The Basis of the Mosaic Approach for Airspace Capacity Estimation

▪ What is the Actual Constraint?
  • Line-Based FCAs Provide a Control Mechanism to Manage Airspace Demand
  • However, the FCA is Not the Constraint

▪ The Actual Constraint is the Sector Capacity and the Sector Controller’s Workload
  • Could also be Route Capacity

▪ Thus, Estimating the Capacity of the FCA is Not the Most Direct Way to Manage Airspace Demand
The Basis of the Mosaic Approach for Airspace Capacity Estimation (cont.)

▪ The Program Rate for the FCA Should Manage to Sector Capacities for All Affected Sectors
  • Including Sectors that May Receive Offload Traffic

▪ Our Approach is Dependent on a Method to Estimate Weather-Adjusted Sector Capacity

▪ Modeling Estimates the Reroutes and Ground Delays Needed to Manage the Traffic to Meet the Actual Constraints (i.e., Weather-Adjusted Sector Capacities)

▪ Candidate FCAs and AFP Program Rates are Derived from the Modeling
Sector Congestion Prediction

- Congestion may occur due to:
  - Capacity constraints due to weather
  - Excessive volume without weather
  - Secondary congestion due to offloading/rerouting to avoid primary congestion
Sector Permeability Computation

Multi-directional scanning algorithm (developed under NASA Wx Translation NRA in 2009)

“How many scan lines are blocked or may be blocked by non-permeable (red) and semi-permeable (yellow) hex cells, respectively?”

Uses 18 scanning directions and weighs directional permeability by directional traffic demand for aggregate total in 15-min increments

ZME46, 2000Z
95% permeable

ZME46, 2200Z
65% permeable

ZME46, 2300Z
40% permeable
Sector Congestion Prediction via Stochastic Modeling of User TOS Reroutes

- Approach:
  - Iterate over congested sector-intervals
  - Generate TOS routes for flights in congested sector interval
  - Reduce probability of TOS route option through congested sector so that expected demand meets expected capacity
  - Increase probability of other TOS routes for flight accordingly to sum to 1.0
Candidate Reroute to Avoid Single Congested Sector
Congestion Solution Heatmap
Congestion Solution Heatmap
Extraction of Decision Support Information

Approach:

- FCA Line Identified
  - Manually, or
  - Algorithmically
- Capture Region that Requires the Most Traffic Reduction
- Algorithmically Calculate the Estimated Flight Count per Hour Through the FCA
- Use as AFP Program Rate
Application to Airspace Flow Programs

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