



# The path to TBO

**Trajectory Based Operations (TBO) is a strategic objective of ICAO and is meant to allow the airspace users to fly a trajectory closer to the optimum through closer collaboration across the different stakeholders within the ATM system.**

**FF-ICE, SWIM, the connected aircraft and long-range ATFM are the main pillars identified to support the realisation of TBO. However, there is a need for some fundamental building blocks under these pillars, without which it will be difficult if not impossible to implement TBO. This paper describes some of the main building blocks.**

## Access to airspace

TBO is described by some as a collaborative environment where trajectory information is shared to achieve a better balance of airspace capacity with user demand thus enabling reduced fuel burn. But it will be difficult for an aircraft to fly a trajectory as close as possible to the optimum if there too many airspace restrictions. Airspace managers should limit the airspace restrictions to the minimum and be flexible so that any unused airspace is made available and known to the users as soon as possible.

## AIM

FF-ICE is based on the assumption that airspace users can prepare a flight plan considering all the constraints that may apply to the flight. Most of the constraints are expected to be published via AIM and made available digitally. Unfortunately, the quality of the aeronautical information is still not always at the standard needed to support FF-ICE and TBO and not always provided digitally. Good quality AIM is crucial for airspace users while planning their flights. Extra fuel is sometimes embarked based on incorrect information being provided.

## Weather

One of the main factors affecting trajectories is weather. Airspace users need a better forecast with a longer look-ahead time to select the best trajectory

and optimise the fuel on-board. This concerns, in particular, all-weather phenomena that can impact a flight like hazardous weather, low visibility conditions and prevailing wind at aerodrome, volcanic ash, or space weather. Increasing the availability of weather forecast up to 15 hours will support planning of ultra-long haul flights.

## Inter-centre coordination

TBO involves the negotiation of trajectory elements with ASPs all the way through destination. It is expected that what is negotiated during the planning phase will be cleared throughout the flight and that any tactical or strategic post-departure changes to the trajectory will be accepted. For this to happen, there is a need for robust automated coordination mechanisms between ATSUs as we cannot expect controllers to exchange on the phone trajectory elements composed of lat-long. The introduction of AIDC is part of the GANP Block 0 but is still very limited in many parts of the world.

## IP network

TBO relies on the exchange of information between airspace users, ANSPs, airports. This exchange of information is made possible thanks to SWIM. Even though SWIM is based on COTS technology, it still requires that the different stakeholders are connected. The communication infrastructure needed is IP-based and while IP can be found in every country to support access to the internet for the public, it is not commonly embedded yet in the aviation communication infrastructure. Without an IP network, there is no SWIM, thus no FF-ICE, nor easy access to Meteorological or aeronautical information.

## Conclusion

It is paramount for States at the national and regional level to integrate as early as possible these building blocks in their TBO implementation plan. Airspace users should work with States and ANSPs to ensure that challenges are addressed. Without working on the building blocks, effective implementation of TBO will not be possible.