National Aeronautics and Space Administration

NASAfacts

Airspace Technology Demonstration 3 (ATD-3)

Applied Traffic Flow Management

What is the problem?

The goal of traffic flow management is to safely and efficiently manage streams of traffic while maintaining throughput. This is challenging during convective weather, which is the leading cause of delay in the National Airspace System.

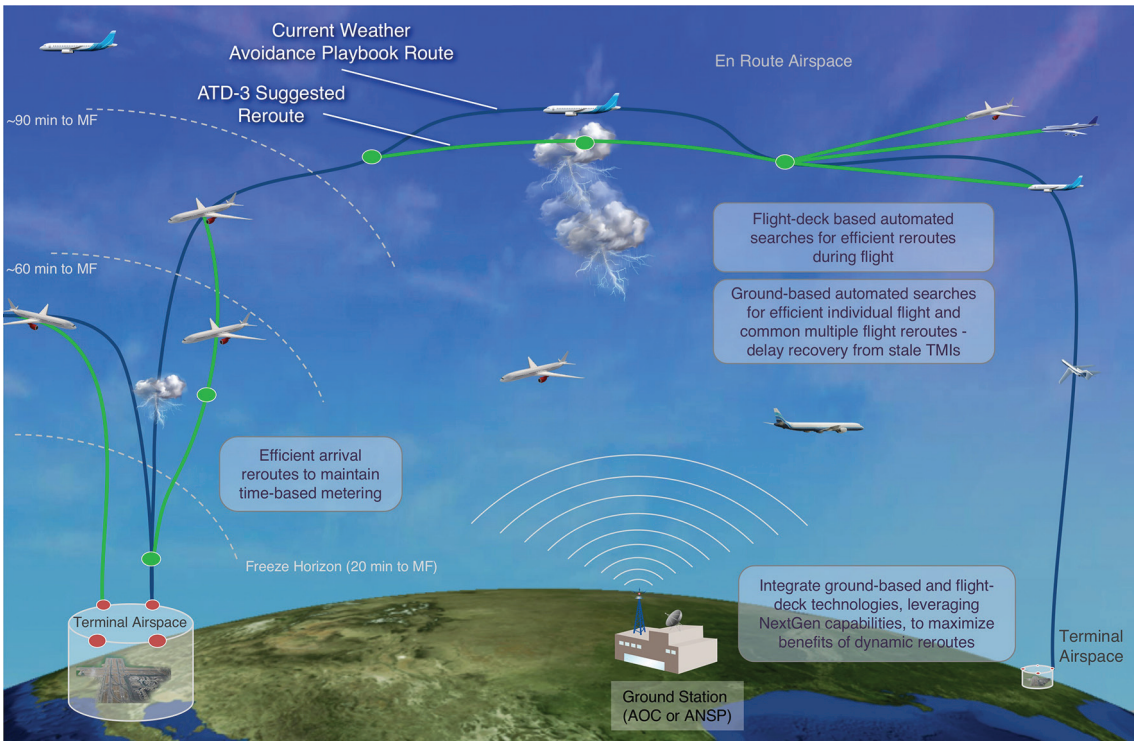
In en route operations, traffic managers apply predetermined reroutes to safely avoid areas of adverse weather or other airspace constraints, and meter traffic when demand exceeds capacity. However, these reroutes can be overly conservative due to uncertainties in forecast accuracy. Consequently, individual flights, and sometimes groups of flights, often remain on inefficient routes even after convective weather has dissipated or moved away, thereby reducing throughput and incurring costly and unnecessary delays, fuel consumption, and emissions. Currently, there is no automation to help operators identify workable opportunities for time- and fuel-saving corrections to weather avoidance routes that have become stale due to changing weather and forecast uncertainty.

In arrival operations, the FAA's terminal-area metering tool facilitates efficient traffic flow when arrival demand approaches or exceeds airport capacity. However, during hazardous weather events, arriving aircraft routinely deviate from standard routes. Such deviations undermine the ability to efficiently manage the arrival traffic flow. In response, controllers must revert to manual procedures that greatly increase flight delays and workload.

What is NASA's solution?

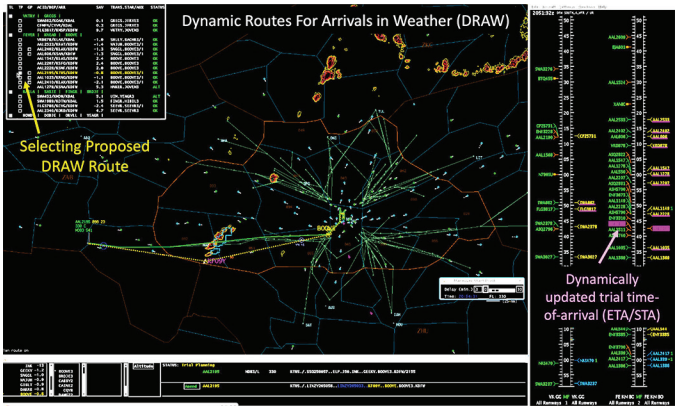
NASA is developing an operational concept, called *Airspace Technology Demonstration 3 (ATD-3)*, that will improve efficiency and throughput in the en route and arrival phases of flight. ATD-3 integrates ground and flight deck technologies that continuously seek and identify more efficient routes around adverse weather and other airspace constraints. NASA will demonstrate the ATD-3 automation technologies to enable air traffic service providers and airspace users to identify, evaluate, and implement workable opportunities for dynamic flight plan route amendments that can result in significant flight time and fuel savings.

The ATD-3 en route solution, Air/Ground Integration (AGI), can reduce delays by proposing more efficient reroutes through the airspace, while accounting for dynamic weather, traffic, and other airspace constraints. AGI includes ground-



Operational Environment for the ATD-3 Concept

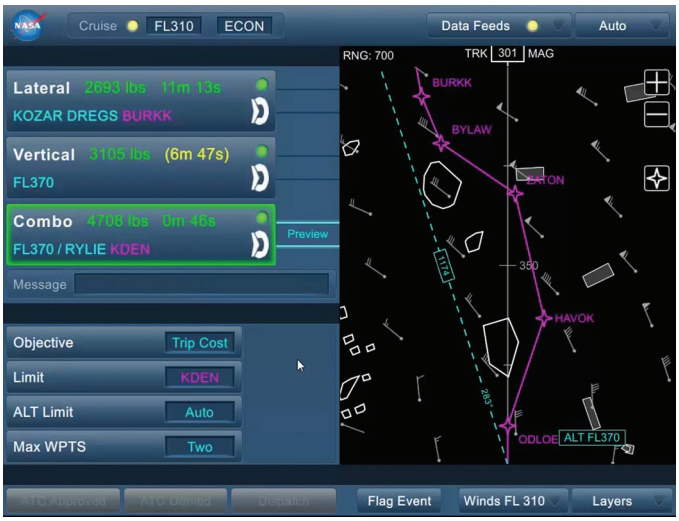
NASA researchers conduct a human-in-the-loop “shakedown” evaluation of the MFCR tool in the NASA Ames Air Traffic Control Laboratory.



The DRAW display showing traffic and weather, along with other efficient arrival routes.

and flight-deck-based components and streamlines the coordination between dispatcher and pilot.

The ground-based component of AGI, Multi-Flight Common Route (MFCR), generates dynamically tailored time- and fuel-saving reroutes and searches for flights that could benefit from these advisories. MFCR advisories can benefit multiple flights on a common trajectory around a constraint, such as adverse weather, and balances potential fuel/time savings with air traffic controller acceptability to achieve the best compromise for the group of flights.



TASAR enables flight crews to identify and request more efficient routes that reduce fuel and/or flight time, and avoid interactions with traffic, weather and restricted airspace.

The cockpit-based component of AGI, Traffic Aware Strategic Aircrew Requests (TASAR), searches for more efficient routes using data available onboard the aircraft. It leverages flight management system and onboard weather radar, wind, and traffic data to identify wind-optimized routes and altitudes that save time and fuel. TASAR provides additional opportunity for optimization and provides benefit for equipped flights. TASAR is anticipated to improve flight schedule compliance, passenger comfort, and reduce pilot and controller workload.

The ATD-3 arrival solution, Dynamic Routes for Arrivals in Weather (DRAW), dynamically reroutes impacted flights and balances arrival demand across meter fixes so that metering operations can be sustained through adverse weather events, thus maintaining throughput and reducing delays during most delay-prone conditions. If weather is impacting only a portion of an arrival route, the system can identify minor route changes that enable aircraft to deviate around weather and return to the currently active arrival route or DRAW redirects them to the next most efficient arrival fix that is free of weather.

Projected benefits

Initial projections from the ground-based system, for 20 en route control centers, indicate a potential annual savings of 135,000 minutes of flying time and 4.2 million pounds of fuel. These data are based on the 60 worst delay days in 2014 and 2015 across all flight operators. The preliminary analyses of partner-airline fleet operations, from the cockpit-based system, indicated average fleet-wide savings potential of 2.8 minutes and 28 pounds of fuel per flight. These can result in several million dollars of annual cost savings for the airline.

Next Steps

The planned demonstration of the Air/Ground Integration technology will be on revenue flights of a US airline. Currently, the ground-based component of AGI is under testing at the American Airlines Integrated Operations Center in Fort Worth, TX. The cockpit-based component of AGI is currently being installed on three Alaska Airlines aircraft and will start evaluation in the fall of 2017. ATD-3 technologies are slated to be incorporated in the FAA operational infrastructure and are planned to be integrated into airline operations.

For more information on Airspace Technology Demonstration 3, please visit **www.aviationsystems.arc.nasa.gov.**

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