Primer on TFMS Trajectories

At its most basic level, the Traffic Flow Management System (TFMS) is a giant demand calculator. Air Traffic Flow Management's (ATFM's) task is to balance demand with capacity and as such, a demand calculator is essential in that equation.

TFMS can store flight schedules up to 11 months in advance of the current day; however, most of the time all that is supplied with the flight schedule is the city pair, scheduled block times and type of aircraft. TFMS must infer the flight's trajectory.

TFMS uses all known data as soon as it comes into the system to constantly update and refine the trajectory. The typical sequence is outlined below.

1. A schedule is known.
2. Starting ~23 hours in advance of the scheduled departure time, TFMS calculates a trajectory. To do so, it uses the previous 168 hours (7 days) of flights operated by that carrier between the scheduled city pair by the scheduled type of aircraft. It uses the trajectory flown the majority of the time for flights that meet the above criteria. This works well for most city pairs, but a flight that only operates once a week may not have any data for TFMS to use as there were no flights operated during the previous 168 hours from the scheduled departure time. If there is no available historic flight, then TFMS does the only thing it can and model the route direct between the city pairs.
3. As time goes along, the airline submits updates to TFMSs knowledge about a particular flight. The following are all additional CDM data elements that can update the TFMS trajectory, making it more accurate.
    a. CDM time field submissions (LGTD/LGTA, LRTD/LRTA, PGTD/PGTA etc) – these update the time of the trajectory, but if this is all that is submitted, TFMS still does not have any more knowledge about the trajectory. These just adjust when it starts and ends.
    b. CDM Early Intent – This is how the flight operator can replace the TFMS Historic Modeled Route with additional information. The Early Intent message updates the TFMS trajectory with airline supplied information on route, altitude, speed etc.
    c. Trajectory Option Set(s) – A TOS also updates the TFMS Trajectory. In the event of a multi-line TOS, the least cost TOS option is used. If a CTOP is actually implemented, then the awarded TOS is used for the route.
    d. A Required Route is issued that captures the flight – this can have two different capturing mechanisms. The TFMS trajectory is updated to the required route if the flight is captured by either type of Required Route.
        i. A City Pair based route will capture flights that operate between the city pairs during the timeframe of the route (based on Estimated Time of Departure)
        ii. An FCA based route will capture flights that cross the line in space that is defining the constraint. If the TFMS trajectory crosses that FCA then the flight is included.
    e. The flight plan is filed – Now TFMS has a comprehensive trajectory with route, altitude, speed provided by the flight operator.
    f. Flight departs – now TFMS uses the current cleared route, reported altitude, and position reports from ERAM to constantly update the trajectory.

Note: For items a. through e. whatever data comes in most recently is used to keep the trajectory current. So, an Early Intent after a TOS will remove the TOS data from the trajectory calculation and the Early Intent data will be used. Likewise, a Required Route will replace the filed flight plan route with the required route, but only for the route of flight, speed and altitude from the flight plan remain unchanged.

How do I know what the most recent update to the trajectory is?

The ETD prefix in TFMS (FSM, Dynamic FEA/FCA Lists) tells you the state of the flight in TFMS.

- If the ETD prefix is "S" then TFMS only knows it is a scheduled flight and the trajectory is the historic modeled route
- The ETD prefix "L" indicates that airline times have been received, but the trajectory is still the historic modeled route
- The ETD prefix "N" indicates an early intent or TOS is being used
- The ETD prefix "P", "T" or "M" indicates a flight plan is being used
- The ETD prefix "A", the trajectory is being updated with live amendments and position reports.

How can an airline use this knowledge to keep their TFMS trajectory current?

1. Submit CDM Early Intent or at least one TOS for a flight. Since the CDM Flight Create (FC) and Flight Modify (FM) messages do not affect the trajectory, these are of no value in this discussion and the Early Intent or TOS is the method to provide the intended trajectory.
2. Submit a Flight Plan. For example, an analysis of 9/29/2022 ORD departure flight plans show that one flight operator submitted flight plans on average 1 hour, 13 minutes before the P-time. Another operator submitted flight plans on average 2 hours, 56 minutes before the P-time. In the absence of Early Intent or TOS, the operator who submitted earlier flight plans will have more flights with accurate trajectories.

AFPs and Trajectories

Wherever the trajectory is in its lifespan when the AFP is issued will determine how well that flight is served by the AFP.

If it is a once a week flight and the flight operator has not filed a flight plan, nor submitted an Early Intent nor TOS, the flight could miss the AFP entirely and then become pop-up demand.

If an entire string of prior days of consistent bad weather cause the historic modeled route to be dissimilar to the desired route, then again a flight could be excluded from an AFP and then become pop-up demand once the flight plan is filed, or Early Intent (EI) or TOS is submitted.

Opportunities for improvement

TFMS - TFMS can tweak the parameters so that the once a week flights have a better chance of not showing a direct route by increasing the parameter to greater than 168 hours. This will prevent some flights from being modeled on direct routes.

Flight Operators – use the knowledge presented here to control your own destiny by using the tools CDM provides in the form of EI or TOS to update your trajectory, or file your flight plans early enough for inclusion in an upcoming AFP.