Can Multi-Regional Trajectory Based Operations Reduce Workload Related Aviation Incidents?

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Abstract

Multi Regional Trajectory Based Operations (MR TBO) was developed by Florida NextGen Test Bed (FTB) along with the Federal Aviation Administration (FAA) as a method for enhancing air traffic management (ATM), both domestically and internationally. TBO offers a shift from voice-based exchanges between Air Traffic Controllers and pilots to highly automated, digital communication exchanges.

The purpose of this poster is two-fold:

•First, it explains how TBO can help improve route amendments, speed change, strategic handling of ground events, and sharing & managing multiple aircraft.

•Second, the poster proposes the integration of MR TBO into the National Airspace System (NAS) to decrease the number of incidents caused by high workloads of ATM.

Results of this poster suggest that the operational value of adopting MR TBO extends towards the airlines, pilots, and air traffic controllers. A resulting increase of efficiency and safety can revolutionize the NAS for future generations of the aviation industry.

Current Process

Air traffic controllers (ATC) and pilots are currently using standard phrases and procedures in verbal, radio communication. These exchanges are necessary to properly communicate specific protocols for takeoff and landing. The general steps are listed below:

- Pilot begins communication with ATC and announces their aircraft.
- Pilot obtains clearance from ATC for instructions such as takeoff, landing, or other.
- Pilot acknowledges and complies with ATC instructions/clearance.
- Pilot reports any changes regarding the flight trajectory or emergency situations.
- ATC provides further instructions if required.

Currently, 80% of accidents are due to human factors/human errors. Flights are at greater risk of human error when high workloads inhibit pilot's and ATC's mitigation of risks. Many different factors can affect the workload on pilots and their flight crew. Some causes of high workloads are listed below:

- Congested Frequencies
- Lack of Situational Awareness
- High Traffic Volume
- Assuring Proper Separation

What is Multi-Regional Trajectory Based Operations ?

Constant Updates → • Increased Access

Digital Interactions → • Better Network

Decreased Uncertainty → • Workload Reduction

Multi-Regional Trajectory Based Operations (MR TBO) is a new method of modernizing Air Traffic Management (ATM) to rely on instantaneous digital communication. This will help in the efficiency of predicting and planning traffic movement. The focus on data sharing between aircrafts and ground controllers will reduce workloads associated with complicated ATM. NextGen hosted a demonstration of MR TBO's functionality in June of 2023. The following are instances of MR TBO's capabilities.

Route Amendment

It's common in Air Traffic Management (ATM) for aircraft to deviate from the planned route due to a variety of circumstances; other aircraft, warning areas, weather, etc. With MR TBO, the process for route amendments can be:

- Deviations will be immediately recognized by the mismatch in data from the onboard Avionics Data to the Agreed Trajectory on the pilot's EFB.
- Through 4-DT sharing, the FOC will identify opportunities for a new optimal route trajectory.
- Once identified, both Air Traffic Control (ATC) and the pilots will review the Trajectory Revision Request.
- Upon acceptance, clearance will be submitted electronically, and the new route will be automatically uploaded into the cockpit's FMC.

Route changes can be quickly resolved to obtain new maximized efficiency with minimal workload on ATC and Pilots.

Speed Change

Speed Changes in MR TBO can enable tactical adjustments to be made mid-flight, impacting the current conditions while improving efficiency downstream. An example of the practicality of MR TBO for a speed change is:

- While enroute an aircraft may experience wake turbulence due to another aircraft.
- In response, the flight crew will reduce the speed to avoid the wake turbulence.
- This will trigger a trajectory update to be sent downstream, notifying how the adjustment will alter future waypoints' ETAs.

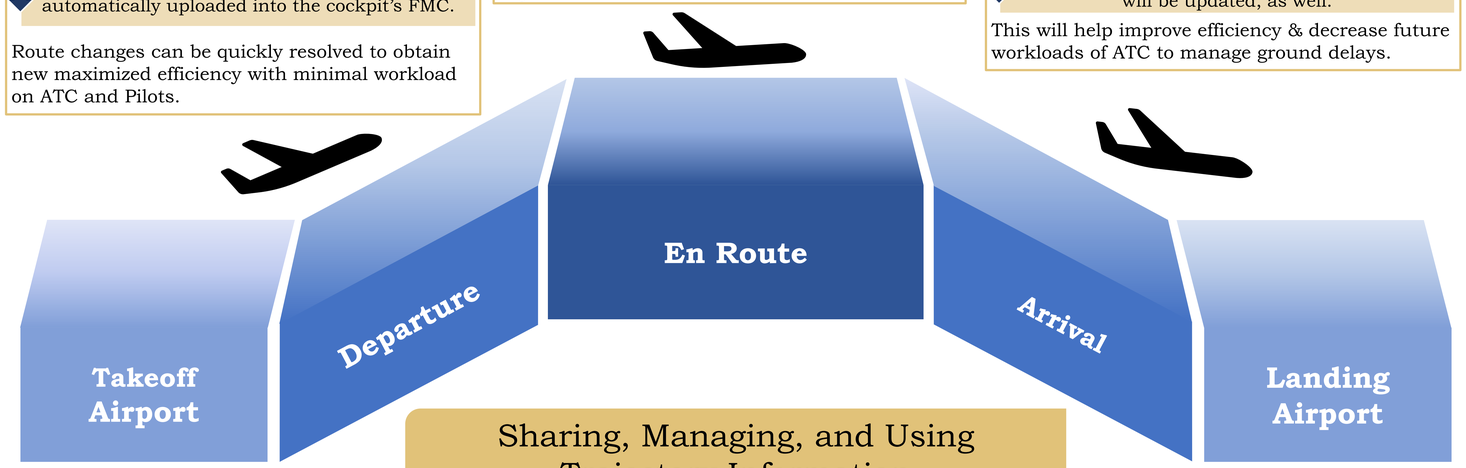
The possible future impact of the speed change can be utilized to anticipate any further necessary adjustments.

Strategic Handling of Events

The continuous transmission of an aircraft's trajectory status will allow for proper adjustments to be made for a strategic handling of a ground related event. An applied example of how MR TBO can help absorb delays is as follows:

- Hours out from arrival, dispatch can predict possible ground delays.
- The optimal speed reduction can be calculated and communicated to ATC, which awaits approval if no conflicts are seen in the feasibility.
- A Revision Request will solidify the adjustment.
- An Agreed Trajectory message will be shared to ATC agencies downstream the aircraft's trajectory path.
- All Estimated Times of Arrival of future waypoints will be updated, as well.

This will help improve efficiency & decrease future workloads of ATC to manage ground delays.



Sharing, Managing, and Using Trajectory Information

The flow of trajectory data in MR TBO is not limited solely between the aircraft and ground operations. A variety of applications in MR TBO allow for information sharing and trajectory negotiation between multiple enroute aircrafts. An example for the use of MR TBO can be shown by an aircraft that's expected to climb by a certain Planned Climb Point:

- From consistent trajectory updates sent by all participating aircraft, the crew can identify their potential to be blocked from their planned climb due to a higher, trailing aircraft that is traveling at a faster airspeed.
- The crew can message the Flight Operations Center (FOC) with a Trial Request to coordinate a climb sooner to assure proper separation.
- ATC will approve the request, allowing a safe climb and downstream controllers to be notified with the adjusted future ETAs.

The seamlessly efficient communication between ATC and other aircrafts allows flight crews to be more proactive in their navigation of the route.

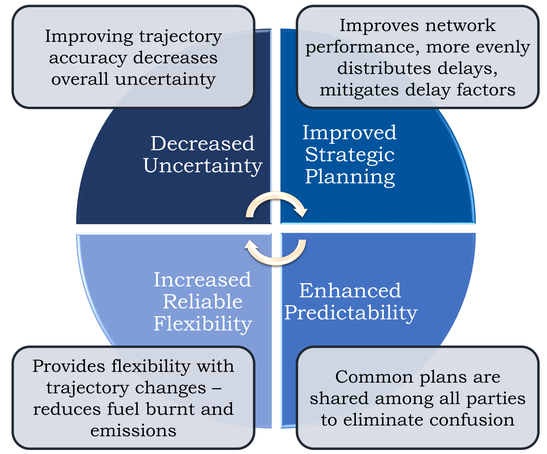
Automated Flow of Data

Power of Predictability

Lower ATC Workload

Increased Safety

Potential Impact



Recommendations

Airlines	• Invest in MR TBO software • Facilitate MR TBO training for pilots
Pilots	• Communicate changes for awareness • Accountability for informed trajectory requests
Air Traffic Control	• Organization of text-based communications • Record incidents related to high workloads

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* Additional References are available on request.