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EUROPEAN  
AVIATION

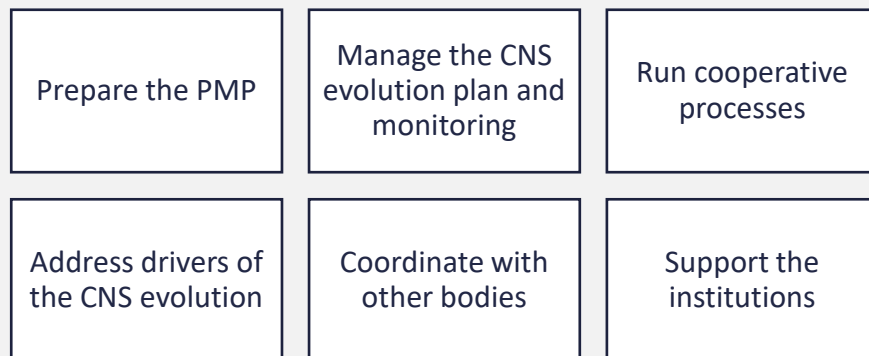
# PBN SG 9 – NAV MON

Hamdi NASSER

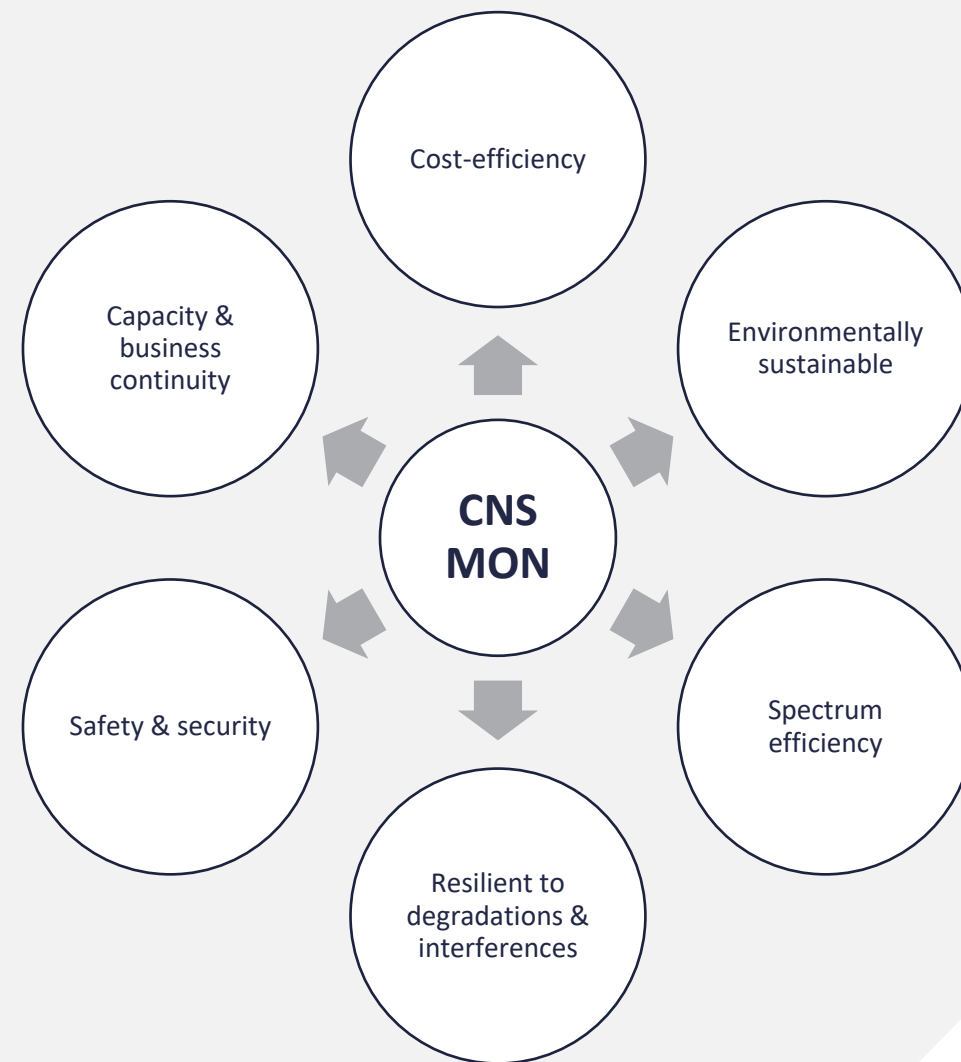


# MON objectives

## CNS program manager



- The **CNS MON** is the minimum subset of CNS infrastructure required to maintain acceptably safe and secure operations in case of the reversion from the primary infrastructure to an alternative infrastructure, supporting continued normal operations, as well as contingency.



# MON considerations

## Operational relevance

Fleet capabilities

Airspace design and procedures

Dual use (Civ-Mil)

## Economic relevance

Costs & benefits

Sharing of infra Between ANSPs

Decommissioning opportunities

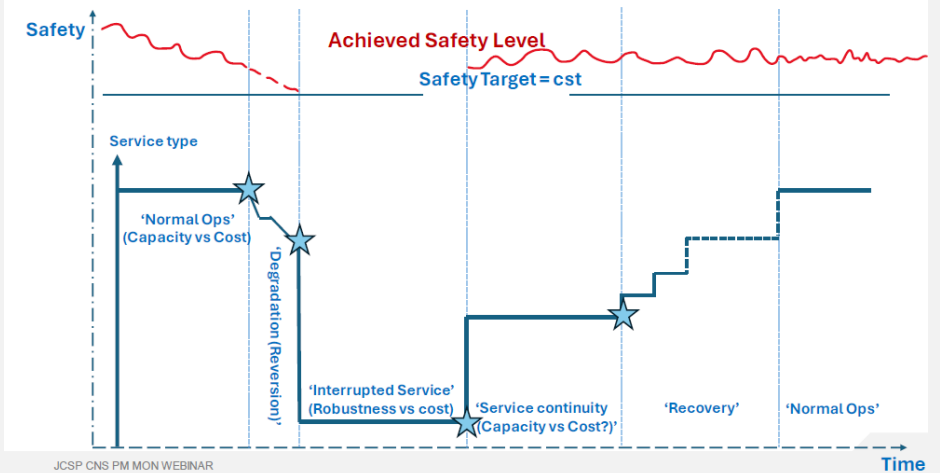
## Safety & security Considerations

Risk level & Decommissioning implications

Contingency strategies

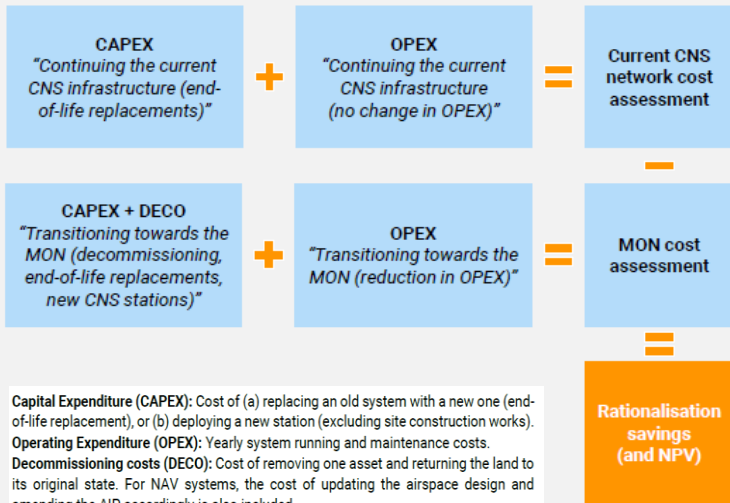
Dependency on Timing

## European/National MON Design Considerations



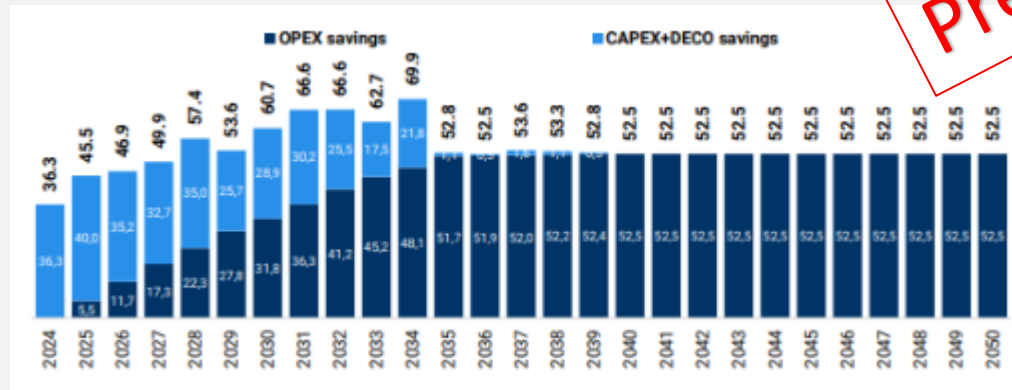
# Economic considerations and CBA

Preliminary

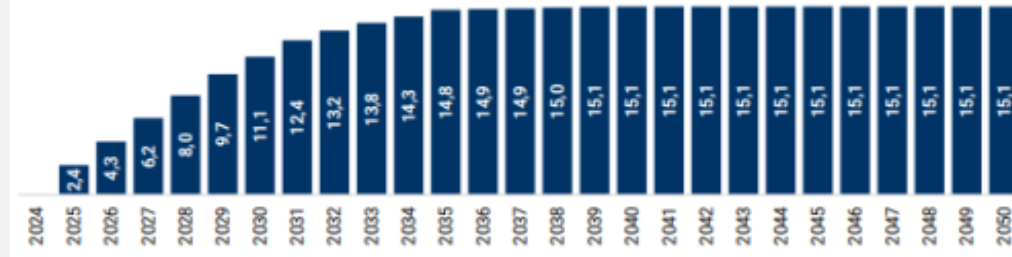


**Capital Expenditure (CAPEX):** Cost of (a) replacing an old system with a new one (end-of-life replacement), or (b) deploying a new station (excluding site construction works).  
**Operating Expenditure (OPEX):** Yearly system running and maintenance costs.  
**Decommissioning costs (DECO):** Cost of removing one asset and returning the land to its original state. For NAV systems, the cost of updating the airspace design and amending the AIP accordingly is also included.

CNS	Cumulative cost savings (EUR)	SES		ECAC	
		2024-2040	2024-2050	2024-2040	2024-2050
NAV	Undiscounted	749m	1,171m	933m	1,458m
	CAPEX+DECO	267m	267m	333m	333m
	OPEX	483m	904m	600m	1,125m
	Discounted (4%)	552m	734m	687m	914m
NAV	CAPEX+DECO	226m	226m	282m	282m
	OPEX	326m	509m	405m	632m



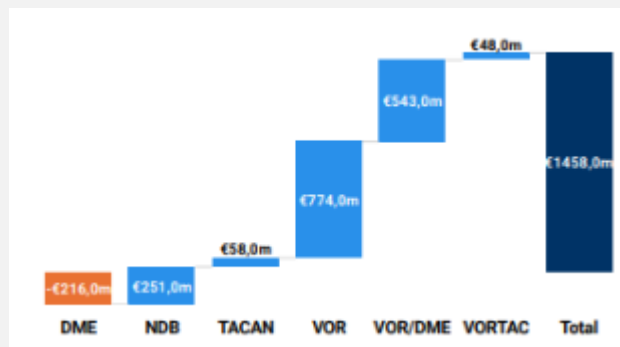
Yearly economic savings (ECAC, undiscounted, M€)



Energy consumption saving (GWh)



GHG emission saving (CO2 tons)



# NAV MON in Europe

## En route (RNAV5)

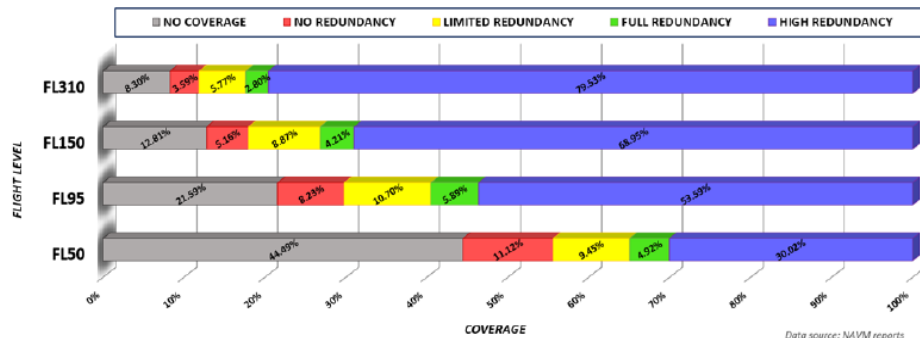
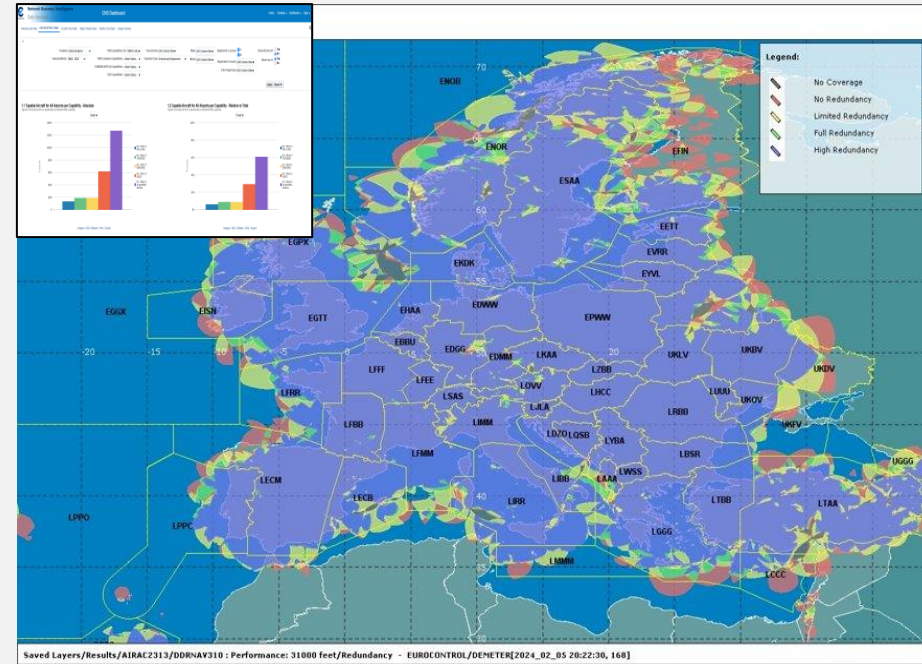
- DME/DME network
- VOR/DME as an alternative

## TMA (RNAV 1)

- DME/DME network
- Conventional SID/STAR based on VOR/DME for contingency depending on local constraints

## APCH

- ILS for PA, VOR/DME for NPA where needed, as contingency



	Capabilities	FPL codes	% of capable aircraft	% of capable flights
Approach capabilities	LNAV-only	S1 and not S2 and not B(*)	15,80%	9,26%
	LNAV/VNAV	S2	63,70%	84,20%
	LPV	B(*)	34,47%	10,12%
	RNP approaches (all 3 minima)	S2 and B(*)	20,85%	7,46%
	RNP AR	T1 or T2	12,49%	9,89%
	RNP AR with RF	T1 and not T2	11,61%	8,73%
	ILS	S or L	98,50%	99,84%
	GBAS	A(*)	9,75%	12,66%
En-route continental capabilities	RNAV 5 (VOR/DME or DME/DME)	(B3 or B4 or B5) AND NOT (B1 or B2 or B6)	2,65%	1,12%
	RNAV 5 (VOR/DME only)	B4 AND NOT (B1 or B2 or B3 or B5 or B6)	0,81%	0,25%
	RNAV 5 (DME/DME only)	B3 AND NOT (B1 or B2 or B4 or B5 or B6)	0,22%	0,04%
	RNAV 5 (GNSS and DME/DME)	B1 or (B2 AND B3)	66,64%	91,32%
	RNAV 5 (GNSS and DME/DME and VOR/DME)	B1 or (B2 AND B3 AND B4)	64,80%	89,88%
	RNAV 5 (GNSS only)	B2 AND NOT (B1 or B3 or B4 or B5 or B6)	25,11%	5,72%
	RNAV 5 (any sensor)	B1 or B2 or B3 or B4 or B5 or B6	93,15%	98,55%
	RNAV 10 (RNP 10) **	A1	70,85%	79,74%
RNP 4**	L1	48,97%	41,31%	
TMA	VOR and DME	(S or O) AND D (*)	95,62%	99,27%
	ADF	F(*)	77,23%	88,45%
	RNAV 1 (DME/DME or DME/DME IRU only)	(D3 or D4) AND NOT (D1 or D2)	1,57%	0,71%
	RNAV 1 (GNSS and DME/DME or DME/DME IRU)	D1 or (D2 AND (D3 or D4))	64,08%	90,64%

# Current status and roadmap



GNSS remains the backbone/primary NAV means



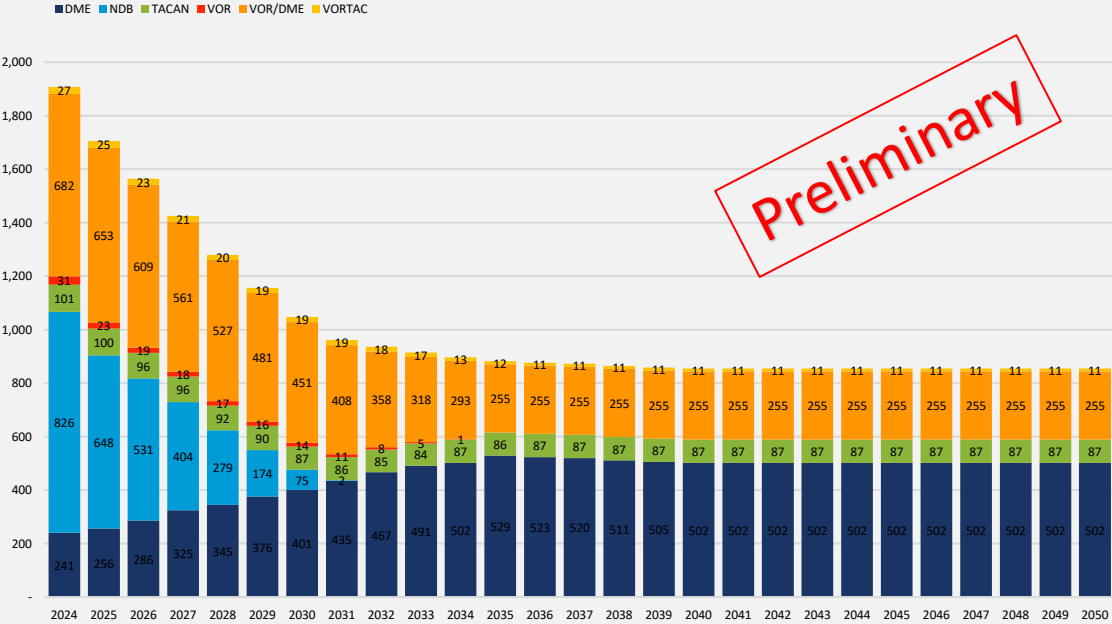
NDBs are not considered for the NAV MON



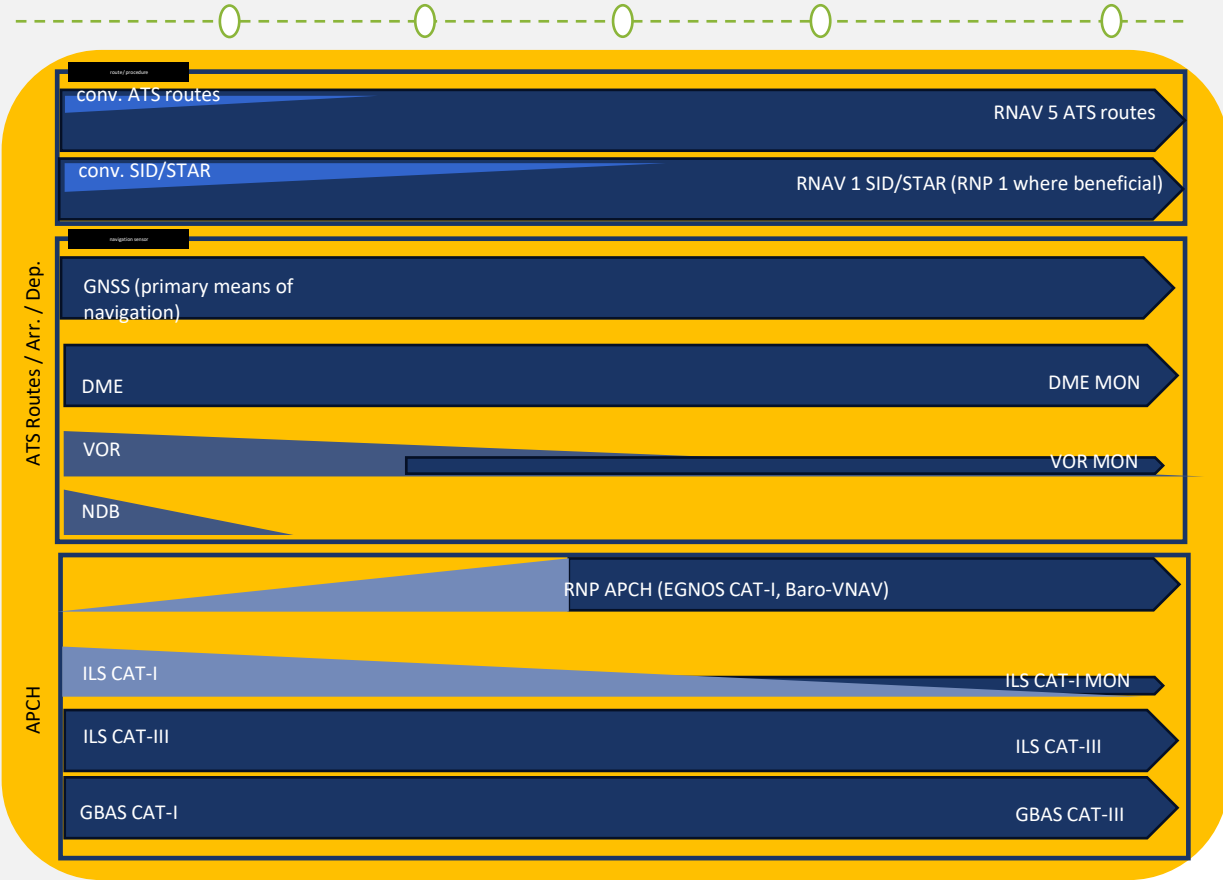
Some VORs were considered for the MON, prioritising those collocated with DME and/or supporting major aerodromes



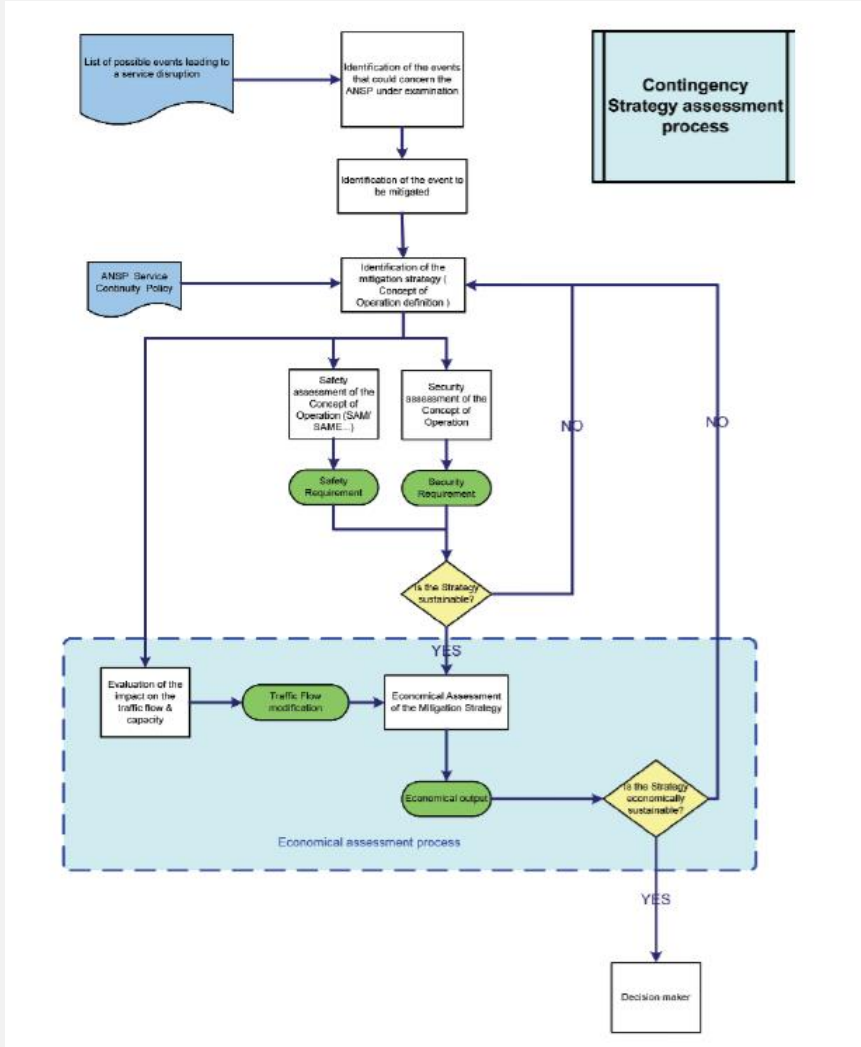
DMEs were considered for the MON, prioritising those declared for TMA and filling gaps with en-route only ones.



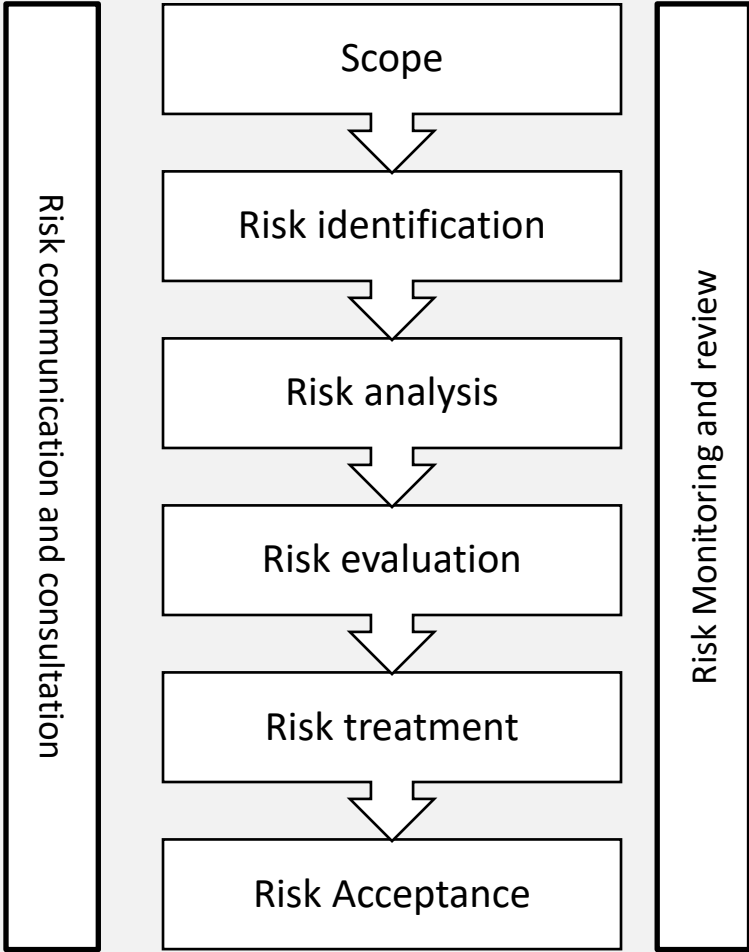
NAVAID/YEAR	2019	2020	2021	2022	2023
ILS LOC ONLY	123	108	102	94	91
ILS CAT I	548	547	558	566	567
ILS CAT II/III	263	263	266	269	271
DME(ILS)	824	811	821	824	823
DME standalone	213	214	228	260	274
TACAN	104	103	103	101	102
VOR standalone	43	39	38	31	31
VOR/DME	697	691	683	667	658
VORTAC	29	29	27	27	25
NDB	1148	1055	1002	919	841
Totals	3992	3860	3828	3758	3683



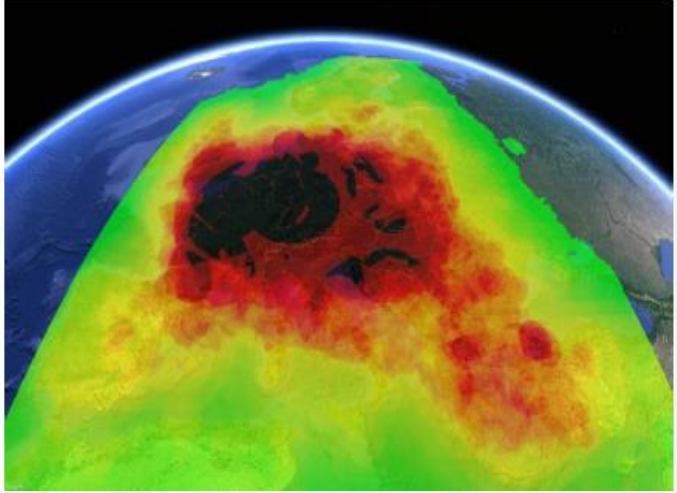
# Risk assessment and contingency planning



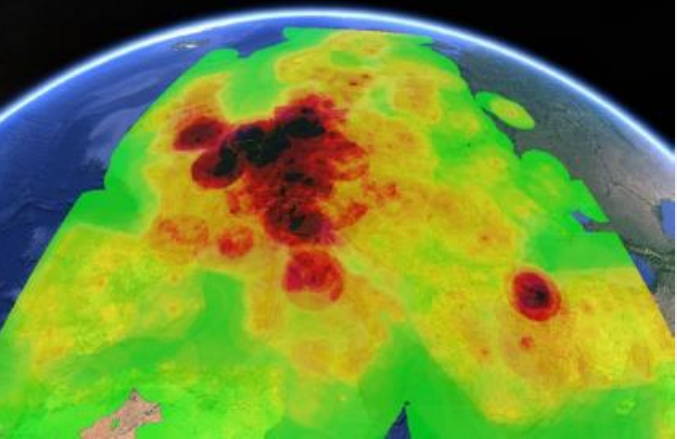
EUROCONTROL contingency planning process



ISO 27005

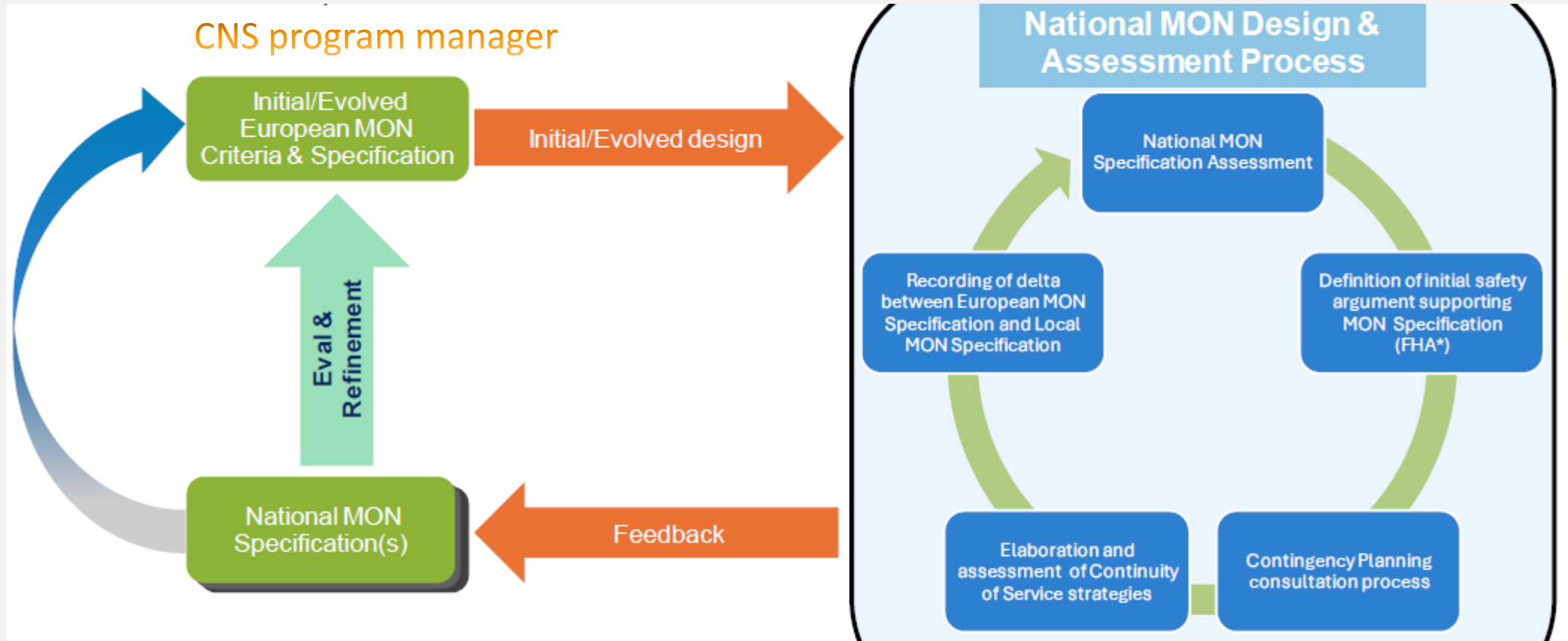


No Available VOR/DME Freq (oct 2023)



No Available ILS/DME Freq

# MON is a cooperative and continuous improvement process





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# Thank you!

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NETWORK  
MANAGER



# Navigation Minimal Operating Networks Plan

- The ASBU element “Navigation Minimal Operating Networks” (NAVS B0/4) has been classified as Priority 1 in the revised MID Region Air Navigation Strategy (MID Doc 002). This element aims to:
  - adjust conventional navaids networks through the increased deployment of satellite-based navigation systems and procedures to ensure the necessary levels of resilience for navigation.
  - provide a minimum level of capabilities to accommodate aircraft operations in mixed operation mode environments (aircraft equipage).
  - make a more efficient use of the frequency spectrum.
- MIDANPIRG/18 meeting held virtually from 15 - 22 February 2021, through Decision 18/42, agreed on the need to develop a template for Navigation Minimal Operating Networks (NAV MON) plan in line with ICAO SARPs and Regional requirements and established NAV MON PLAN AD-HOC ACTION GROUP, to develop the template.
- The NAV MON PLAN AD-HOC ACTION GROUP developed a template to serve as a standardized pre-designed format that can be used by MID States for their national NAV MON plan.

# Navigation Minimal Operating Networks Plan

- MIDANPIRG/21 Meeting noted that PBN SG inputs and tasked the ATM SG to submit their inputs to the CNS SG/13 Meeting for consolidation Accordingly, the MIDANPIRG/21 meeting endorsed the following MIDANPIRG Conclusion:

*MIDANPIRG CONCLUSION 21/26: NAV MON PLAN TEMPLATE*

*That, the CNS SG in coordination with ATM SG and PBN SG review and update, as deem necessary, the NAV MON Plan Template to be presented to MIDANPIRG/22 for endorsement.*

- MIDANPIRG/20 (Muscat, Oman, 14 – 17 May 2023); agreed through DECISION 20/46: NAV MON Plan Template that, the ATM SG, CNS SG and PBN SG be tasked to review and update, as deem necessary, the NAV MON Plan Template to be presented to MIDANPIRG/21 for further review and endorsement.
- [Navigation Minimal Operating Networks Plan Template](#)

## **ACTION BY THE MEETING**

The meeting is invited to :

- a) note the content of the presentation; and
  
- b) review and, if necessary, amend the MON NAV Template provided in Appendix A.