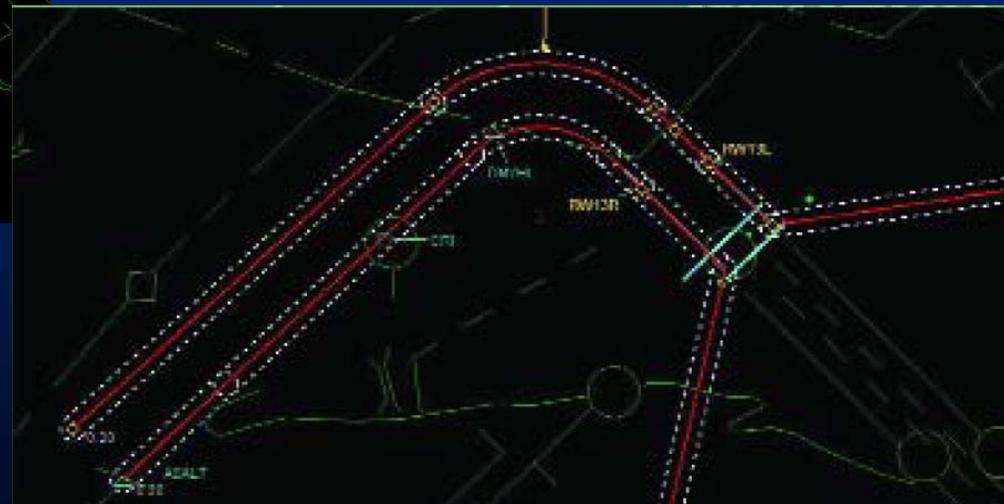
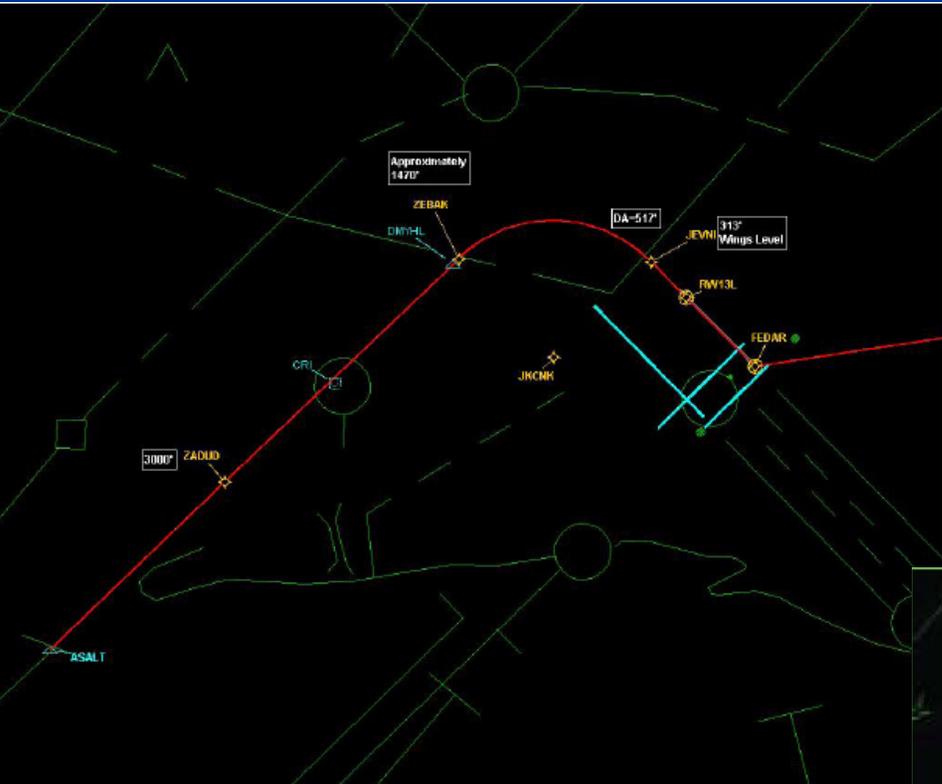
- ILS - Instrument Landing System
- EWR - Newark International Airport
- JFK - Kennedy International Airport
- LGA - LaGuardia International Airport
- TEB - Teterboro Airport

# Applying RNAV / RNP to Airport Approaches

## De-conflicting Approaches to Multiple Airports



# Planned RNP SAAAR Approach to JFK Runway 13L/R Sponsored by JetBlue Airways



Source: Federal Aviation  
Administration

# Applying RNAV to Departure Procedures

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Increasing capacity and efficiency in departure corridors

## Departure Procedures- Before & After RNAV

### BEFORE

- Departures are vectored
- Significant dispersion
- Limited exit points

### AFTER

- Departures fly RNAV tracks (not vectored)
- Flight-track dispersions reduced
- More efficient vertical profiles
- Additional exit points available
- Voice transmissions reduced (30-50%)

Source: Federal Aviation  
Administration

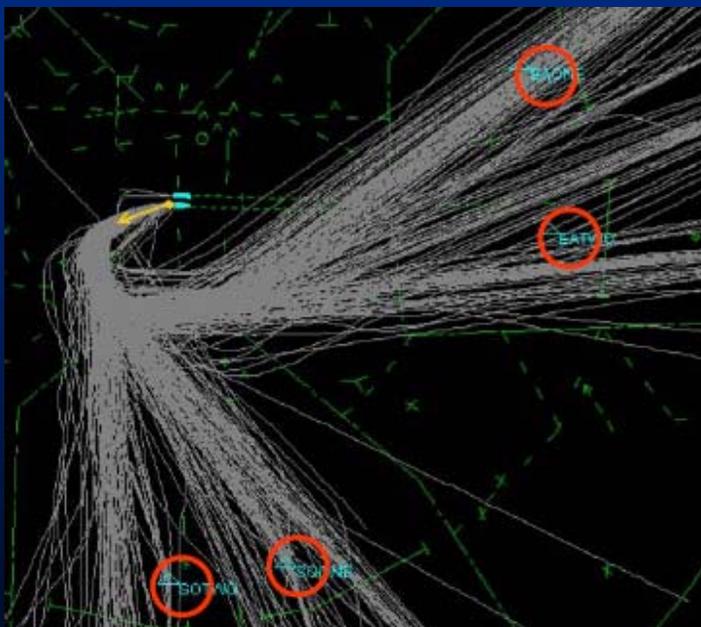
# Applying RNAV to Departure Procedures

Increasing capacity and efficiency in departure corridors

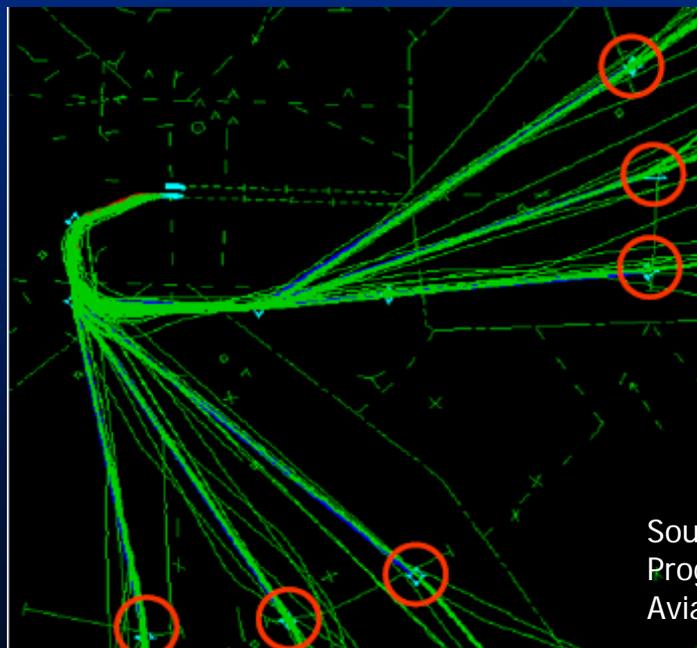
## Radar Flight Tracks Before & After RNAV SIDS

### ATL RNAV Standard Instrument Departures

Non-RNAV SIDS



RNAV SIDS



Source: RNAV/RNP  
Program Update, Federal  
Aviation Administration

# Applying RNAV to Departure Procedures

Increasing capacity and efficiency in departure corridors

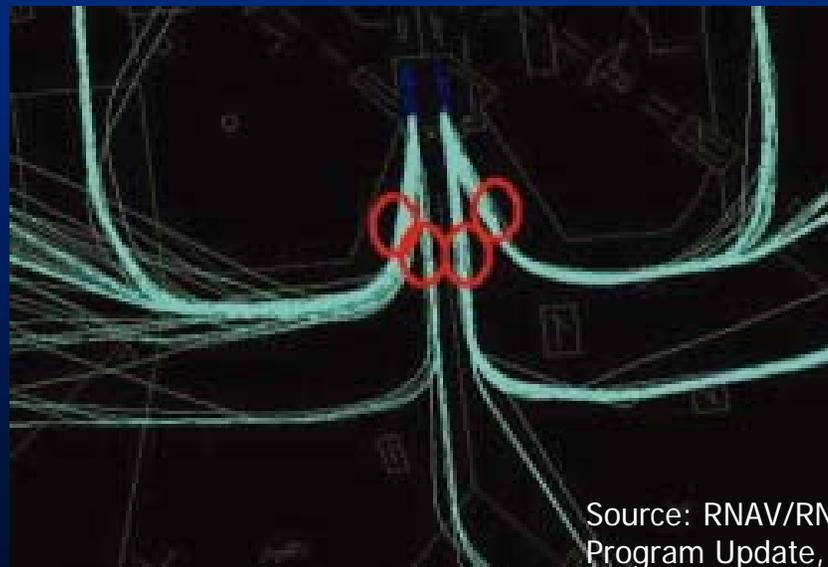
## Radar Flight Tracks Before & After RNAV SIDS

### DFW (AAL) RNAV Standard Instrument Departures

Non-RNAV SIDS



RNAV SIDS



Source: RNAV/RNP  
Program Update, Federal  
Aviation Administration

# Enhancing Airport Capacity with on-board technologies

## Automatic Dependent Surveillance-Broadcast (ADS-B) Cockpit Display of Traffic Information (CDTI)



# Enhancing Airport Capacity with on-board technologies

## HUD – Heads Up Displays

- Enables aircraft to takeoff in visibility conditions as low as 300 feet; normal visibility minimums are 600 feet
- Facilitates airport surface movements



# Enhancing Airport Capacity with on-board technologies

## Enhanced Vision System (EVS) Displays

Enables Gulfstream 550 to fly CAT-I approach down to a decision height of 100 feet



# Enhancing Airport Capacity with on-board technologies

## Synthetic Vision Displays

Provides pilots with a realistic depiction of terrain databases and standard aircraft systems on a standard flight deck display.



# Applying Advanced Technologies to Enhance Airport System Capacity

Many on-board technologies now available in the most basic aircraft.



Photo courtesy  
Cessna Aircraft

# Applying Advanced Technologies to Enhance Airport System Capacity

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Application of enhanced navigation technologies can increase capacity of existing runway and local airspace infrastructure by:

- Providing more precise approach and departure routing
- Reducing approach and departure minima
- Facilitating reduced separations between aircraft
- Opening additional corridors to traffic
- Reducing conflicts among close proximity airports
- Increases capacity at far more airports than 50 miles of runway could.

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THANK YOU.