RNP-based Parallel Instrument Approaches: Concepts and Benefits

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3 May 2005

CAASD

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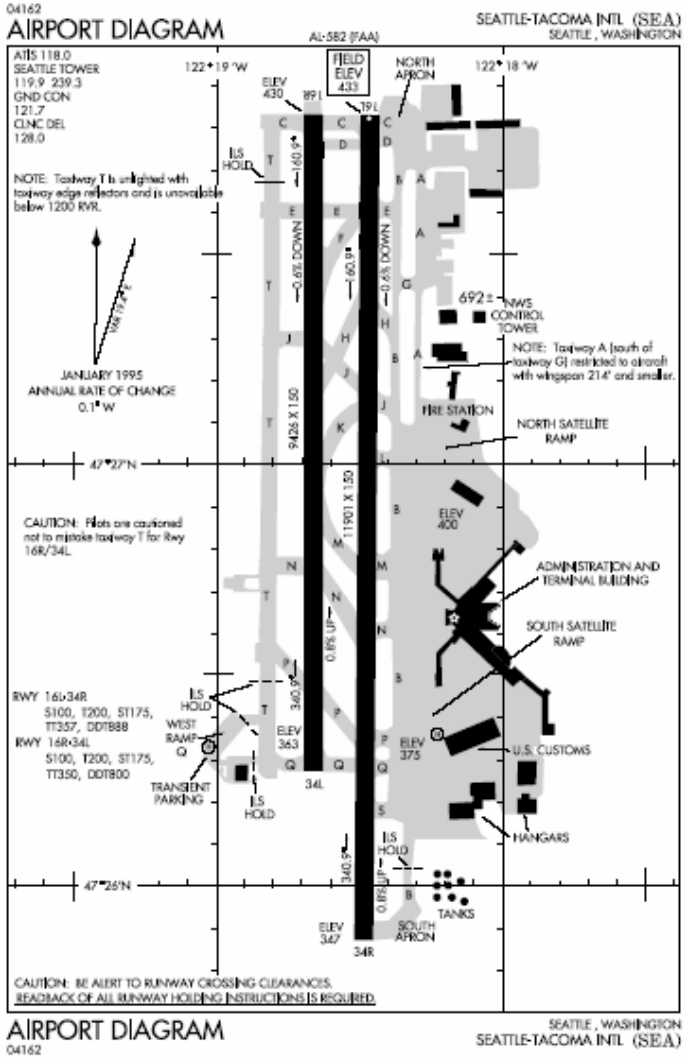
Current Parallel Operations

- **Problem: Simultaneous approaches to closely spaced parallel runways are stopped in marginal and instrument weather conditions (or when ILS is out of service)**
- **Example: Seattle-Tacoma (KSEA) uses single arrival stream when ceilings are below approx. 4500’**
  - **Capacity drops from 44 to 36 arrivals/hour**
- **Extending simultaneous arrivals to MVMC and IMC would increase capacity and reduce delays**



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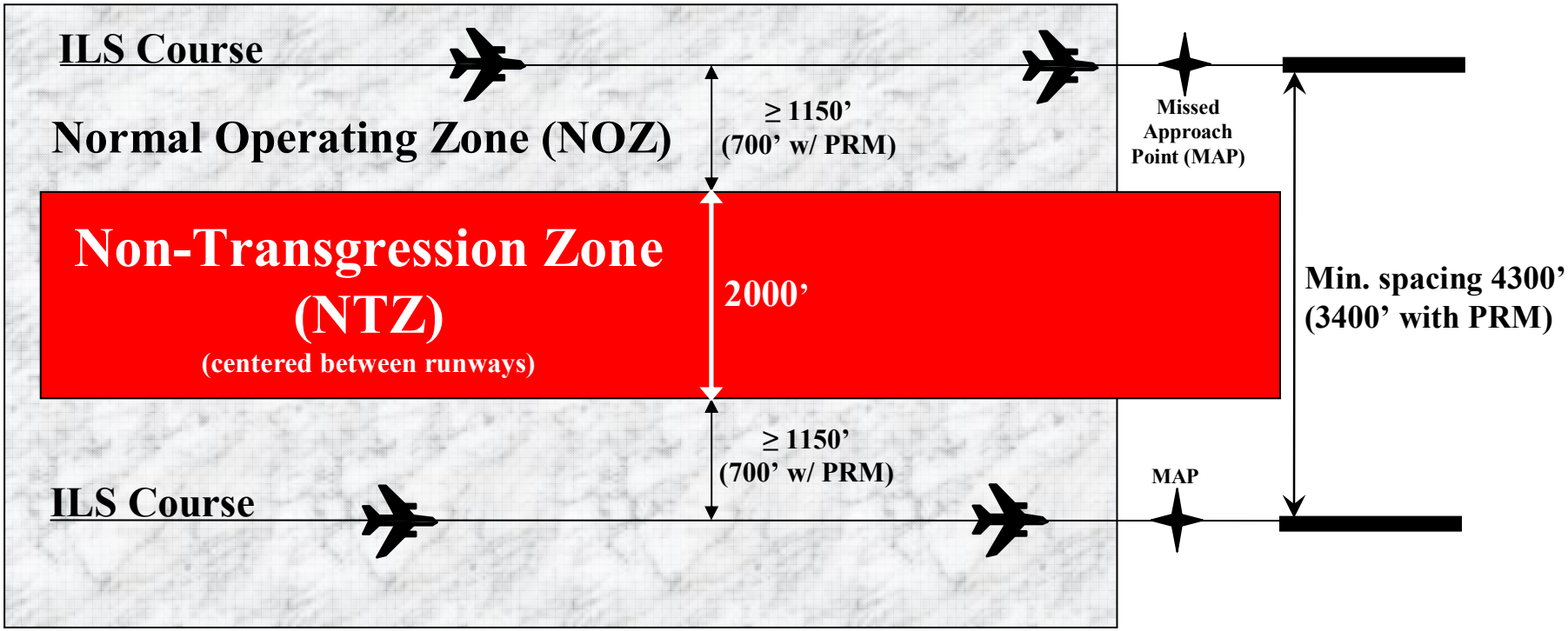
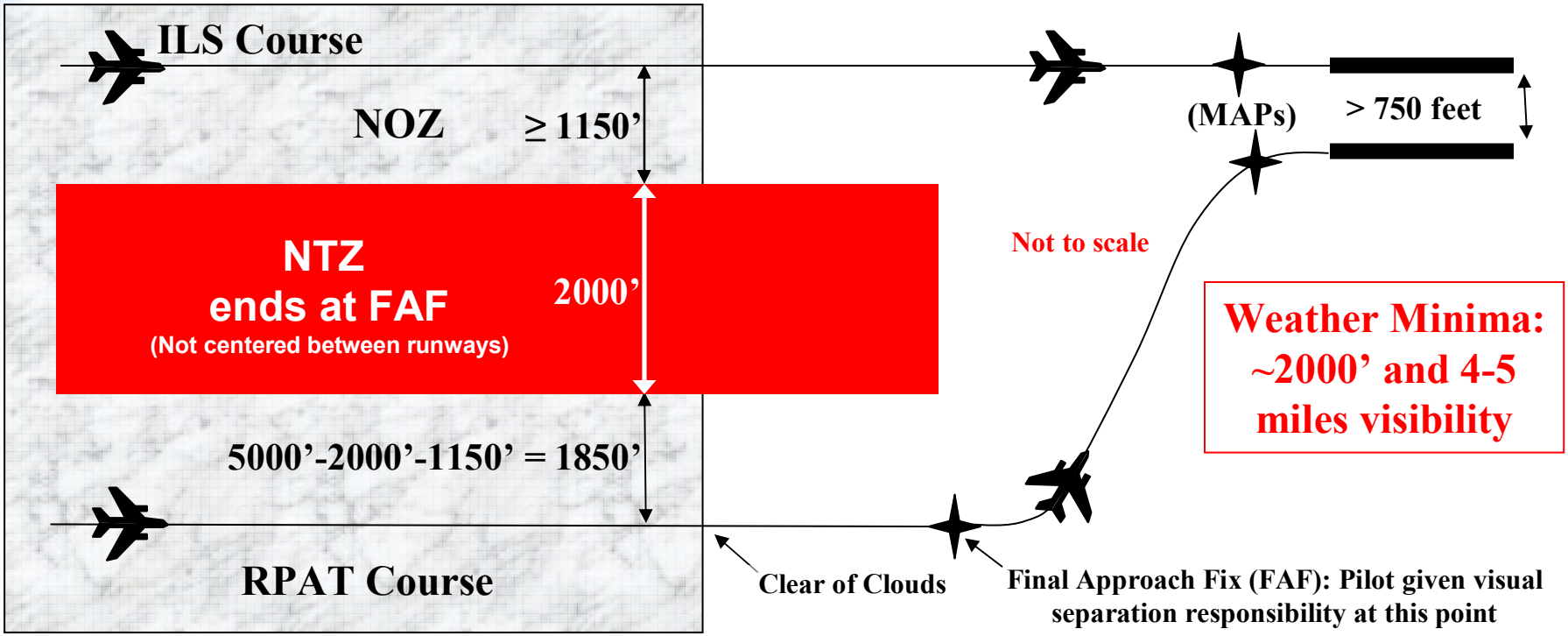
Current Requirements for Simultaneous ILS Approaches in IMC



RNP Approach Procedures

- **Required Navigational Performance (RNP) is an important element of performance based navigation**
  - **Fly point to point**
  - **Monitor navigation accuracy**
  - **Alert pilot if aircraft deviates from nominal path**
- **RNP instrument approach procedures need not rely on ground-based navaids**
  - **Allow narrower approach segments**
  - **Segments can be straight or curved**
  - **Will improve capacity and access**
  - **Will be classified as Special Aircraft and Aircrew Authorization Required (SAAAR)**

RNP Parallel Approach with Transition (RPAT)



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

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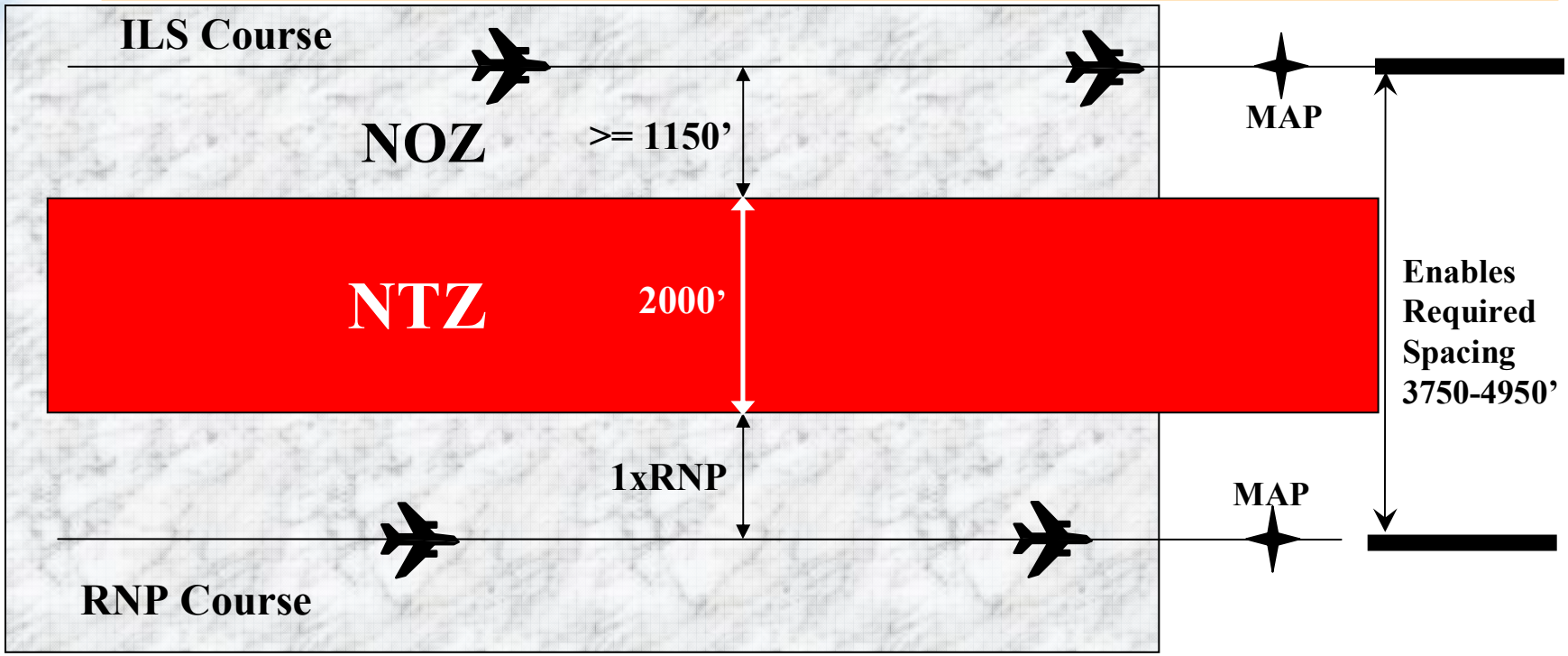
RNP Parallel Approach without Transition (ILS/RPA)



- Provides up to twice the capacity of a single runway in IMC (250' and mile)
- Provides standard ILS approach to accommodate mixed equipage
- Provides backup for ILS

Level	NTZ+RNP NOZ	Required Spacing
RNP-0.3	3150+1800	4950
RNP-0.2	3150+1200	4350
RNP-0.15	3150+900	4050
RNP-0.1	3150+600	3750

} ILS Backup

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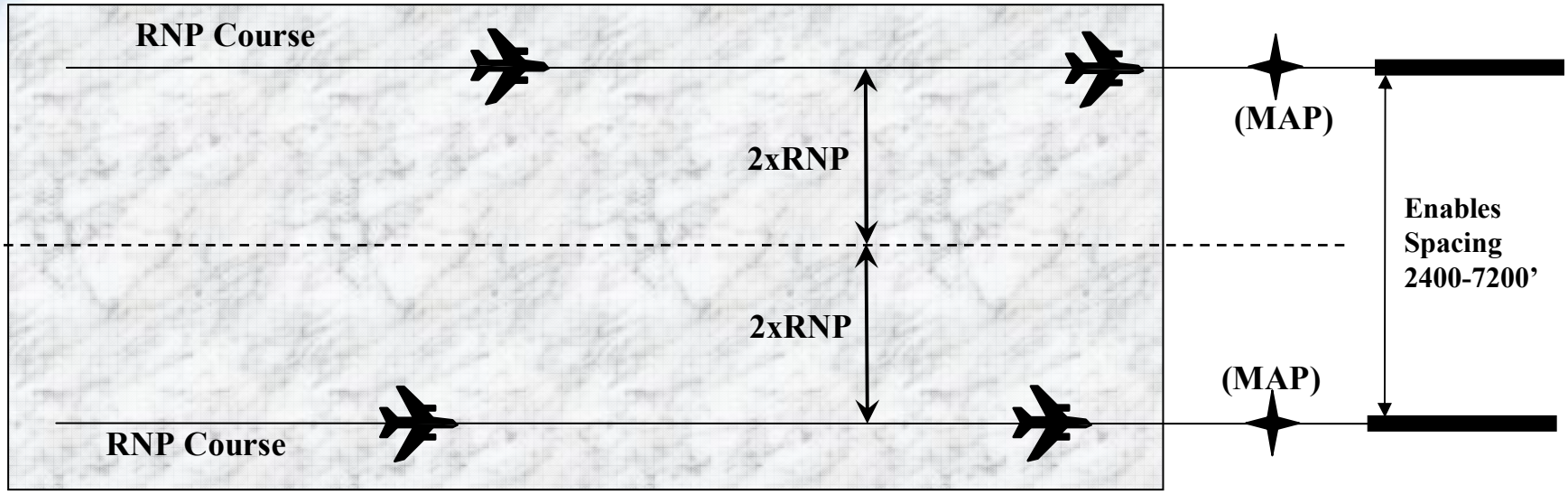
Future RPA Concept



- Applicable to runways spaced as close as 2400’ with RNP-0.1 approach procedures
- Provides up to twice the capacity of a single runway in IMC (250’ and mile)
- No ILS necessary, but requires high participation rates

Level	4xRNP	Required Spacing	
RNP-0.3	3600+3600	7200	} ILS Backup
RNP-0.2	2400+2400	4800	
RNP-0.15	1800+1800	3600	
RNP-0.1	1200+1200	2400	

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Candidate Airports and Delay Benefits

- MITRE was sponsored by FAA to analyze RPAT/RPA benefits and to determine a list of candidate airports for implementation
- Found 12 RPAT, 6 RPA candidates, based on traffic level, runway spacing, and runway length.
- Delay reduction benefit calculated by modeling
  - RPAT arrival capacity determined at each candidate airport by Monte Carlo simulation
  - New capacities were applied to 2003 ASPM airport data replacing historical arrival rates when RPAT/RPA applied
  - Higher throughput translates to fewer delayed flights

Candidate Airports and Delay Benefits (concluded)

Site	Applicable Runways	Fraction of time RPAT is applicable	Potential Annual RPAT Airborne Delay Benefit (minutes)	Fraction of time RPA is applicable	Potential Annual RPA Airborne Delay Benefit (minutes)
Atlanta	26R/27L/28, 8L/9R/10 (Triples)	17%	120,000	37%	320,000
Boston	4L/R	6%	14,000	-	-
Cleveland	24L/R, 6L/R	14%	24,000	-	-
Detroit	21L/R, 22L/R, 3L/R, 4L/R (Triples)	18%	43,000	34%	120,000
Newark	4L/R 22L/R (possibly)	11%	28,000	-	-
JFK	4R/L, 22R/L	5%	3,400	67%	6,200
Las Vegas	25R/L, 19R/L, 7R/L, 1R/L	3%	6,700	-	-
Portland	10R/L, 28R/L	23%	4,000	36%	11,000
Philadelphia	26/27R	7%	11,000	-	-
Seattle	16R/L or 16W/L*, 34R/L	23%	68,000	41%	100,000
San Francisco	10s, 28s, 1s, 19s	14%	33,000	-	-
St. Louis	12R/L, 30R/L	16%	22,000	31%	55,000

* 16W refers to the new runway at SEA scheduled for completion in 2008

Delay benefit calculated assuming 100% equipage and participation

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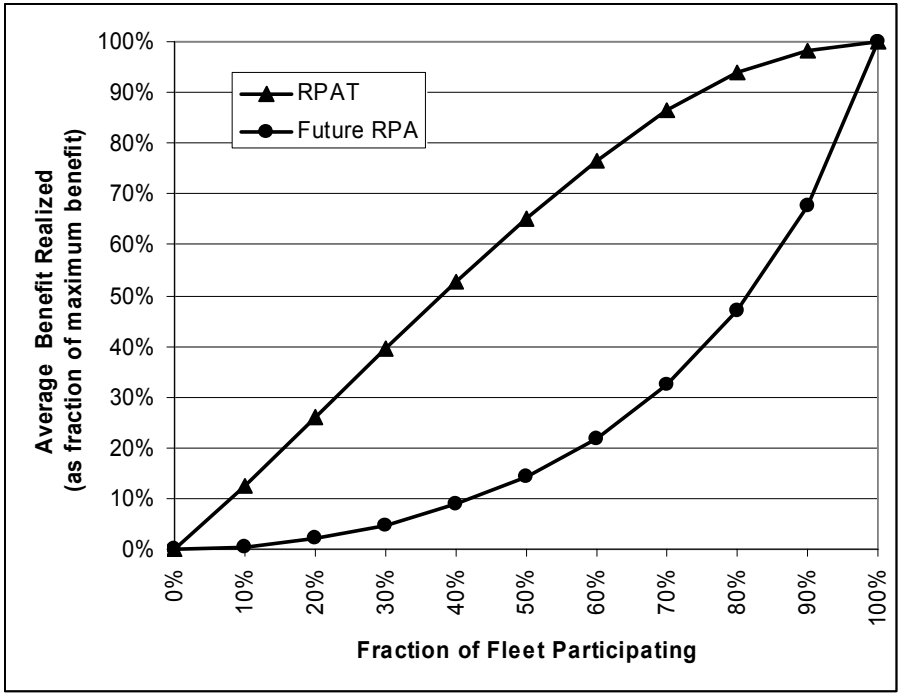
Accommodating Mixed Equipage

- RNP-SAAAR procedures require advanced avionics equipment that has not been deployed by all operators
  - Dual flight management systems
  - GPS or Inertial guidance systems
  - Vertical Navigation (VNAV)
  - Radius-to-Fix RNAV leg capability
- Aircraft that are not RNP-SAAAR authorized must still have access to airports where RPAT/RPA are in use
- Unequipped flights would likely be worked into pattern, but would impact capacity
  - RPAT and ILS/RPA have ILS approach available, so only one flight of each pair needs to be equipped
  - Future-RPA procedures require both simultaneous arrivals be participating

Accommodating Mixed Equipage (concluded)

- **Effect of mixed equipage upon delay benefit determined by modeling**
- **Actual RPAT benefit scales approximately linearly with equipage rate**
- **Future RPA benefit reduced strongly for equipage less than 90%**



AIRPORT	Arrival Ops RPAT Equipped	AIRPORT	Arrival Ops RPAT Equipped
ATL	46%	LAS	35%
BOS	51%	PDX	54%
CLE	60%	PHL	39%
DTW	34%	SEA	73%
EWR	66%	SFO	49%
JFK	42%	STL	52%

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Implementation Issues

- **RPAT is currently being studied for implementation in the near term**
  - **Uses existing separation and monitoring standards**
  - **Offset course may occupy new airspace, requiring environmental considerations**
  - **Wake vortex mitigation strategies are being studied**
- **RPA could provide greater benefits at a later time**
  - **Uses existing flight paths, less environmental impact**
  - **Applicable to runways closer than 3750 feet only with reduced NTZ, so updated "blunder" scenario needed**
  - **Requires new separation and monitoring standards on the final approach segment**

Conclusion

- Utilization of closely spaced parallel runways is reduced in MVMC and IMC.
- RNP-SAAAR based approach procedures are being developed to extend use of simultaneous approaches
  - FAA RNP office is working toward RPAT implementation this year
- Current equipage rates will allow realization of partial benefit from RPAT and ILS/RPA.
- Most beneficial Future RPA procedures will require revision of “blunder” analysis and new separation standards based on aircraft containment