



Network and Traffic Flow Optimization

Themes - 8 Papers

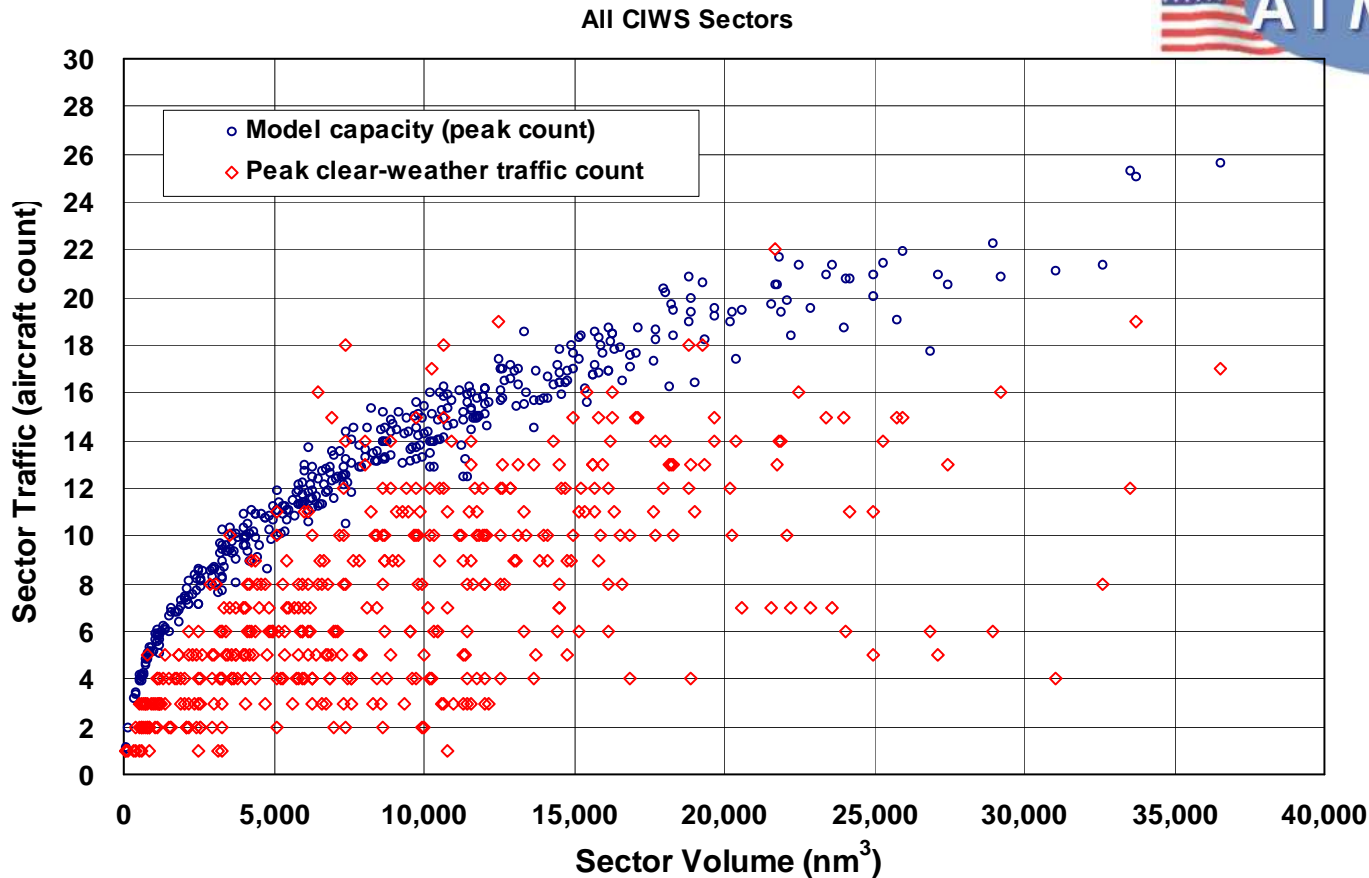


- Evaluating Baseline Inputs – constraints(2)
- Traffic Flow Methodology
 - Equity In TFM (1)
 - Tactical TFM (1)
 - Strategic TFM Methods(4)



- Evaluating Baseline Inputs – constraint values (2)
 - Identifying Sector Capacity
 - Inverting workload calculations into sector capacity's
 - Identifying Resolution Constraints
 - Intriguing approach to mapping the solution space

Fitted Model Capacities and Observed Counts

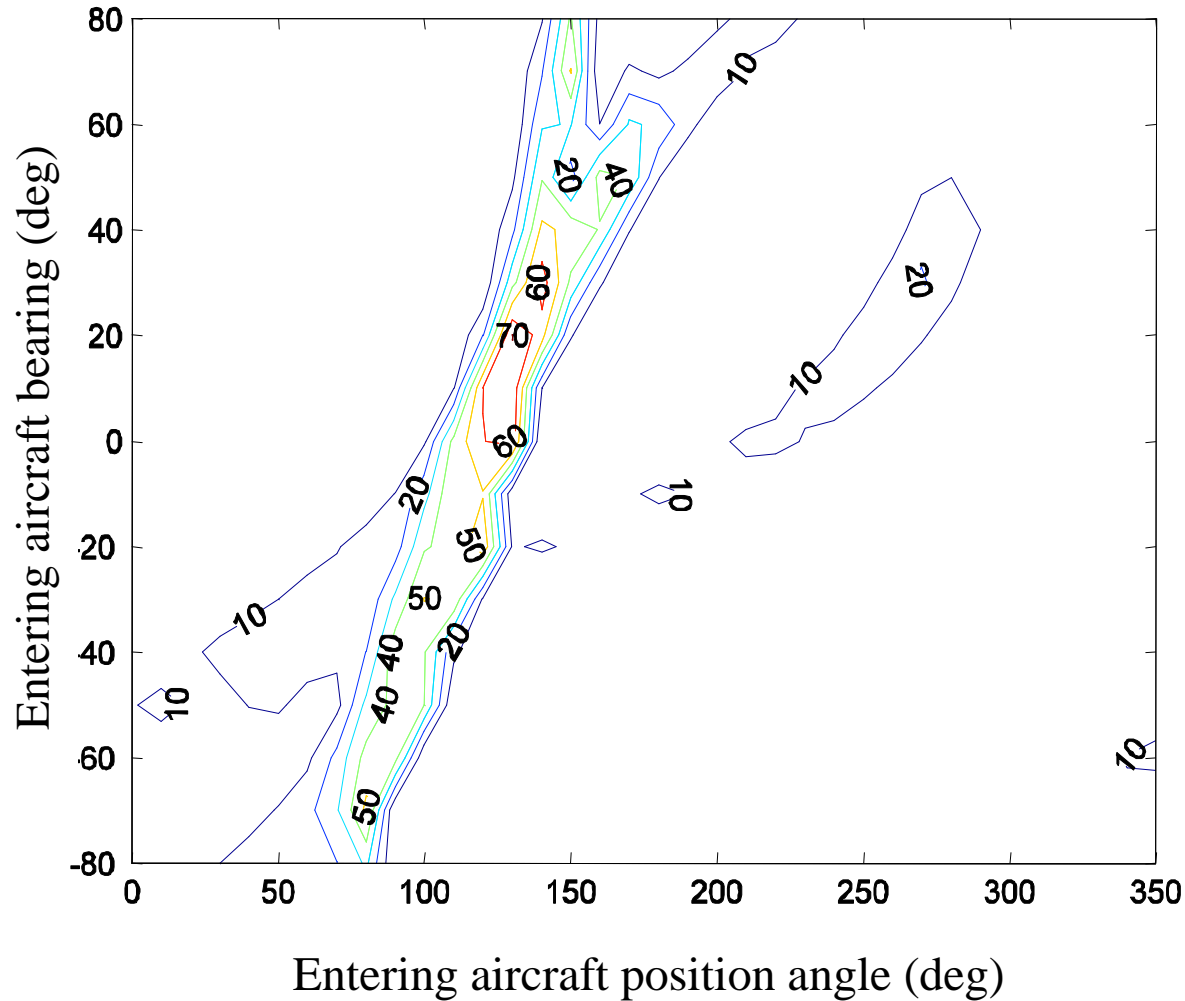


Fitted Model parameters

Maximum observed count at each volume fits model bound. Most sectors operate below capacity.

tt=	15	transit work time/aircraft (s)
tc=	50	conflict work time/aircraft (s)
tr=	10.2	recurring work time/aircraft (s)
Mh=	5.7	(miles)

Complexity Map of Traffic Situation #1



■ Contours of minimum control activity required to accept entering aircraft



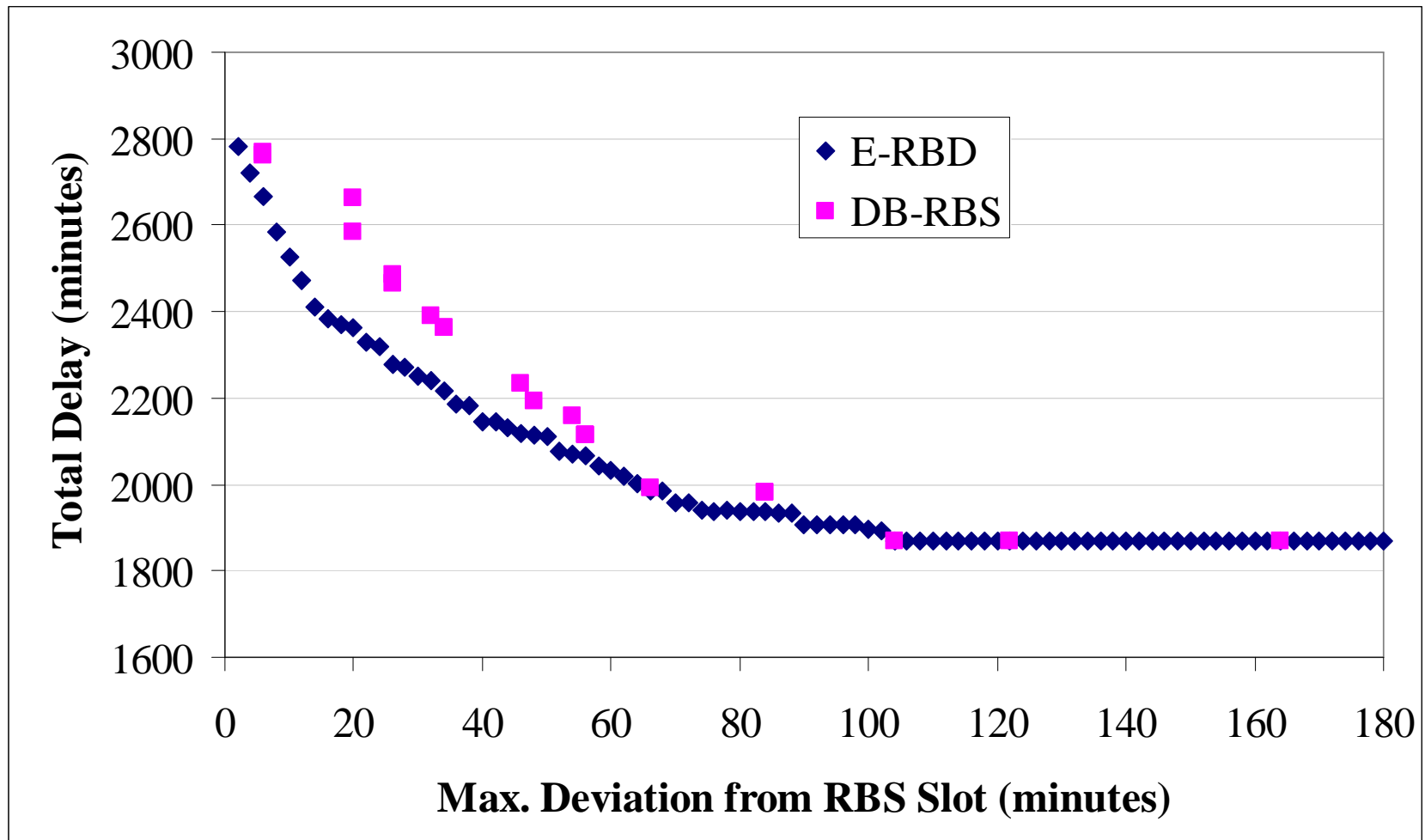
- Traffic Flow Methodology
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Equity (1)



- Examines an improvement to the allocation process which meets twin objectives
 - Preserve a sense of equity while hedging for program weather (duration/intensity)

Efficient Frontiers for E-RBD and Distance-Based GDP Planning Algorithms



Tactical TFM(1)

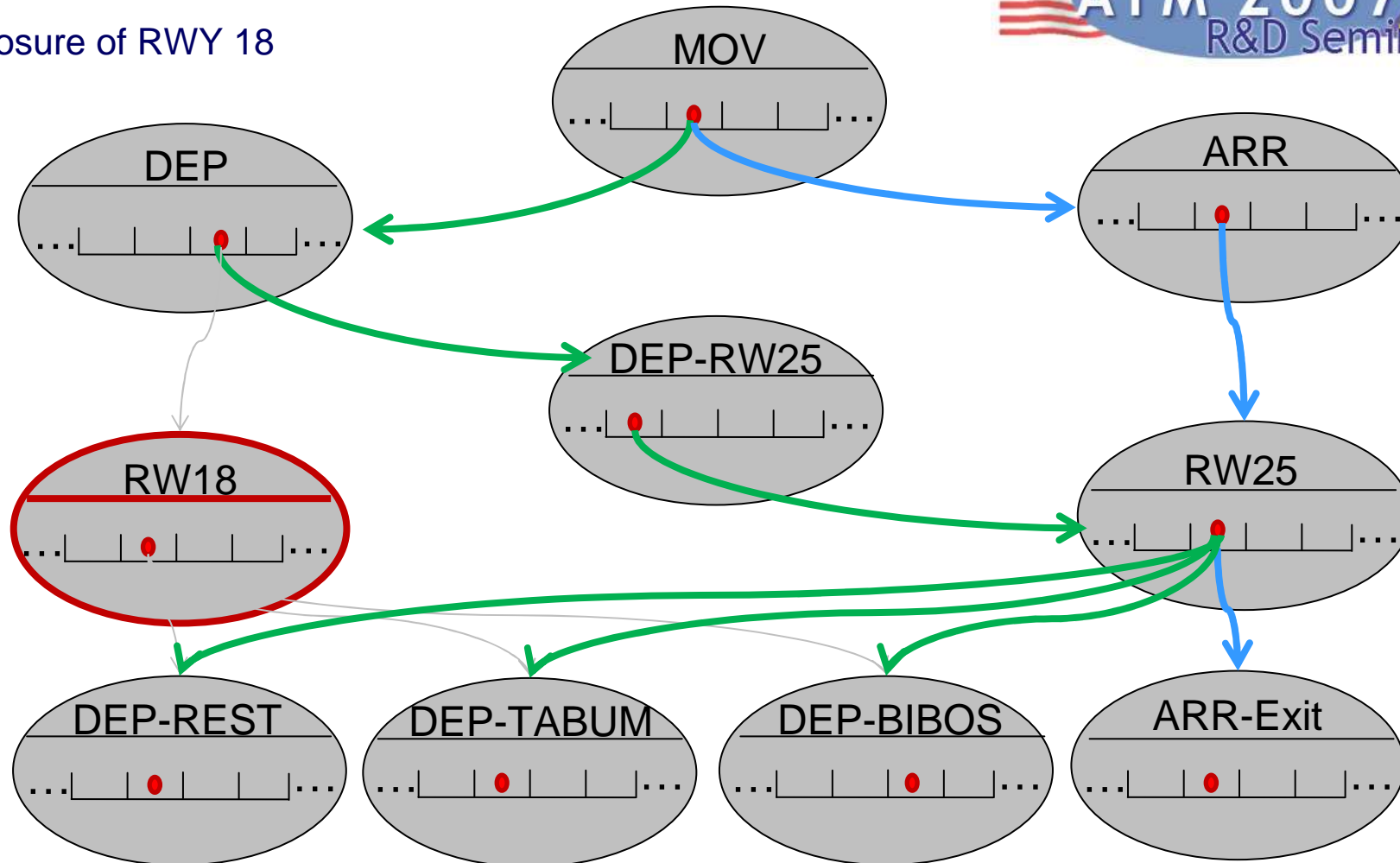


- Method for doing strategic runway assignments/configuration management
 - Provides a fine tuning of the flow plan
 - Network optimization

Capacity Resource Counter Network



Closure of RWY 18



Strategic TFM Methods(4)

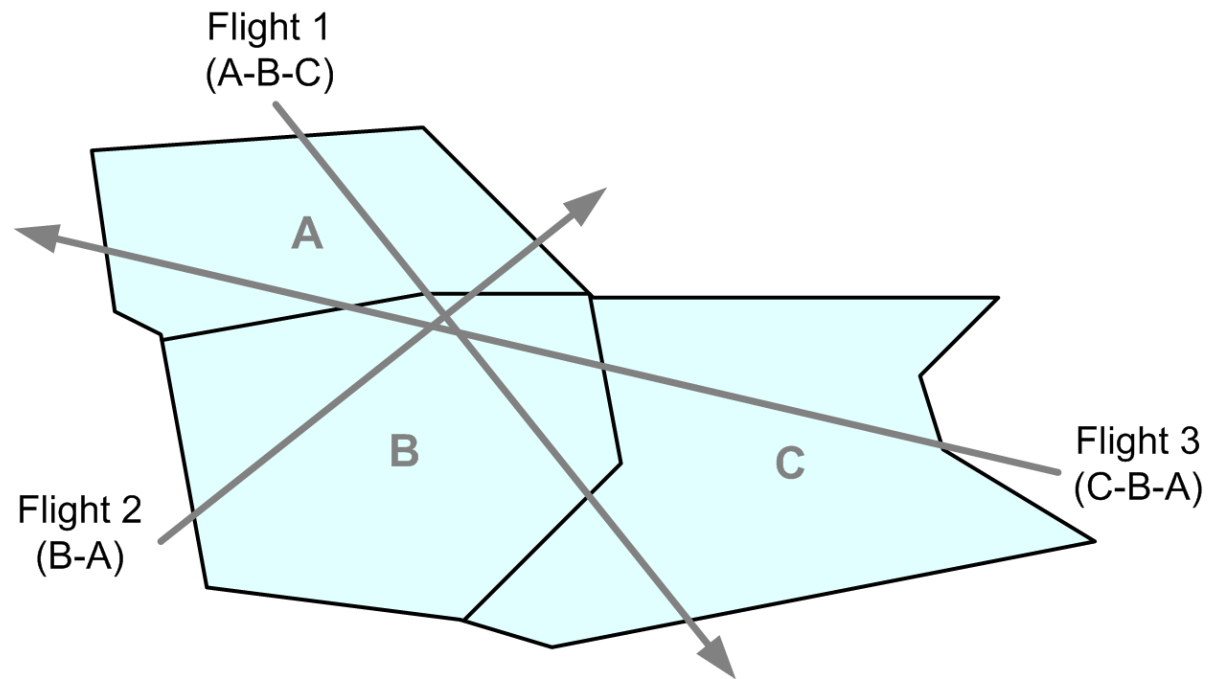


- Solving the capacity constraint problem efficiently – objectives and methods(2)
- Incorporating Stochastic elements (2)

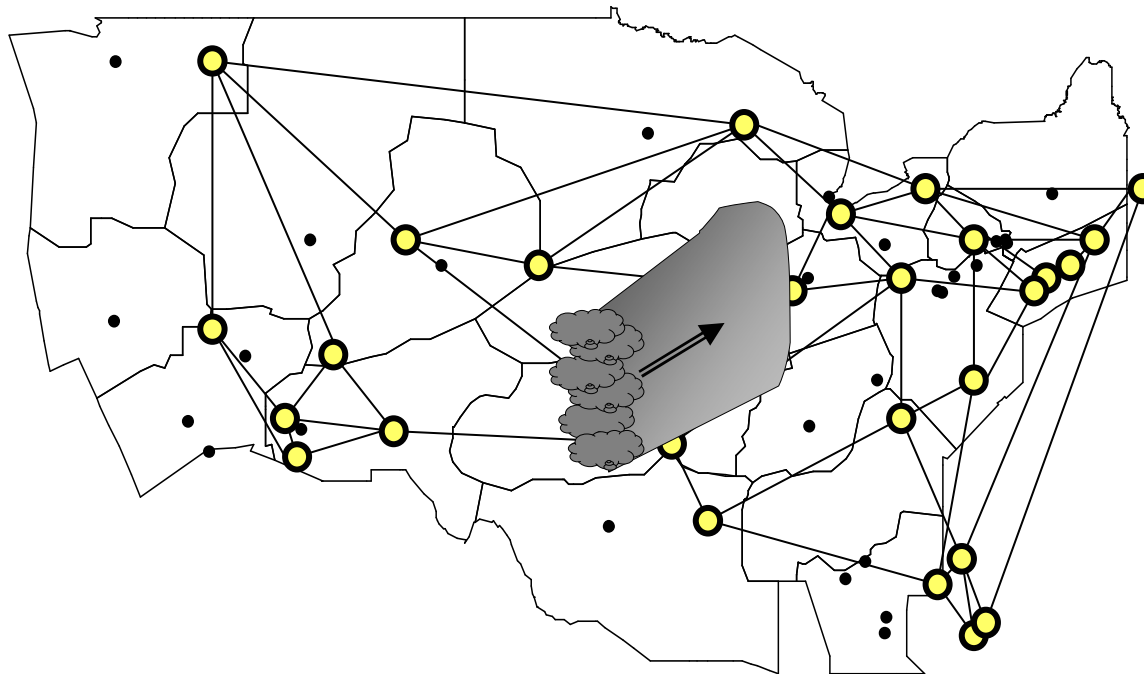
Issues for Selection of an Approach - II



- Issue B: It is not obvious how to sort flights using a dispatching rule for multiple sectors.
 - Flights may not only pass through volumes of airspace going in different directions, but may also enter different sectors according to different arrival sequences.
 - Dispatching rules produce better solutions when flights are sorted in time order.



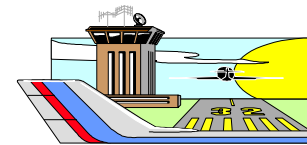
National Flow Model (NFM) Overview



ETMS/
OAG

Traffic represented by
ETMS flight plans (FZ)
and departure records
(DZ) or OAG schedule

Simulation schedules
aircraft on queues



Airports and
sectors
represented as
queues

Aircraft enter and leave
network segments
according to event
queue schedule



Aircraft move
between queues
over the
network

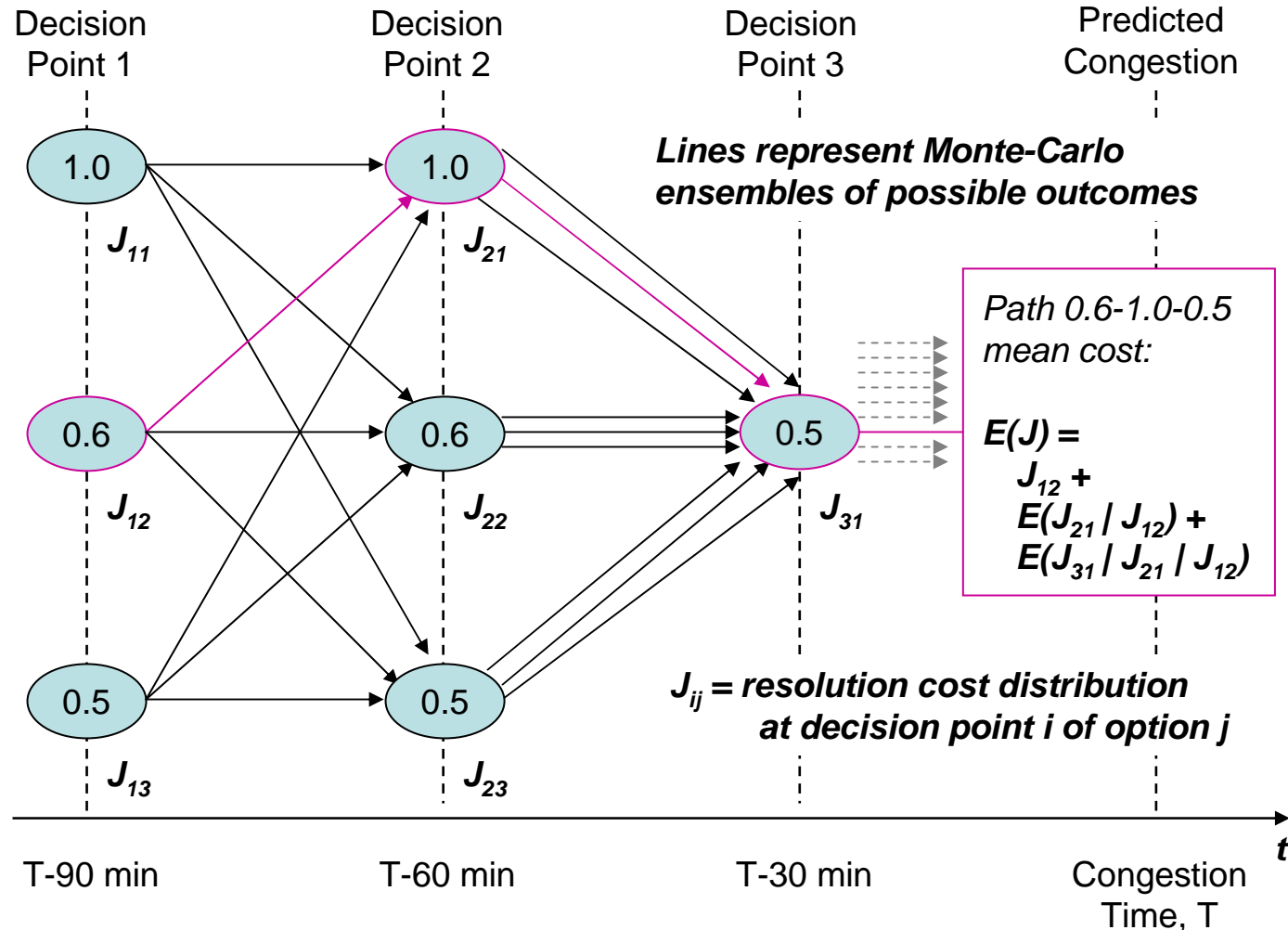
Delay
Throughput ...

Solution: The Probabilistic Incremental Congestion Alleviator (PICA)



Start:
Set of predicted trajectories and corresponding congestion probabilities

Start:
Set of predicted trajectories, **predicted weather, weather-impacted capacity,** and congestion probabilities



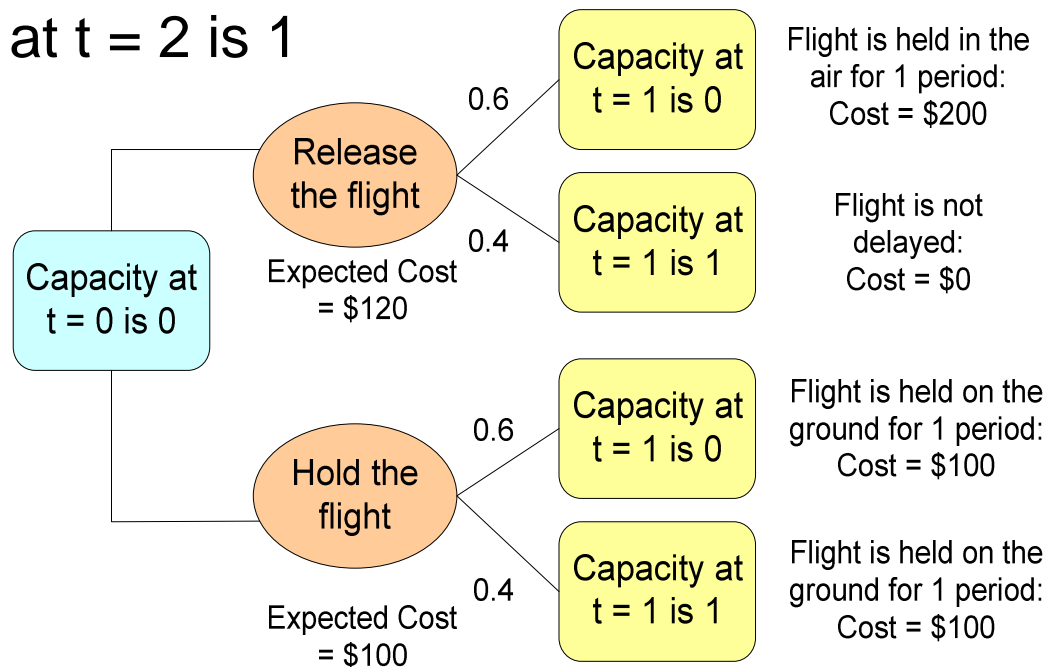
Modeling using a Markovian Approach

- An Example



- Suppose capacity evolution is Markovian with transition matrix:

$$\begin{matrix} & \begin{matrix} 0 & 1 \end{matrix} \\ \begin{matrix} 0 \\ 1 \end{matrix} & \begin{bmatrix} 0.6 & 0.4 \\ 0.4 & 0.6 \end{bmatrix} \end{matrix}$$
- Flight time: 1 period
- Capacity at $t = 2$ is 1



Summary



- Session had a good range
- Session showed “evolution”
 - Extensions of prior work
- R&D timeline ranged from the “immediate” to the exploratory
- Still a target-rich environment – lots of questions that began
 - Did you consider ...
 - Could you extend ...