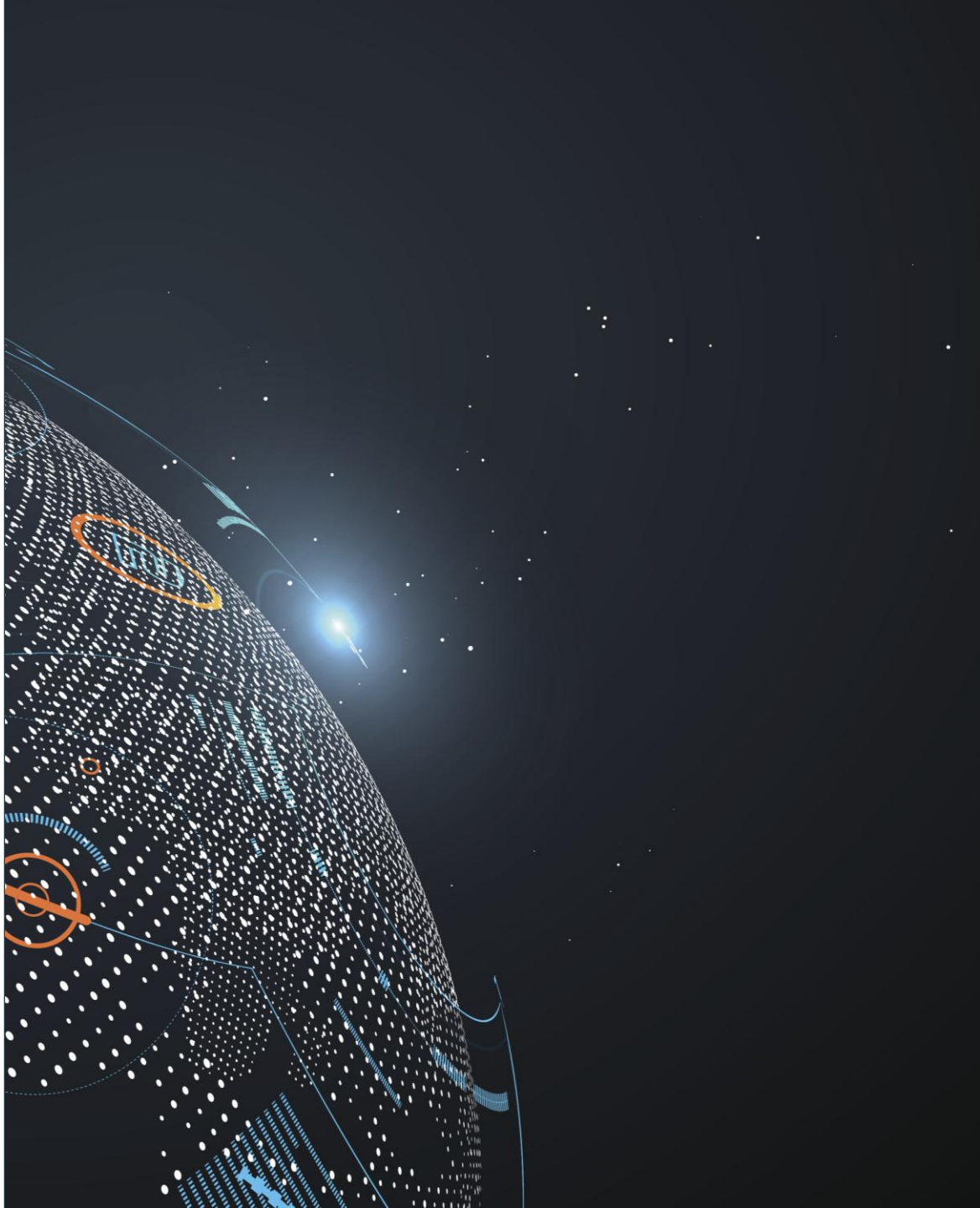

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INTERNATIONAL
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ORGANIZATION

Minimum Navigation Operational Network (NAV MON)

Irwandi Krisnata/ Regional Officer, PBN
ICAO APAC RSO

PBNICG/13 Meeting
Bangkok – Thailand, 14-16 October 2026



Overview

01 ICAO Roadmap addressing GNSS RFI



02 Global and Regional Plan



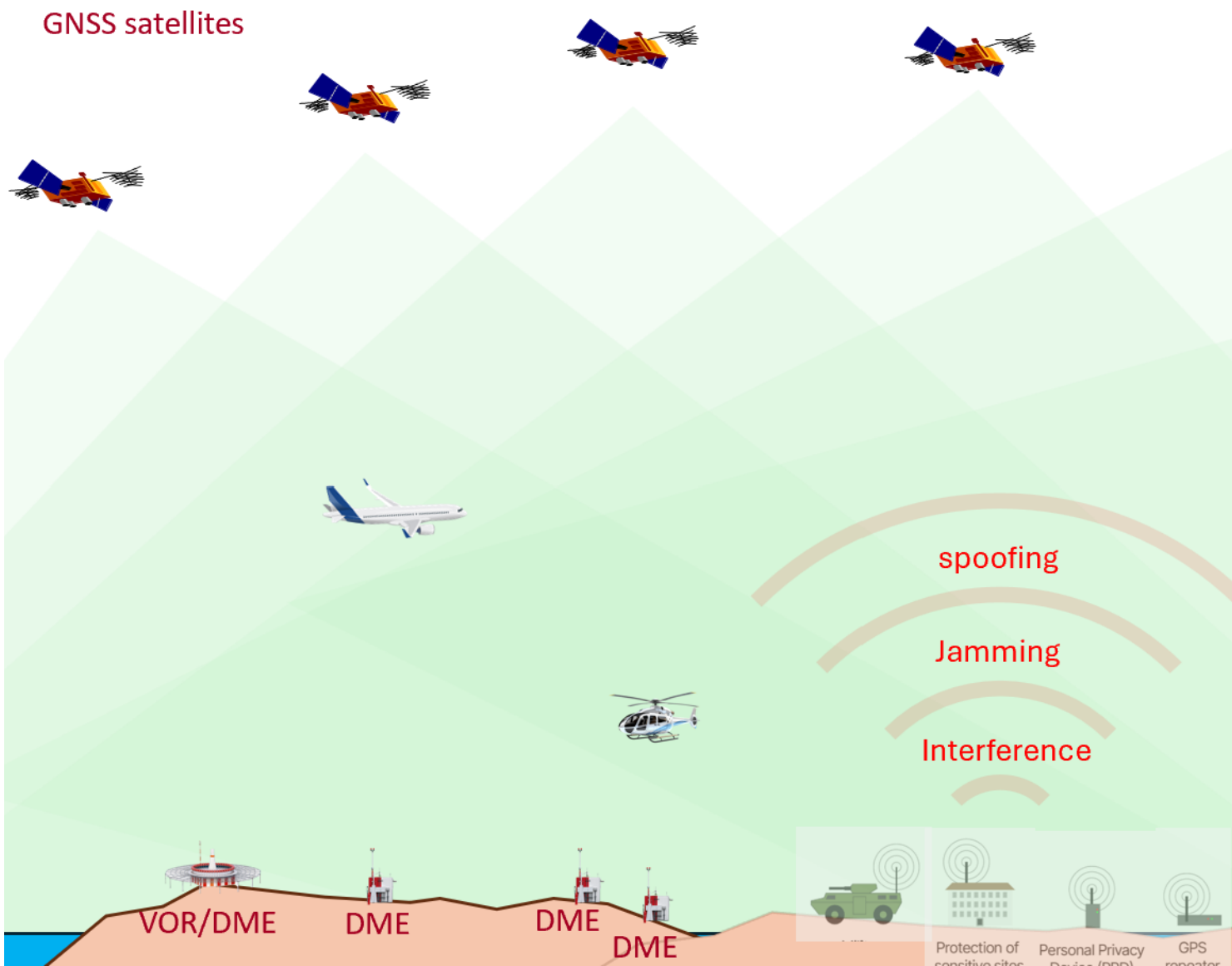
03 Rationalization the conventional Navigational aids network

ICAO Roadmap addressing GNSS RFI



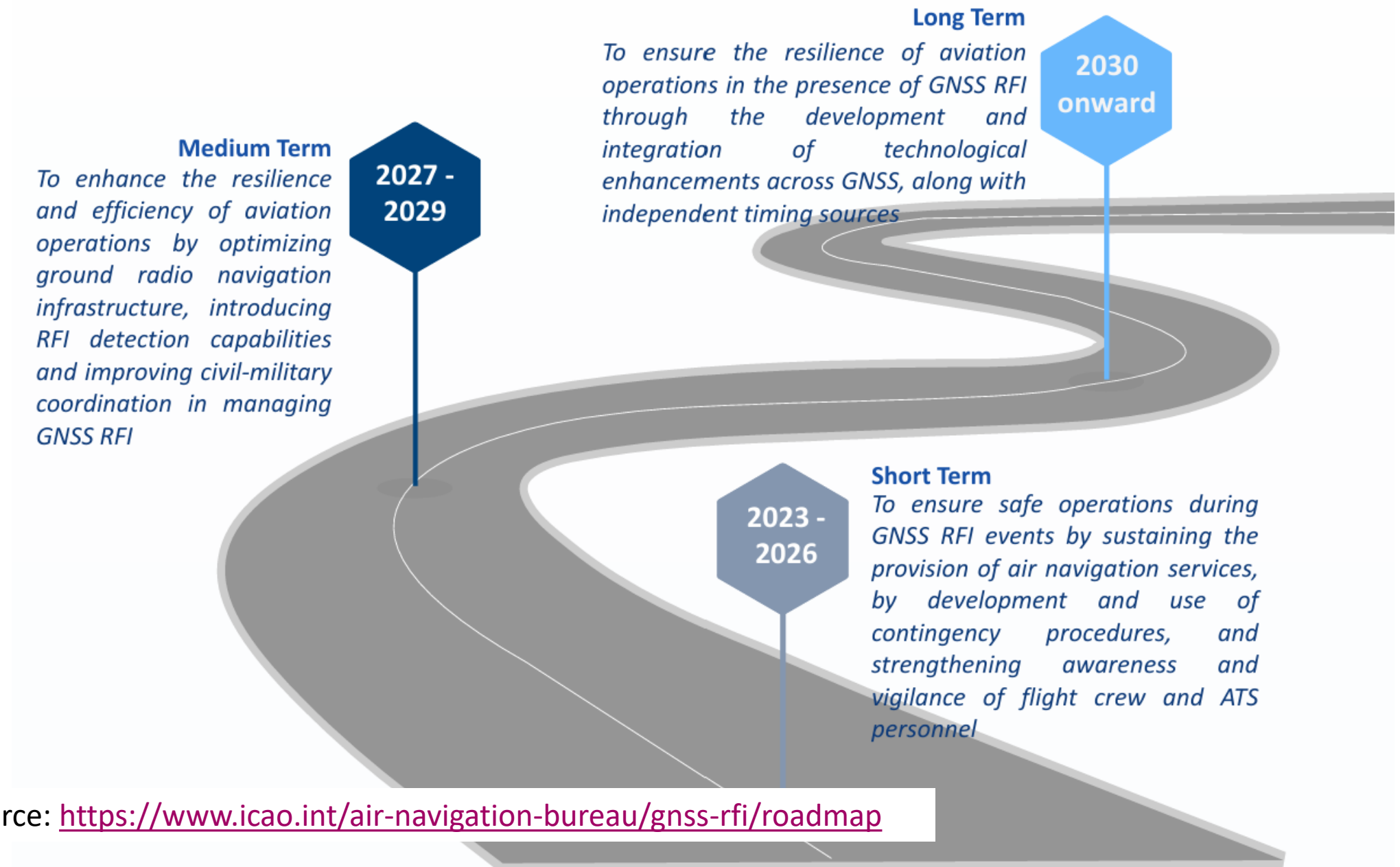
ICAO GNSS RFI Roadmap (Radio Frequency Interference)

- **Radio Frequency Interference (RFI)** has emerged as one of the current challenges **affecting aircraft positioning** capabilities, given that the Global Navigation Satellite System (GNSS) serves as a primary **enabler of PBN** operations.



ICAO

ICAO GNSS RFI Roadmap



Source: https://www.icao.int/air-navigation-bureau/gnss-rfi/roadmap

ICAO GNSS RFI Roadmap (Short Term)

focus on **ensuring the safe continuity of air navigation services** during GNSS RFI events through the development and implementation of contingency procedures, as well as by strengthening awareness and vigilance among flight crews and air traffic services (ATS) personnel

2023 - 2026



ICAO GNSS RFI Roadmap (Mid Term)

To ensure the **resilience of aviation operations** in the presence of GNSS RFI through the integration development of and technological enhancements across GNSS, along with independent timing sources

2027 - 2029



Resilient Navigation Operational Network (NAV RON)



New Guidance for Civil-Military coordination



Update PBN Manual to support PBN operations in case of GNSS RFI



Onboard RFI detection capability

Inclusion of GNSS RFI in Security risk assessment and update relevant security guidance (2027)

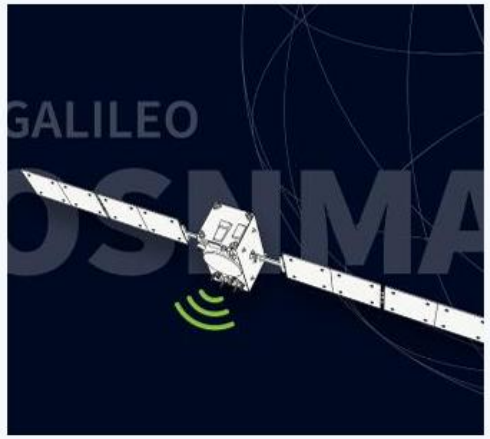
ICAO GNSS RFI Roadmap (Long Term)

To **enhance the resilience and efficiency** of aviation operations by optimizing ground radio navigation infrastructure, introducing RFI detection capabilities and improving civil-military coordination in managing GNSS RFI

2030 onward



Complementary Positioning, Navigation and Timing (C-PNT)



GNSS Signals Authentication for Core Constellations (Galileo OSNMA)



GNSS Signals Authentication for augmentation systems (SBAS Authentication)



Dual Frequency Multiple Constellation (DFMC GNSS)

ICAO

Global and Regional Plan

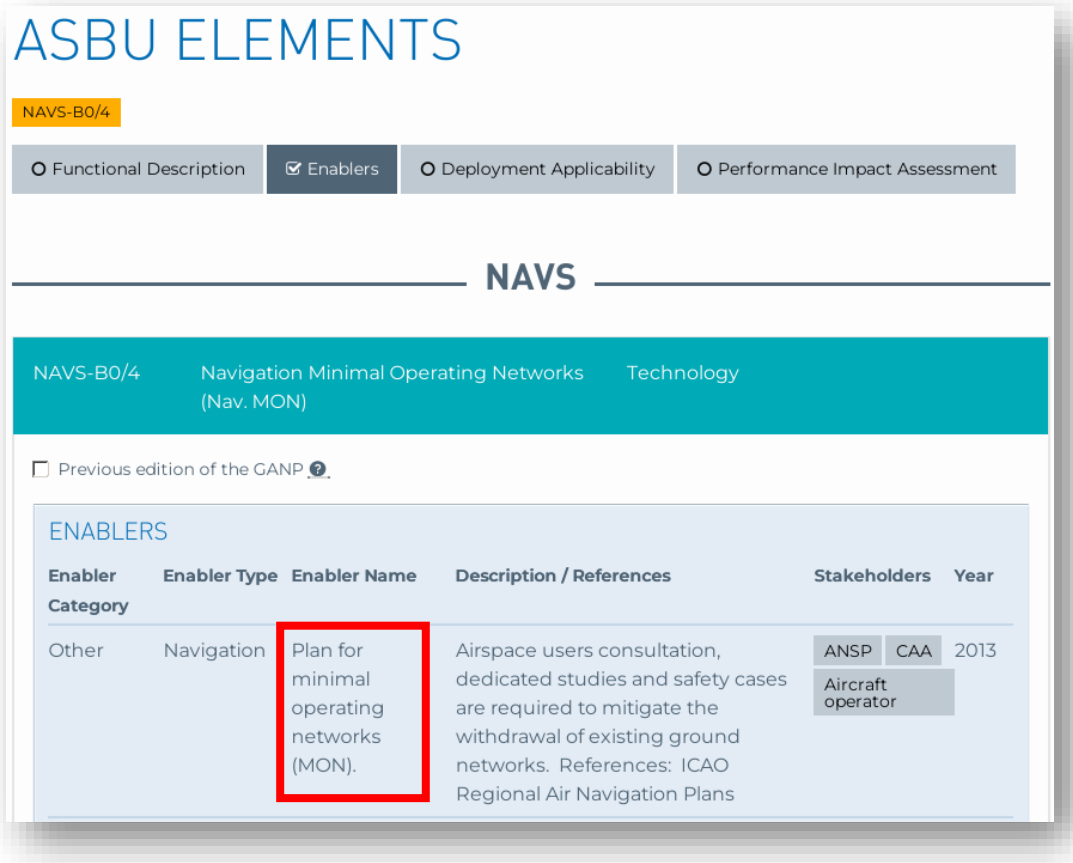


Global and Regional Plan – *ASBU*

- The introduction of new element in the GANP "Navigation Minimal Operating Networks" **(NAVS B0/4)**

- NAVS B0/4 has been classified as **priority 1** in the **Asia/Pacific Seamless ANS Plan (Version 4.0)**

- NAV MON, according to the GANP, aims to **rationalize the conventional Navigational aids** network through the increased deployment of the satellite based navigation system.



ICAO

Global and Regional Plan – *ICAO Assembly Resolution*

ICAO 42nd Assembly Resolution

Resolution A42-8, Consolidated statement of continuing ICAO policies and practices related to a global air traffic management (ATM) system and communications, navigation, and surveillance/air traffic management (CNS/ATM) systems

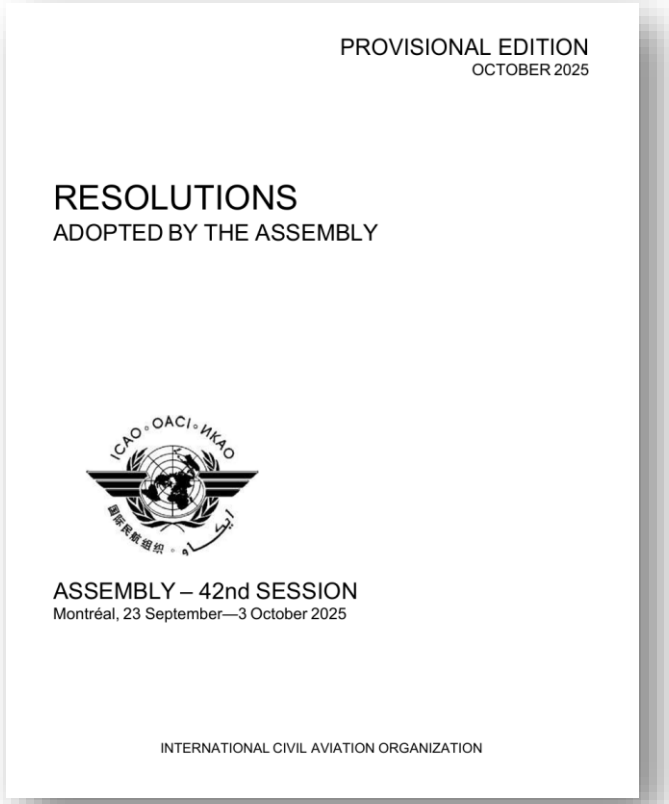
Appendix C

Ensuring the resilience of ICAO CNS/ATM systems and services

ICAO Policy on GNSS Resilience Included operative clause on NAV RON

> *"….. Encourages States to ensure that ~~sufficient~~ ***resilient** terrestrial CNS capabilities remain available …..*

**(Updated Resolution A41-8)*



Document link

Global and Regional Plan - *Resilient Navigation Operational Network (NAV RON)*

- ✓ The RON concept **evolves** from the navigation minimal operational network (NAV MON) to ensure operational safety and continuity during GNSS RFI
- ✓ Optimize deployment of terrestrial navigation aids based on traffic density, operational requirements, and aircraft capabilities
- ✓ Better utilize combinations of available conventional terrestrial navigation aids to support GNSS reversion during disruptions:
  - as redundant aids to **support PBN navigation** specifications and enable cross-check with GNSS
  - as **contingency support** to facilitate pilot positional awareness and/or
  - as already well established, as infrastructure for conventional Instrument Flight Procedures (IFP).

Global and Regional Plan - *Job Card NSP Panel (NAV RON)*

NSP.010.01		Resilient Navigation Operational Network (High Priority)		
ID	**Document Affected**	**Description of Amendment proposal Actin**	**Status**	**Delivery Date**
10808	Actions	Improve aeronautical charts to optimise navigation infrastructure utilization by incorporating (or restoring) chart annotations that enable VOR/DME crosschecks or facilitate ILS intercept	On schedule	Q4 2027
10809	Actions	Identify how to maintain route spacing within mix of conventional and PBN procedures to support operations during GNSS reversion	On schedule	Q4 2027
10810	Actions	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	On schedule	Q4 2027
10812	Actions	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.	On schedule	Q4 2027
10813	Actions	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	On schedule	Q4 2027
10807	Actions	Provide guidance as appropriate to maintain safe and efficient operations in case of GNSS degradations	On schedule	Q4 2030
10811	Actions	To develop the RON CONOPS and the inter-relation between the two concepts, MON and RON	On schedule	Q4 2030
10814	Actions	Identify relevant document to be updated and develop subsequential amendments.	On schedule	Q4 2030

ICAO

Rationalization the conventional Navigational aids

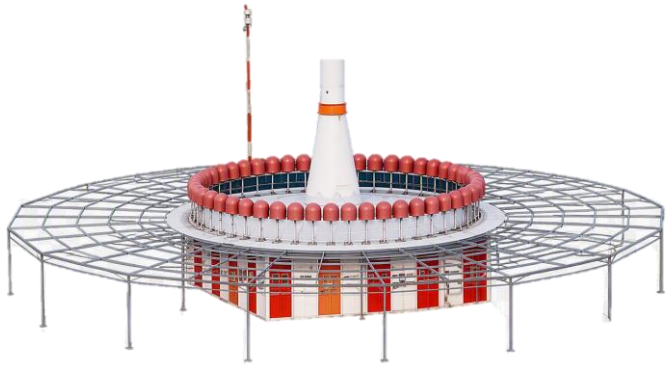


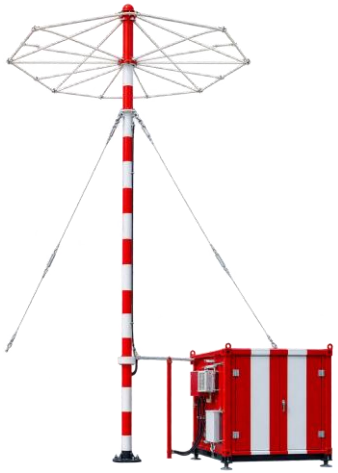
ICAO

Rationalization the conventional Navigational aids

(NDB , VOR Only, VOR DME, DME/DME Role in PBN)

VOR Only	VOR DME	NDB	DME/DME
No role (**generally obsolete)**	**RNAV 5**	No role (**generally obsolete)**	**RNAV 1, RNAV 2 and RNAV 5** ***(RNP 1 RNP2 Advance RNP on progress)***
No new stand-alone VOR facilities	for VOR/DME **inertial updating** where DME/DME updating is not available	NDBs used as a **non-precision approach** aid should be **withdrawn**	the **most suitable** current terrestrial PBN capability





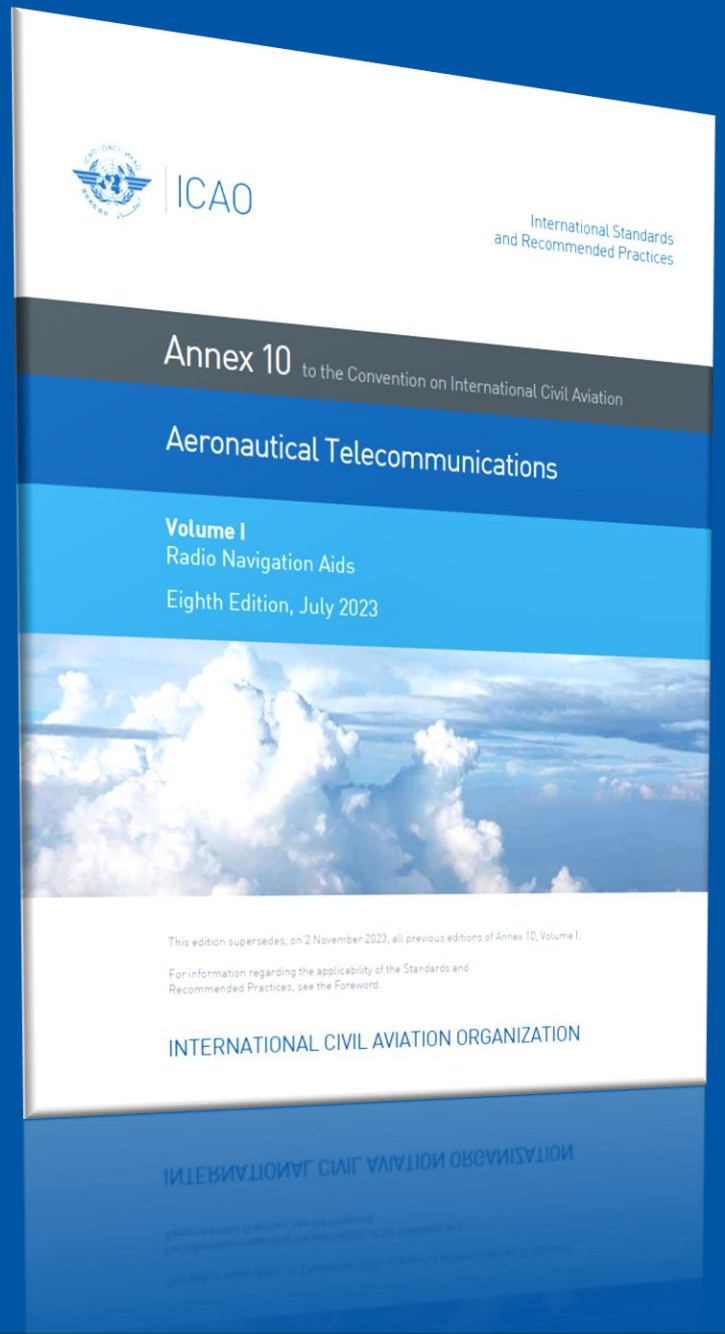


Rationalization the conventional Navigational aids
(Annex 10, Volume I Attachment H)

The strategy to facilitate the **rationalization of navigation aids** while supporting the coordinated evolution of terrestrial navigation infrastructure.

- ✓ maintain at least the **current level of safety** for enroute and terminal navigation operations;
- ✓ **facilitate PBN** implementation;
- ✓ maintain **global interoperability**;
- ✓ provide regional flexibility through **coordinated regional planning;**
- ✓ encourage airspace users to **equip with appropriate PBN avionics**;
- ✓ take account of **economic, operational and technical considerations.**

"navigation infrastructure require corresponding efforts in airspace planning, procedure design, regulatory activities and consultation with affected stakeholders"



Action by the meeting:

The meeting is invited to :

1. Note the information presented;
2. Encourage states to exchange information on challenges, best practices, and lessons learned associated with *implementation of NAV MON*

Thank You



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