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CAPACITY & EFFICIENCY

Optimal Surveillance Requirements for PBN implementation

Eddian Méndez

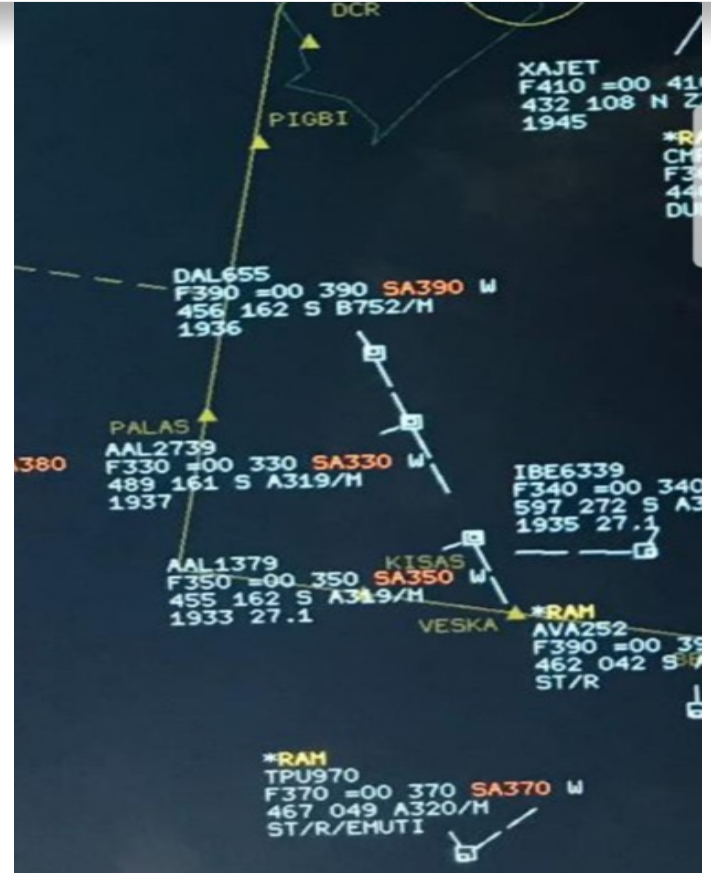
ICAO NACC ATM/SAR Regional Officer

Ottawa, Canada, 21-23 August 2019





✈ "One Look Is Worth A Thousand Words"





Benefits for ATS Surveillance

- ✈ Improved Safety.
- ✈ Enhanced Situational Awareness.
- ✈ Increased Capacity.
- ✈ Reduced Workload.



PBN: ICAO's Highest Implementation Priority

- ✈ Several PBN advanced functions and options are being developed which will increase PBN usability in challenging environments, allowing safer access to more airports and improved route efficiencies.
- ✈ Implementation of PBN in terminal airspace is seen as a key enabler for the advanced terminal operations envisaged by a mature ATM modernization programme, and the developments planned for the concept will ensure its widest possible applicability.



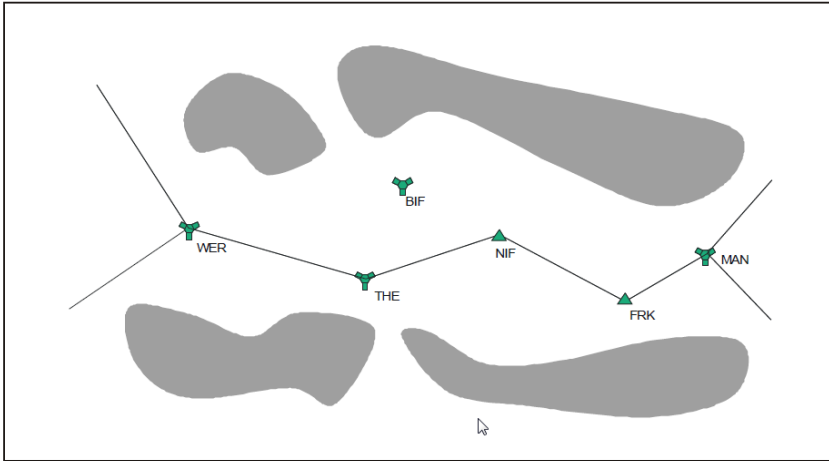
Performance Based Navigation (PBN)

✈ What is PBN?

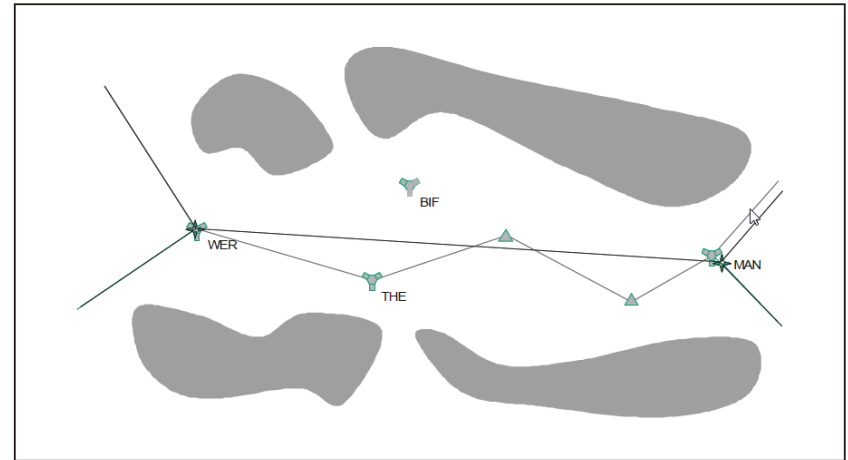
- ✈ PBN defines performance requirements for aircraft navigating on an ATS route, on a terminal or on an approach procedure.
- ✈ System performance requirements are defined in terms of accuracy, integrity, continuity and functionality required for the proposed operations in the context of a particular airspace concept, when supported by the appropriate NAVAID infrastructure.
- ✈ The PBN concept represents a shift from sensor-based to PBN. Performance requirements are identified in navigation specifications, which also identify the choice of navigation sensors and equipment that may be used to meet the performance requirements. These navigation specifications provide specific implementation guidance for States and operators in order to facilitate global harmonization.

Performance Based Navigation (PBN)

Conventional IFP Design



RNAV Procedure Design





Performance Based Navigation (PBN)

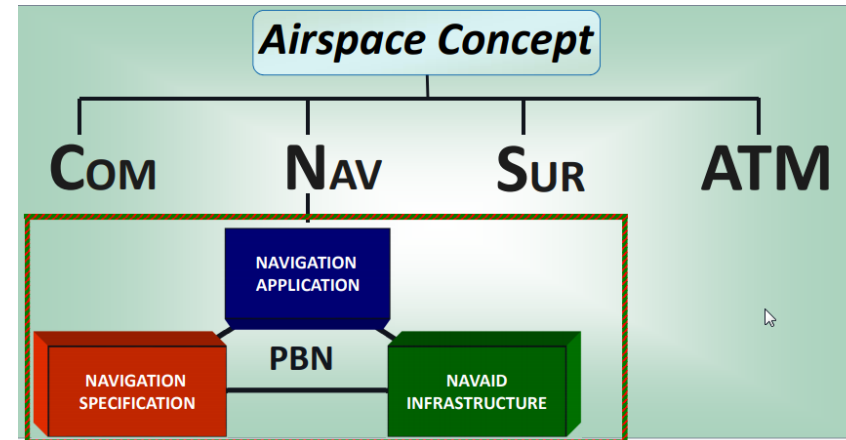
✈ Benefits of PBN

- ✈ Reduces ANS infrastructure operating costs;
- ✈ Allows a more efficient evolution of air navigation services;
- ✈ Improves safety and accessibility to challenging airports;
- ✈ Allows for more efficient use of airspace (route placement, fuel efficiency and noise abatement);
- ✈ Increases capacity (reduces congestion);
- ✈ Reduces workload of ATC personnel; and
- ✈ Reduces Environmental Impact.



Components of the PBN Concept

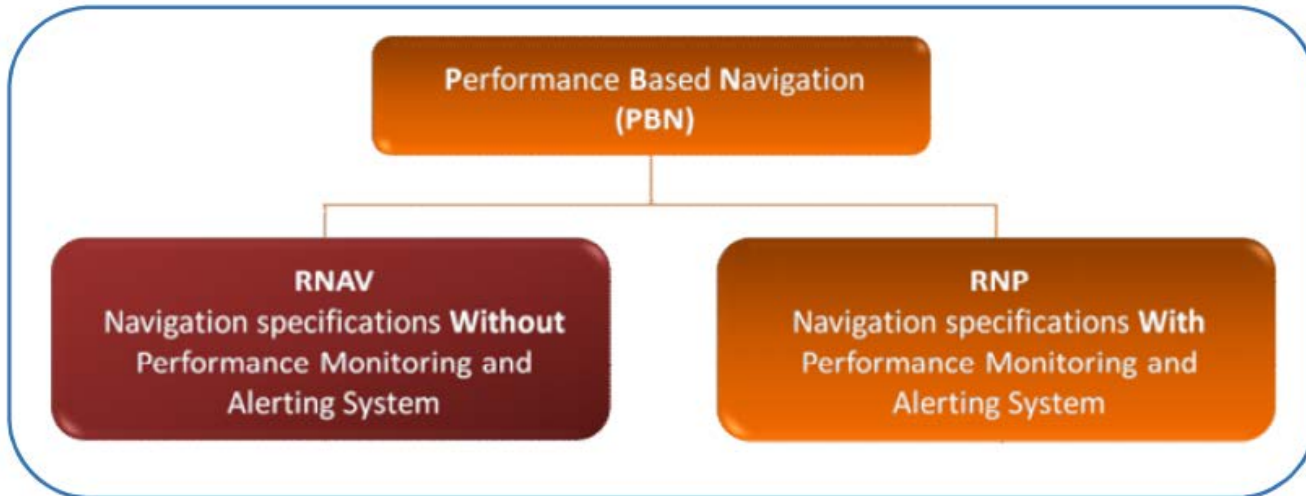
- ✈ PBN is one of several enablers of an Airspace Concept. The others are Communications, ATS Surveillance and ATM.
- ✈ The PBN Concept is comprised of three components: The Navigation Specification, the Navaid Infrastructure and the Navigation Application.
 - ✈ The Navigation Specification prescribes the performance requirements in terms of accuracy, integrity, continuity for proposed operations in a particular Airspace. The Navigation Specification also describes how these performance requirements are to be achieved. A Navigation Specification is either an RNP specification or an RNAV specification.
 - ✈ The Navaid Infrastructure relates to ground- or space-based navigation aids that are called up in each Navigation Specification. The availability of the navaid infrastructure has to be considered in order to enable the navigation application.
 - ✈ The Navigation Application refers to the application of the Navigation Specification and Navaid Infrastructure in the context of an airspace concept to ATS routes and instrument flight procedures.





Navigation Specification

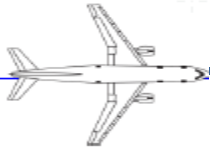
Two types of navigation specifications exist



RNP = RNAV + OPMA (On-board Performance Monitoring and Alerting)



RNAV X



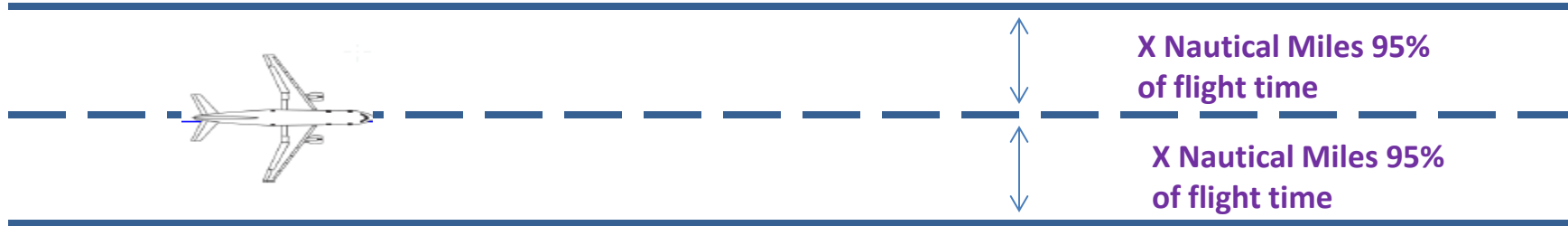
**X Nautical Miles 95%
of flight time**

**X Nautical Miles 95%
of flight time**



RNP X

Alert to Pilot



Key Difference is On-Board Performance Monitoring and Alerting



Model Concept for PBN Harmonization within the CAR Region

Upper Airspace

- ✈ Implementation of RNAV 5 routes.
- ✈ Removal of conventional routes made redundant by PBN route implementation.
- ✈ Implementation of RNAV 1/2 STAR/SIDs (CCOs and CDOs) to TMAs within the FIR.
- ✈ Implementation of 20NM longitudinal separation at FIR boundaries.
- ✈ All routes and waypoints published by the States are correctly processed through the ICAO International Codes and Route Designators (ICARD) database.
- ✈ Oceanic airspace lateral separation 50 NM/30NM (where applicable).

Lower Airspace

- ✈ Implementation of RNAV 1/2 STAR/SIDs (CCOs and CDOs) to TMAs within the FIR.
- ✈ Implementation of at least LNAV approaches for International Airports.
- ✈ LNAV/VNAV (BARO VNAV) Approaches if analysis determines a benefit.
- ✈ Implementation of RNP AR Approaches if analysis determines a benefit.
- ✈ Implementation of APV (GBAS) Approaches if analysis determines a benefit.



Optimal Surveillance Capabilities for PBN

- ✈ While the PBN mainly addresses performance requirements for aircraft navigating on an ATS route, on a terminal or on an approach procedure, ATS Surveillance is an enabler for full PBN potential.
- ✈ The complexity of determining route spacing and separation minima is affected by the availability of a radar surveillance service and the type of communications used. If an ATS surveillance service is available, this means that the risk can be mitigated by including requirements for ATC intervention.
- ✈ The availability of communications between the aircraft and ATS provider may impact the level of air traffic intervention capability needed for safe operations. In an ATS surveillance environment, one aircraft with a failure of navigation capability could normally be handled successfully by ATC. Where there is no ATS surveillance, it is necessary to consider two situations: 1) the complete failure of the RNAV system; and 2) the potential that an aircraft's navigation system has an unreported position error. In either case, mitigations will need to be identified and incorporated into the operating procedures in order to implement the navigation application.
- ✈ The availability of ATS surveillance along the route is a major element in determining whether the desired route spacing for the planned navigation implementation will support the TLS.
- ✈ Increased information from ATS surveillance system significantly reduces DCPC
- ✈ Enhanced separation minima can be applied while under ATS surveillance.
- ✈ Increased capacity to allow multiple sequential operations.



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