Innovations in Aviation Flow Management

REDUCING CONGESTION AND INCREASING CAPACITY
Introduction

With passenger volumes rising steadily, the global aviation system is facing a challenge: How to accommodate more air traffic when politics and economics make it difficult to expand airports on the ground.

Technological innovations are no longer nice-to-have but a necessity. New software solutions are enabling airports and airlines to manage the flow of air traffic from takeoff to landing, dynamically adjusting journeys in the air to minimize delays.

Innovations in aviation flow management are key to making air traffic flow faster, smoother, and more environmentally friendly.

FLYING THE CONGESTED SKIES

The International Air Transport Association (IATA) predicts that we can expect to see passenger rates grow from around 3.2 billion in 2016 to more than six billion by 2036, representing nearly a 100 percent increase in traffic load. Not surprisingly, the Federal Aviation Administration (FAA) projects that, with steady traffic growth, delays will continue to grow through 2030. The FAA predicts that 12 airports in the United States alone will have 'significant' congestion, with 11 of those reaching severe levels.

Under the FAA’s model, significant congestion means a delay of seven minutes per flight or greater with delays affecting more than 30 percent of hours at the airport between 0700 and 2259. Severe congestion means delays of 15 minutes affecting 50 percent of hours in that time window.

Increased traffic volumes aren’t the only challenge facing stakeholders in the aviation industry. Weather impacts continue to present problems — heavy winds can limit the number of available runways, and in certain parts of the world, air quality issues affect visibility. This impacts aircraft arrivals and departures and makes it necessary to increase spacing between aircraft.

An increase in poor weather conditions also promises to ground more aircraft over time. In the Summer of 2017, airlines were forced to ground dozens of flights in Phoenix as extremely high temperatures thinned the air at ground level, making it more difficult for smaller jets to generate enough lift. This creates heavy congestion as airlines struggle to fit passengers aboard already overbooked flights.

All of this has an adverse effect on capacity management at a time when traffic volumes are not only increasing, but also becoming more complex. The increasing size and weight of commercial airliners has led to a 'super-heavy' weight class for an aircraft such as the Airbus A380. These have their own unique flight characteristics, including wake turbulence envelopes that controllers must factor into the flow of air traffic.
PILOTING A PATH FORWARD

These developments make life increasingly difficult for the airlines, airports and air traffic management stakeholders who are charged with keeping aircrafts moving smoothly and safely through national and oceanic airspace.

Simply building more runways is not always an option. Opposition from local residents and environmental groups combined with public policy and budgetary issues make such expansions difficult.

Leidos has been working closely with stakeholders in the aviation industry to introduce innovations that can drive efficiencies in the aviation flow management ecosystem. One area in which we’re delivering next-generation technology is Time-Based Flow Management (TBFM).

TBFM is a time-based scheduling tool that monitors aircraft through all stages of flight. Enhancing the legacy Traffic Management Advisor (TMA) system, TBFM uses software logic and metering points further out from arrival airports to improve air traffic scheduling. It enhances arrival slot calculations for aircraft, helping to provide an optimized sequence while minimizing total delay. The FAA has documented capacity increases of three to five percent, and reductions in no-notice holding.

In TBFM, as aircraft travel through the en route air space that lies between airport approaches and departures, en route controllers are beginning to use Ground-Based Interval Management Spacing (GiM-S) to monitor aircraft and adjust their speed accordingly.

If bad weather changes conditions at the arrival airport, en route controllers can instruct aircraft to slow down earlier in their journey, minimizing extended flying times at lower altitudes after entering terminal airspace.

TBFM combines this GiM-S technology with Integrated Departure and Arrival Capability (IDAC) systems that better enable airports and airlines to coordinate departures and arrivals over congested terminal airspace.

All of these systems support a big step forward for the aviation industry by helping to route aircraft more efficiently in national airspace.
There’s still room for innovation at both ends of the TBFM value chain. One technology we have developed is International Traffic-Based Flow Management (iTBFM), which makes TBFM easily portable across non-FAA environments.

**TAKING TRAFFIC-BASED FLOW MANAGEMENT GLOBAL**

iTBFM provides recommended flight adjustments to crossing time and delay absorption times. It also provides speed advice at a dynamically adjustable distance from air traffic flow merge points. Receiving adjustments earlier in the flight enables an aircraft to minimize the necessary speed changes, perhaps reducing speed by only a couple of knots.

These small adjustments earlier in the journey reduce the need for larger, more expensive adjustments later on. They put the aircraft at precisely the right time for transition into terminal airspace to begin its approach.

By minimizing holding patterns in terminal airspace, iTBFM saves the airline fuel, and brings efficiency to airports who can manage arriving traffic even more smoothly. It also reduces their workload, since they are getting a more steadily-space flow of aircraft.

**INTELLIGENT APPROACH**

A combination of advanced technologies and ATC expertise allows airports to remain resilient and provide runway capacity with a concept we call Intelligent Approach. One element of Intelligent Approach is Time-Based Separation (TBS), which offers a way to get aircraft on the ground safely without losing time in adverse wind conditions. This new concept changes the separation calculation that planes use for approaching the runway.

Airports have traditionally scheduled aircraft for their final landing approach by allowing a minimum distance between each one, in an approach known as distance-based separation. This distance, under normal circumstances, is set at a minimum of 3 nautical miles, but it often increases far above that based on wind and visibility conditions.

Leidos, working in partnership with NATS, looked more closely at the effect that one craft has on another traveling behind it (a concept known as wake turbulence) and concluded that these calculations could be made based on the time needed between each aircraft rather than the distance.

Each aircraft type has its own wake turbulence profile, in which wind speed plays a part. Leidos determined that controllers could reduce the time between aircrafts by calculating wake turbulence more accurately.

After analyzing years of LIDAR data, we found that as headwinds increase, the risk from turbulent aircraft wake actually decreases. This makes it theoretically possible to land aircraft closer together during a strong head wind.

Using TBS to sustain landing rates in headwinds can lead to substantial time and cost savings at airports. We surveyed historical data from Heathrow and found that over a two-year period, strong winds contributed to a majority of ATFM Delays at Heathrow. Reducing that number would help to make an already excellent airport even more efficient.
OPTIMIZING LANDING WITH TERMINAL SPACING AND SEQUENCING (TSAS)

Intelligent Approach is especially effective when combined with another aviation flow management tool: Terminal Spacing and Sequencing (TSAS). This software helps provide a metered flow of air traffic all the way down to the runway.

TSAS helps to merge various traffic flows into the final approach flows for landing runways, and also enables them to make a more efficient approach using curved path navigation rather than the angular approach patterns used more traditionally. It also provides tools to controllers to merge various streams of traffic into one.

According to the FAA, TSAS can help aircraft to descend in a continuous fashion rather than the traditional stepped approach, reducing fuel burn to rates nearing idle. This can save fuel in a traditionally carbon-intensive industry, offering environmental benefits.

BRINGING INNOVATIONS TO THE SKIES ACROSS THE WORLD

As different countries recognize the benefits of this multi-layered but integrated approach to managing aviation traffic flow, more airspace controllers and authorities are jumping aboard.

Leidos is working at the national and international level to find new traffic optimization opportunities across the world. A combination of international, national and local flow management can help mitigate potential congestion issues for airports in the U.S., Europe and further afield.

Leidos is excited to be at the forefront of the revitalization and renewal of the global aviation system to accommodate a new generation of air travel.
ABOUT LEIDOS

Leidos is a global science and technology solutions and services leader working to solve the world’s toughest challenges in the defense, intelligence, homeland security, civil, and health markets. The company’s 32,000 employees support vital missions for government and commercial customers. Headquartered in Reston, Virginia, Leidos reported annual revenues of approximately $7.04 billion for the fiscal year ended December 30, 2016.