

# ICAO EUR/MID Radio Navigation Symposium



## Rationalisation of Conventional NAV Aids

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# Rationalisation of Conventional NAV Aids

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## Context

Airspace complexity and challenges

## Airspace Concept design

Strategy definition, infrastructure support, rationalization and MON concept

## Nav aids infrastructure plan and capabilities evolution

Recommendations, planning and evolutions

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# CONTEXT

## Airspace complexity and challenges

The increase of complexity in operational and environmental requirements for civil and military operations, asks for innovative, compact, resilient, fast deployable and energy efficient systems to support safe and effective air navigation and landing operations both in peace, crisis or war / conflict time.

The objective of the Service provider is to develop an airspace concept ensuring efficient flows of traffic while creating opportunities to safely improve airspace capacity and meet environmental commitments.

Implementation of the Performance Based Navigation (PBN) will be planned to ensure that the airspace concept is achieved in time and in line with the State authorizes.

To support efficient and cost effective solution, Minimum Operational Network (MON) concept has to be followed.



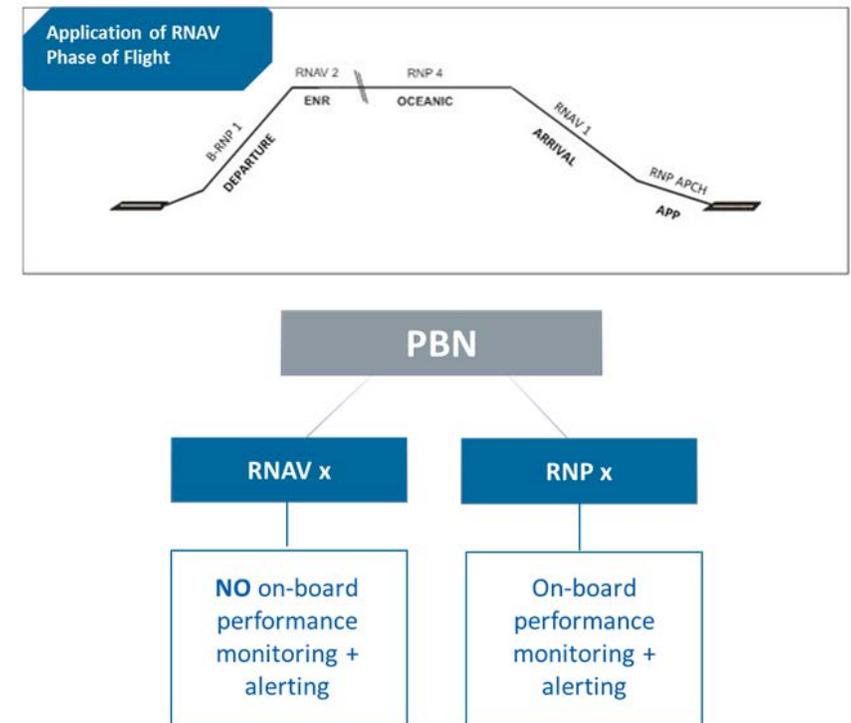
# AIRSPACE CONCEPT DESIGN

## Performance Based Navigation: RNAV & RNP applications

Performance Based navigation “PBN” is a global set of area navigation standards, based on performance requirements for aircraft navigating on departure, arrival, approach or en-route segments of flight, to implement airspace concept design

The PBN concept is defined in the ICAO Doc. 9613 and encompasses two types of navigation specifications

- Area navigation (RNAV), and
- Required Navigation Performance (RNP)



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# AIRSPACE CONCEPT DESIGN

## Airspace Concept strategy definition

While designing the airspace concept, Service Providers shall comply with both European (in particular PBN IR and ICAO Resolution 37-11) and national regulatory requirements and should plan the transition from current operations to PBN operations in the most efficient and cost beneficial way

Furthermore, the airspace concept development has to cope with the possibility of interferences on GNSS signal, exposing the system to possible GNSS intentional or non-intentional disturbances (spoofing, jamming)

Global Air Navigation Plan (GANP) (Doc 9750), while setting the strategy to drive the evolution of the global air navigation system and while identifying the related technological roadmap, indicates the following:

- Single frequency GNSS capability as the main and most accurate source available on global basis.
- Until a solution to ensure adequate GNSS resilience is available, it is essential that a terrestrial navigation infrastructure is provided, suitably dimensioned to be capable of maintaining safety and continuity of aircraft operations

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# AIRSPACE CONCEPT DESIGN

## Nav aids infrastructure to support GNSS services outages

As recommended by Air Navigation Conferences (ANC), ANC 12, Standard Nav aids are the alternative infrastructure to support GNSS services outages, so called GNSS reverse

In particular, planning for mitigation of global navigation satellite system vulnerabilities has to give priority / preference to the following systems:

- DME: retention of DME to support inertial system (INS/DME navigation) or DME/DME area navigation
- ILS: Instrument Landing System at the runways selected as vulnerable

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# AIRSPACE CONCEPT DESIGN

## Nav aids infrastructure rationalization strategies

Air Navigation Conferences (ANC), ANC 12, to optimize the overall navigation infrastructure investments, also provided recommendation for rationalization of terrestrial navigation aids while implementation of performance-based navigation:

- a) Assess the opportunity for realizing economic benefits by reducing the number of navigation aids through the implementation of performance-based navigation
- b) Ensure that an adequate terrestrial navigation and air traffic management infrastructure remains available to mitigate the potential loss of global navigation satellite system service in their airspace
- c) Align performance-based navigation implementation plans with navigation aid replacement cycles, where feasible, to maximize cost savings by avoiding unnecessary infrastructure investment



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# AIRSPACE CONCEPT DESIGN

## Minimum Operational Network (MON) concept

To implement efficient and rationalized Navaid infrastructure, PBN Handbook no. 4 aims to plan the infrastructure needed to provide the required level of (ATM/ANS) service both for normal and contingency operations

Minimum Operational Network (MON) concept aim to support the design of the minimum Navaid infrastructure needed to provide the required level of (ATM/ANS) service for both normal and contingency operations

While Handbooks 1 and 6 explain the operational need for both a ground-based Navaid infrastructure and its Minimum Operational Network (MON), Handbook, No 4, provides the 'how to' package related to infrastructure evolution and creation of a MON



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# NAVAIDS INFRASTRUCTURE PLAN AND CAPABILITIES EVOLUTION

## Nav aids infrastructure recommendations

PBN Handbook no. 4 main recommendations:

- NDB: rationalization of the NDB network and associated conventional procedures is suggested, including associated procedures, possibly in alignment with the end-of-life of each equipment with respect to the PBN implementation strategy
- VOR: new VOR installations are not encouraged, but a Minimum Operational Network has to be maintained in order to provide guidance in case of GNSS loss and in case of Aircraft not equipped with DME/DME capabilities
- DME & DME/DME: DME is able to provide a fully redundant capability for RNAV applications. Suitable DME network design should be done to provide optimized positioning and best performance. DME/DME is considered as the major system supporting GNSS reverse
- ILS: ILS support the replacement of conventional approaches without vertical guidance with vertically guided approaches

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# NAVAIDS INFRASTRUCTURE PLAN AND CAPABILITIES EVOLUTION

## Key infrastructure planning rationalization methodology

To support key infrastructure planning rationalization, two main processes defined in Global Air Navigation Plan (Doc 9750):

- Top-Down approach: starting from the operational need (coverage, performances, etc.) the infrastructure is designed. Such kind of approach aim at satisfying an ATM adequate level of service both for normal and contingency operations and might lead to a non optimized costing
- Bottom-up approach: the main idea is «not to renovate» Nav aids that reached their end-of-life re-assessing the final system performances. Such approach might lead to an insufficient level of service both for normal and contingency operations

Strong suggestion is to use a mix of the two methodologies above to combine performances efficiency and cost efficiency in the most effective way

Starting point, to support rationalization, is the use of specific performance prediction tools to preliminary assess the preferred terrestrial navigation aids



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# NAVAIDS INFRASTRUCTURE PLAN AND CAPABILITIES EVOLUTION

## Nav aids product Evolution supporting efficient deployment and rationalization

While planning for the Nav aids infrastructure, new features are under development on DME (Enhanced DME) within the frame of SESAR project and including:

- DME/DME passive ranging: interrogation reductions thanks to spontaneous synchronization signals emission from the ground to allow airplanes to calculate their positions in the space
- DME Z-channel introduction, on top of the used X and Y channel cos

Furthermore, considering the opportunity to benefit of commonalities and dual use of Military forces' Navigation Aids infrastructure, cooperation with them can increase the rationalization principle, in particular:

- Re-assess the TACAN coverage to better plan and use the DME signal that can be generated by the TACAN equipment
- Possibility to introduce Enhanced DME capabilities in TACAN equipment can strengthen the seamless use of the global Nav aids infrastructure

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# NAVAIDS INFRASTRUCTURE PLAN AND CAPABILITIES EVOLUTION

## A-PNT resilience and interoperability for civil and military dual uses

To improve A-PNT resilience and interoperability using DME and TACAN, evolutions and new functionalities can be introduced in both systems in parallel

Due to the DME capabilities included in the TACAN and due to the frequency commonalities with the DME, a joint effort for civil and military purposes can to be taken

Both NATO and European Defence Agency launched various projects to create A-PNT network for military customers, always pushing to serve civil and military air traffic at the same time benefitting of dual use of the equipment to rationalize costs, infrastructures and environment pollution

Following NATO and EDA initiatives, huge effort is going to be put in place by various military ANSPs to increment the TACAN coverage in Europe, and consequently also DME coverage through the VOR/DME, in case or VORTAC applications, and DME-DME navigation





Thank You!