

Supporting
European
Aviation



From Navigation MON to RON

Minimum vs Resilient Operational Network

ICAO MID Workshop on GNSS / PBN

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NETWORK
MANAGER



ICAO Assembly Resolution 42-8C



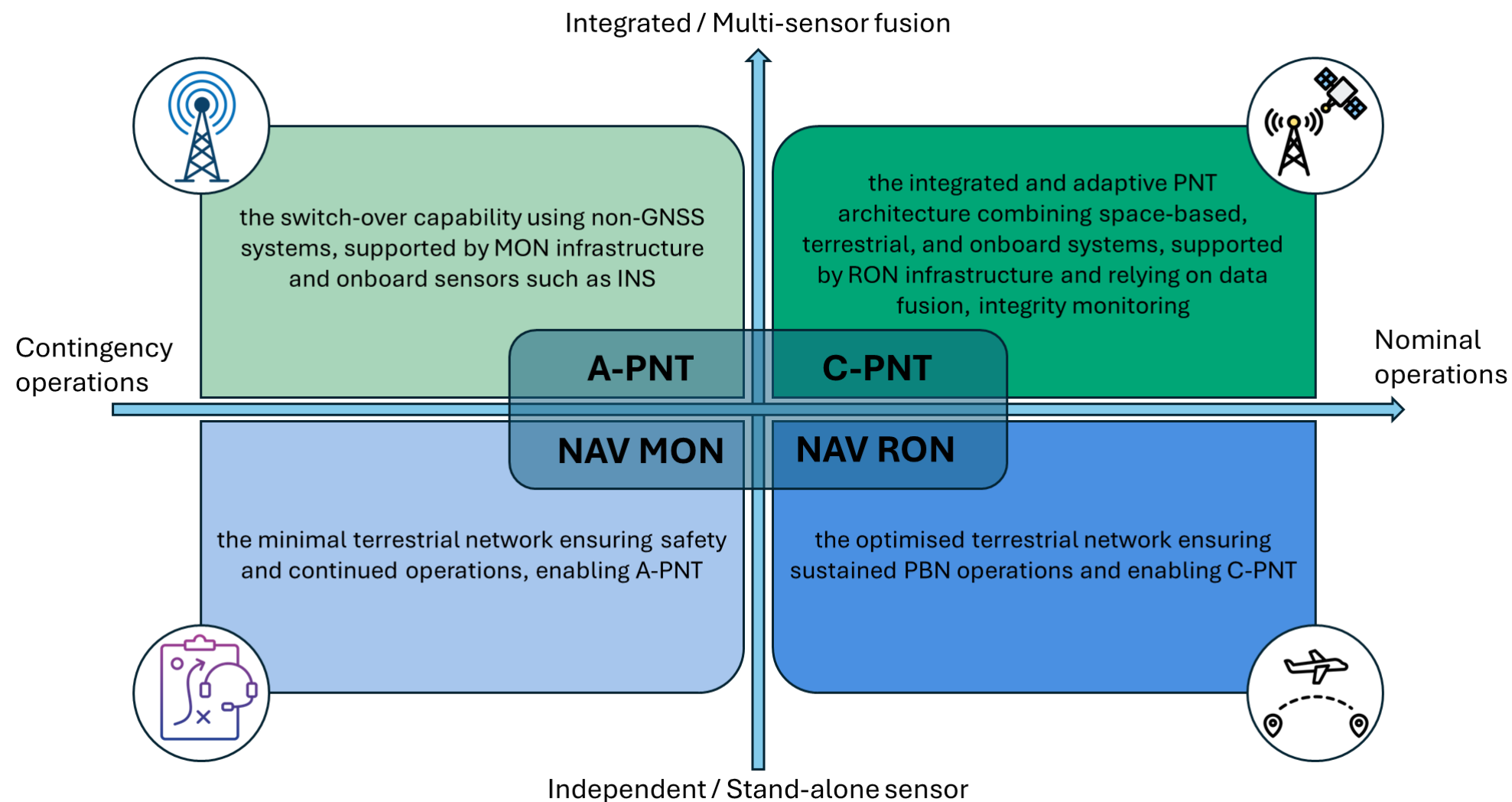
The Assembly:

1. Encourages States to transition towards optimized, secure CNS systems based on **complementary integration** of suitable and **independent aircraft capabilities, satellite- and ground-based infrastructure** which **maximize resiliency and robustness to any type of interference**;
5. Encourages **standardization bodies and industry** to collaborate with ICAO in advancing PNT solutions that align with ICAO initiatives;

Reversion Terminology in Context

- **GNSS Reversion** = a switch from GNSS as a navigation source to a different, non-GNSS navigation sensor
- **Contingency** = an unusual event which requires some mitigation and which leads to an inability to maintain normal capacity levels for an extended timeframe
- *Consequently:*
 - A GNSS Reversion which leads to a contingency is supported by a **MON**
 - A GNSS Reversion which *doesn't* lead to any operational impact is supported by a **RON**

NAV RON and PNT Context



The 3 Functions of Conventional Navigation Aids

- 1) as redundant aids to support PBN NAV specifications (esp RNAV1, RNAV 5)
- 2) to facilitate pilot positional awareness and cross-checks
- 3) as infrastructure for conventional Instrument Flight Procedures (IFP)

NAV RON Job Card Objective (NSP.010.01):

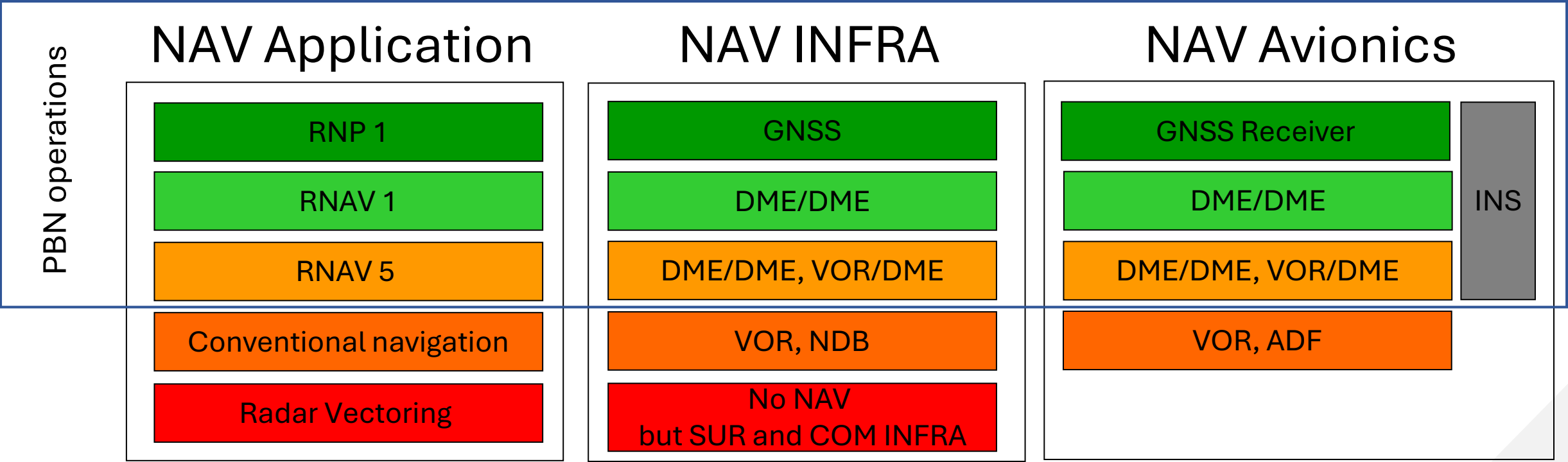
- A strategic approach to enable States' determination of the right size/number, composition (e.g. type/Capabilities), and distribution/ layout of the terrestrial navigation network (Resilient Operational Network) at the minimum cost, considering operator equipage, to find the right balance between availability, efficiency, and seamless operation transition during GNSS disruption and support initial complementary PNT use

ICAO NSP NAV RON Job Card Actions

- Provide guidance as appropriate to maintain **safe and efficient operations in case of GNSS degradations**
- To develop the RON **CONOPS** and the inter-relation between the two concepts, MON and RON
- Improve **aeronautical charts** to optimise navigation infrastructure utilization by incorporating (or restoring) chart annotations that enable VOR/DME cross-checks or **facilitate ILS intercept**
- Identify how to maintain **route spacing** within mix of conventional and PBN procedures to support operations during GNSS reversion
- Define digital data that enable aircraft and aircrew to understand what **level of infrastructure is provided** which supports a given PBN procedure and **avoid specifying GNSS only** as appropriate
- Clarify criteria related to **DME facility selection** and tuning for PBN to ensure that available infrastructure gets used for continued operation in case of GNSS reversion
- Develop methods for **network pulse load assessment** to optimize facility planning, to ensure satisfactory service of a given density of a DME network for a given set or density of traffic

Reversion Scenarios: Many Variables

Type of Airspace: Traffic Complexity & Density, Terrain
ATC Intervention Capabilities: COM & SUR



ICAO PBN Handbook Doc 9613 and DME Positioning

Table II-A-1-4. Navigation specifications and (Required or Optional) NAVAID infrastructure

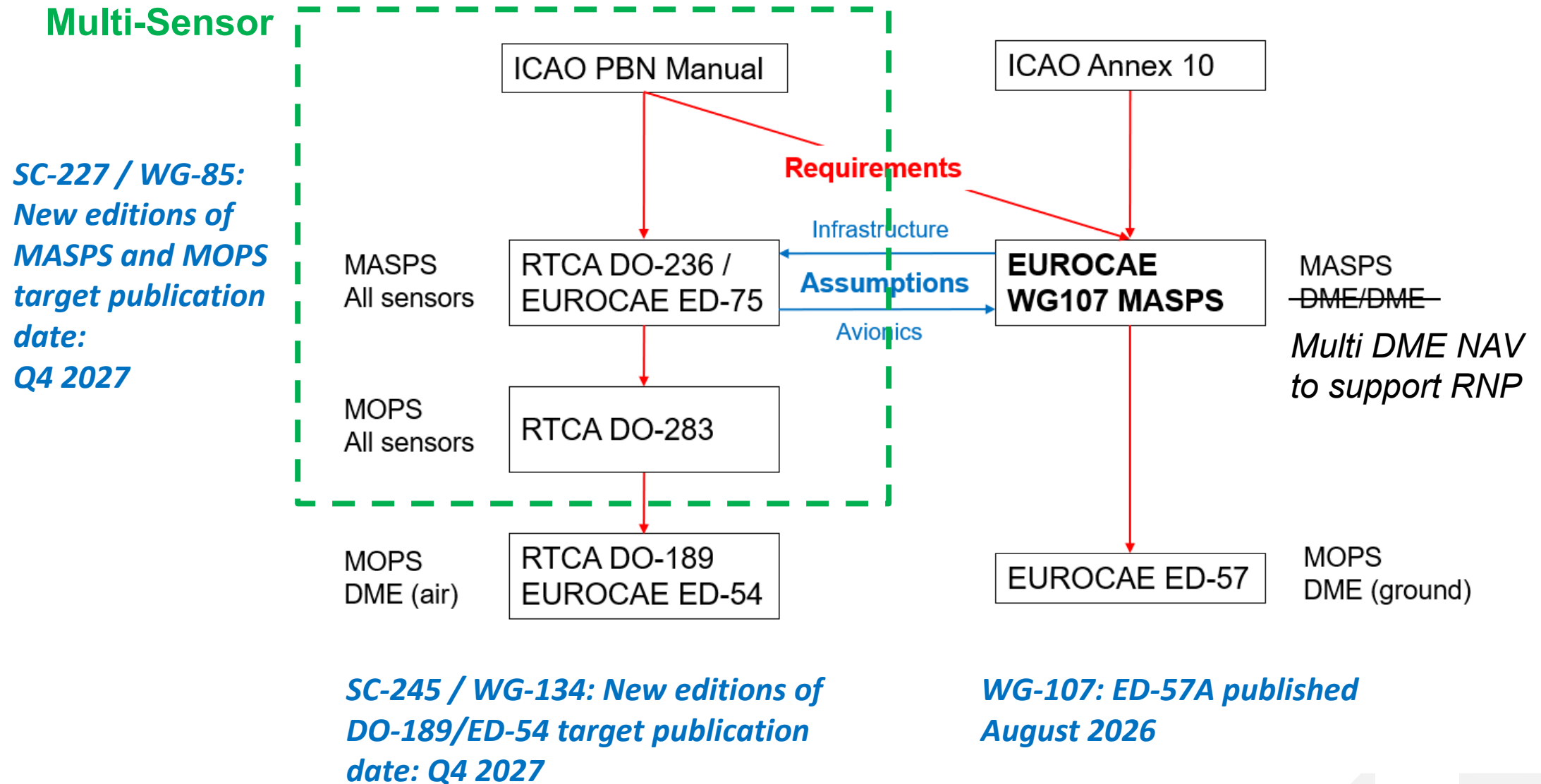
- DME/DME requires “State Authorization” to support RNP1 or Advanced RNP
- RNP supports fixed radius (RF) turn capability which can help solve many TMA issues
- Concerns about GNSS RFI lead States to hesitate implementing RNP due to “reversion to RNAV”
- Objective of EUROCAE WG107 is to provide guidance to States on what should be done as a basis for such an authorization

	GNSS	GNSS/inertial navigation system ³	DME/DME	DME/DME/inertial navigation system ³	VOR/DME
RNAV 10 ^{1, 4}	O	O			
RNAV 5 ¹	O	O	O	O	O
RNAV 2 ¹ & 1 ¹	O		O	O	
RNP 4	R				
RNP 2	R		O ²	O ²	
RNP 1	R		O ²	O ²	
ADVANCED RNP	R		O ²	O ²	
RNP APCH	R				
RNP AR	R	R			
RNP 0.3	R				

Notes.

1. For these navigation specifications where there is a choice of navigation infrastructure/positioning sources, at least one NAVAID is required for the promulgated associated navigation application.
2. The use of DME/DME for this navigation specification requires a specific State authorization.
3. Inertial navigation systems may be integrated with the GNSS or DME/DME sensor to improve performance and continuity of the operation.
4. DME and/or VOR may be used to check aircraft navigation accuracy prior to entry into oceanic airspace. DME and/or VOR may also be used to extend the RNAV 10 navigation capability by updating the navigation system, when en-route.

RTCA / EUROCAE Standardisation Activities



Summary

- NAV RON Effort is focused on short term measures to maximise the utility of conventional navigation aids to complement GNSS-based PBN
 - To help keep airspace open safely despite GNSS RFI
- Operational driver: airspace where GNSS degradations are of a long duration
 - GNSS RFI can be very dynamic
 - Waiting until RFI happens “in your airspace” is not a responsible strategy
- The word “Minimum” had a flavor of reducing navaid count to save costs
 - Getting everyone safely on the ground was acceptable because GNSS RFI was thought to be a rare event
 - NAV RON can still allow rationalization but focus is on operational resilience
- DME-based RNP effort seeks to give credit to current ground and avionics capabilities
 - Initial step towards more fundamental C-PNT improvements which will take time
 - Remove obstacles for implementation of RNP-related airspace benefits
- *Backup Slides: Some initial NAV and CNS RON work in Europe*

NAV RON Design Principles Summary

Phase of flight	NAV RON function (terrestrial navigation infrastructure supporting nominal PBN operations)
En-route continental	• DME/DME to support RNAV 5 for suitably equipped aircraft. • VOR/DME routes as an alternative, especially where DME/DME coverage is not feasible.
Terminal	• DME navigation to support RNAV 1 and RNP 1 for suitably equipped aircraft. • Conventional SID/STAR based on VOR (or VOR/DME) as an alternative.
Approach	• ILS for precision approaches (not subject to rationalisation in the RON context). • Conventional non-precision approaches based on VOR/DME and, where still required locally, NDB.



Further guidance on the design of the NAV MON is available in **EUROCONTROL's PBN Handbook #4**, the European Navaid Infrastructure Planning Handbook including Minimum Operational Network (MON), available in the PBN Portal Library.

RON related work by other organisations

ICAO (A42, 2025)

Assembly resolution urges close collaboration of aviation, military and spectrum authorities, and notification of the responsible ANSP when State security or defence activities may cause jamming.

EASA-EUROCONTROL

Joint Action Plan (March 2026) with short, mid and long-term actions, owners and dates; maintained via JCSP. EASA SIB 2022-02 revised in 2026: spoofing seen as riskier than jamming.

IATA

EASA-IATA plan (2025) on reporting, monitoring and mitigation. EASA-IATA workshop (2024): retention of a MON of conventional navaids as GNSS backup.

CANSO

NAV MON guidelines (2025): MON planning as part of PBN transition, adapted to the local airspace. ANSP guidance on GNSS interference (2026), incl. ADS-B based monitoring metrics.

EUROCAE

WG-62: ED-259B update incl. automatic receiver recovery after leaving an RFI area. WG-107: DME ground MOPS and DME-based RNP MASPS. WG-133: CRPA for civil aviation.

Pilots and controllers

IFALPA, ECA and IFATCA joint position on GNSS disruption. IFALPA 2026 Conference: operations should not depend on a single PNT source; retention of VOR, DME and ILS until alternatives are implemented.

General aviation

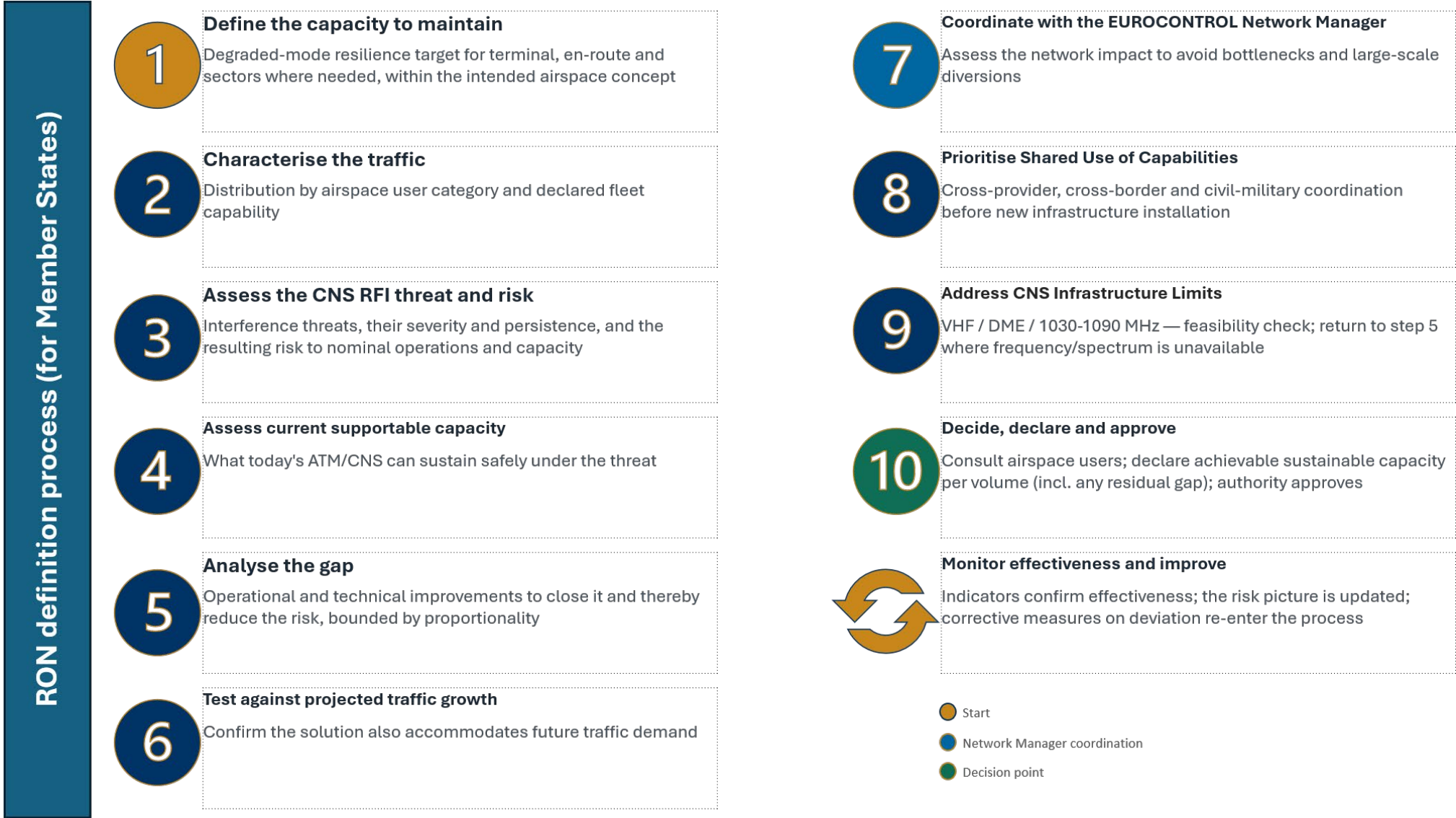
No dedicated IAOPA Europe position identified. Many GA aircraft are not DME/DME RNAV capable; VOR retention remains relevant (see FAA VOR MON).

NATO and EDA

NATO Aeronautical CNS Strategy (2023) and EDA CNS Military Strategy (2021) form the military baseline referenced in the civil-military guidance.

Common elements: GNSS-independent infrastructure, RFI monitoring and reporting, avionics robustness, civil-military coordination.

RON definition process for Member States [*proposal*]



Safety and security risk management: continuous through all steps.

Objectives of RON implementation

Mitigating the impact of CNS service degradation on ATM operations

ATM operational

Limit the impact of CNS service degradation on ATM operations



Airspace capacity

Capacity retained during degradation at the level declared per airspace volume, instead of unplanned reductions.



Traffic flow

Predictable ATFCM response during degradation, without network bottlenecks or large-scale diversions.



Airspace user needs

Continued service to CAT, GA, State aircraft and new entrants at their equipage level.



Connectivity

Routes, alternate and diversion aerodromes and cross-border connections remain usable.

CNS technical

Reduce the likelihood and the severity of CNS service degradation



Reduced 1030/1090 MHz over-interrogation

Lower risk of cooperative surveillance degradation: optimised sensor mix, data sharing, coordinated interrogators (incl. military).



Reduced channel congestion

Frequencies available in the VHF COM and NAV bands where back-up COM and DME infrastructure is required.



Improved cross-border use

Sharing of infrastructure and data between adjacent providers and between civil and military maintains coverage when local assets are lost.

Objectives are assessed under degraded conditions. Where they are not met, they appear as constraints and hazards in national safety assessments; the Guidelines will link each objective to performance indicators.