Airspace Resource Allocation -Operations Impact

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Preliminary Thoughts

- **Have not seen the political argument to justify the costs/pain of transition**
  - What is the problem we are trying to solve
  - What are the functional requirements
  - Is this an issue which extends beyond LGA
- **Current system is regulated by delay**
  - Schedule integrity, passenger tolerance
- **Current system is complex, evolved and impedance matched**
  - Gates
  - Runways
  - Taxiways
  - Landside
  - Security
  - Arrival fixes
  - Departure fixes
- **Safety Concerns will drive Arguments to Resist**

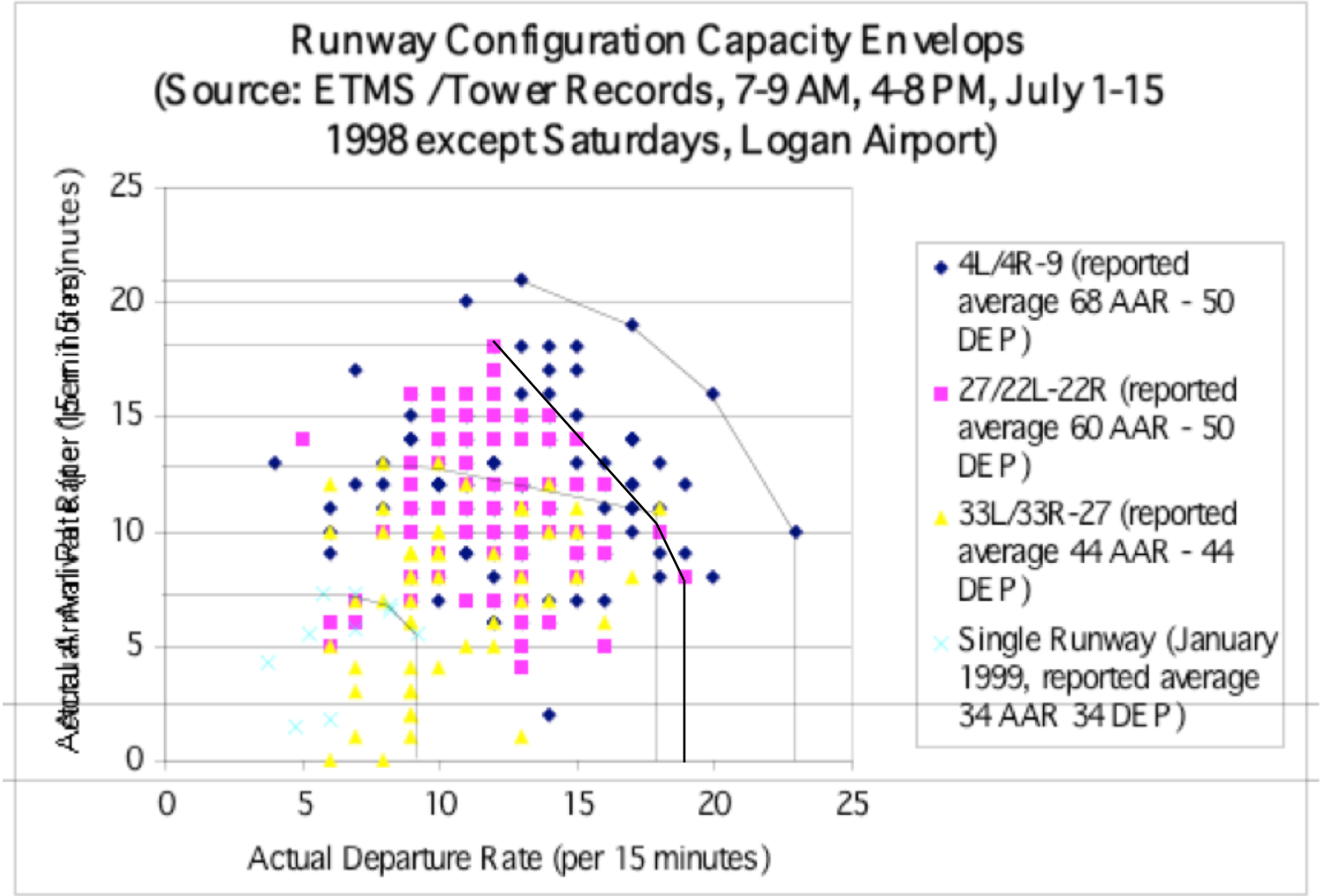
What are the property rights that make sense in the operating environment?

- **Landing Slots (Perishable)**
  - ❑ Time Based
    - ◆ Time scale (1min, 15 min, 1hr, 3hr, day)
  - ❑ Sequence Based
- **Priority**
- **What are the rights and responsibilities of property ownership**
  - ❑ Users
    - ◆ Precision
      - ➪ When do you loose the resource
      - ➪ Provider (Safety) induced delays (who is responsible)
  - ❑ Providers
    - ◆ Guarantees
    - ◆ Substitution
    - ◆ Failure propagation

How do you set the resource limit?

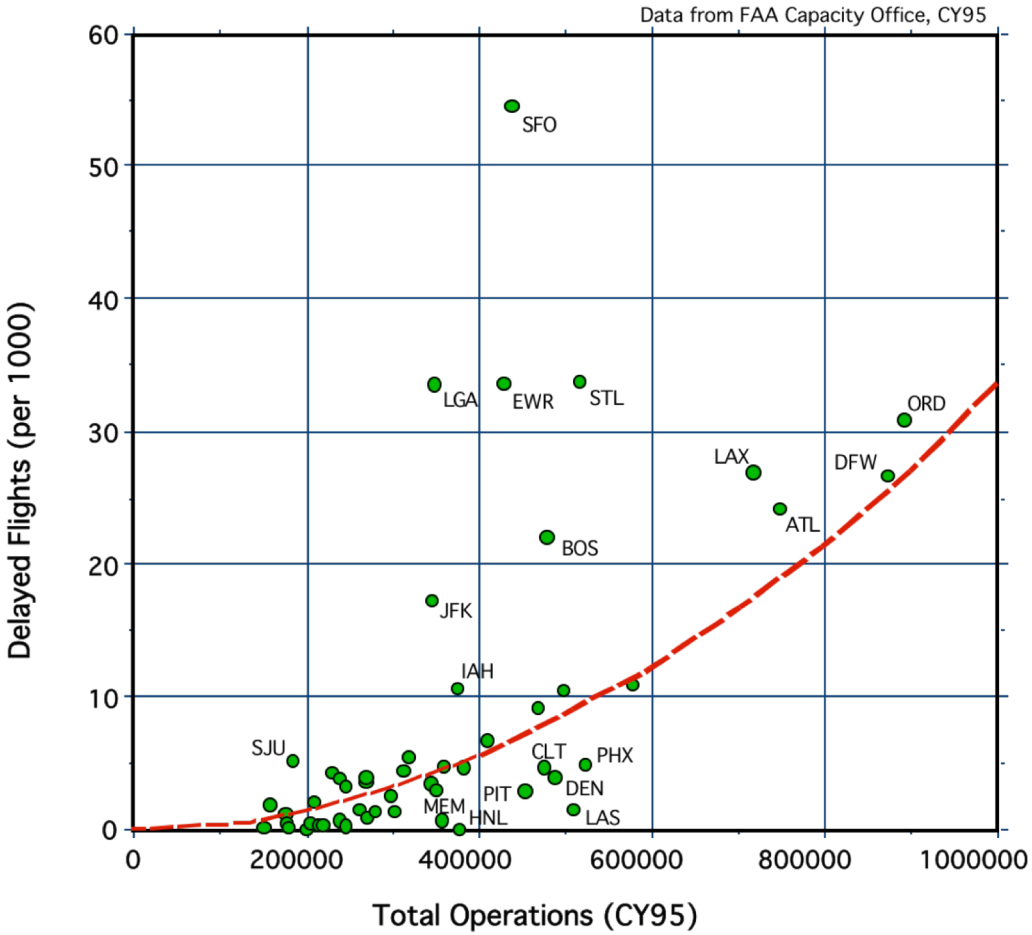
- **VFR Capacity ?**
- **IFR Capacity ?**
- **With Margin ?**
- **Peak Capacity**
  - ❑ Airport “flush” modes

Runway Configuration Capacity Envelops



Variable Capacity Effects

1995 Delays vs Operations

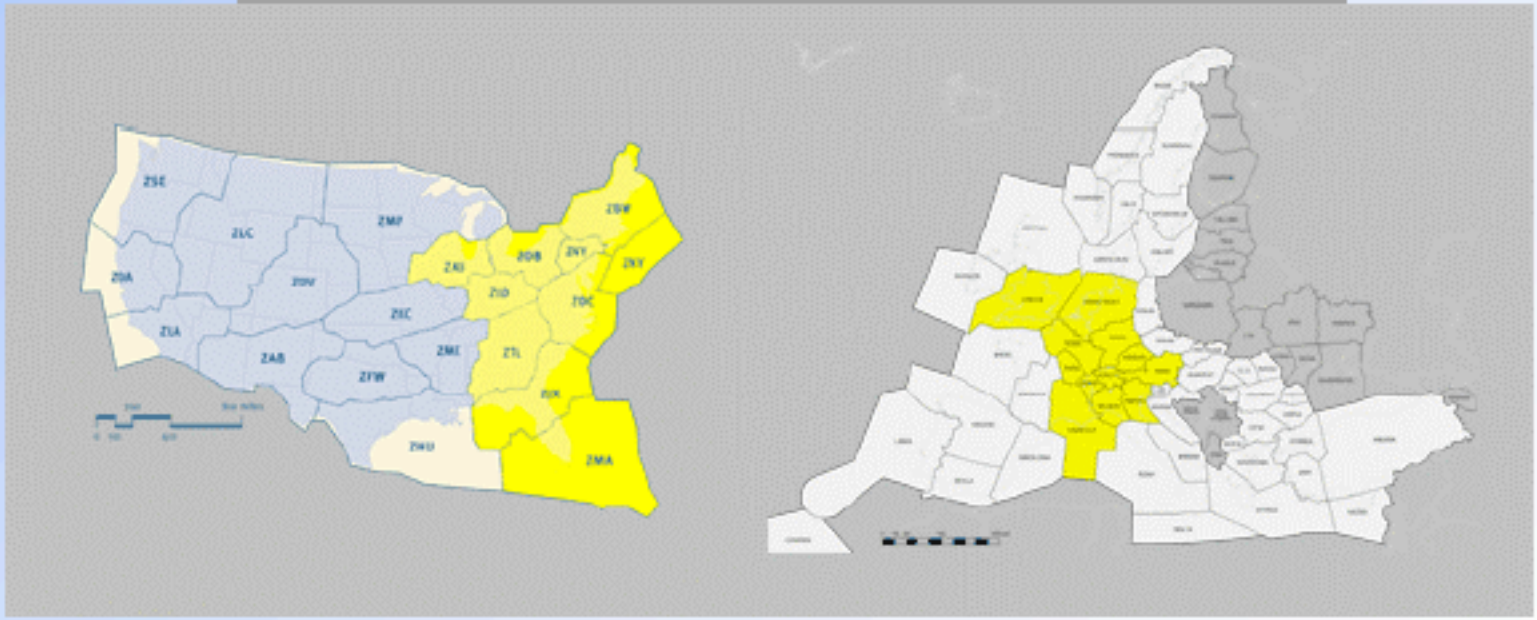


From John Andrews, MIT Lincoln Lab

ATM Performance

EUROCONTROL

US and European ARTCCs



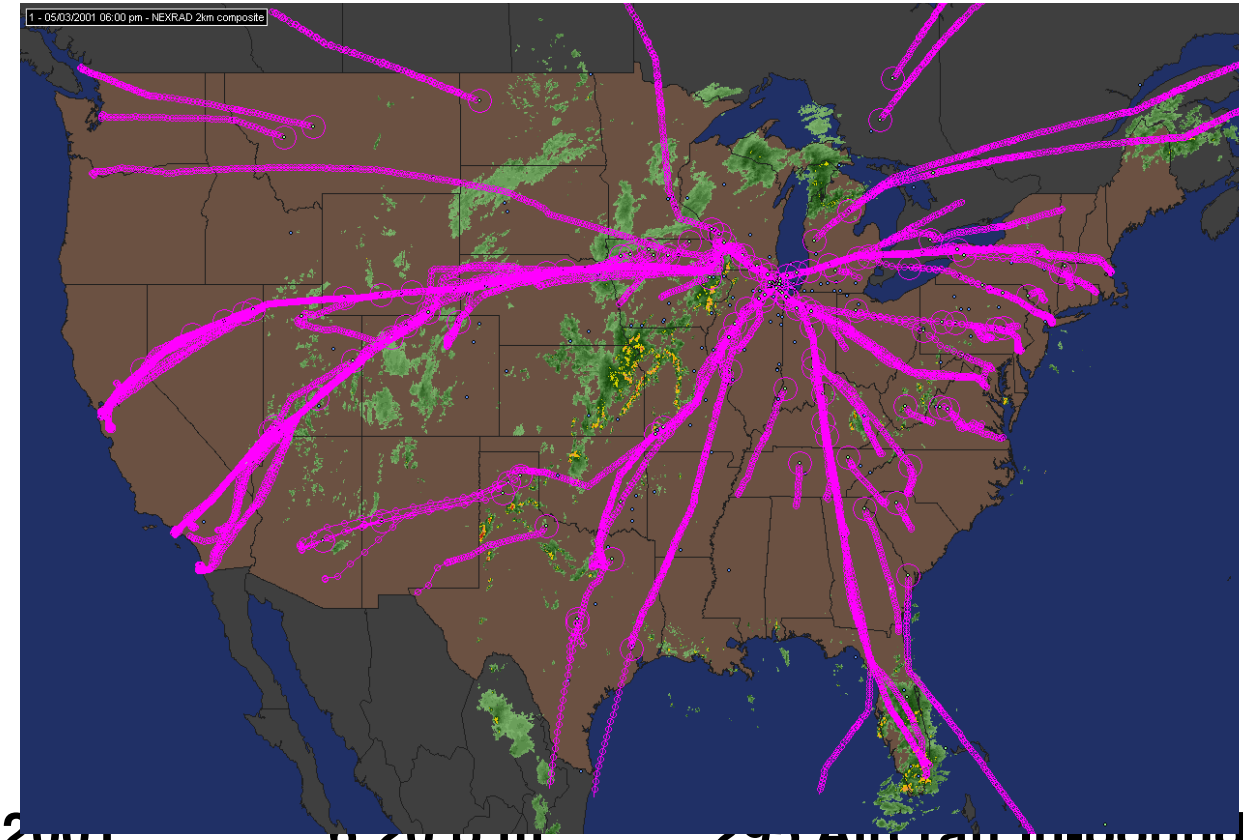
9.8 M km²	10.5 M km²
15.9 M flights	7.9 M flights
12700 M km	6300 M km

From: Xavier Fron, Eurocontrol

Robustness Issues

- **Robustness Issues**
  - ❑ Flexibility to normal interruptions
    - ◆ Convective Weather
    - ◆ Go around
    - ◆ Mechanicals
    - ◆ Deicing
    - ◆ Lack of Data
    - ◆ Special Runway Requirements
- **Non-Normal Ops**
- **How do you handle high priority non planned demand?**
  - ❑ Air Force 1
  - ❑ “Lifeguard”
- **How do you handle unplanned resource loss?**
  - ❑ Disabled Aircraft
  - ❑ Blown Tire
  - ❑ Snow Plow

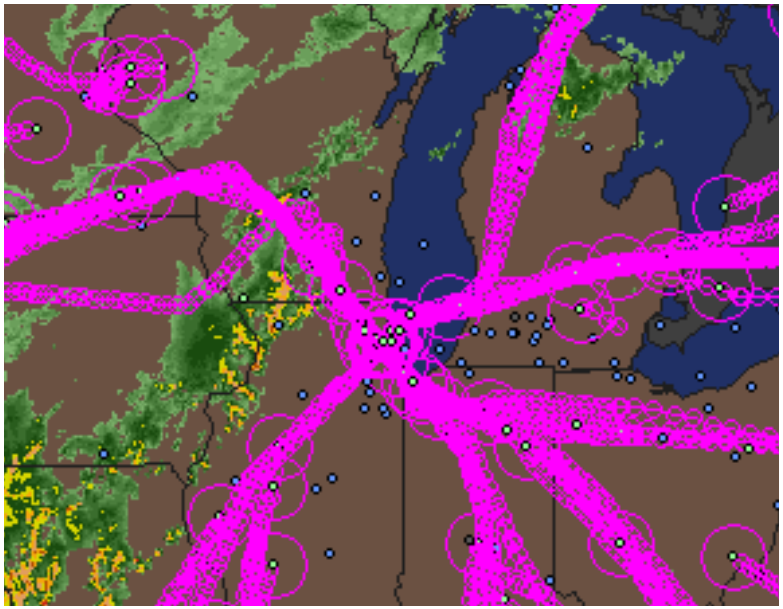
Convective Weather Impact

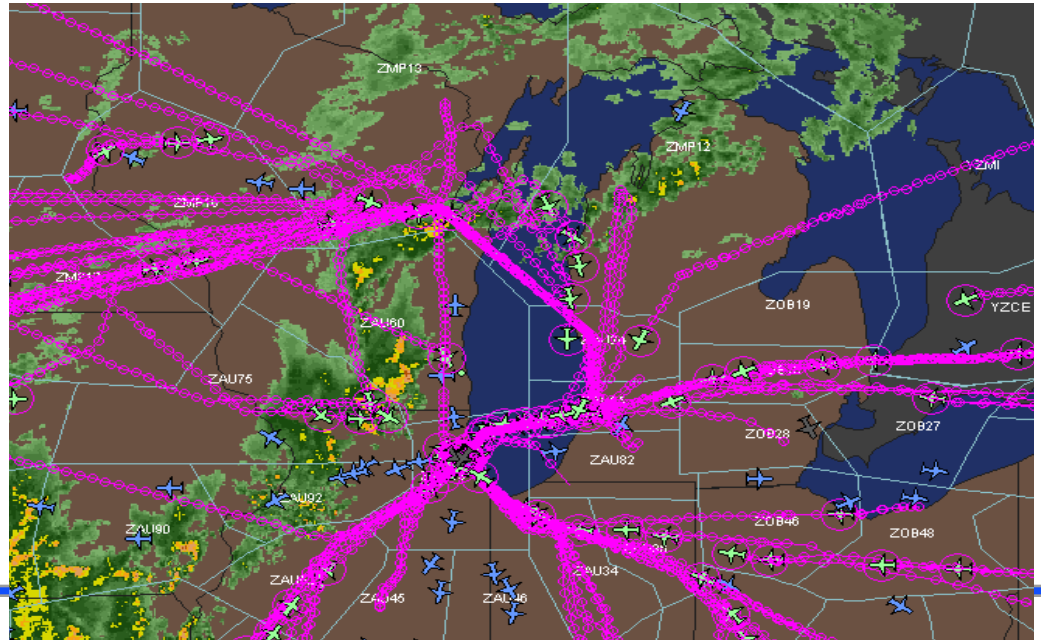


- May 3, 2001 6:20 p.m. 295 Aircraft in-bound

Terminal Area Weather Impact

- **Weather disrupting NW corner fix into Chicago perturbs standard flow abstraction.**





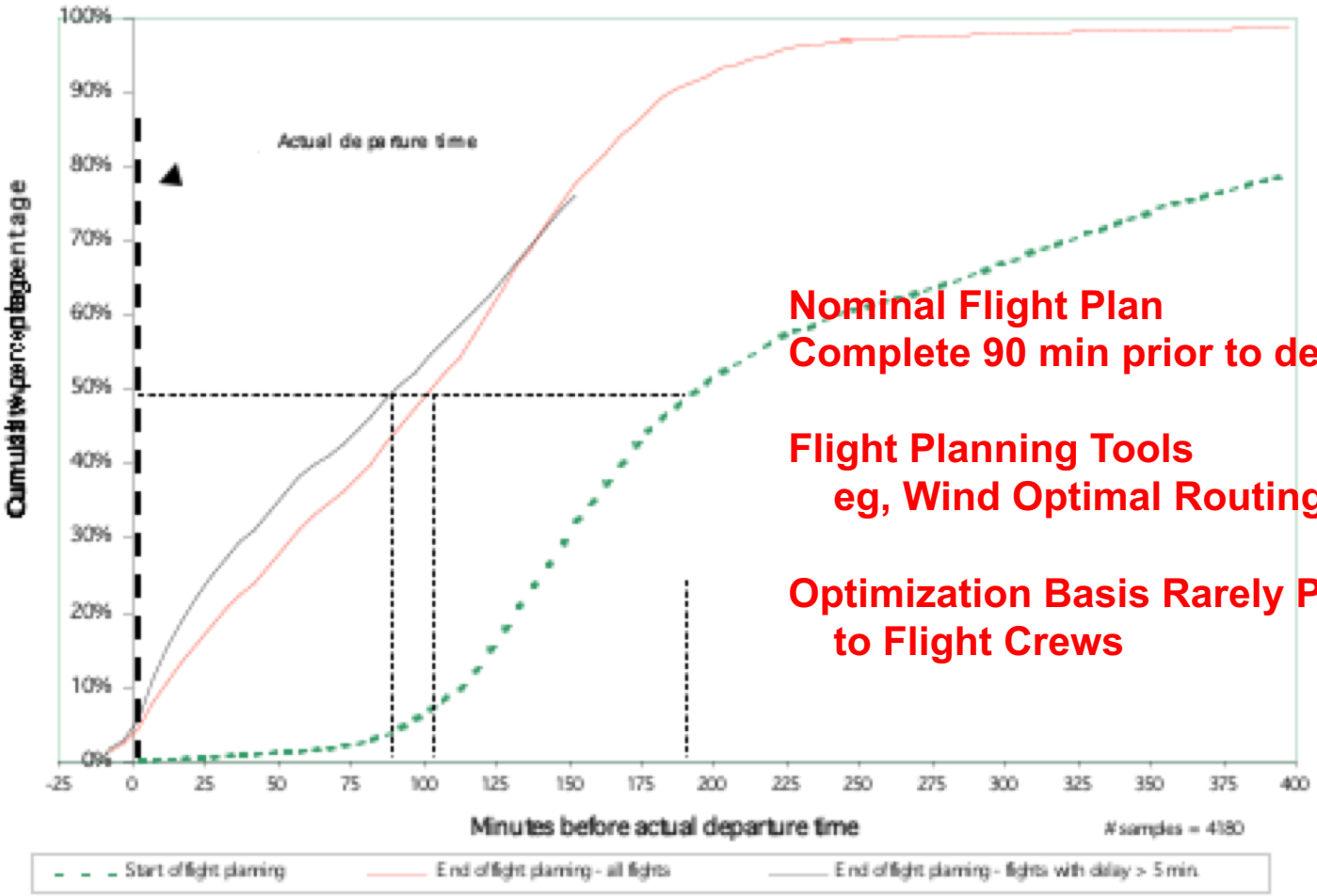
- **Two responses observed:**
  - ❑ Standard flow abstraction for aircraft traversing the weather no longer available – aircraft treated as “special cases.”
  - ❑ Alternative standard flow abstraction is used.

Real Time Allocation Challenges

- **Planning Time Horizons**
  - ❑ Weather time constants (< 30 min for convective)
  - ❑ Airline response time constants (
  - ❑ ATC Response
- **Safety Constraints**
  - ❑ Acceptable Level of Traffic
  - ❑ Wake Vortex
- **Asymmetric Control**
  - ❑ Fast Shut Down
  - ❑ Slow Start Up
- **Airline Planning/Response issues**
  - ❑ Planning time constant
    - ◆ (median 90 min)
  - ❑ Disrupted Options
  - ❑ Lack of consistent or clear objective function
    - ◆ Inter Airline Units

Identification of AOC dynamics

Timing of Flight Planning



Nominal Flight Plan
Complete 90 min prior to departure

Flight Planning Tools
eg, Wind Optimal Routing

Optimization Basis Rarely Presented to Flight Crews

Source: AOC computer transactional data from a major airline (March 1998)