Airspace and Airport System Simulation with DPAT

MITRE

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9 January 2000

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Outline

- What is DPAT?
- Samples of recent studies using DPAT
- Excerpts from an example DPAT study (1997):
  - Future air traffic on the Pacific rim
- Some current DPAT applications
DPAT - The Detailed Policy Assessment Tool

- **DPAT characteristics**
  - An ultra-fast time, global air traffic simulation
  - Can model current and future air traffic, for any world region
  - Represents airports and airspace as a network of finite-capacity resources
  - Models individual flights and itineraries, and computes delays
  - Propagates delay across system resources

- **DPAT applications**
  - System-wide airport and airspace planning
  - Prediction of system-wide effects of weather and traffic flow management restrictions, such as ground delay programs and miles-in-trail restrictions
  - Assessment of economic benefits of proposed system improvements
  - Identification of total-system effects of future traffic growth
DPAT Development and Performance

- **DPAT development**
  - DPAT and its predecessor (NASPAC) have been used as planning tools by the U. S. FAA since the 1980’s
  - DPAT achieves far shorter run times than NASPAC through more efficient coding and parallel processing
  - NASPAC and DPAT have been improved continuously to better reflect ATC operations

- **On a four-processor Unix workstation, DPAT simulates a full day of U.S. air traffic in under 1 minute (OAG plus non-scheduled traffic)**

- **DPAT performance implications:**
  - DPAT can be run hundreds of times overnight for analysis across many days of traffic and weather, or for sensitivity analysis (with appropriate pre- and post-processing software)
  - DPAT has potential for use in real-time ATM operations
Samples of Recent Studies Using DPAT

- ADS-B/CDTI benefit assessment
  - Computed annualized benefit of reducing delay using improved separation standards in moderately poor weather
  - 730 runs (365x2) representing weather and traffic conditions for each day in 1997

- Analysis of MIT restrictions into ORD from the southeast
  - Computed the system-wide effect of easing and/or removing miles in trail restrictions in the Chicago area.

- Separation Reduction Impact Analysis
  - Analyzed the effectiveness of reduced separation standards, and how that would interact with other NAS components

- Impact of Regional Jets on Congestion in the NAS
  - Projected future congestion in ATC sectors from regional jets

- Taipei (Taiwan) FIR delay analysis
  - Performed delay analysis of Taipei FIR
  - Provided insight into need-dates for capacity related improvements
Excerpts from Pacific-rim DPAT study (1997)

- Major airport infrastructure investments planned for the Pacific rim over the next 20 years
- How will system demand and capacity match up over the next 20 years
  - If infrastructure completed on time and demand grows as expected
  - If infrastructure not completed on time or demand does not grow as expected
  - Also look at interactions between airports
- Summary of results
  - Identified airports where there may be too little or excess capacity, based on current plans
  - At some airports, there will be problems if schedules slip
  - Some of these problems do propagate to other airports

Technical Arrival Delay at Hong Kong from DPAT
Effective Arrival Delay at Hong Kong from DPAT

Maximum hourly effective arrival delay, Hong Kong (Kai Tak and Chek Lap Kok), China

Delay (minutes) vs. Year of capacity vs. Year of demand
Technical Arrival Delay at Bangkok from DPAT

Maximum hourly technical arrival delay, Bangkok (Don Muang and Nong Ngu Hao), Thailand
Some Current DPAT Applications

- Analysis of future benefits of possible improvements to the U.S. NAS

- Prototype integration of DPAT with Sector Design and Analysis Tool (SDAT) using DoD High-Level Architecture (HLA)

- Exploration of real-time operational DPAT use to aid traffic flow management (TFM) decision-making
Future Delay with IMC Enhancements
(Preliminary Results)

All Cases – Average Delays for Selected Days

Comparison of All Cases (6-day average)
Concept of Operation for SDAT/DPAT Prototype Integration Using High-Level Architecture (HLA)
Operational Concept:
Collaborative Flow Management

Assess  Trial  Airline  Reassess
Decision  Response
Exploration of NAS Modeling for Impact Assessment

Current, Predicted Resource Capacities (Airports, Airspace)

Traffic Flow Restrictions (MITs, GDPs, GSs…)

Predicted Aircraft Trajectories (Undelayed)

Delay Model (DPAT):
Apply Resource Capacities
Trajectories Interact

Demand Model (CRCT):
No Resource Capacities*
Trajectories Are Independent

Input Parameters: Actual Situation or Proposed Solution

How many aircraft want to use a resource?
*…how many if selected restrictions are applied?

What delays will occur due to excess demand?