



Airspace Capacity Estimation Approach

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The Basis of the Mosaic Approach for Airspace Capacity Estimation



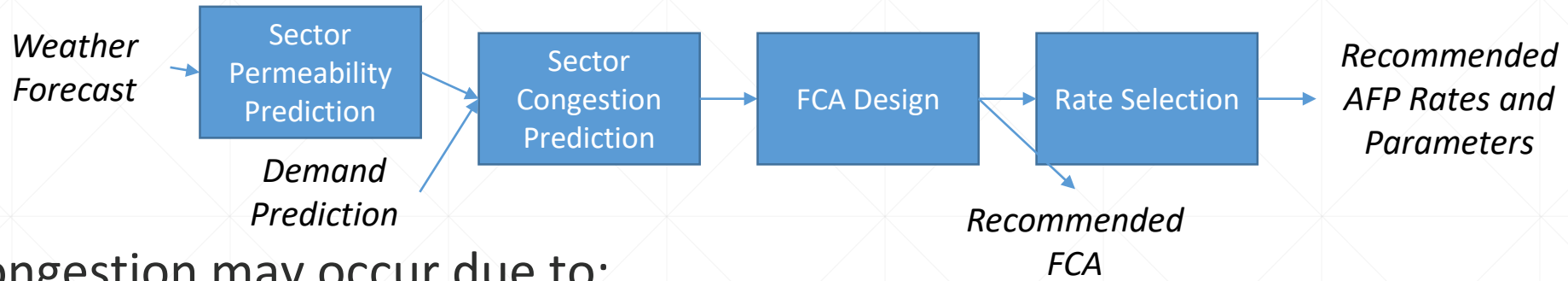
- What is the Actual Constraint?
 - Line-Based FCAs Provide a Control Mechanism to Manage Airspace Demand
 - However, the FCA is Not the Constraint
- The Actual Constraint is the Sector Capacity and the Sector Controller's Workload
 - Could also be Route Capacity
- Thus, Estimating the Capacity of the FCA is Not the Most Direct Way to Manage Airspace Demand

The Basis of the Mosaic Approach for Airspace Capacity Estimation (cont.)

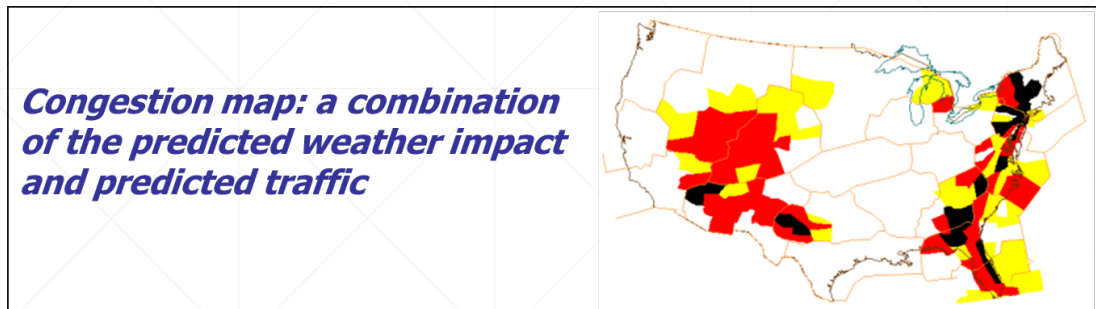
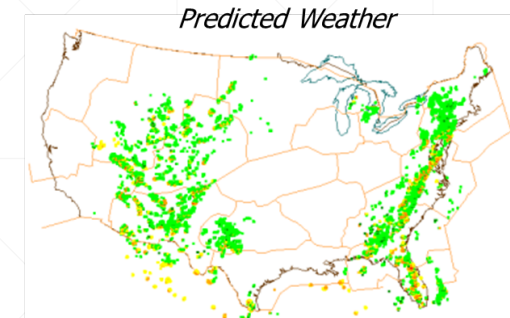
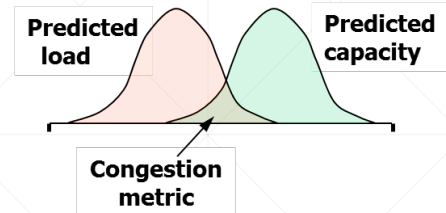


- The Program Rate for the FCA Should Manage to Sector Capacities for All Affected Sectors
 - Including Sectors that May Receive Offload Traffic
- Our Approach is Dependent on a Method to Estimate Weather-Adjusted Sector Capacity
- Modeling Estimates the Reroutes and Ground Delays Needed to Manage the Traffic to Meet the Actual Constraints (i.e., Weather-Adjusted Sector Capacities)
- Candidate FCAs and AFP Program Rates are Derived from the Modeling

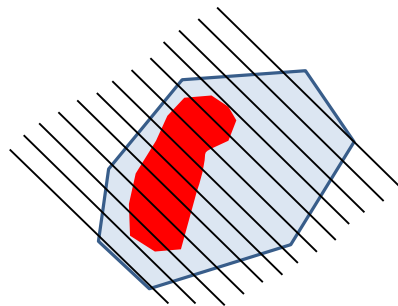
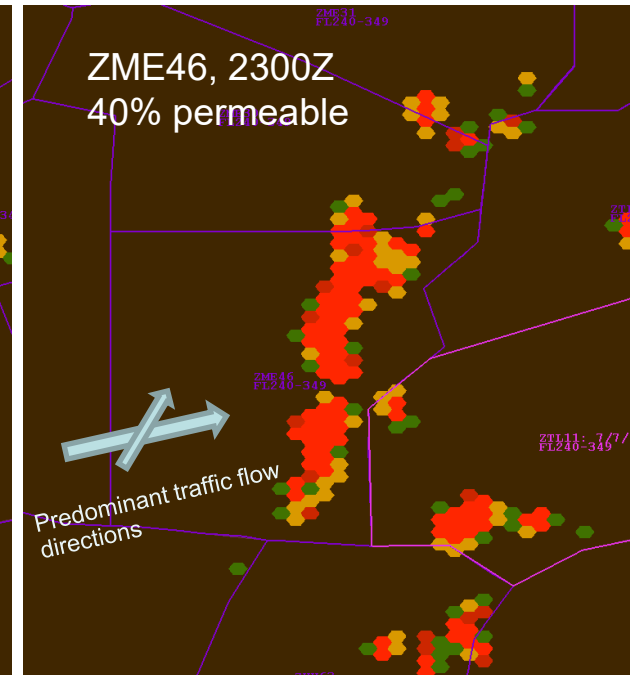
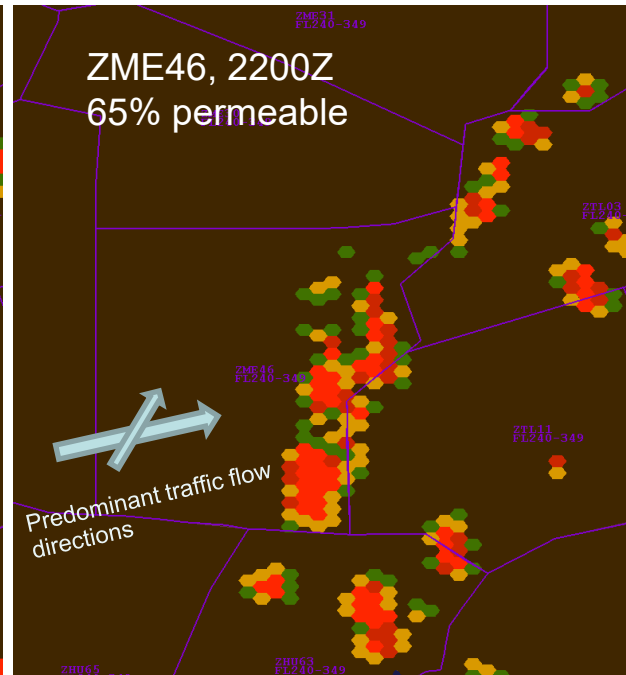
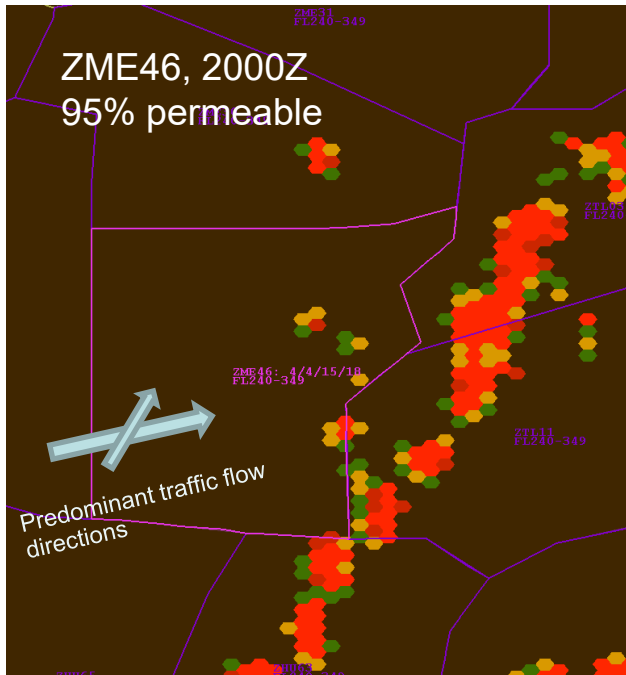
Sector Congestion Prediction



- 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)

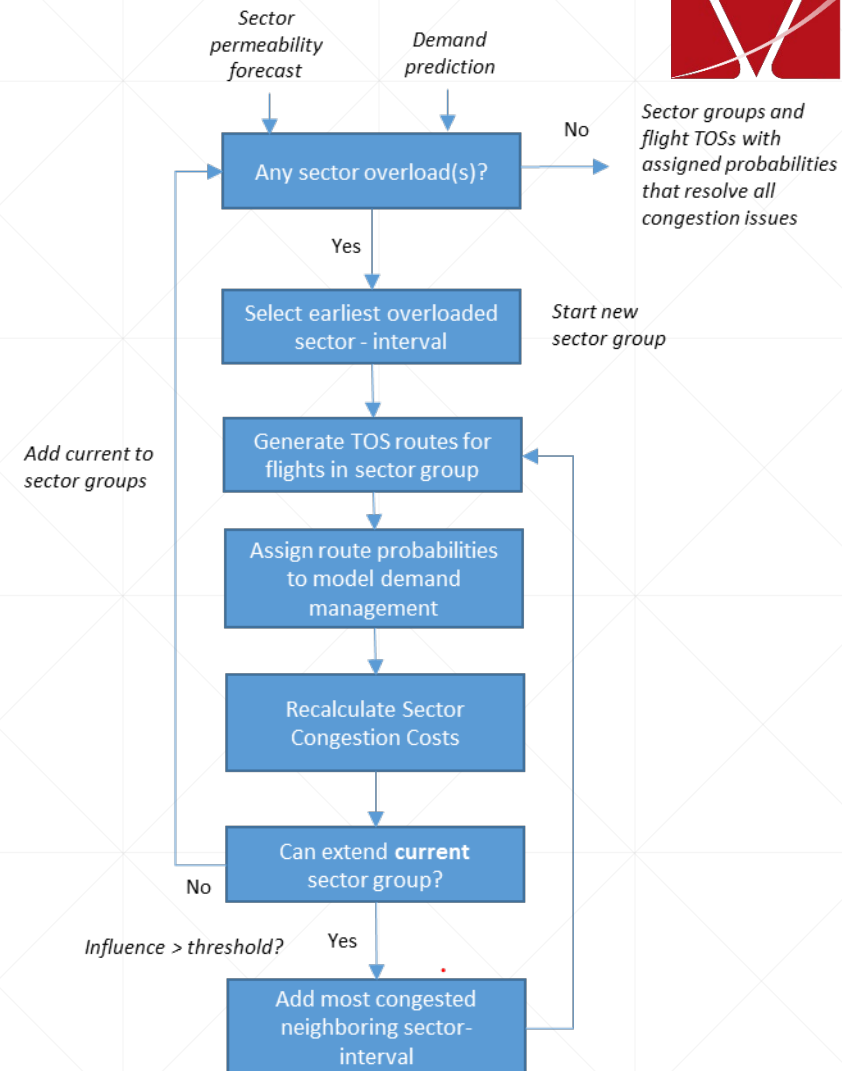
“How many scan lines are blocked or may be blocked by non-permeable (red) and semi-permeable (yellow) hex cells, respectively?”

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

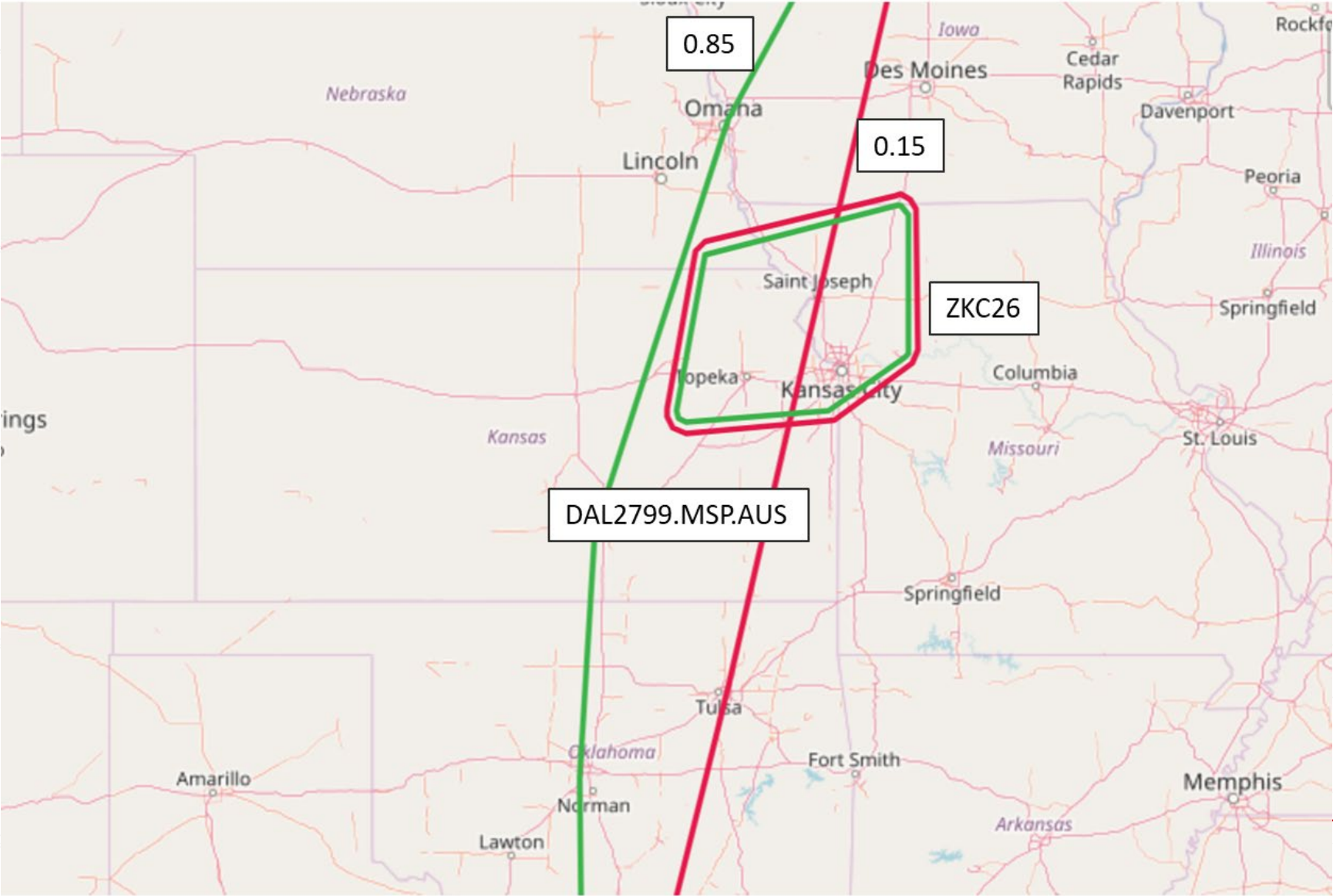
Sector Congestion Prediction via Stochastic Modeling of User TOS Reroutes



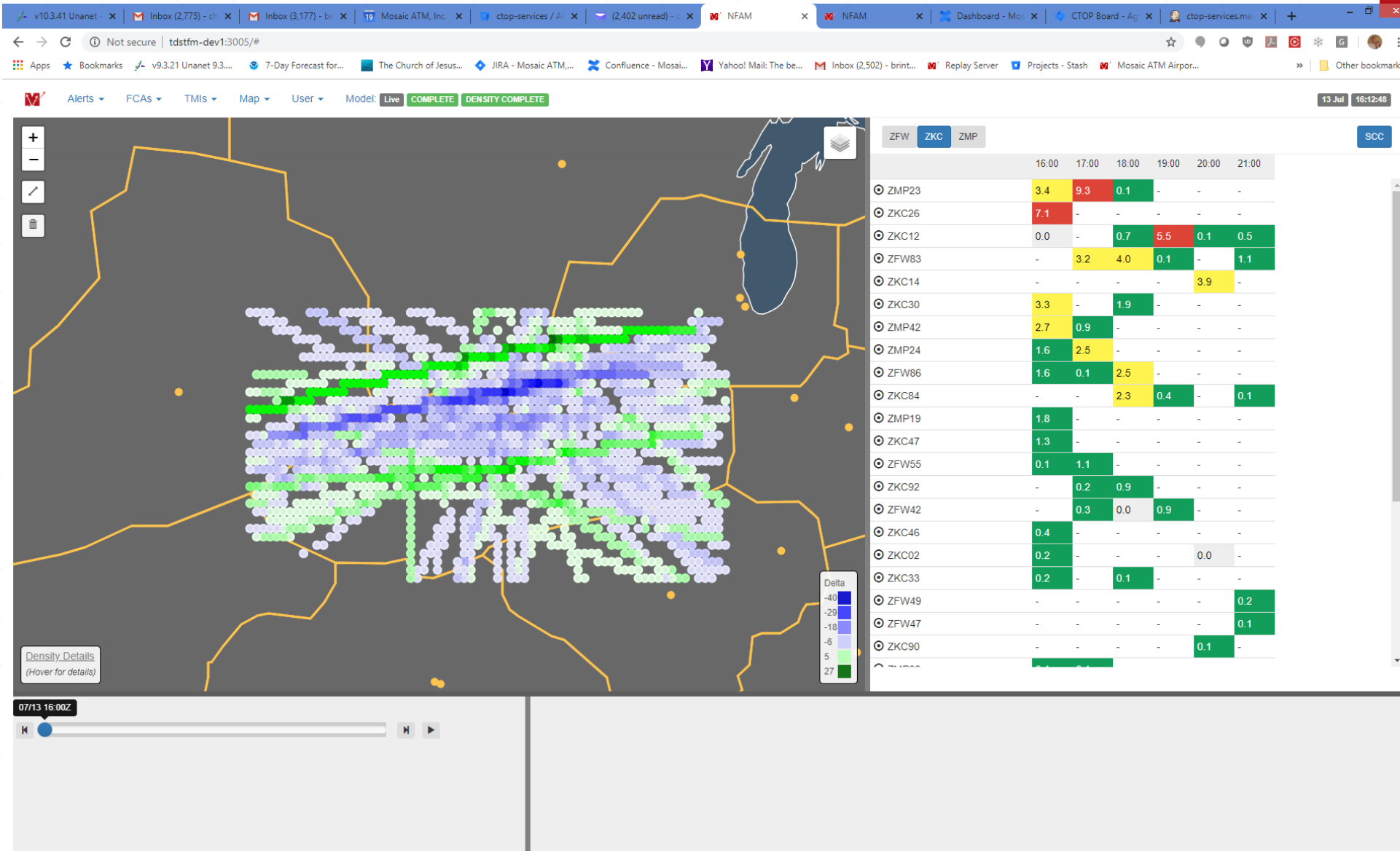
- Approach:
 - Iterate over congested sector-intervals
 - Generate TOS routes for flights in congested sector interval
 - Reduce probability of TOS route option through congested sector so that expected demand meets expected capacity
 - Increase probability of other TOS routes for flight accordingly to sum to 1.0



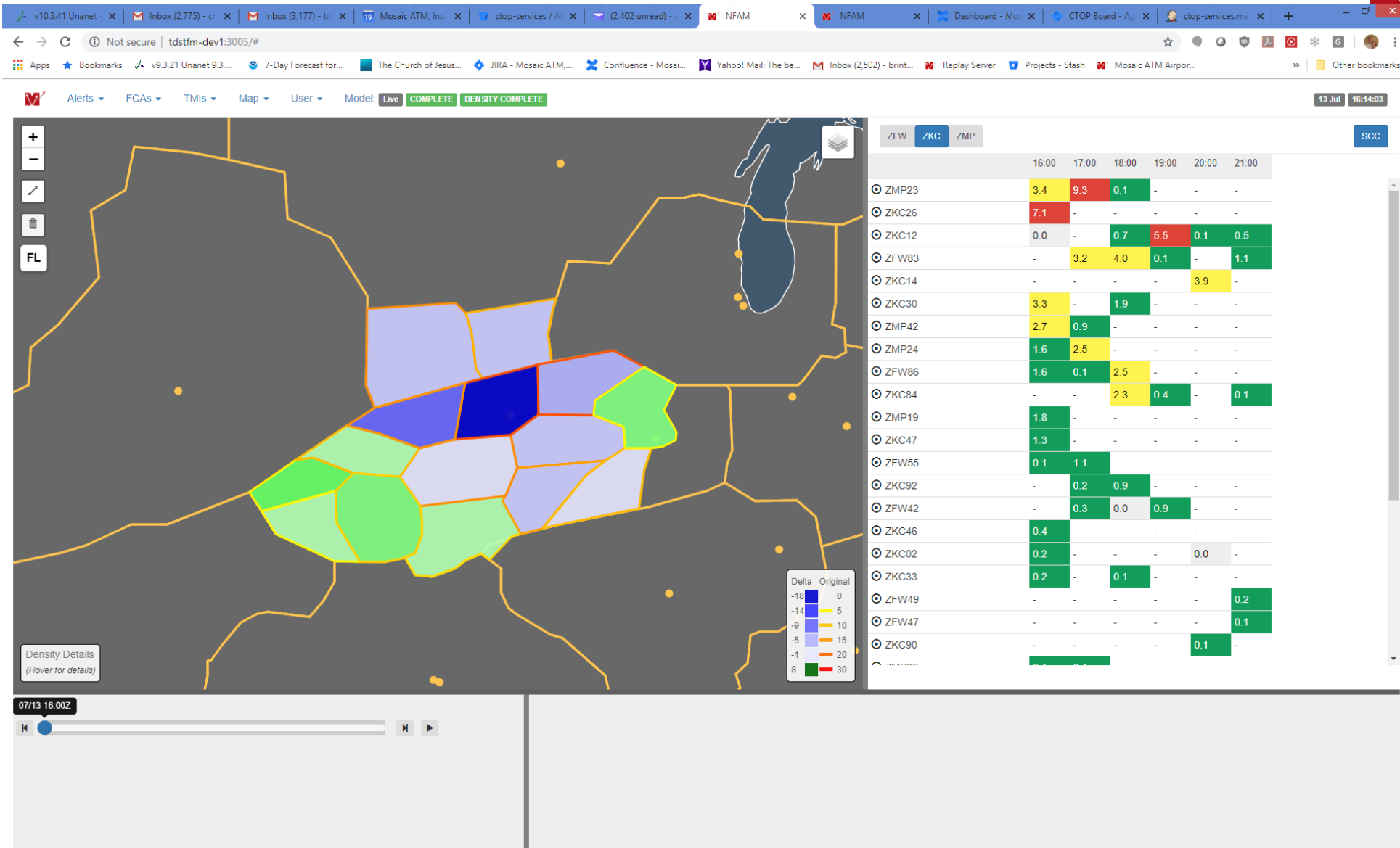
Candidate Reroute to Avoid Single Congested Sector



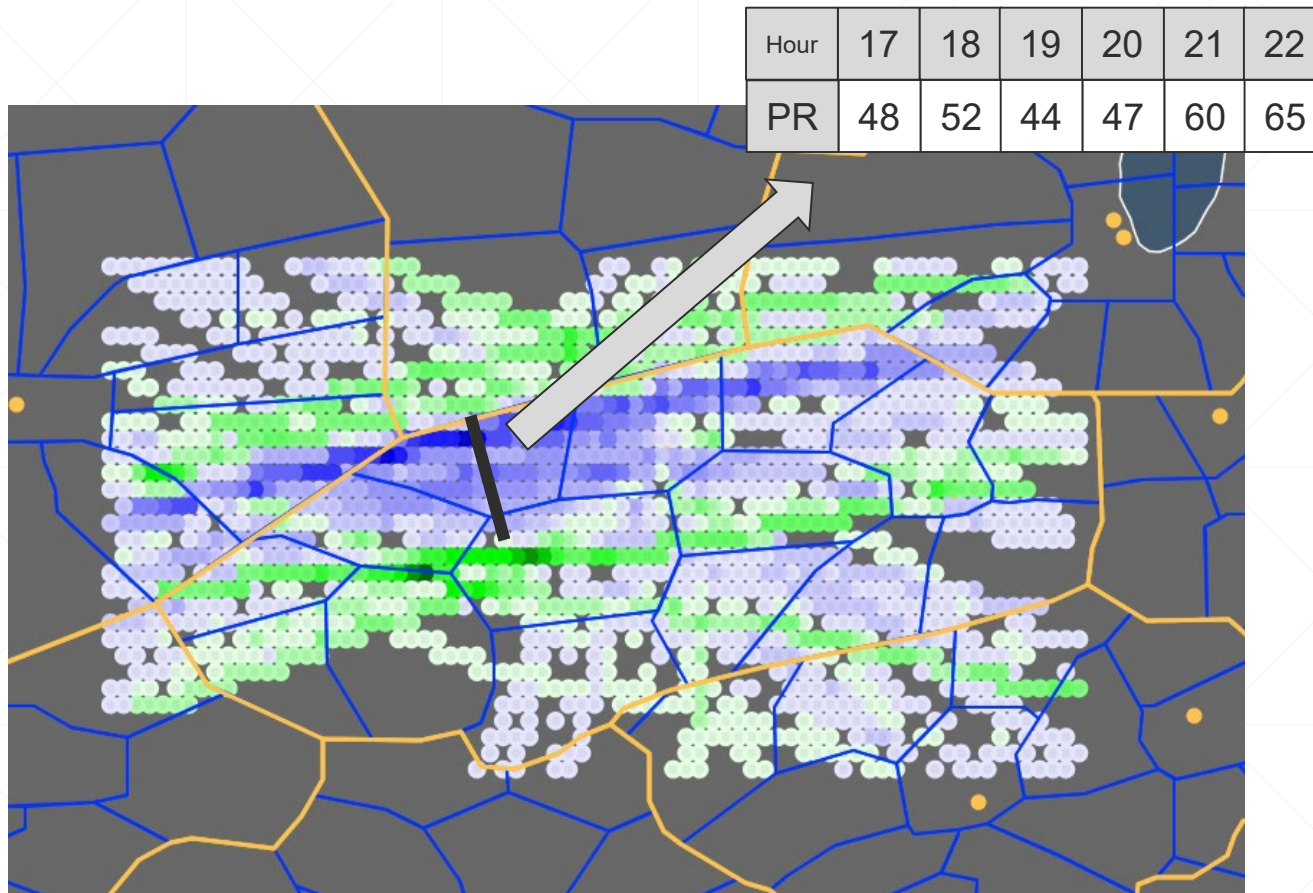
Congestion Solution Heatmap



Congestion Solution Heatmap



Extraction of Decision Support Information



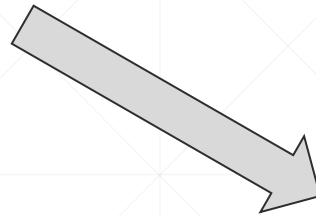
Approach:

- 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



Hour	17	18	19	20	21	22
PR	48	52	44	47	60	65



The screenshot shows the FSM software interface. The main window is titled 'GDT Setup: FCACW3 2014/Jun/20 1806 GDT'. It features a 'Parameters' tab with various settings for the program, including 'Program Time Options' (Start: 201806, End: 211245), 'Program Rate' (Set to Program Rate), and 'General Options' (Delay Limit: 180, Target Delay: 1.0). A 'Bar Graph: FCACW3 2014/Jun/20 1806 GDT' is displayed on the right, showing demand over time. The bar graph has a title 'GDT FCACW3 Model 06/20/2014 18:06Z ENTR' and shows demand values for 60-minute increments from 1700 to 0500. The demand values are: 1700: 24, 1800: 24, 1900: 16, 2000: 16, 2100: 8, 2200: 4, 2300: 4, 2400: 0, 2500: 0, 2600: 0, 2700: 0, 2800: 0, 2900: 0, 3000: 0, 3100: 0, 3200: 0, 3300: 0, 3400: 0, 3500: 0, 3600: 0, 3700: 0, 3800: 0, 3900: 0, 4000: 0, 4100: 0, 4200: 0, 4300: 0, 4400: 0, 4500: 0, 4600: 0, 4700: 0, 4800: 0, 4900: 0, 5000: 0.