Current terminal airspace operations consist largely of controllers vectoring aircraft from the end of Standard Terminal Arrival Routes (STARs) to the final approach and vectoring aircraft from the runway to the beginning of Departure Procedures (DPs). Vectoring often causes large variations in the flight times of aircraft in the terminal area. These large variations frequently lead to aircraft flying extended paths in the terminal area, resulting in additional time and fuel. The flight time variations also result in reduced schedule predictability for users, leading to poor on-time performance, disrupted bank schedules, and passenger delays. Aircraft that are Flight Management System (FMS)/Area Navigation (RNAV) equipped can precisely navigate point-to-point without flying directly over ground-based navigation aids. Because of this, the use of FMS/RNAV-based arrival and departure procedures can help alleviate some of these problems. The operational benefits of terminal RNAV routes include reduced air/ground communications, improved schedule predictability, reduced flying time and potential fuel savings, and improved situational awareness for controllers and pilots.

The Federal Aviation Administration (FAA) and the airline industry are making a concerted effort to develop FMS/RNAV procedures in the terminal airspace. The MITRE Corporation’s Center for Advanced Aviation System Development (CAASD) has supported this effort at a number of major airports that include:

- Philadelphia
- Houston
- JFK
- Newark
- Dulles
- Boston
- Charlotte
- Detroit

CAASD’s support includes facilitation of the implementation process and engineering support for the design and implementation of RNAV routes. To aid the facilitation and engineering support, CAASD developed a software tool to assist with procedure design and assessment. The tool also has capabilities that include traffic visualization and simulation of the terminal area. These capabilities were designed to support controller familiarization with a new procedure and operational assessment. CAASD’s visualization and simulation capabilities coupled with a streamlined implementation process have already led to the fast-track field trials of RNAV-based routes at the airports mentioned above.

Terminal RNAV Procedures Implementation Process

Advanced RNAV systems are already installed aboard a majority of high performance aircraft. These systems provide for predictable vertical and horizontal flight tracks and are available for use today. In order to take advantage of these capabilities, a clear process was required for the FAA and RNAV implementation teams to use when creating terminal procedures. CAASD helped codify a repeatable process that identifies participants, defines project goals and timelines and a tasking sequence to successfully design, test, and publicly chart terminal RNAV procedures. This process was developed collaboratively by stakeholders such as FAA Headquarters, FAA regions and facilities, NATCA, airlines, charters, CAASD, and others. As this process has been applied to additional airports, geographic and airspace diversity has provided lessons learned and validated the applicability and repeatability of the process.

TARGETS

CAASD, under sponsorship of the FAA, developed the Terminal Area Route Generation, Evaluation, and Traffic Simulation tool or TARGETS. This tool offers a unique combination of capabilities for RNAV procedure design, flyability assessment, and air traffic control/operator assessment through simulation.

Route Design Capabilities

The route design functionality of TARGETS includes the ability to display navigation aids, runways, and topographic data, and to overlay multiple reference maps, including the site’s video map. The user can easily create and modify a route with the TARGETS design toolset by selecting desired waypoints located on the map using the point-and-click method to connect waypoints. Alternatively, the waypoints can be entered directly in tabular form and then displayed. Similarly, the user can enter speeds, altitudes, and turn types associated with the waypoints. Projections and range rings allow for precise distance measurement and accurate waypoint placement with all calculations.
done using standard reference frames. Blocks of airspace can be designed for special consideration during the design process and annotated for collaboration with other members of the implementation team. To visualize current terminal traffic flows, the user can import, filter, and display recorded radar track data.

Traffic Simulation

An essential component to RNAV procedure development is assessing impact on current operations. The TARGETS simulation tool can be used to play back recorded traffic and then to script traffic to fly the proposed RNAV route(s) and assess impact on operations. The traffic simulation capability can be used to assess air traffic control compatibility, which is crucial to procedure acceptance and use, during the design phase. With the TARGETS scenario builder, recorded radar track data can be used as a basis for realistic traffic modeling, or, if desired, new traffic flows can be created from any point or route. The level of RNAV equipage is easily defined to simulate mixed equipage flows. Users may interact with various aircraft by issuing vectors or clearing aircraft to fly the RNAV routes. Aircraft can also be cleared to fly direct to any waypoint on the RNAV route, or vectored off a route. The drag-and-drop control lines of TARGETS are effective tools for simulating controller and/or pilot actions. These control lines support filtering of aircraft based upon such useful categories as aircraft type, equipage, carrier, and identification. Speeds, headings, and altitudes can be assigned or aircraft cleared to join the new routes or instrument landing system approaches with control lines. Lines can also be hidden to create a simulation which has unexpected aircraft behavior or procedure compliance. Once the simulation is built, it can be run in real or fast time through an intuitive interface for operational assessment.

Flyability Assessment of Route

Flyability assessment is an integral part of the design process. Once a route is defined, its flyability is tested with user defined aircraft performance data and wind conditions. Early identification of flyability problems reduces the risk of encountering such issues when a proposed route is flown in a costly, high fidelity simulator or when the route undergoes flight check during certification. TARGETS allows the user to specify altitude dependent aircraft performance and wind profiles along with simple assignment of speeds and altitudes to waypoints for a flyability check. Immediate feedback on flyability, with specific identification of problem segments and drag-and-drop simplicity, assure easy modification of routes when required.

For more information contact:
MITRE Technology Transfer Office
The MITRE Corporation
7515 Colshire Drive
McLean, VA 22102-7508
Phone: 703.883.6053
E-mail: techtransfer@mitre.org
www.mitrecaasd.org