Traffic Flow Management Use Case

Scenario: Traffic Flow Management for a Large-Scale Weather Event with FMDS

This scenario depicts a large-scale weather event impacting the southeastern US, where multiple traffic management initiatives (TMIs) are planned and negotiated. It describes traffic flow management (TFM) coordination and decision-making that involves numerous FAA facilities and National Airspace System (NAS) users.

Airspace Flow Program (AFP) Event Planning

Traffic flow management planning usually starts on the day prior. The planning team monitors long-range weather forecasts (see Figure 1) and documents TMIs that could address the potential demand/capacity imbalances created by the weather constraint(s). This information is discussed twice daily with NAS stakeholders during Advanced Planning Webinars. The resulting collaboration between FAA traffic management units (TMUs) and NAS users creates the "Plan, Execute, Review Train and Improve (PERTI) plan," which includes the expected TFM strategies for the next day's operations.

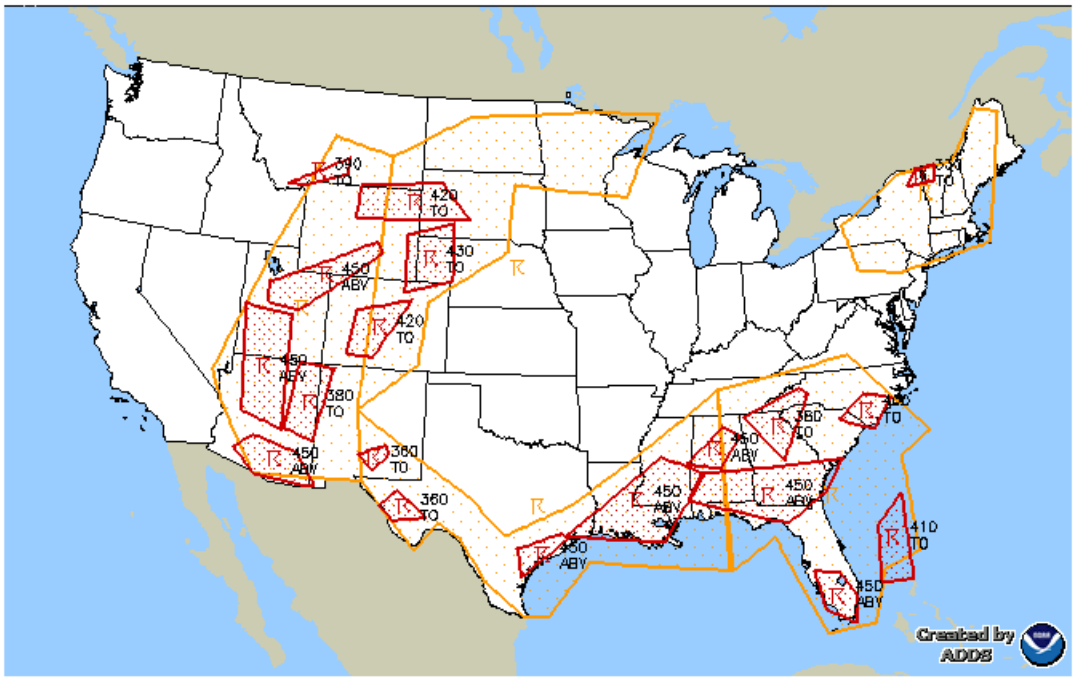

Figure 1. Convective Weather Forecast

The following morning, the Air Traffic Control System Command Center (ATCSCC) Severe Weather Unit and the Southeast Terminal Area review the PERTI plan and determine that Ground Delay Programs (GDPs) for the Florida airports, an AFP, and Playbook routes need to be discussed on the first Strategic Planning Webinar. To help facilitate those discussions, the ATCSCC traffic managers use the Flow Management Data and Services (FMDS) system to view traffic, weather, and the latest information about Special Activity Airspace (SAA) schedule and status.

To model an AFP, the traffic managers need to first either select an existing Flow Constrained Area (FCA) to associate with the AFP or create a new FCA. They then need to set filters on the FCA that will determine which flights will be included in the AFP.

The traffic managers select an existing line FCA (JX7, the line shown in orange in Figure 2) because it will effectively capture all the north-south traffic to/from the major Florida airports. They also consider which altitudes to include. It may be possible for some flights to stay above the weather, and so traffic managers might put an upper limit on the altitudes included in the FCA. In addition to avoiding the weather, traffic managers also want to encourage NAS users to remain below ZJX en route airspace because of the potential for a controller staffing shortage. Thus, the traffic managers decide to create a floor for the FCA. They choose to include flight levels (FLs) 200-500, or altitudes from 20,000 to 50,000 ft.[1] These altitude filters on the FCA provide the "Altitude Floor/Ceiling" for the AFP shown in Figure 2.

In addition to filtering on altitude, traffic managers can create filters for the FCA to select flights based on the type of aircraft, the direction of flight, the arrival/destination airport, or some other factors. In this case, they choose southbound flights that are not going to Jacksonville International Airport (JAX).

The traffic managers decide what time the AFP should start and stop based on when they expect the weather and other constraints to affect the area (10:00 AM EDT to 10:59 PM EDT) and the number of flights they think will be able to cross through the airspace during each hour given the severity of the weather (hourly program rate).

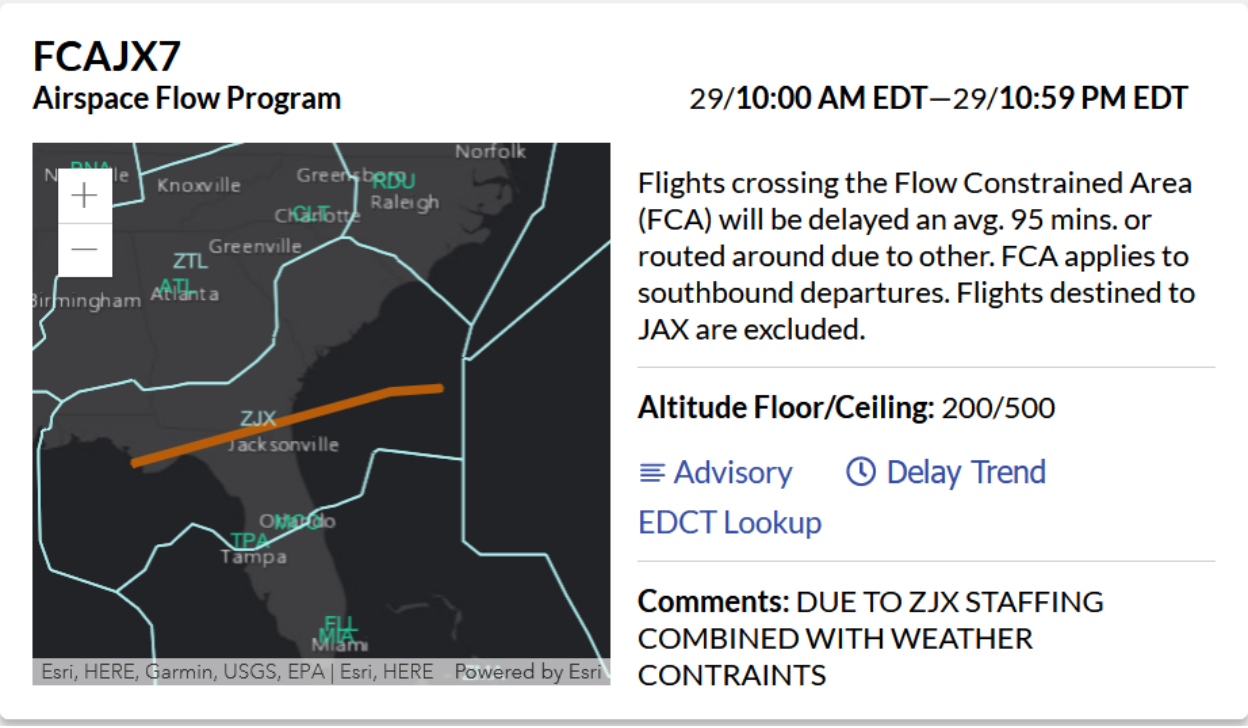

Figure 2. FCAJX7 for AFP

The traffic managers use FMDS to model the AFP using the selected parameters and view the results. They are most interested in the number of flights included in the AFP, the average delay that the AFP

[1] https://www.faa.gov/air_traffic/publications/atpubs/pcg_html/glossary-f.html#$FLIGHT%20LEVEL

will assign to included flights, and the maximum delay assigned to any flight. If desired, the traffic manager could view the list of included flights, the Expect Departure Clearance Time (EDCT) for each flight, and the amount of delay allocated to each flight if they were to implement that AFP. They may model the AFP multiple times with different combinations of parameters until they find a set of parameters that seems to hit the "sweet spot" between controlling demand relative to the weather-restricted capacity without imposing too much delay while equitably assigning delay to flights.

While developing the AFP, traffic managers also need to consider how confident they are in the weather forecast, how NAS users might respond to the AFP, and what alternate strategies they should keep in mind in case the weather or other aspects of the operation turn out differently than they expect. For example, if the weather moves through the constrained area faster than forecasted, they may need to change the start/stop times and program rates. If too many NAS users choose routes that avoid the AFP, other congestion problems may occur in different parts of the airspace.

To prevent congestion caused by too many NAS users planning routes that avoid the AFP, the traffic managers think about what alternate routes NAS users might choose and the likely impact of the weather on those routes. If the weather is likely to impact the NAS users' likely alternate routes, the traffic managers consider what time those impacts are likely to occur to set up triggers for decision making. With the AFP based on the ZJX7 FCA, flights that route around the AFP to the east will pass far enough over the ocean to require specially equipped aircraft for overwater routes; this will create a natural limit on the number of flights that can take that route.

The traffic managers decide that these natural limits are likely to prevent congestion on alternate routes, and so required routes are not needed at this time. However, they want to have a contingency plan at the ready in case there are too many flights that route out of the AFP. During the planning webinar, they communicate to NAS users and other webinar participants that if they encounter too much congestion on alternate routes, they will create a set of required routes for flights to Florida based on the "Midwest to Florida" and "NE to Florida" Playbook routes.[2] If required routes are needed, traffic managers will use the Playbook routes as a starting point, but they will adjust portions of the route as needed based on weather forecasts of impacted areas. As the planning day goes on, the traffic managers will adjust the potential required routes as needed.

When the ATCSCC traffic managers agree on a strategy to manage the weather situation, they use FMDS to share the proposal with affected facilities (ARTCCs like Jacksonville [ZJX], Miami [ZMA], Atlanta [ZTL], Houston [ZHU], and Washington [ZDC]). The message from FMDS includes all the proposed TMIs and their parameters so that other users can easily model the proposed TMIs on their local FMDS display. Affected facilities consider how the proposed TMIs will affect demand in their airspace. They might use one or more Flow Evaluation Areas (FEAs) to see how many flights delayed due to the AFP will interact with other flights (not included in the AFP) that are traversing their airspace.

The ATCSCC briefs the strategy during each planning webinar, held every two hours. The traffic manager displays the weather and explains the modeled results to webinar participants, allowing them to see the constraints driving the traffic manager's plan and to provide feedback. Based on the analysis above, the ARTCC traffic managers may suggest amendments to the proposed AFP and required routes, or make

[2] https://www.fly.faa.gov/PLAYBOOK/pbindex.html

other suggestions to the ATCSCC traffic managers for modifications to the strategy to reduce the impact on operations in their airspace.

AFP Strategy Execution

After the planning webinar, the ATCSCC issues an advisory for the AFP that provides all the program information (see Figure 3), including the program parameters and modeled results. Program parameters include the applicable-altitudes, start and stop times, ARTCCs included, and the "program rate," which specifies the number of aircraft that can be scheduled through the FCA each hour.

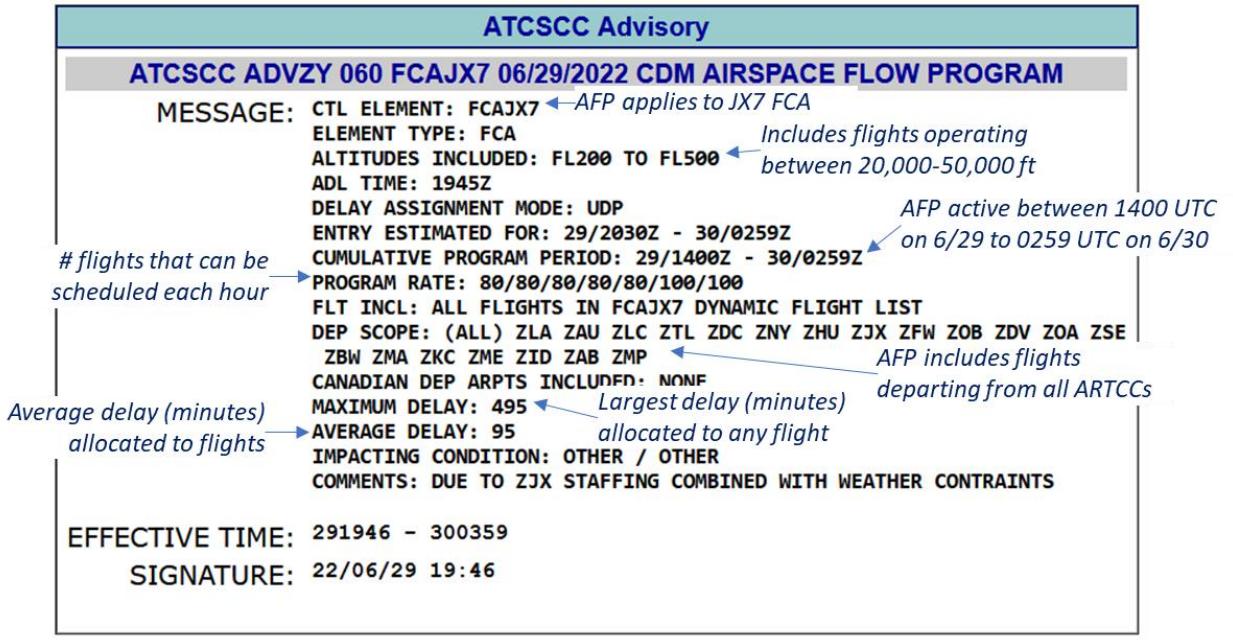

Figure 3. Advisory Initiating the AFP

Traffic managers at other facilities, NAS users, and other interested parties receive and view the advisory and incorporate the information about the AFP into their operations planning for the day. Traffic managers at one or more ARTCCs might implement additional TMIs to manage traffic flows to the AFP and/or to manage constraints within their airspace (like weather). All TMIs that impact neighboring facilities must be coordinated through the traffic managers working at the ATCSCC, who are looking to prevent local TMIs from affecting distant traffic flows and other unintended consequences.

For example, if an ARTCC implements a miles-in-trail (MIT) restriction on a neighboring facility, that neighboring facility may, in turn, have to impose a "passback" MIT restriction on its neighboring facility, and so on. Suppose that ZTL traffic managers request that their upstream facility, ZID, provide 25 MIT on aircraft heading to airports in ZJX. ZID traffic managers review the request and consider the impact on traffic flows within their airspace, but ATCSCC traffic managers also review the request to consider the impact on traffic flows across the NAS. If ATCSCC traffic managers anticipate that the impact will be widespread, they may use FMDS to reject the request or request a teleconference with all the relevant facilities to negotiate changes to the restriction.

AFP Monitoring

Throughout the AFP event, traffic managers at the ATCSCC and ARTCCs monitor the weather forecast, traffic volume through the AFP, and what routes NAS users are filing that might be trying to avoid the AFP and causing congestion. They monitor the number of flights that fly through the AFP each hour compared to the number of flights that were scheduled to fly through the AFP. They also monitor changes in the number of flights predicted to fly through the AFP each hour as flights depart and FMDS updates their predicted trajectories and arrival times.

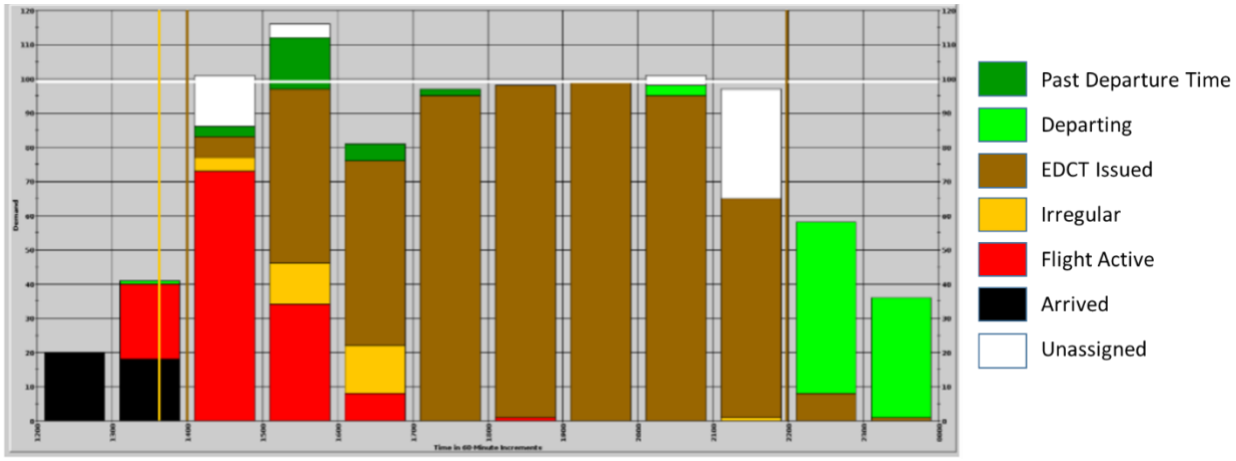

Figure 4. Example Bar Chart Showing Changes in Demand Relative to Program Capacity

Traffic managers resolve excess traffic demand by adding and modifying TMIs as necessary. They consider whether they need to implement the contingency routing strategy they developed earlier to manage the traffic and weather as it has developed. They use FMDS to share the information needed to coordinate these TMIs and log all their actions to support post-event analysis. When they make changes, traffic managers consider the impact of changes to NAS users, who must adapt their operational plans every time the TMIs affecting their flights change.

The processes described above are continually reviewed and updated throughout the severe weather event. The ATCSCC has the responsibility for monitoring the overall AFP “big picture.”

AFP Conclusion

Near the end of the AFP event, the ATCSCC traffic manager monitors the diminishing weather and traffic volume, while receiving updates from ZJX indicating that the weather that was impacting air traffic has diminished enough to cancel the program. ZJX traffic managers report that there are fewer large cells of heavy precipitation on the weather display (i.e., echo tops are lower) and aircraft are not deviating quite as much to avoid the weather.

When the ATCSCC traffic manager cancels the AFP, FMDS purges any remaining EDCTs and publishes the updated flight information. NAS users receive the cancellation advisories and adjust their remaining flights accordingly. To manage any pent-up demand, they might include other TMIs like MIT to prevent everyone from taking off at once and creating new bottlenecks.