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ACES RTCA Results

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VAMS TIM #4

NASA Ames Research Center

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Agenda

- Goals and Objectives
- Assessment Approach
  - Enroute Results
  - Arrival/Departure Results
- Conclusions
- Challenges

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Assessment Goals and Objectives

- Goals
  - Conduct an evaluation of key aspects of the RTCA CONOPS utilizing ACES Build 2.
  - Provide insight into a representative sample of the RTCA "Operational Statements"
- Objectives
  - Asses the capacity benefits offered by the concept
  - Demonstrate the application of ACES as a tool for independent concept evaluation

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RTCA Operational Concept

- **RTCA CONOPS covers the following areas**
  - **NAS Management, Flight Planning and Emergency and Alerting Services, Surface, Arrival/Departure, Enroute, International Oceanic**
- **Domains and Operational Statements addressed in ACES Assessment**
  - **NAS Management/Enroute**
    - Assess the impact of reducing constraints and reducing restrictions
    - Airspace structure is adjusted when demand exceeds capacity
  - **Arrival/Departure**
    - DSSs provides optimization of sequencing and spacing to airports and runways, including multi-airport arrival stream(s)
    - FMS offset approaches/departures and parallel RNP/RNAV routes

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Assessment Approach

- Select RTCA Operational Concepts for representation in ACES B 2.0
  1) NAS Management/Enroute: Remove the constraints in terminal, vary sector capacities to assess changes in sector congestion
  2) Arrival/Departure: Use sector capacities established in Step 1, and vary airport capacities to assess changes in delay
- Future Demand Flight Data Set
  - LMI "economic growth and airline recovery" scenario
  - Used by NASA Hdqrtr Preliminary Assessment, Sept 03
- Define test matrix and select metrics
- Generate post-processing tools
- Perform sensitivity analysis and collect results

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NASA Management/Enroute Assessment

- RTCA optimizes resources through functions including
  - Improved Sector Management
  - Accommodate User Priorities
  - Improved Decision Support Tools
- Determine impact of the enhanced operations by selectively modifying sector capacities

  1) Set airport capacities high (200) to eliminate airport capacity limits and use baseline enroute sector capacities. Run ACES and identify congested sectors

  2) Vary capacity limit of congested sectors until near-zero sector congestion alerts occur

  Identify the parent center of the congested sectors

  %Center Congestion(n) = # congested sectors(n)/total sectors(n)

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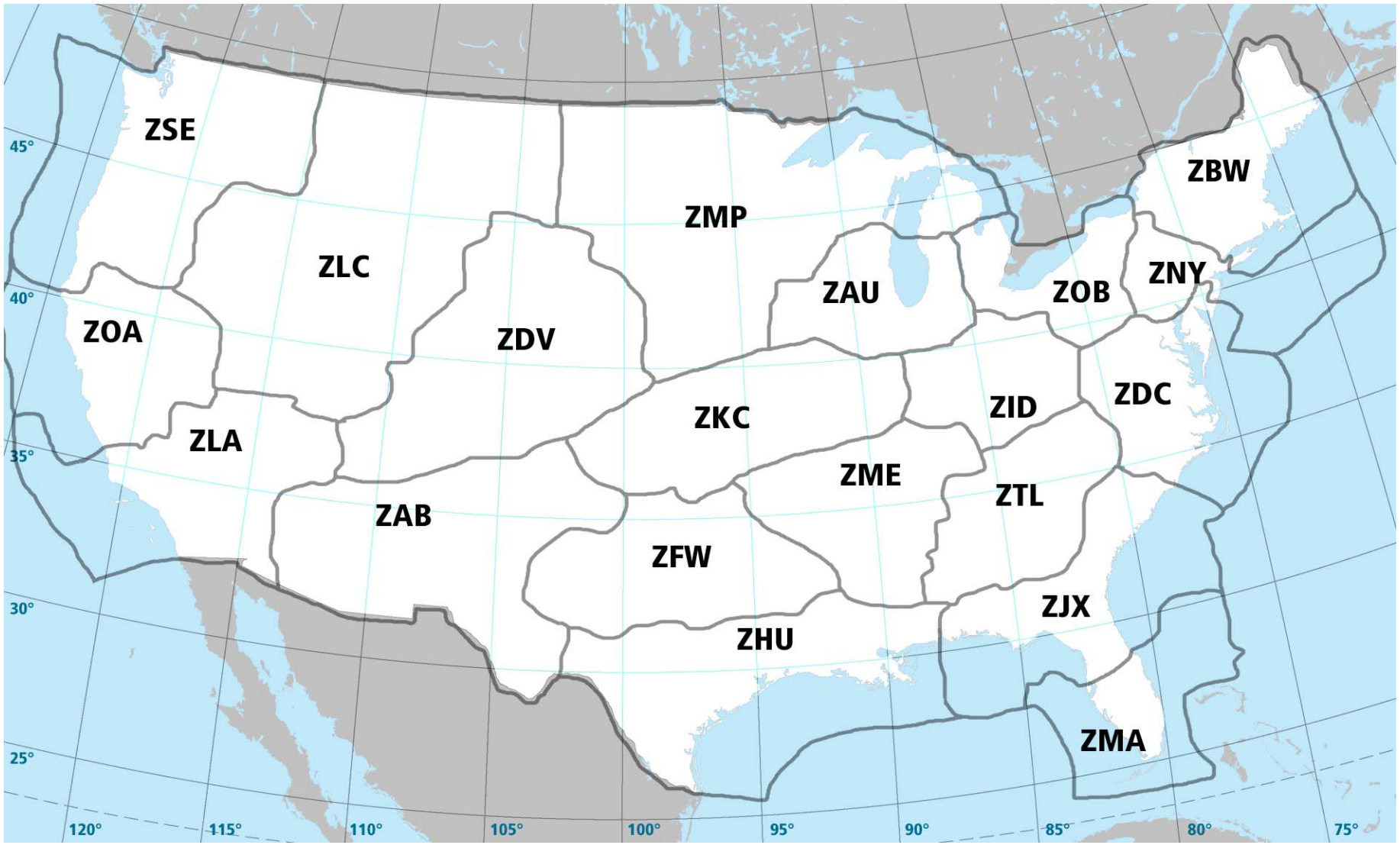
20 Centers



Case A, Baseline Sector Capacities
141 congested sectors (out of 730)

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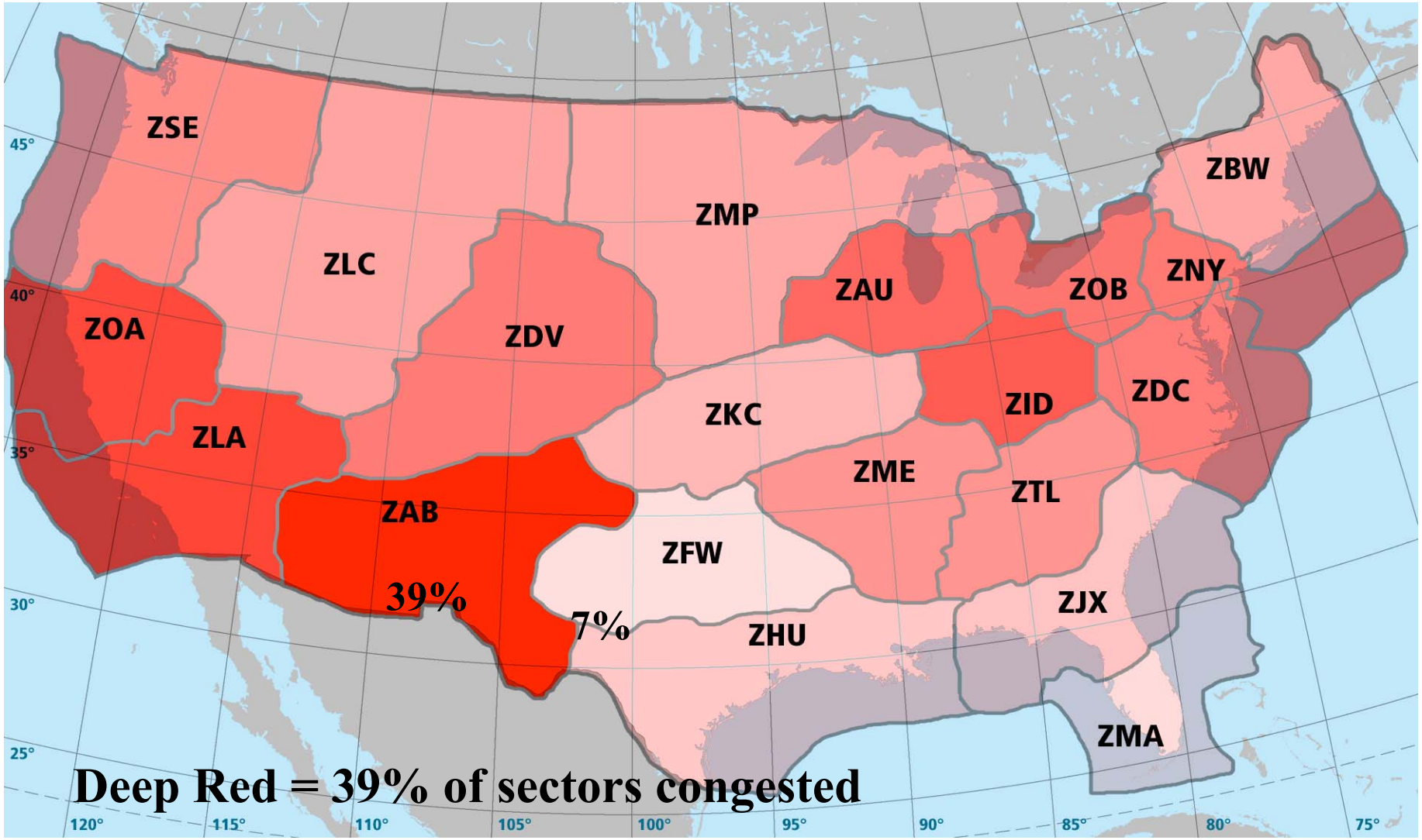

Case B, Case A Congested Sectors + 5
70 congested sectors

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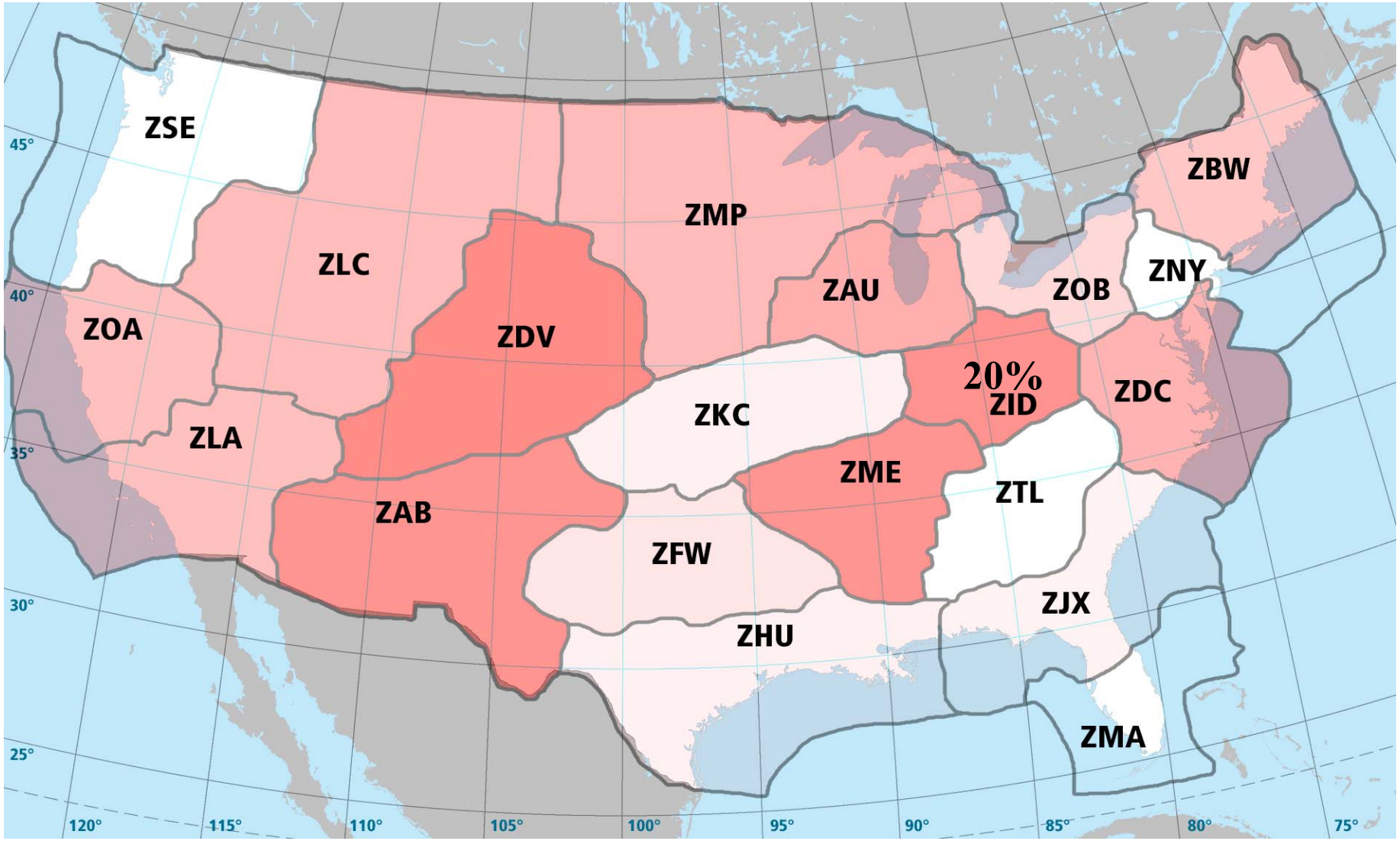

Case C, Case B Congested Sectors + 5
33 congested sectors

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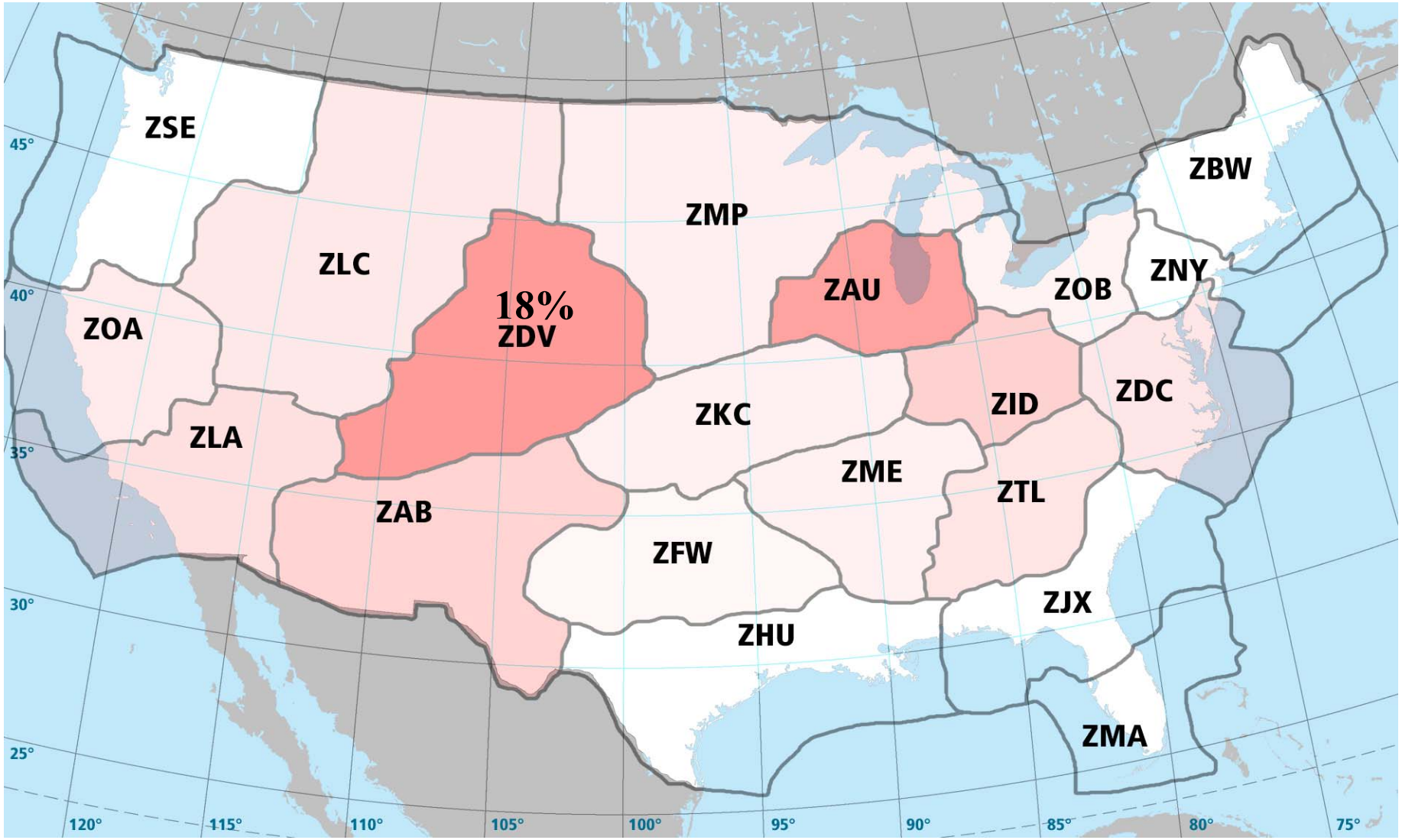

Case D, Case C Congested Sectors + 5
8 congested sectors

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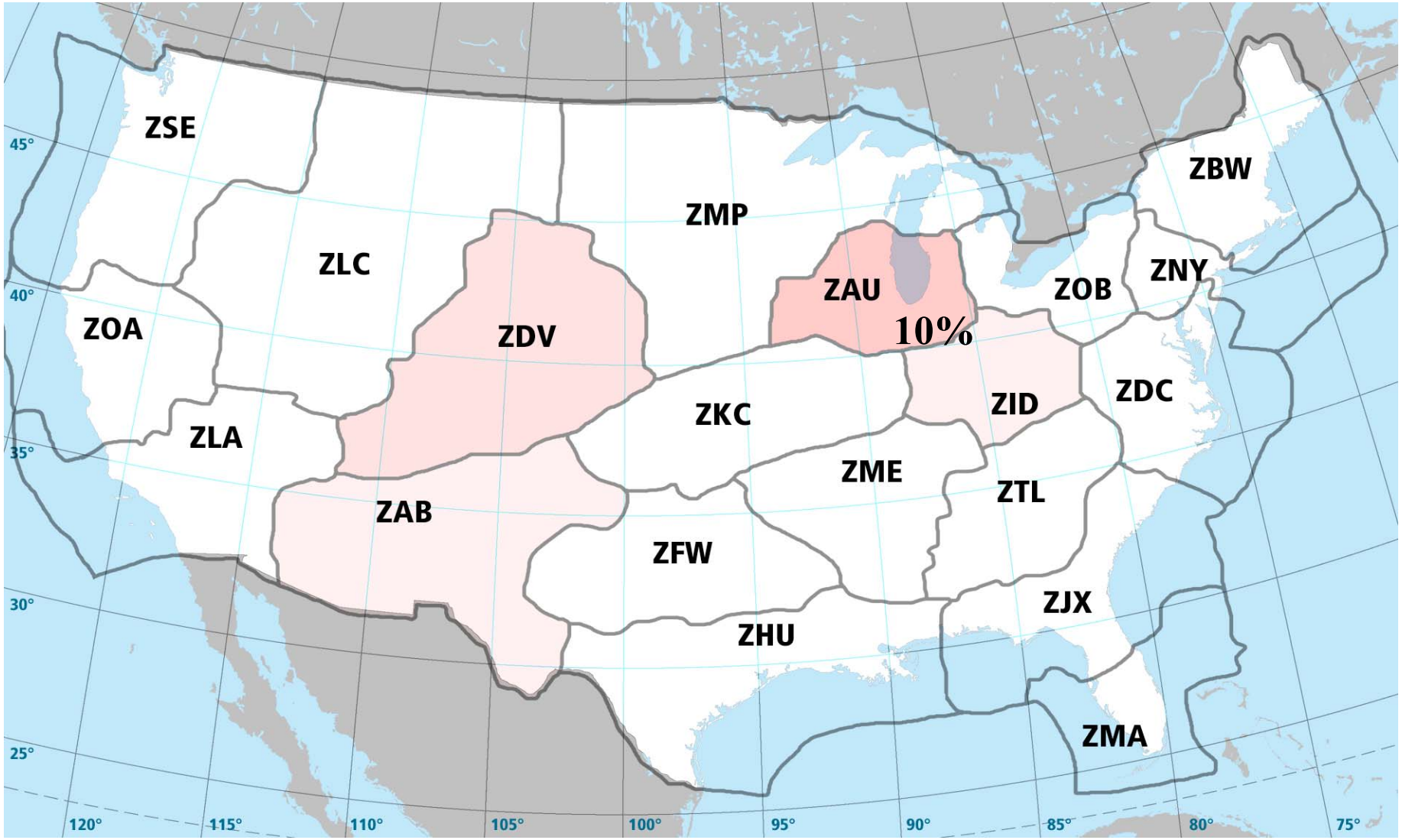

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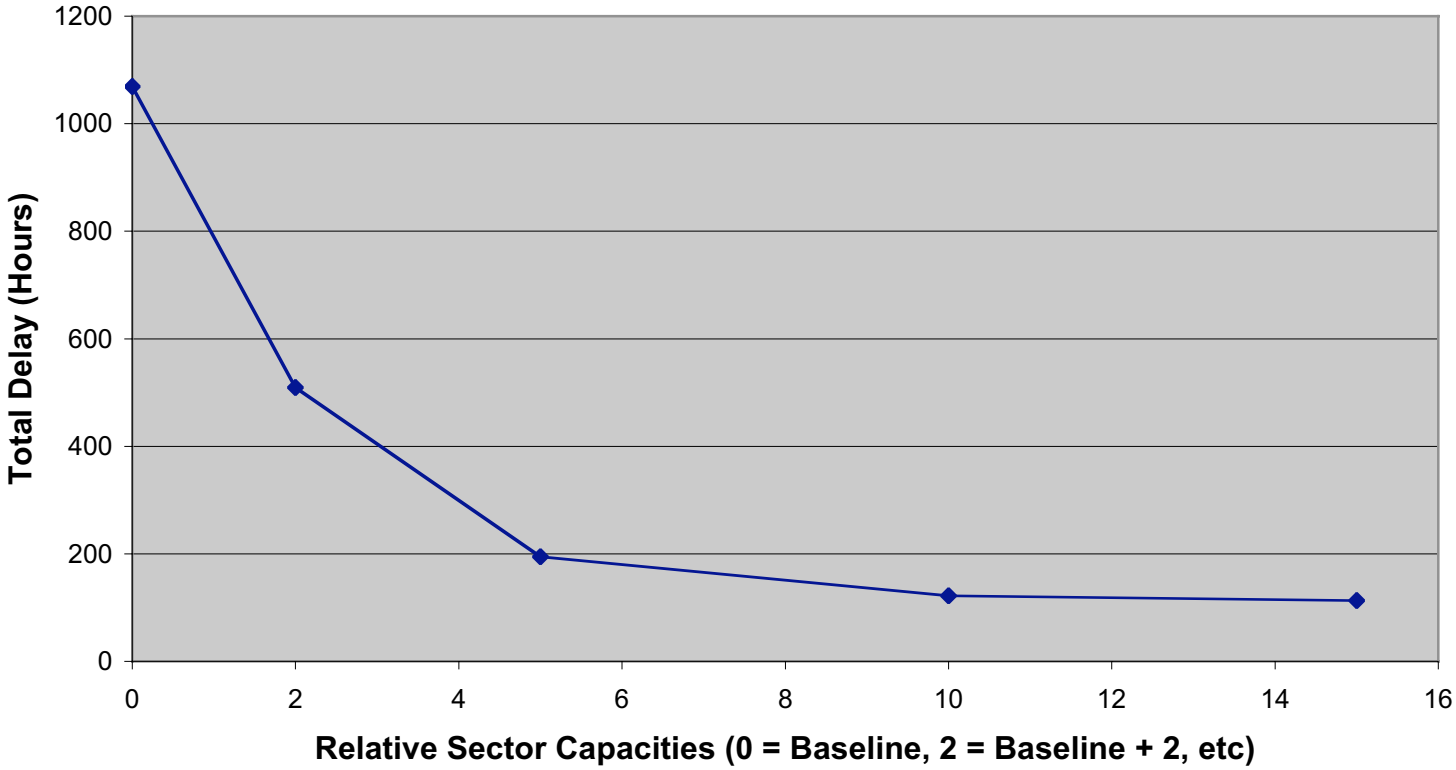
Total Delay vs Sector Capacity



Baseline Capacities: Min = 6, Max = 25, Avg = 16.9, 1 Sigma = 2.8
Enhanced Capacities: Min = 6, Max = 35, Avg = 18.5, 1 Sigma = 4.1

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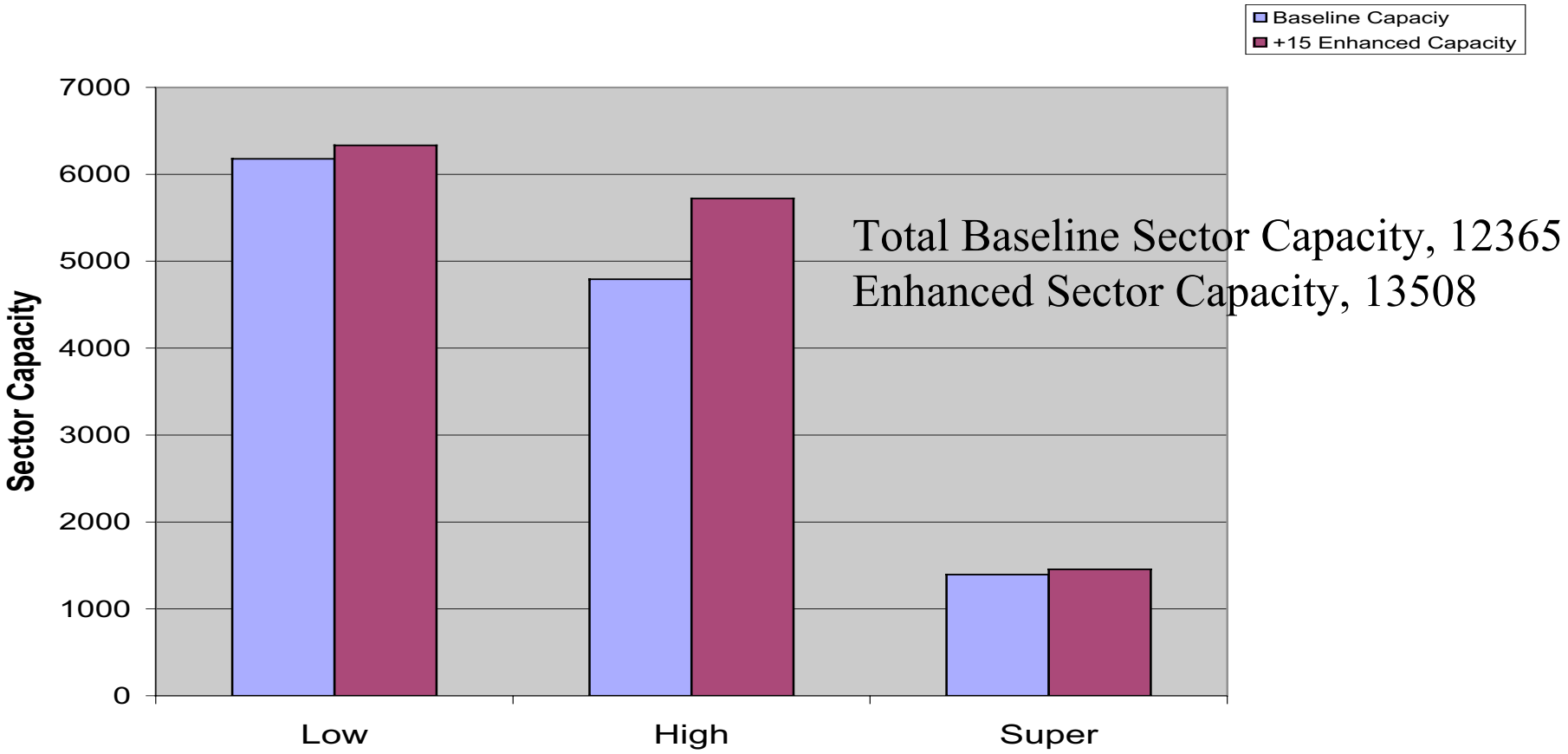
Total Baseline and Enhanced Sector Capacities



Total Baseline Sector Capacity, 12365
Enhanced Sector Capacity, 13508

Increasing NAS-wide Sector Capacity 9% Reduces Total Delay by 9x

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Arrival/Departure Assessment

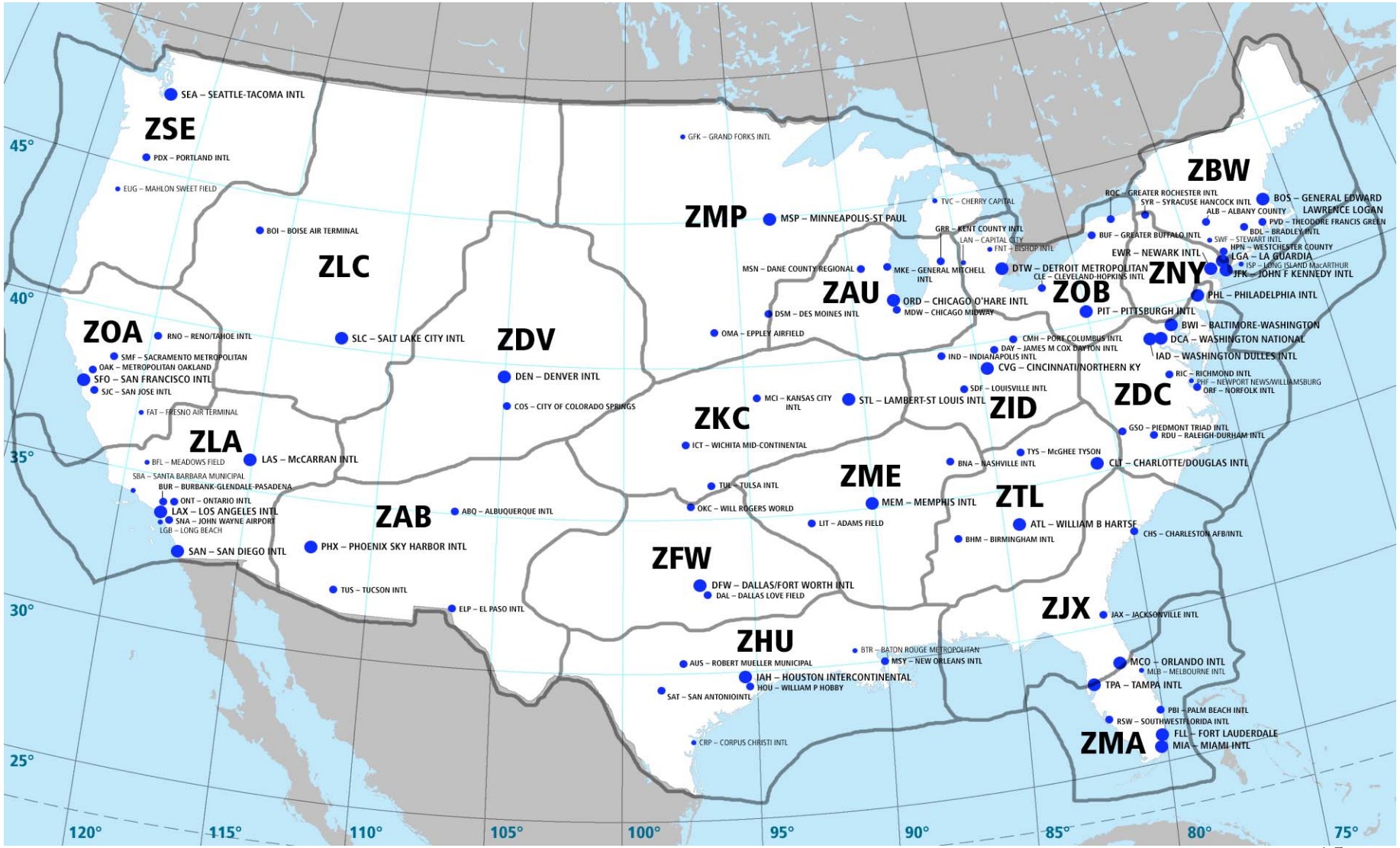
- Enhanced RTCA Arrival/Departure operations included
  - Optimize Traffic Flow thru DSSs
  - Closely Spaced Parallel Runways

- Evaluate impact of the enhanced operations by selectively modifying airport arrival/departure rates
  - Using enhanced Enroute sector capacities to minimize effect of enroute congestion problems

    1) Use baseline airport capacities. Run ACES and identify congested airports

    2) Vary capacity of congested airports until near-zero airport congestion alerts occur. Evaluate Total Flight Delay = sum (ActualGateArrival(n) - ScheduledGateArrival(n))

Future Demand Set 98 Airports



Case A, OEP Airport Capacities

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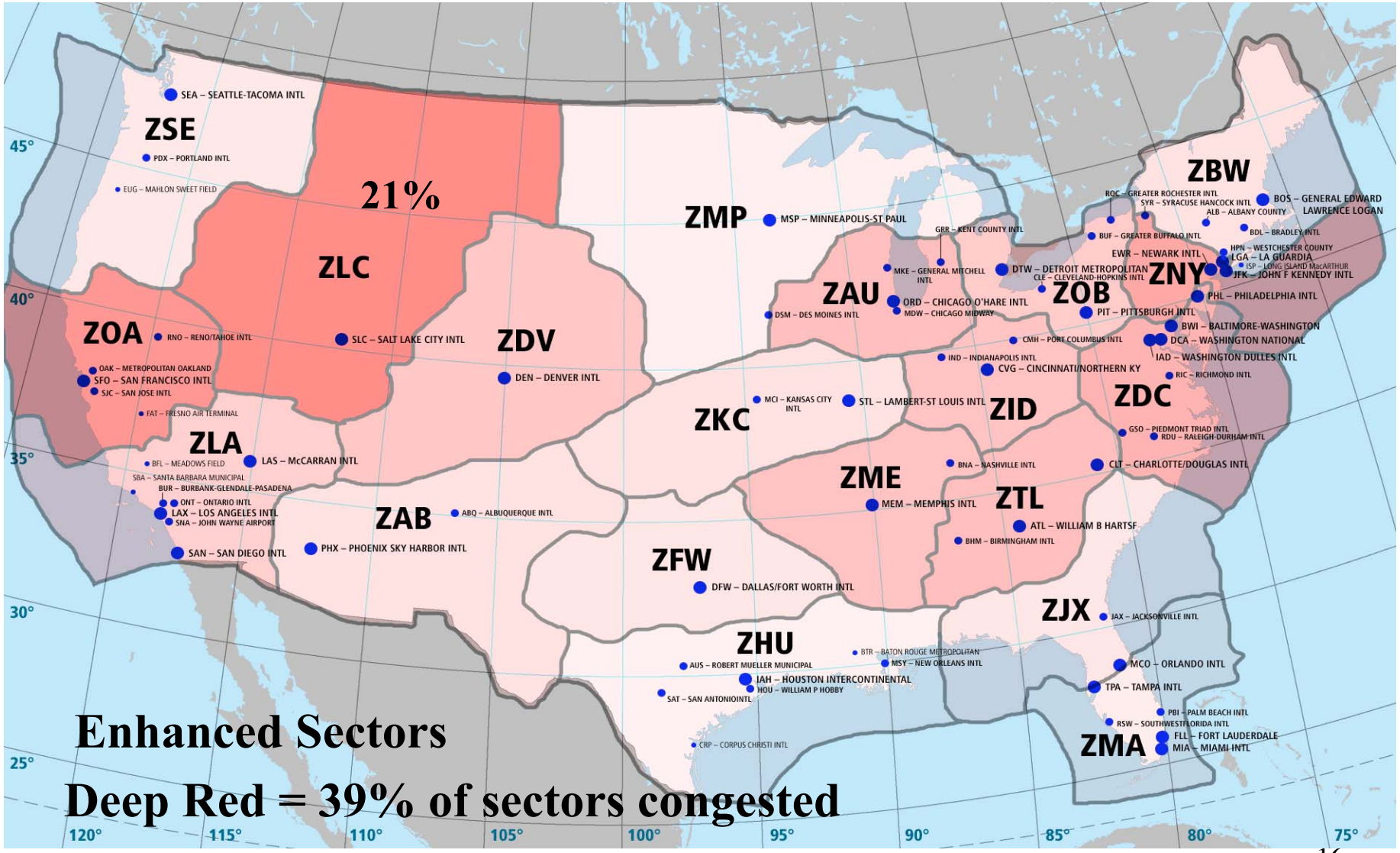

Case B, Case A Congested Aps + 10 (OEP + 10)

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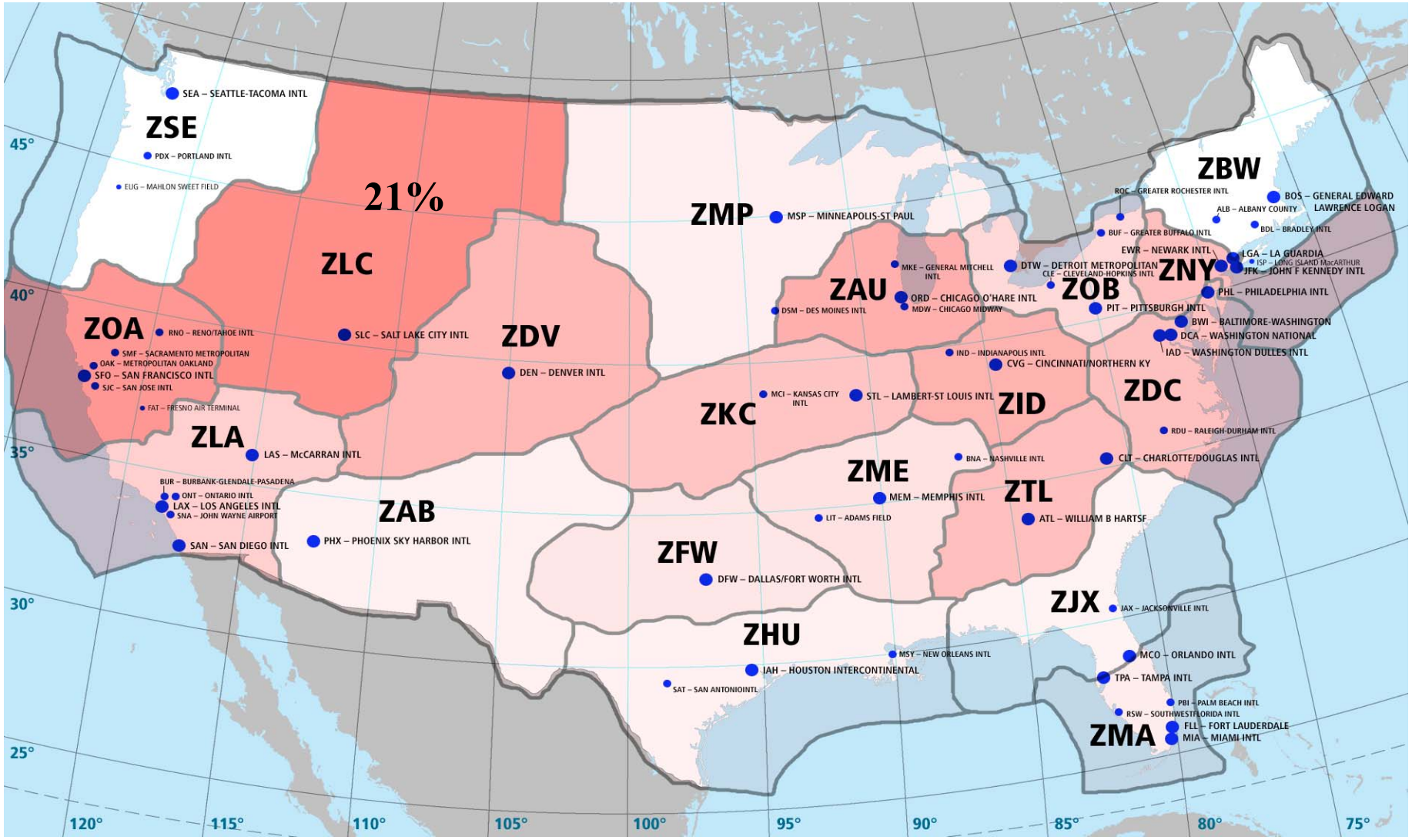

Case C. Case B Congested APs + 20 (OEP + 35)

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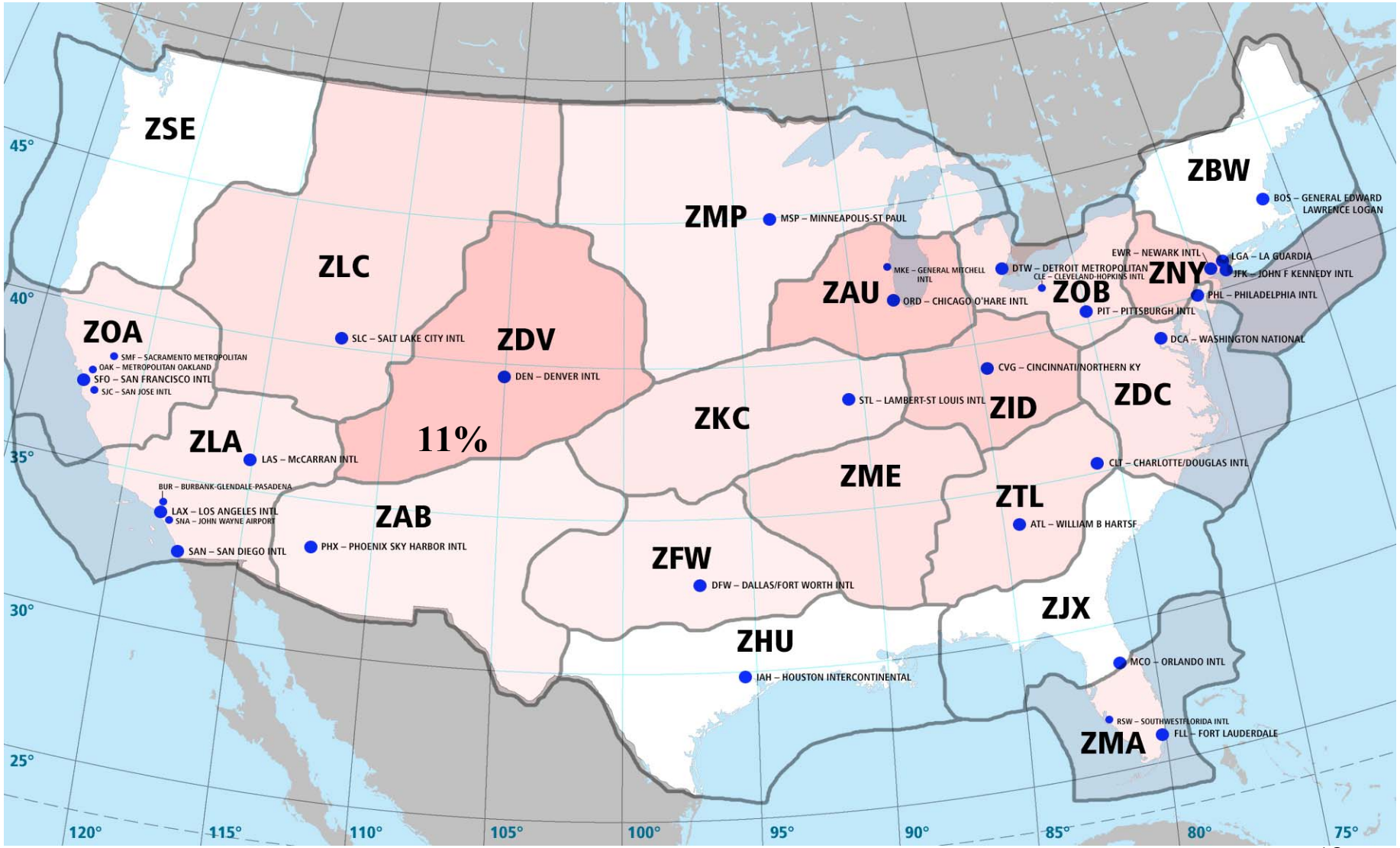

Case E. Case D Congested APs + 40 (OEP + 115)

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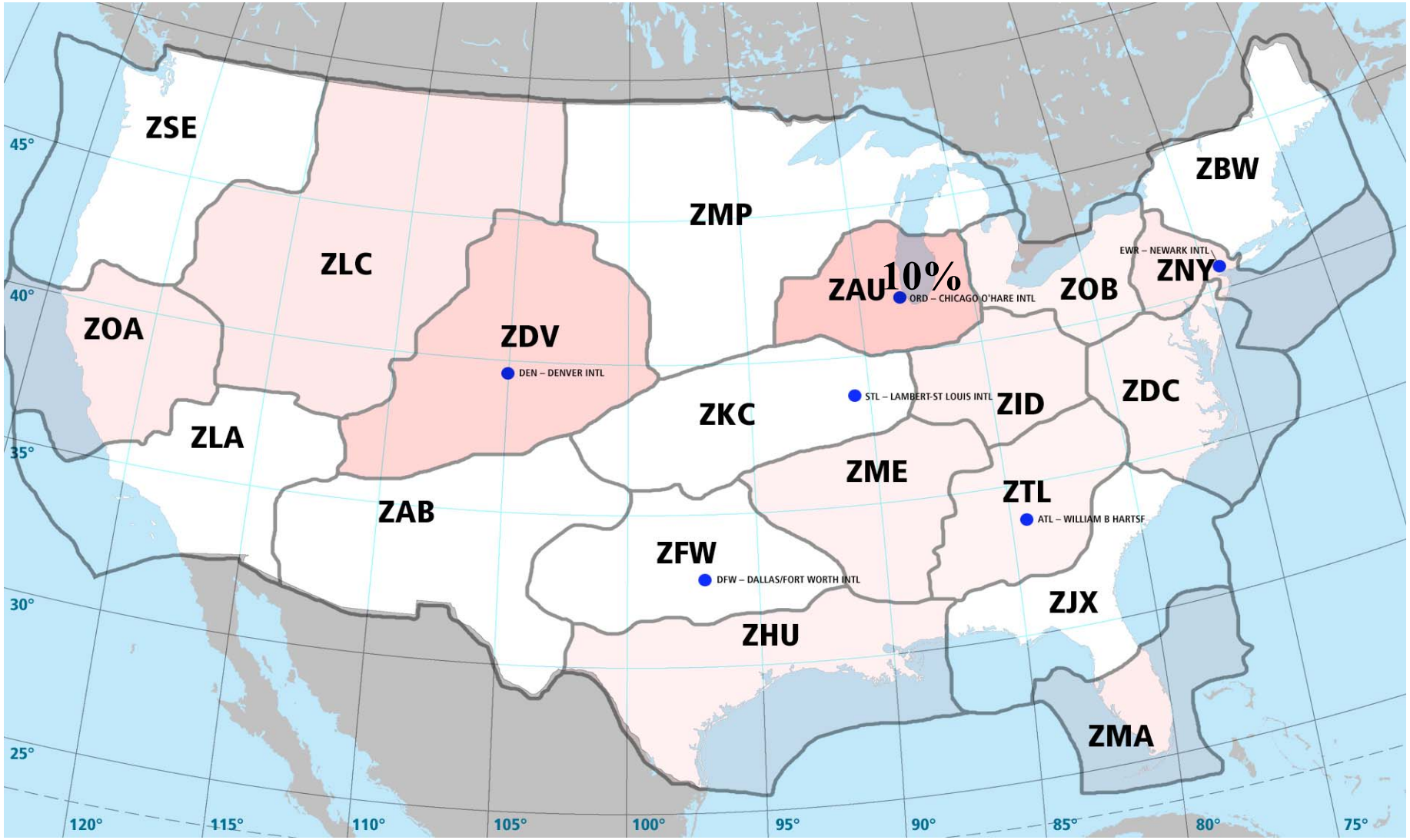

Total Delay
Vary Airport Capacity, Enhanced Sectors

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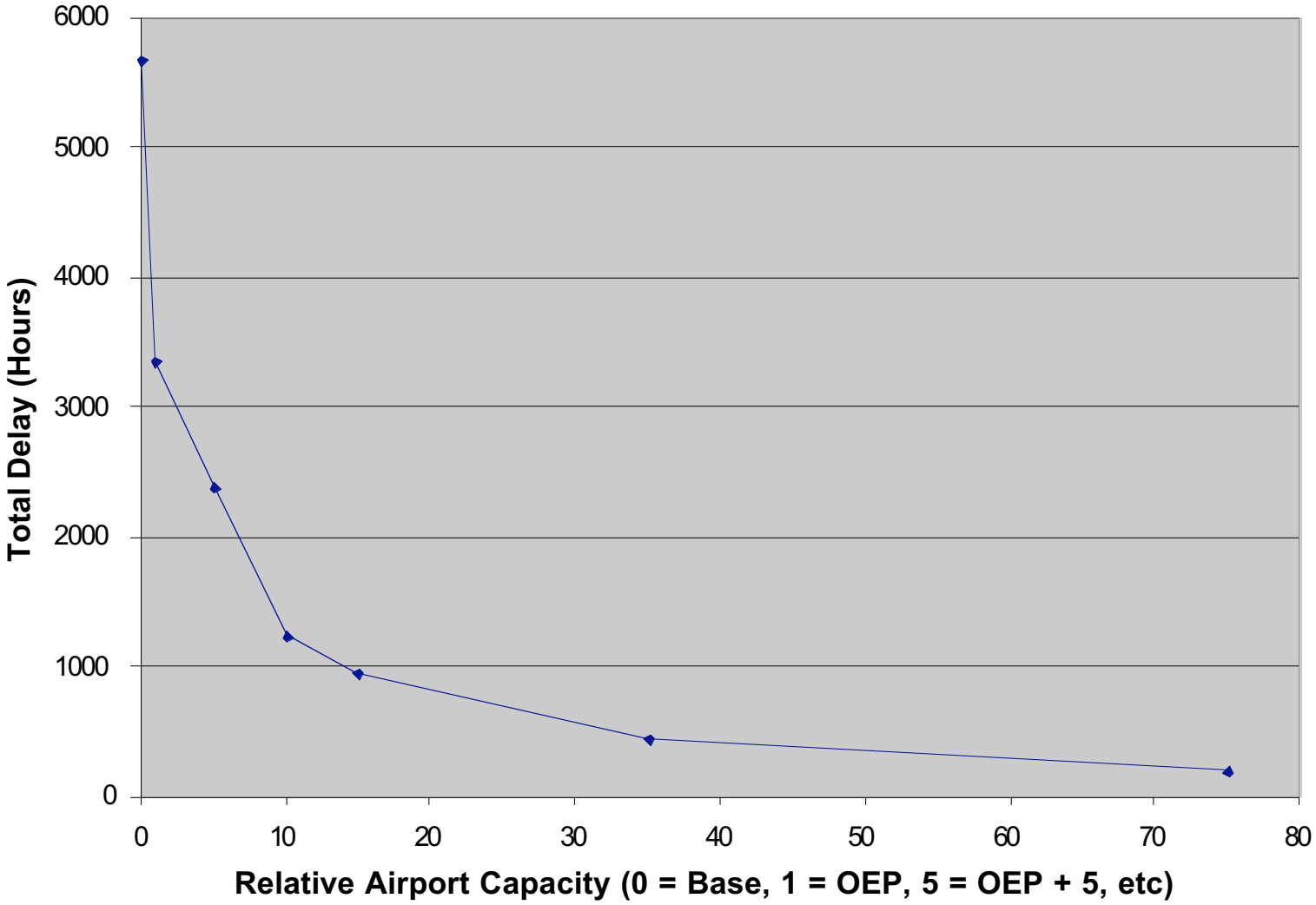

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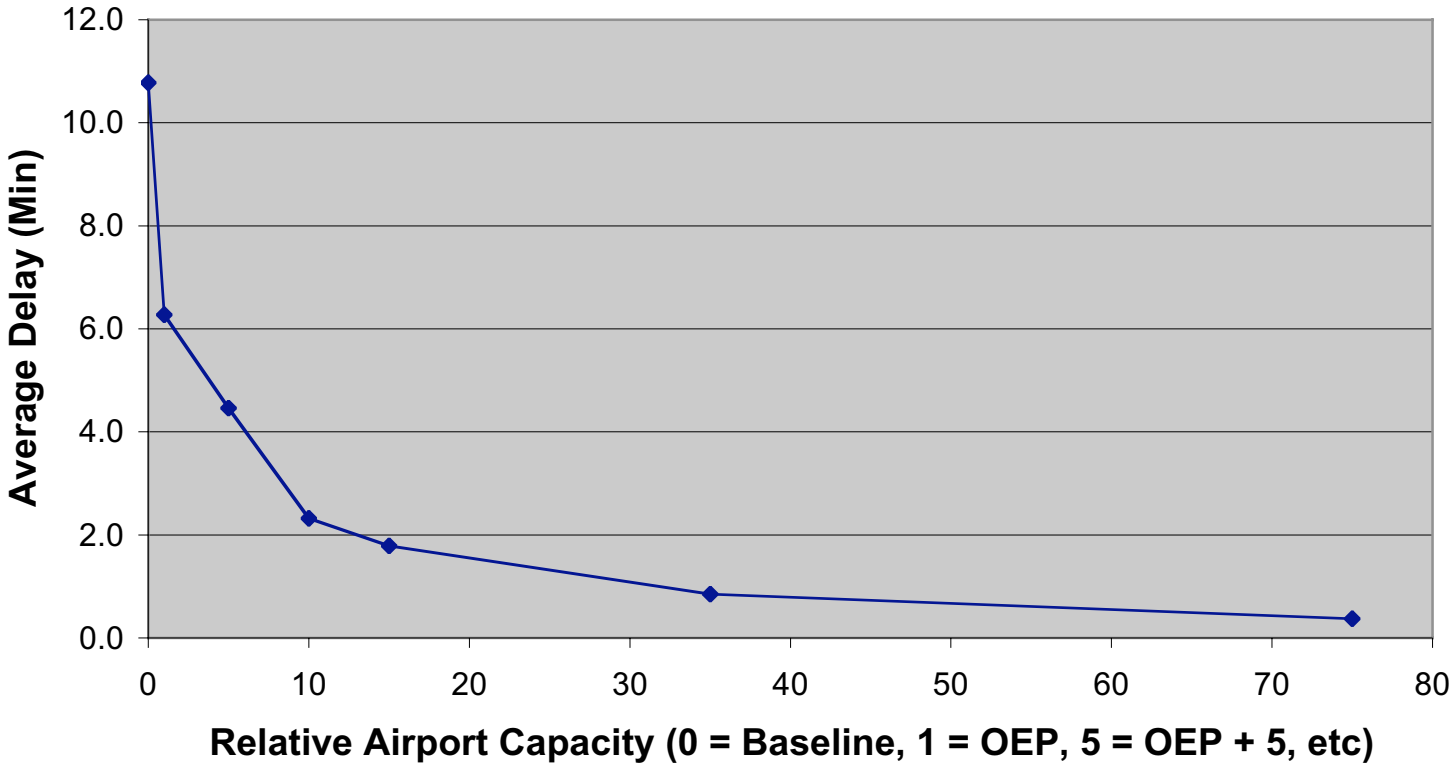
Average Delay



Maximum Delay
Vary Airport Capacity, Enhanced Sectors

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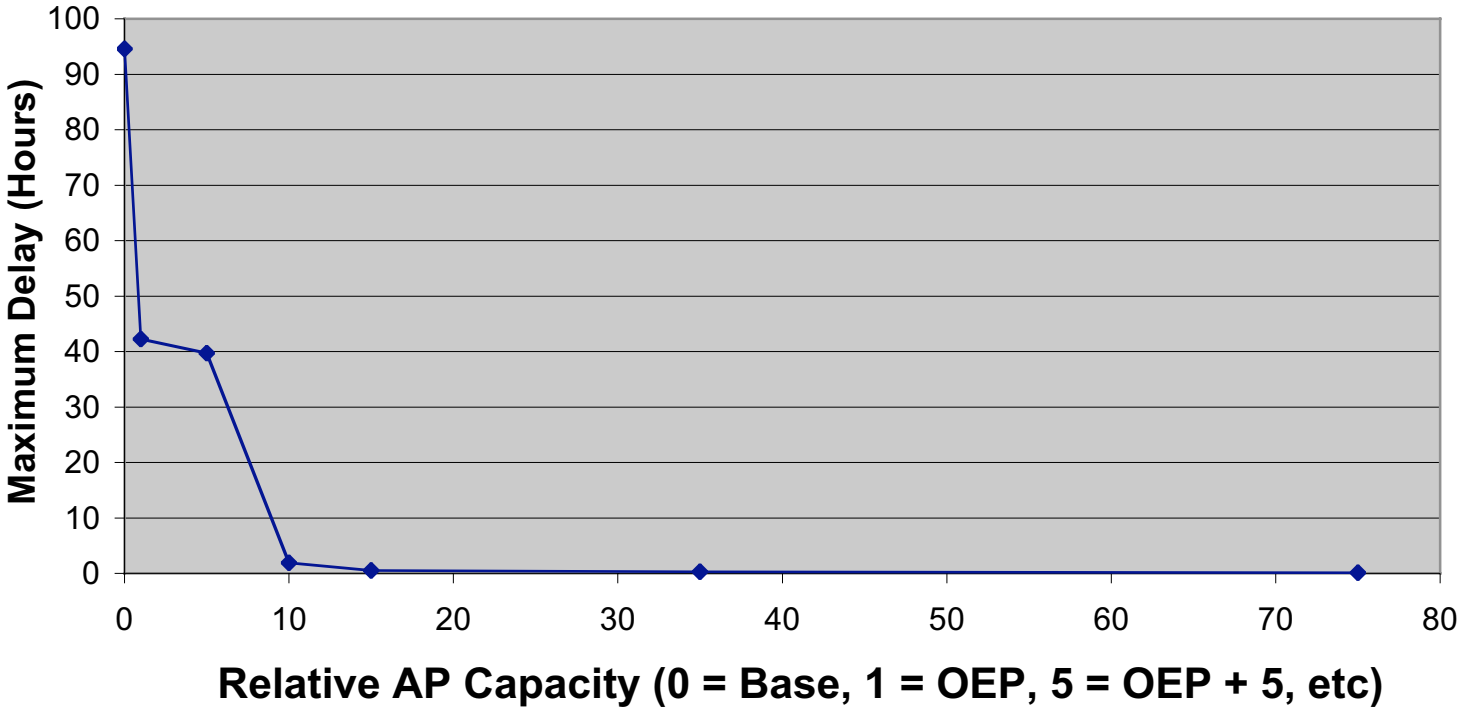

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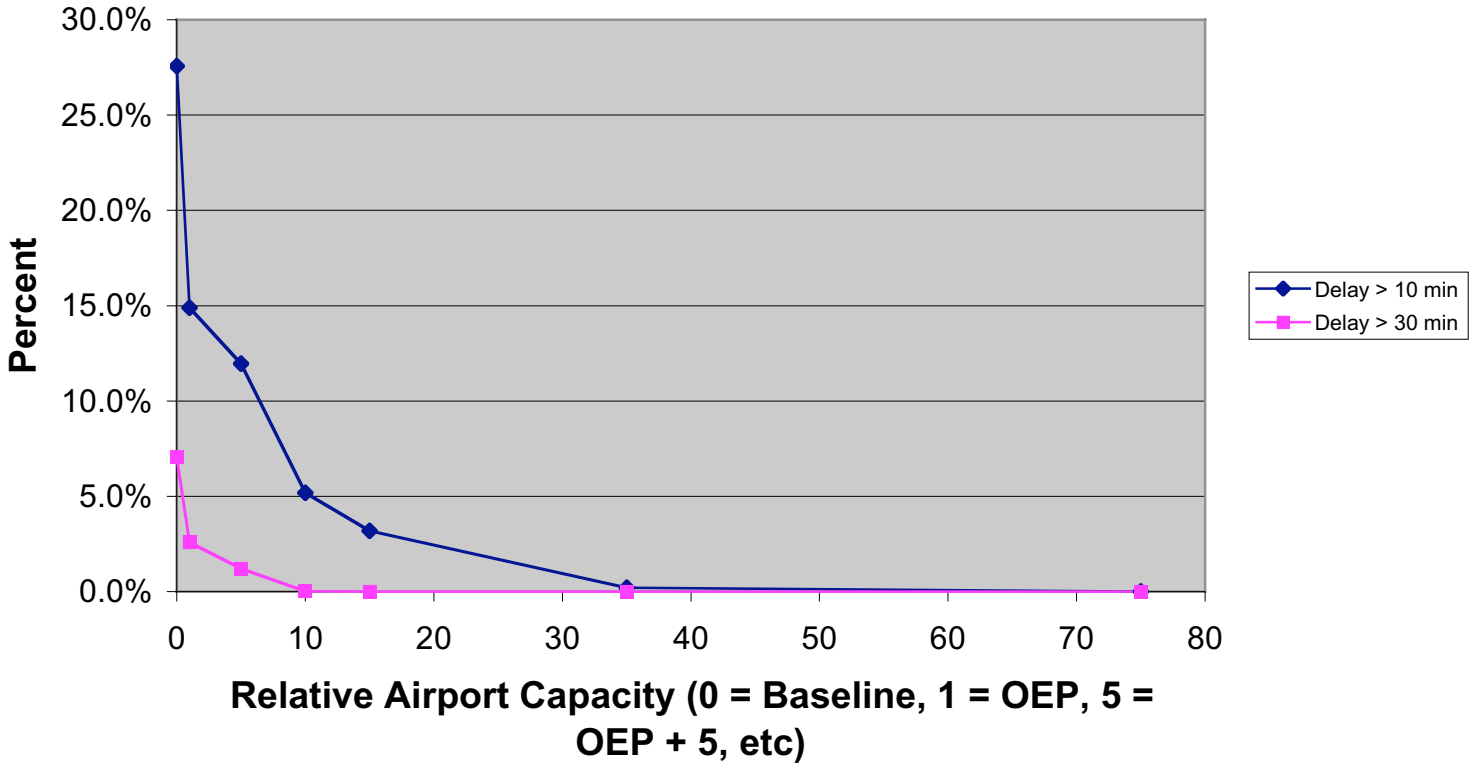
% Flights with Delay > 10 and 30 min



% Flights with Zero Delay and Delay > 1 min

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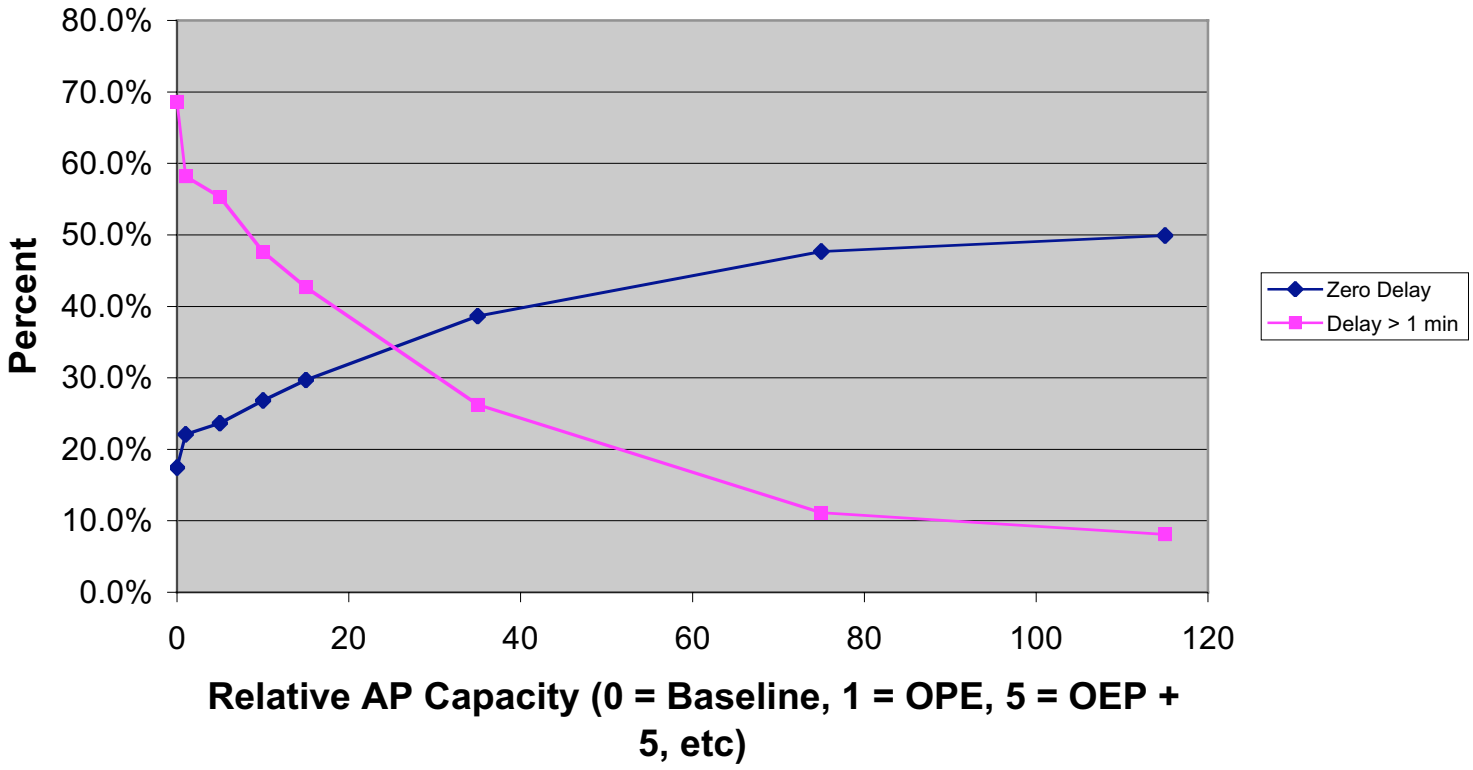

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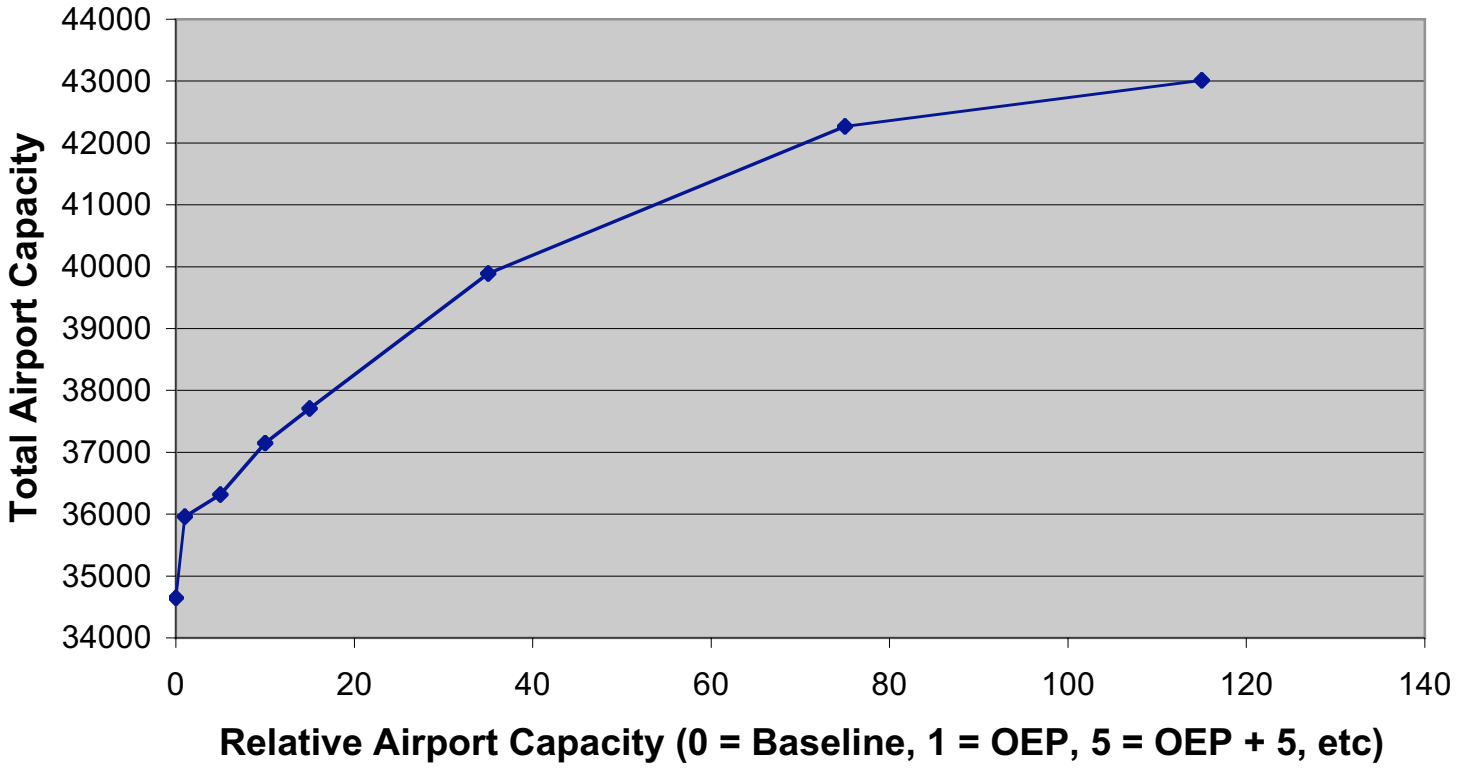
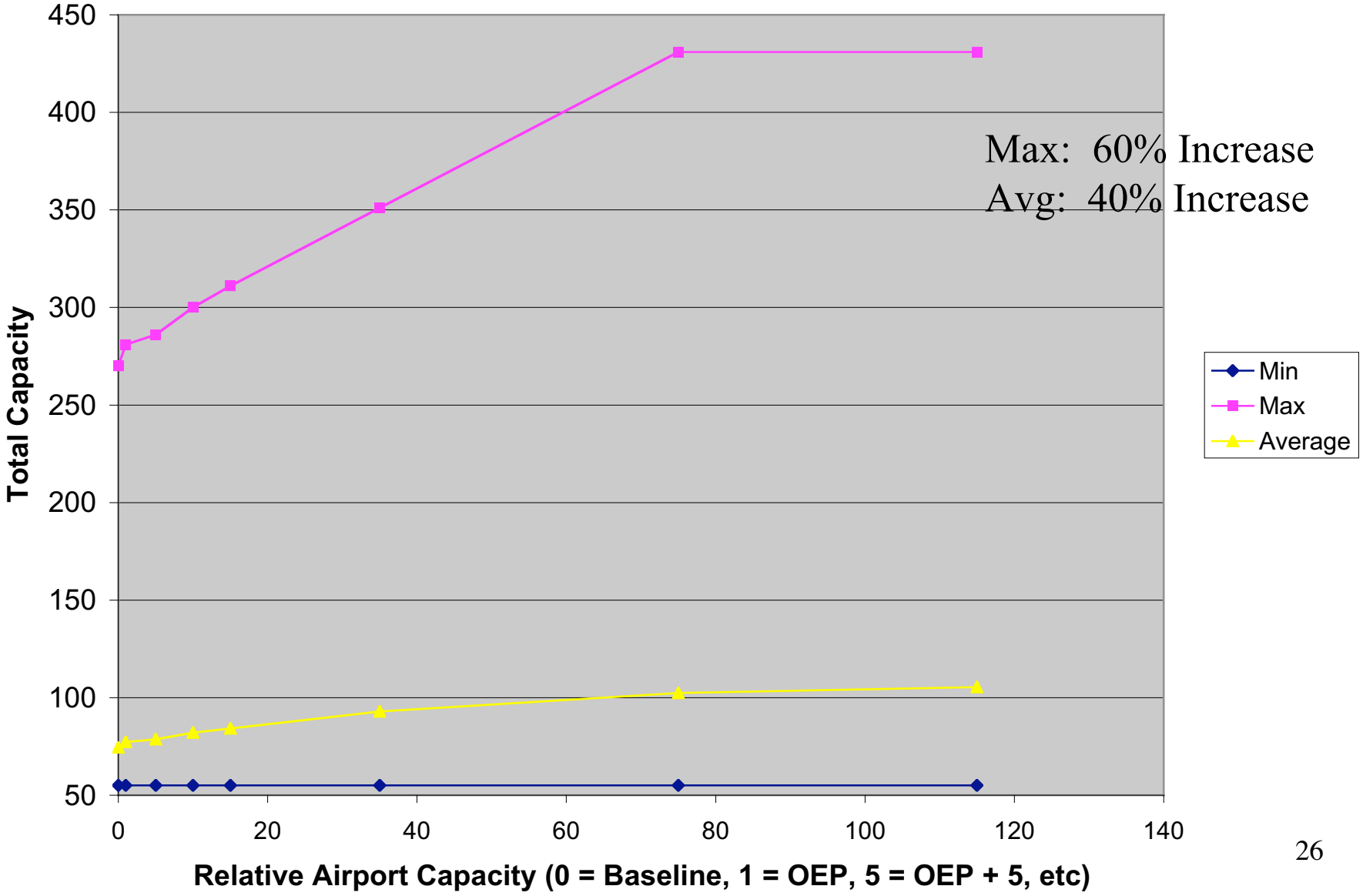
NAS-Wide Airport Total Capacity

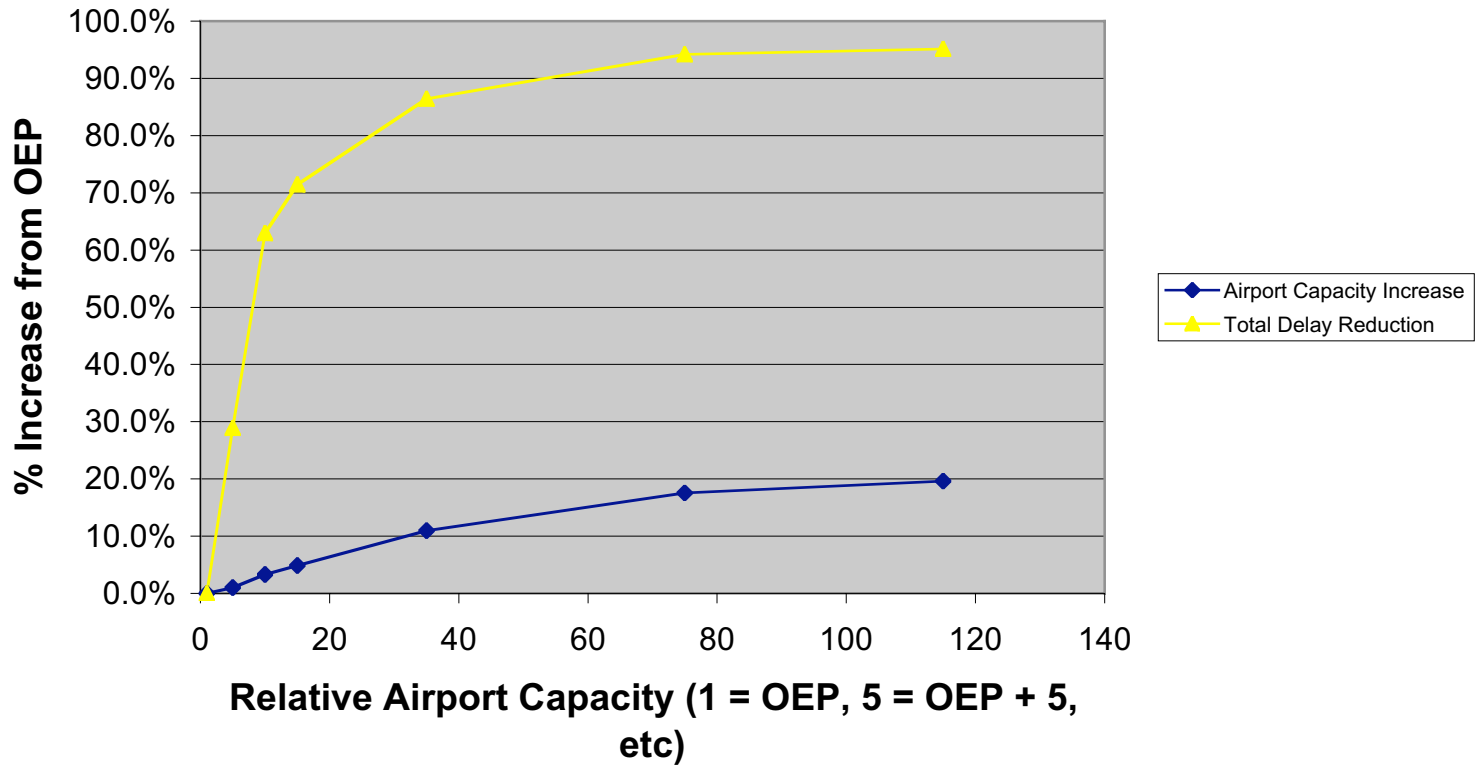


Total Capacity Growth



Airport Capacity and Delay

- OEP Increases Total Capacity by 1313 Operations/Hour (3.8%)
  - Reduces Total Delay by 2319 Hours (41%)
- RTCA Relative to OEP shown below



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Analysis Conclusions

- NAS Management/Enroute
  - Baseline Sector Total Capacity 12365
  - Increasing Sector Total Capacity by 1143 (9%) reduces Total Delay from 1069 to 113 hours

- Arrival/Departure
  - OEP Airport Capacity 39595 Operations/Hour
  - Increasing Airport Total Capacity by 3930 Ops/Hr (11%) reduces Total Delay by 86%
    - Flights > 30 min delay, 0%
    - Flights > 10 min delay, 0.2%

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Challenges

- Basing assessment on a single day, single future scenario is risky
  - Need flight data sets/schedules representing additional days/seasons of current future demand scenario (economic growth and airline recovery)
  - Additional future demand scenarios should also be considered
- Some limitations with ACES data collection have been recognized (i.e., ability to determine duration that a particular sector is congested)
  - Limitations have been documented and are being considered for a Future Build

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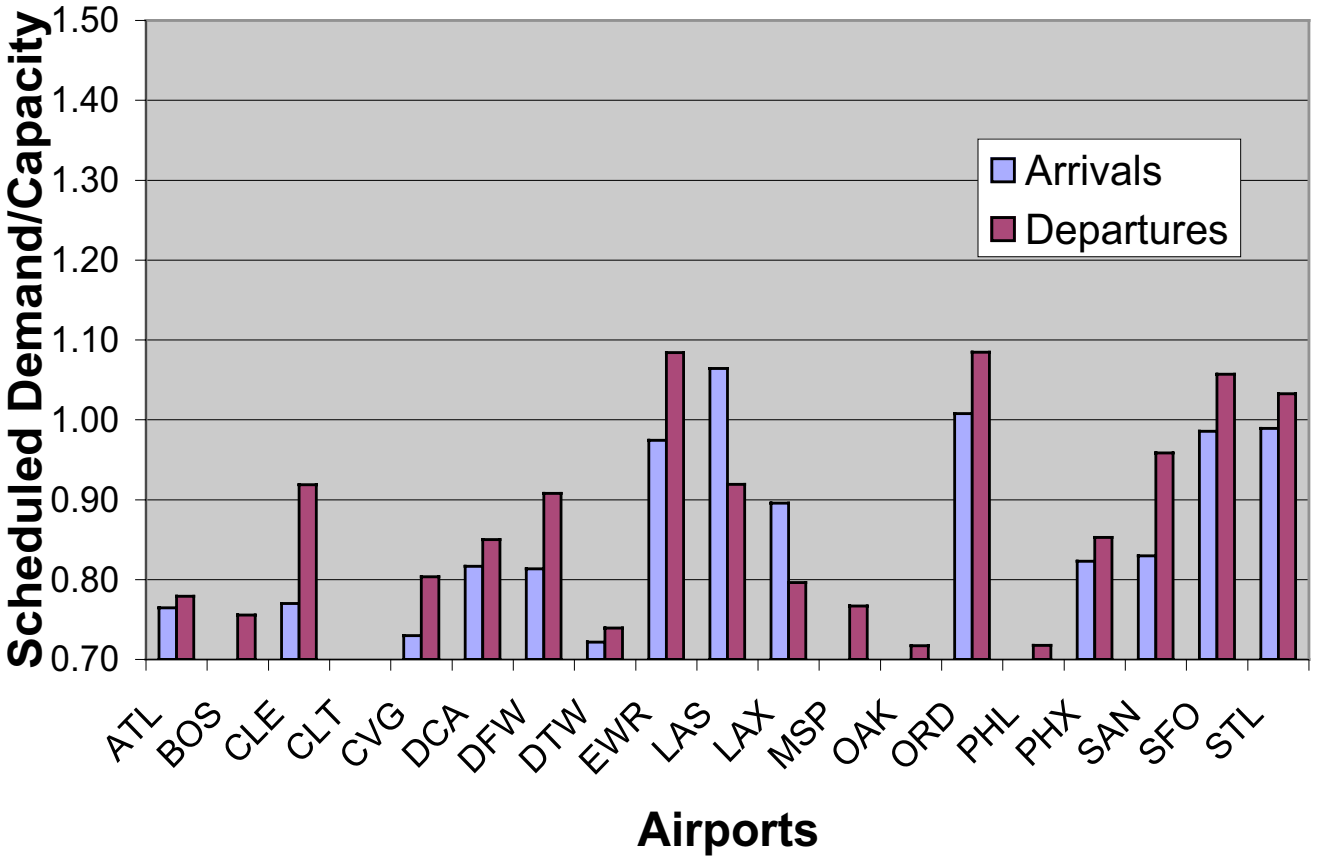
OEP + 15 Congested Airports



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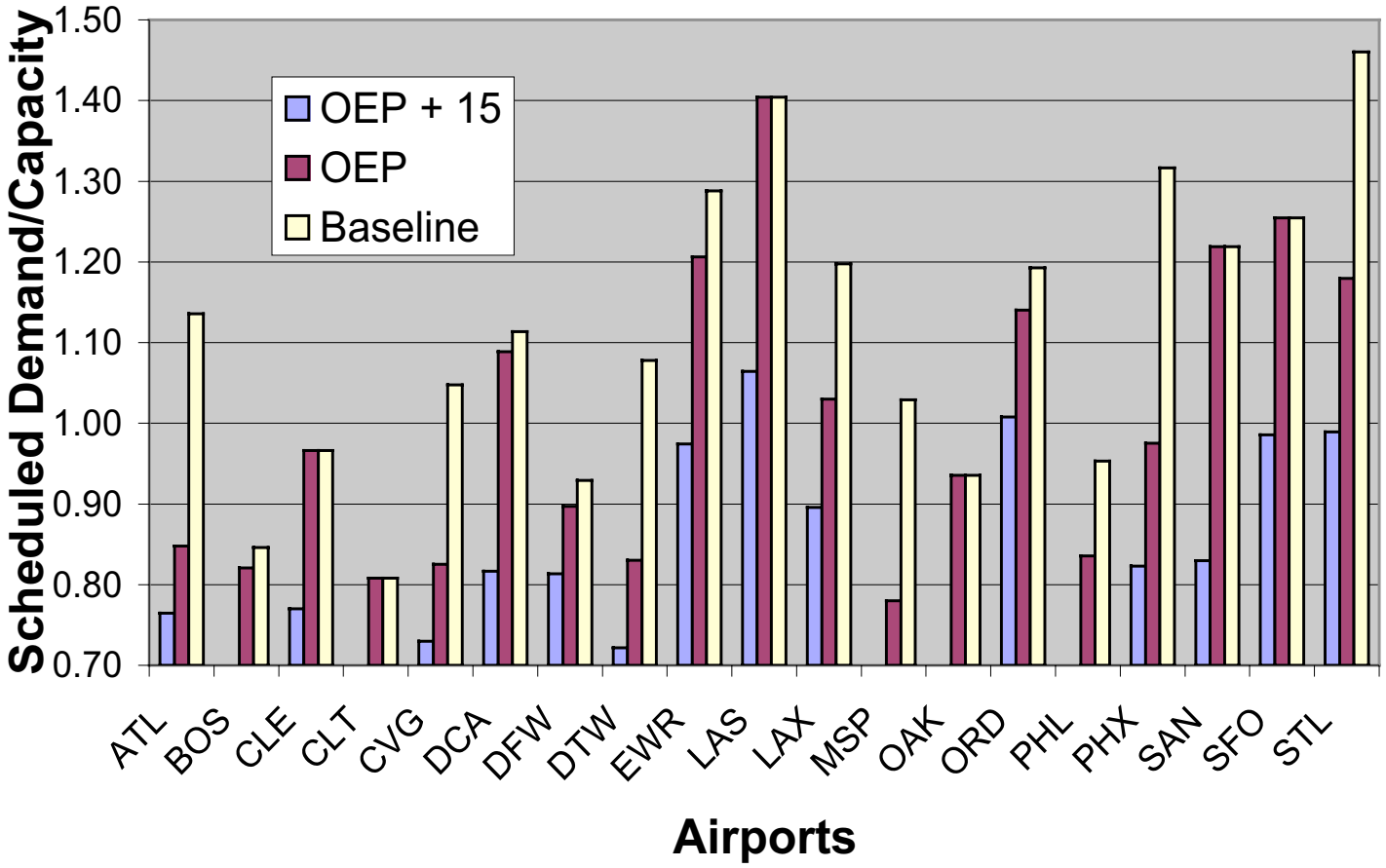
OEP + 15, OEP, and Baseline: Arrivals



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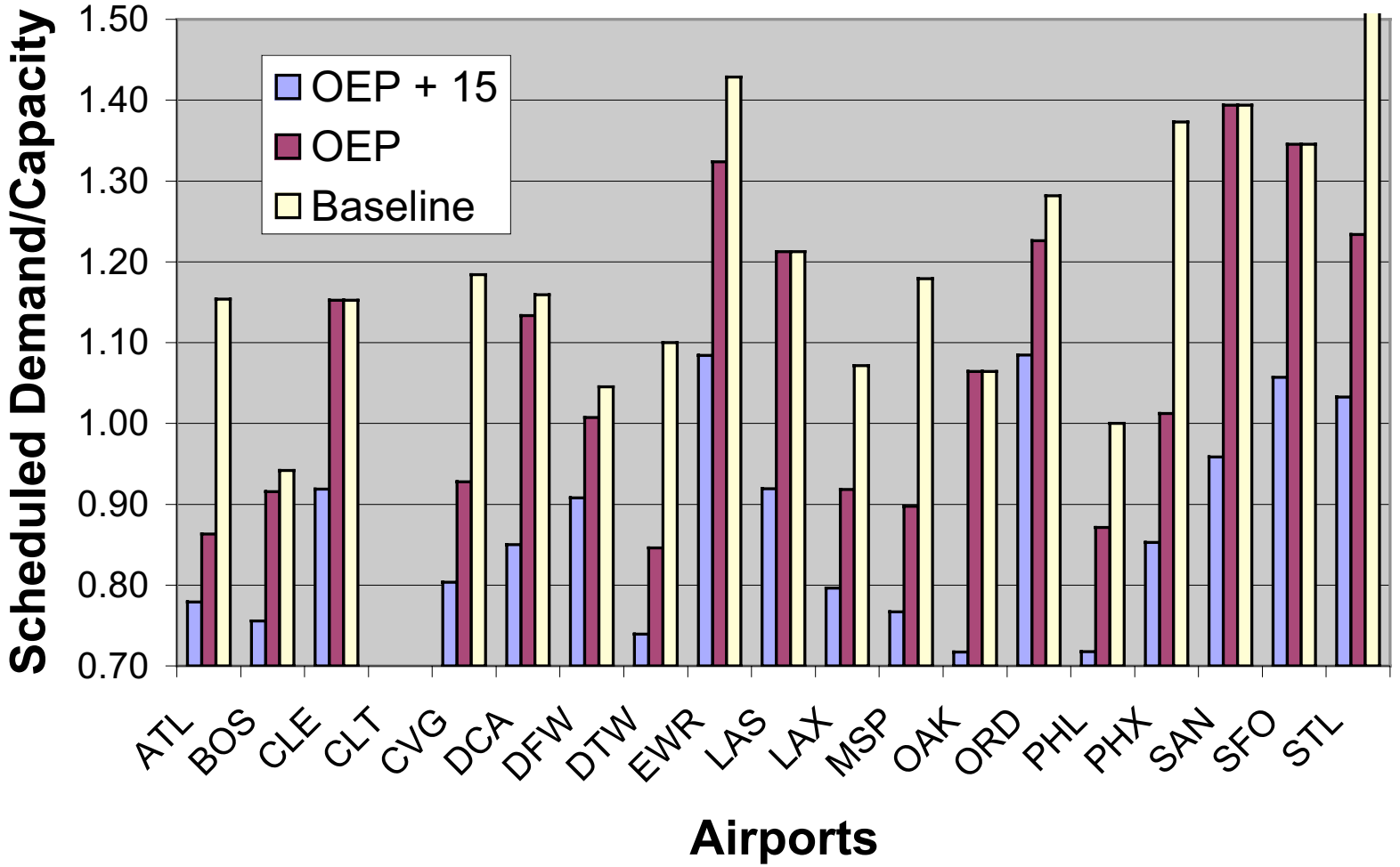
OEP + 15, OEP, and Baseline: Departures