

*A TECHNOLOGY WHITE PAPER*

# INTEGRATING AIR TRAFFIC FLOW MANAGEMENT AND PERFORMANCE-BASED NAVIGATION TO TRANSFORM AIRSPACE EFFICIENCY

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## I. Introduction

Performance-based Navigation (PBN) enables an aircraft to fly the most efficient 3D flight path, providing economic, efficiency, environmental and safety benefits to the operator. Air Traffic Flow Management (ATFM) enables the most efficient use of airspace by all aircraft, providing economic, efficiency, environmental and safety benefits for all users of the system. The future integration of PBN and ATFM enables the efficient airspace of the future where aircraft operators fly their preferred trajectories within a collaborative, time-based, system-wide ATFM framework.

## II. Background

As air traffic increased around the world, some form of ATFM was used tactically. Whether it was unplanned airborne holding, expanded miles-in-trail and vectoring, or ground stops, as the demand overwhelmed the system capacity, some form of ATFM had to be and still is used today. Airline scheduling practices, with major arrival and departure banks at airports all over the world, create a demand versus capacity imbalance during certain periods of the day that must be managed. ATFM is evolving into the gate-to-gate integration and synchronization of systems and processes that optimize end-to-end performance. Metron Aviation is leading the evolution of ATFM, including incorporating environmental considerations into the design of new concepts and systems.

PBN usage and benefits during periods of high demand will continue to be limited when tactical Air Traffic Control (ATC) is required to vector aircraft from the PBN route in order to satisfy separation rules. Ensuring a steady stream of de-conflicted air traffic before entering the arrival phase will allow more aircraft to complete the full area navigation (RNAV) approach and receive the maximum benefits. Planning the departure queues on the surface will allow more departures to execute the RNAV departure procedures and will also reduce the workload on ATC and the pilots.

Until now, PBN has been mainly focused on the terminal area, particularly on arrivals and approaches. There are near-term opportunities to integrate PBN with ATFM technologies, as well as longer term PBN-ATFM integration that promise even greater performance gains. Envisioning system-wide implementation of integrated PBN and ATFM has been discussed in the past but very little has been accomplished to date. Both PBN and ATFM are being adopted throughout the global aviation community; however, integrating PBN and ATFM will provide even greater benefits.

### **III. ATFM-PBN Integration**

Our generation has inherited the system which is “Interoperable” but not “Integrated.” All this is about to change. Integration across all ATM domains including Air + Ground + Communication + Navigation + Surveillance components is an essential next step in evolving the global air navigation system.

The key to unlocking the maximum benefits from PBN for more aircraft is integrating PBN with ATFM utilizing Collaborative Decision Making (CDM) techniques. PBN integrated with ATFM can transition from a distance-based ATC system to a time-based system using CDM data from the Air Navigation Service Provider’s (ANSP), the operator’s flight planning system and the aircraft’s Flight Management System (FMS). Precision Time Control (PTC) allows aircraft five-second accuracy to any point in the flight, including the runway threshold. The use of integrated PBN with ATFM strategically and pre-tactically with the use of Required Time of Arrival (RTA) tactically under a time-based flow management system will ensure the benefits from PBN to a greater number of aircraft. The advantage of using ATFM is that it can cross FIR and country boundaries and creates seamless airspace within a region. This allows ATFM issued RTA’s far enough out from the destination to ensure no holding and permit successive arrivals to conduct unimpeded PBN approaches.

Information sharing between ANSP, aircraft operators and airport authorities provides the essential data required to manage the system and increase the planning horizon to include strategic, pre-tactical and tactical operations which provides the maximum benefits for all. In addition to modeling and predicting demand and capacity using ANSP data, CDM data and weather forecasts, this data can be integrated for 4-D Trajectory-Based Operations (TBO) across all phases of flight: taxi out, departure, en route, arrival and taxi in.

### **IV. The Way Forward**

A paradigm shift is emerging in the industry through the use of the automation and the latest technology in the air and on the ground to enable the newest CDM techniques to better manage the operation to ensure peak system performance. Much the same way that pilots are managing their flights today using airborne automation, controllers need to transition to managing the operation as opposed to controlling every aspect and phase of flight.

Current PBN and ATFM technologies provide specific benefits independently. The integration and synchronization of the PBN and ATFM generate additional benefits from merging the technologies including:

- **Improved Safety**
  - Continuous vertical guidance
  - Standardization
  
- **Reduced Costs**
  - Lower fuel burn
  - Less track miles
  - Reduced delays
  - Standardized training
  - Increased Airspace capacity
  
- **Environmental Benefits**
  - Lower emissions
  - Active noise management
  - Improved community acceptance
  
- **Supports NextGen and SESAR Operational Capabilities**
  - Trajectory-Based Operations
  - Integrated ATM
  - Flexible Terminals and Airports
  - Continually Optimized Flight Profiles

## **V. Taking the Concept to Operations**

There are many locations around the world where PBN routes and RNAV arrivals/departures are in place today as well as a national ATFM facility. The U.S. FAA Air Traffic Control System Command Center, EUROCONTROL's Central Flow Management Unit, NAV CANADA's National Operations Centre, Airservices Australia's National Operations Centre, and South Africa's ATNS Central Airspace Management Unit are just a few examples of where both ATFM and PBN technologies are in use or are planned. Support from IATA, ICAO and CANSO is essential in the acknowledgement of the concept and initiating the implementation process. With the active involvement of these organizations and a targeted ANSP, a field trial can be designed to operationally demonstrate the benefits of integrating ATFM and PBN.

Independently, ATFM and PBN hold a great deal of promise for improving airspace efficiency today. Together, ATFM-PBN offer powerful capabilities that will help transform and harmonize the global aviation system of tomorrow.