

# Airspace Flow Programs

## Collaborative Decision Making – Flow Evaluation Team

15 September 2005

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### Introduction

While working towards better ways to manage en route congestion in the NAS, the CDM community has long recognized the potential value of a capability to apply strategic departure control to flights while still on the ground. In particular, the community has long sought the ability to

- Identify a constrained NAS resource, such as a fix, a sector or a region of airspace,
- Produce a real-time list of flights that are expected to use that resource, and,
- Create and distribute controlled departure times for those flights to bring demand in line with the capacity of the resource.

Many potential applications of such a system have been suggested, with the most attention given to using this as a component of Severe Weather Avoidance Procedures (SWAP).

A number of significant barriers, however, have historically blocked progress towards this goal. But recent new capabilities and structural improvements in the CDM suite of tools have now opened the door to the development and deployment of such a capability. In particular,

- The Flow Evaluation Area/Flow Constrained Area (FEA/FCA) capability now provides a means for traffic managers to precisely identify a set of flights they wish to be controlled based on the en route resources they use,
- The ETMS hardware refresh provides the hub site with the computational power needed to support the data demands of a major new project, and,
- The conversion of the Flight Schedule Monitor (FSM) into Java gives it the flexibility and versatility to expand its monitoring and management of groups of flights beyond a list of airport arrivals.

### AFP Concept Overview

Serious discussion of the potential for the near-term deployment of such a system began in the fall of 2004. A general approach was first defined, and responsibility for resolving operational details and identifying a feasible path to deployment was given to the Flow Evaluation Team (FET), a newly formed subgroup in CDM combining the functions of the IRT and FCA/Reroute workgroups. The capability resulting from this program has been named the Airspace Flow Program (AFP).

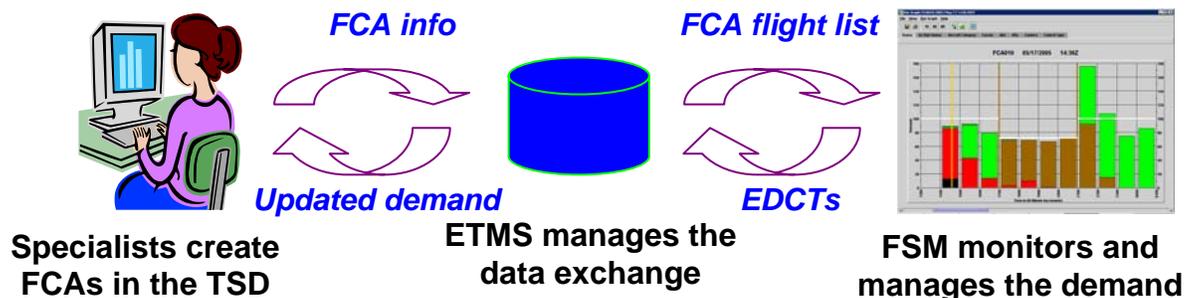


Figure 1. AFP Schematic

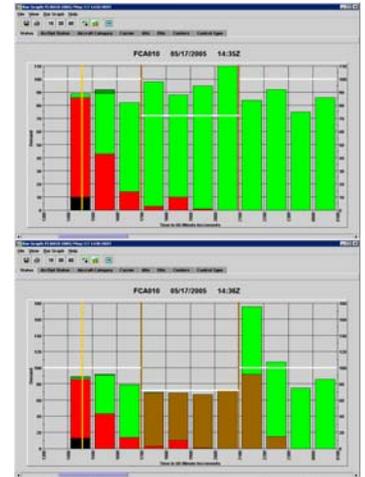
The foundation of the AFP program is an integration of the FEA/FCA function of the Traffic Situation Display (TSD) with FSM. In the operational concept, Traffic Management Specialists, after consultation with the field Traffic Management Coordinators and customers, will create an FEA or FCA in the TSD. The FEA/FCA could be a polygon, a line, a sector, or a box. If the FEA/FCA is designated as 'FSM-eligible,' then ETMS will begin to generate an Aggregate Demand List (ADL), containing

detailed information about every flight expected to be part of that FEA/FCA for its duration and several hours afterwards. Anyone with an FSM connection can then choose to monitor that FEA/FCA as he would an airport. FSM will provide a variety of views of the projected demand in the FEA/FCA for the period of interest. ETMS will revise the flight list every five minutes based on flight changes, so the picture presented by FSM will remain current.

## Program Execution

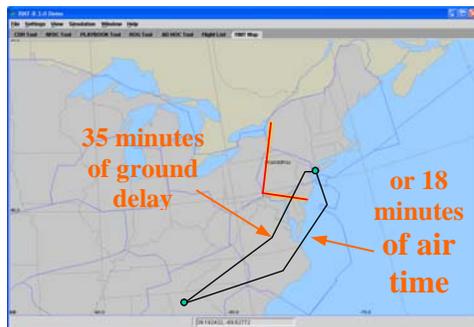
When the demand in the FEA/FCA is projected to substantially exceed capacity, the specialists at the ATCSCC can issue an AFP for the constrained resource. (An FEA must be converted to an FCA before an AFP can be executed.) This will be similar to issuing a GDP for an airport. The primary steps in the process are:

- The specialists will specify a program rate (flights per hour), the duration of the program, and any appropriate flight exemptions,
- FSM will generate a list of entry times, or slots, consistent with the specified rate,
- These slots will be allocated to flights expected to enter the FCA in a manner consistent with the philosophy of Ration by Schedule (RBS),
- For each affected flight, the estimated time from departure to entry into the FCA will be computed based on the flight plan,
- This transit time will be subtracted from the slot time to produce an Estimate Departure Clearance Time (EDCT) for the flight,
- The EDCTs for each flight will then be sent to the centers and towers for action, to the operators of the flights for their schedule management, and to ETMS to maintain a consistent tactical picture.



## Response to Changes

It is well recognized that predicted demand in the airspace changes rapidly and substantially, even more so than for airports. In addition to popup traffic and cancellations, changes in routing can affect the flights expected to use an en route resource. Accordingly, much of the design emphasis for AFPs has been on responding effectively to change.



If a flight gets caught up in an AFP and is assigned an EDCT, its operator may have alternatives to just waiting out the delay. If there is another route available that would take the flight out of the FCA, and the effective extra cost of flying the route is less than the cost of the delay, the operator can refile the flight plan. ETMS will recognize that the flight is no longer in the program and lift the assigned delay. These actions benefit the operators, as they have options to better meet their business needs, and they benefit the community in that the demand for a constrained resource is reduced. In certain circumstances the

operators will retain ownership rights to entry slots vacated by reroutes, which will give that operator extra benefit in the event of a compression (see below).

If an uncontrolled flight enters an AFP, either as a flight new to ETMS or due to a change in route, the flight will be treated as a popup. It will be assigned a departure delay consistent with the delay received by other flights that had wanted to enter the FCA at about the same time. This is known as a 'Fuel Advisory' or FA delay.

In some cases the number of popup flights may substantially exceed the number of drop-outs due to



rerouting and cancellations, and the demand may grow to the point where it again exceeds capacity. When this happens the ATCSCC may revise the program. In such a revision, recomputed entry slots are assigned to flights in the order of their current assigned entry time, and the demand is again spaced out to meet the capacity. Revisions may also be issued if the projected capacity of the FCA or the time the program must be imposed changes.



In some cases the number of flights that drop out of the FCA through cancellations and reroutes will substantially exceed the number of popups, and demand will fall below the expected capacity. In such cases the ATCSCC can compress the flights in the FCA. In a compression entry slots are redistributed so that flights that are able will be moved earlier in the

program, with the associated delay reduction. In most cases operators that have contributed to the reduction in demand by cancellations and reroutes will benefit the most from the compression under the principles of RBS.

If the expected demand falls well below capacity, or if the weather event that necessitated the AFP dissipates, then the program will be cancelled and all EDCTs will be lifted.

## Managing Multiple Programs

Typically inclement weather affects more than a single area, and the ATCSCC will have to implement multiple TMIs, including multiple GDPs and AFPs. Flights may fall under the province of more than one such initiative. To manage such instances a set of precedence rules have been established.

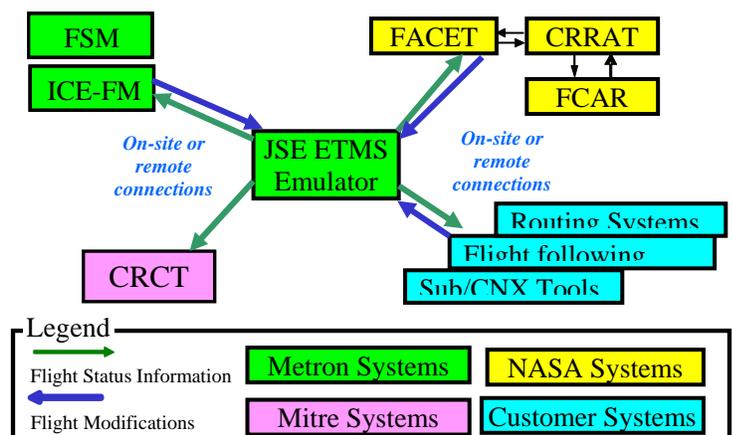
Airport GDPs will always have the highest precedence. If an airport GDP is imposed or revised, any control times assigned to flights from AFPs will be ignored and overwritten. When an AFP is executed any flights already controlled by a GDP are exempted, and their control times are not changed. Since no flight can be involved in more than one GDP no precedence rules among GDPs are required.

If a flight passes through multiple FCAs with active AFPs, the basic rule is that the first AFP to control the flight has precedence. That is, if, when an AFP is executed, a flight already has a control time set by another AFP (or by a GDP), the flight is treated as exempt in the second AFP and its control times are not changed. This is to minimize the disruption to existing programs that a new AFP may cause.

Sometimes, however, an acute need to control flights in an FCA may be recognized, and a new AFP may take precedence over any existing ones. This is known as an override AFP. An override AFP will ignore and overwrite the control times set by any other AFPs. (Control times set by GDPs, however, will not be changed.) After the execution of an override AFP traffic managers will reexamine the status of the other programs, to see if any adjustments there are now needed.

## Human in the Loop Simulations

AFPs mark a significant new step in en route traffic management and the community



is making every effort to ensure that the deployment will be successful from the start. A critical dependency for that success will be whether AFPs are employed in the right circumstances and whether effective and manageable procedures are applied. To help ensure this, an extensive simulation system, the Integrated Simulation Environment (ISE), has been developed to support Human-in-the-Loop (HITL) testing of the system and the associated procedures.

The ISE integrates decision support tools from several research organizations to provide a rich and realistic environment to explore the performance and behavior of the AFP concept. It will be used extensively through the fall by a combination of ATCSCC specialists, representatives from the field, and a variety of customers to develop a set of procedures for the application that are effective and acceptable to all parties. The software needs for later releases of the capability will also be identified in the HITLs.

## ***A Phased Approach to Deployment***

Throughout the design process, the emphasis has been on the integrating and reusing existing capabilities rather than designing new ones. This has the benefits of

- Minimizing development effort and risk,
- Maximizing continuity and familiarity for customers and service providers, and,
- Providing a better path for the eventual integration of TFM initiatives in different domains.

The first release of the AFP capability is scheduled for April of 2006, in ETMS 8.2. Under the phased deployment model this first release AFP will have only limited scope, to minimize risk and increase the likelihood of a successful deployment. Many desirable features and functions will be deferred until later releases. Experience gained through the HITLs and the first season of deployment will identify and prioritize the capabilities for the future.

## ***Contact Information***

Further information on the AFP programmatic may be obtained from

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