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Workshop on PBN airspace Design

31 May - 04 June 2021





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En-route and Terminal Navigation Specifications



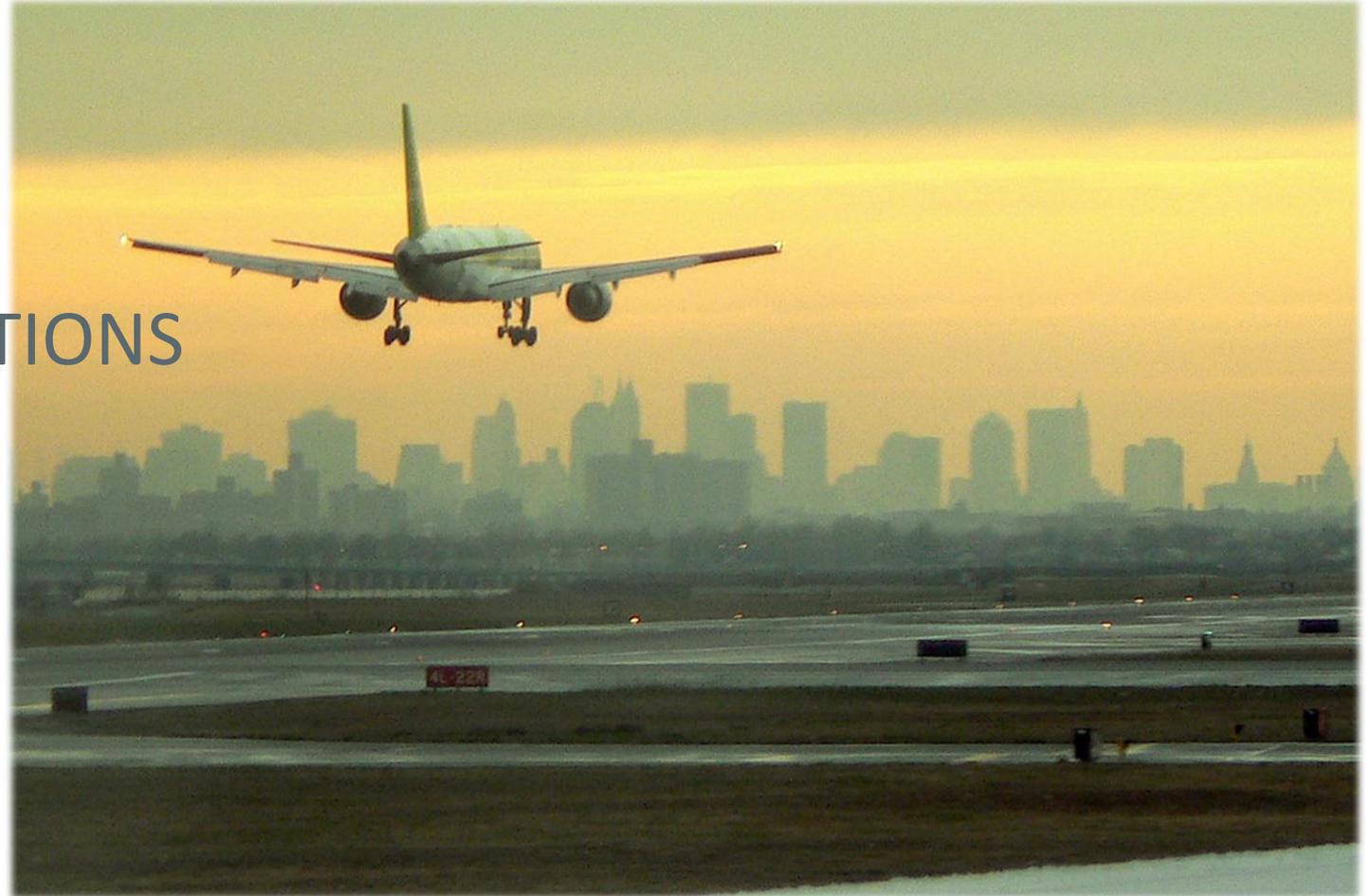


- General
- Oceanic and Remote Navigation Specifications
- En-route Navigation Specifications
- Terminal Navigation Specifications

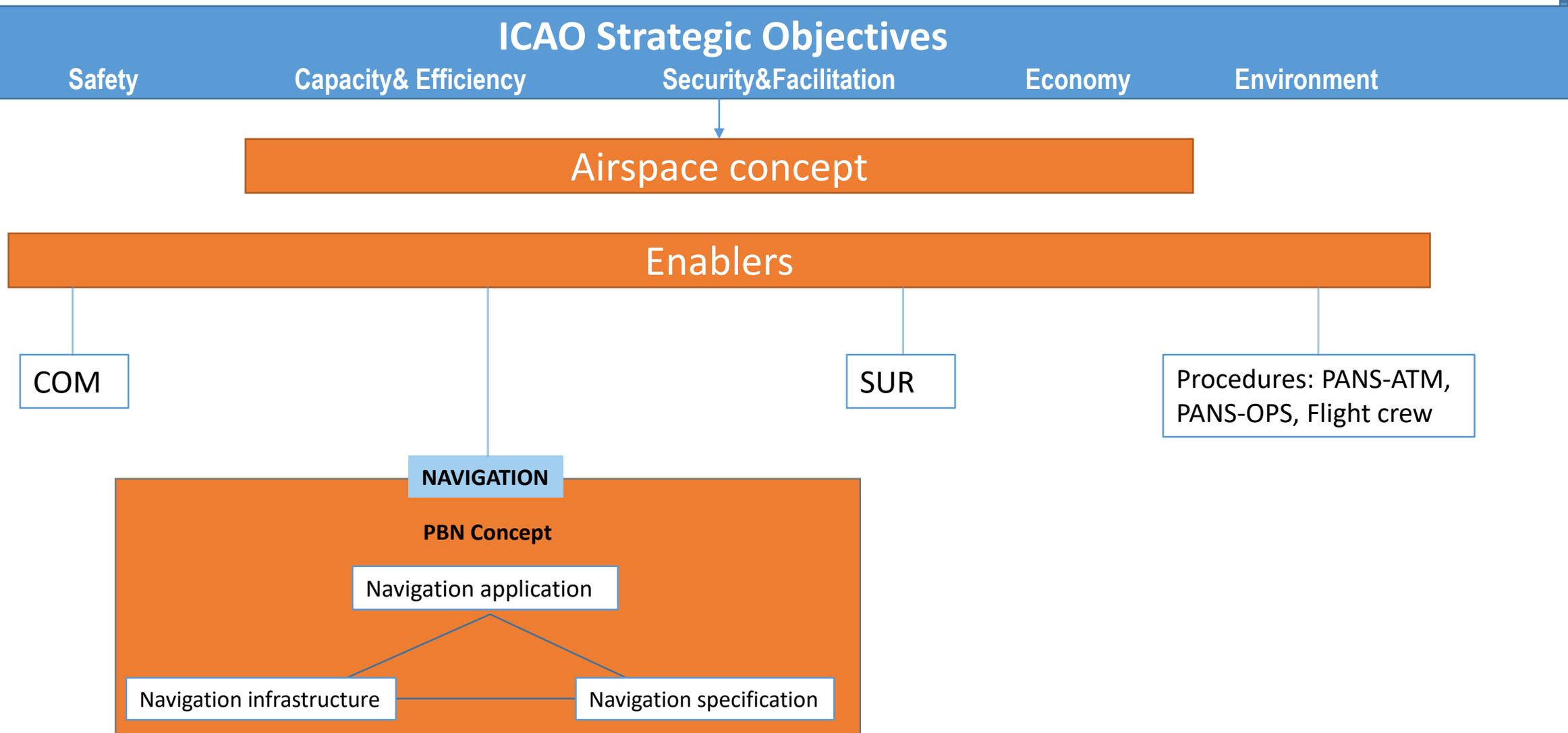


NAVIGATION SPECIFICATIONS

GENERAL



PBN components





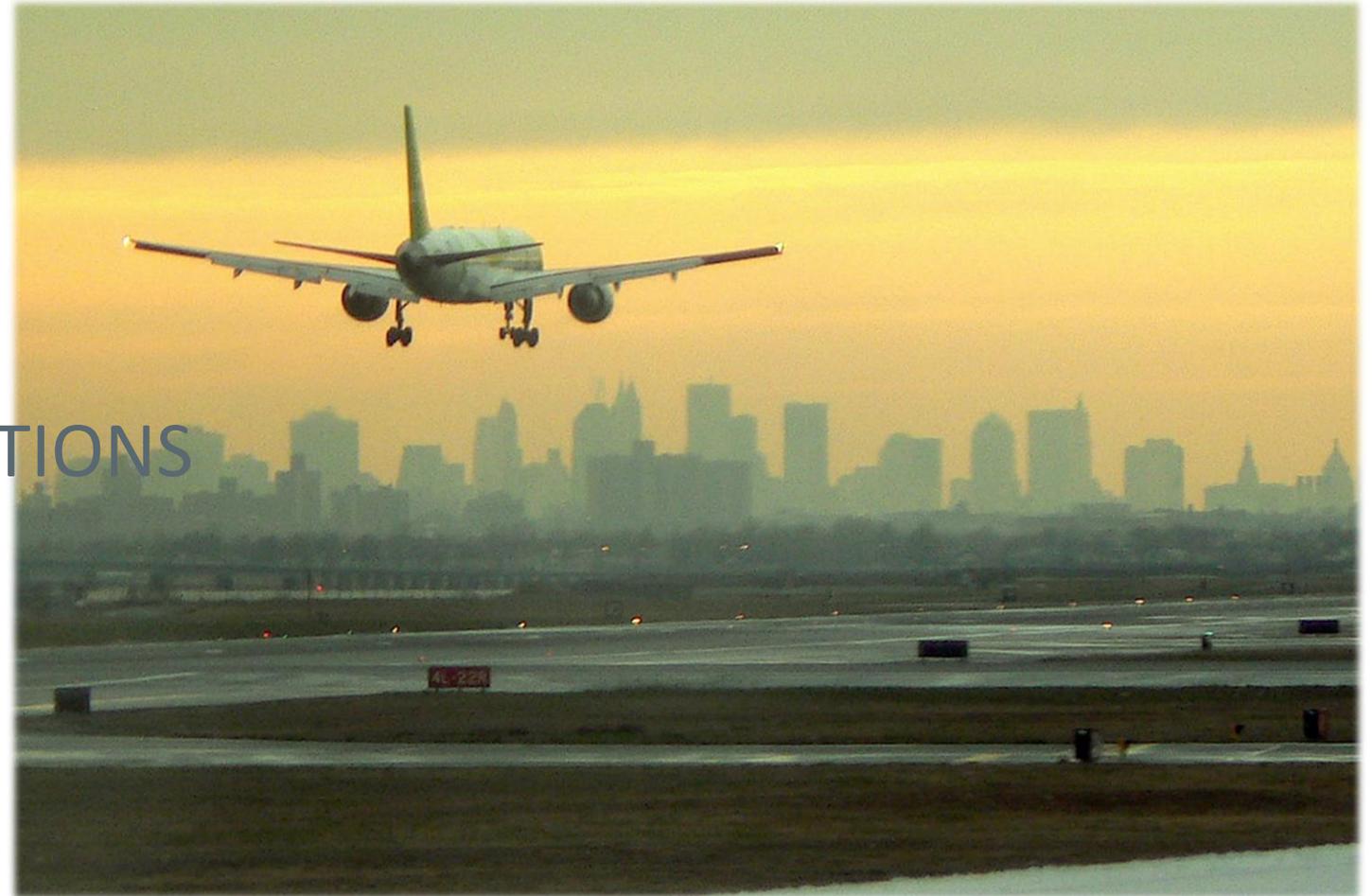
Navigation Specifications

African Flight Procedure Programme (AFPP)

- ❑ We will focus on the main Nav Specs that you will most likely will be implementing during your airspace design, e.g. RNAV 2, RNP 1, RNAV 1 and PBN approaches;
- ❑ Information on ASNP Implementation Considerations are in Doc 9613 – PBN Manual, Vol II, Part B, Chapter X.2
 - ➔ X.2.1 NAVAID Infrastructure
 - ➔ X.2.2 Communications and ATS Surveillance
 - ➔ X.2.3 Obstacle clearance, Route Spacing and Separation Minima
 - Attachment B for route spacing, 5. Terminal Airspace (Page 392/396)
 - ➔ X.2.4 Additional considerations
 - ➔ X.2.5 Publication
 - ➔ X.2.6 Controller Training



NAVIGATION SPECIFICATIONS
**OCEANIC &
REMOTE
AIRSPACE**

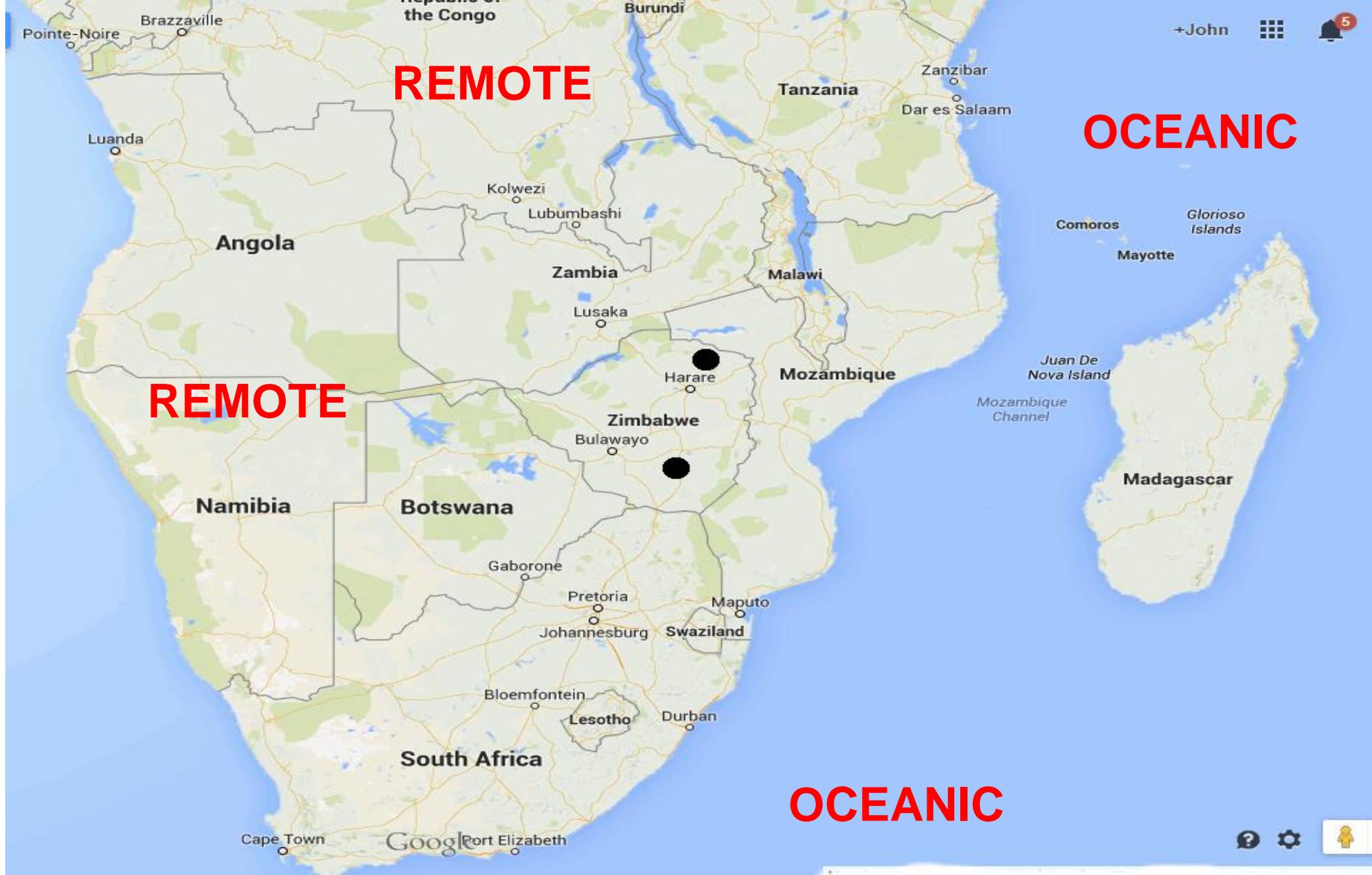




Oceanic & Remote Nav Specs

African Flight Procedure Programme (AFPP)

- ❑ How is “Oceanic & Remote” distinguished from “Continental Enroute”?
- ❑ Oceanic & Remote refers to a domain that does not provide any or only minimal ground-based NAVAIDs
- ❑ Therefore, any oceanic airspace beyond the range of coastal NAVAIDs... in excess of 200 NM
- ❑ And remote airspace with only minimal or no NAVAIDs like the Arctic, large deserts, large portions of the African Continent
 - ☞ African Continent because many existing NAVAIDs may be unreliable/unserviceable for long periods of time





Oceanic & Remote Nav Specs

African Flight Procedure Programme (AFPP)

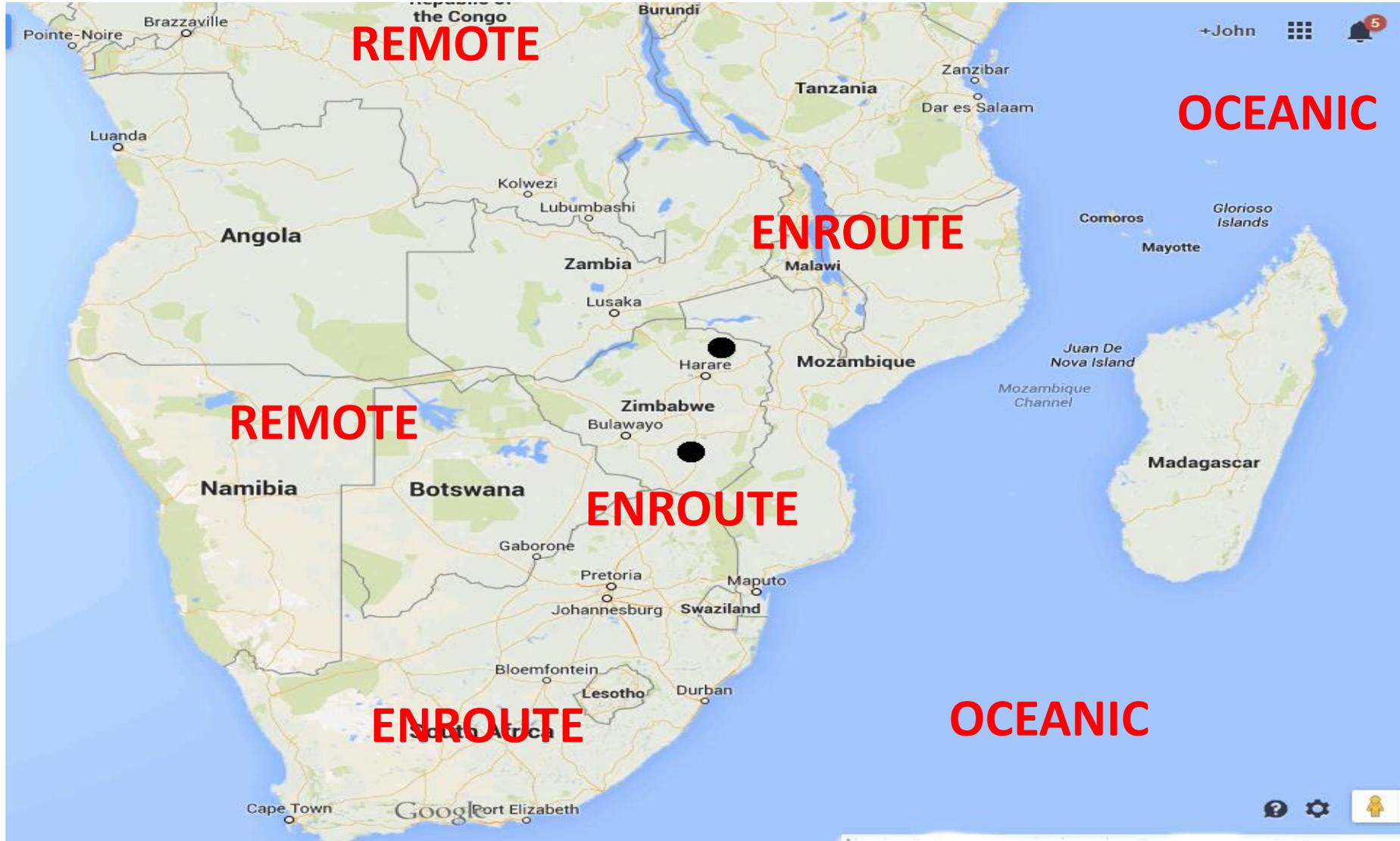
- ❑ There are two main Nav Specs applicable in this domain
- ❑ RNAV 10 and RNP 4.
- ❑ There is also RNP 2 (0) for Oceanic/Remote operations for off-coastal airspace, gulfs like the “Gulf of Biafra” or seas, or perhaps the for routes between mainland Africa and Madagascar.



Oceanic & Remote Nav Specs

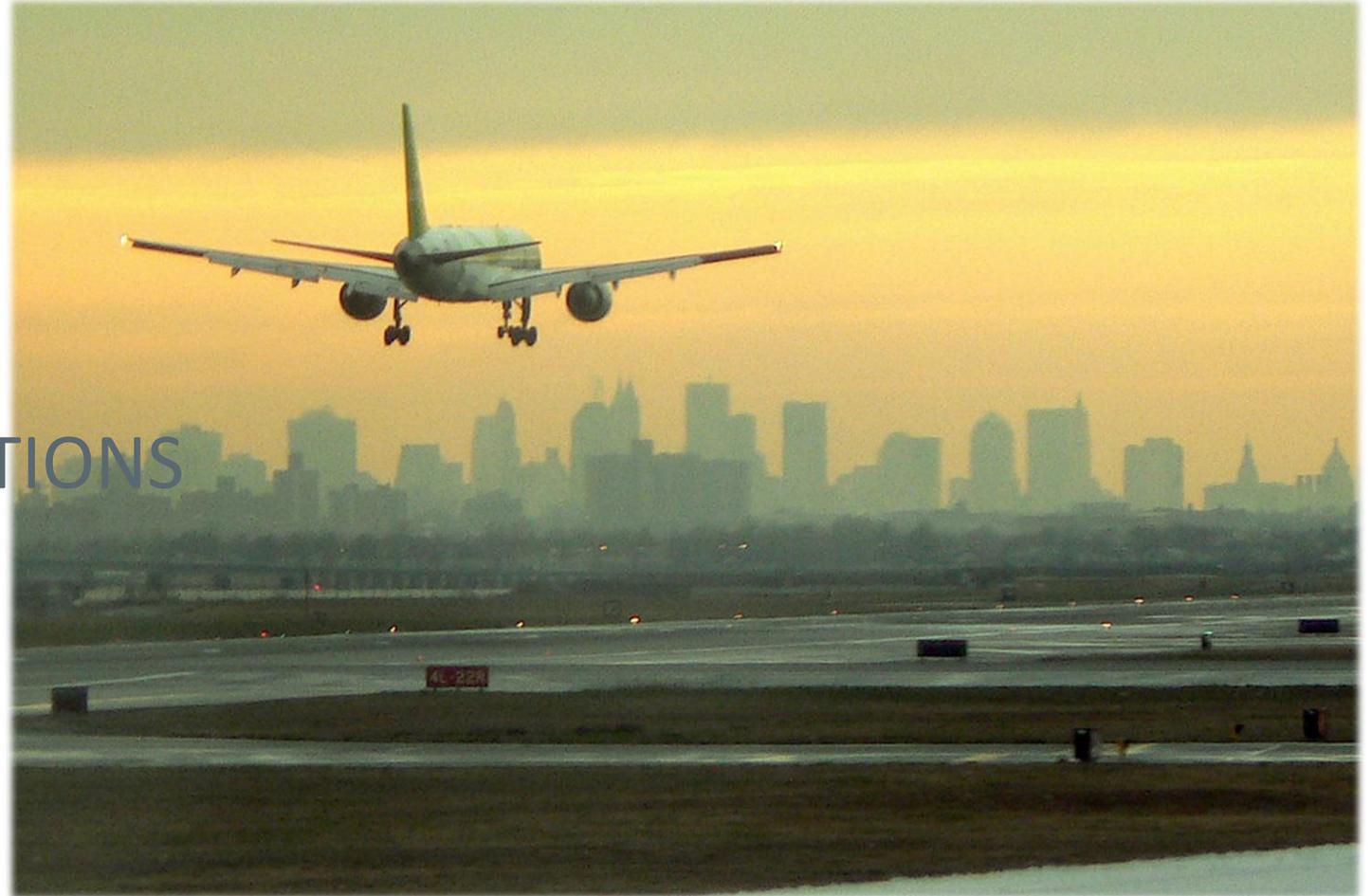
African Flight Procedure Programme (AFPP)

| Navspecs | NAV | COM | Surveillance |
|-------------------------------|-------------------------------|-------------------|---------------------------------------|
| RNAV 10 | 2 INS INS + GNSS 2 GNSS | HF | Periodic Pilot Position Reports |
| RNP 4 | (2/3)GNSS | (CPDLC) Data Link | ADS-C 14-min PPR |
| Future Implementations | | | |
| RNP 2 (O) | (2) GNSS | Data Link VHF | ADS-C |





NAVIGATION SPECIFICATIONS
**EN-ROUTE
AIRSPACE**





Enroute Nav Specs

African Flight Procedure Programme (AFPP)

- ❑ Enroute domain applies to all airspace that is not Oceanic/Remote or Terminal.
- ❑ Therefore any continental airspace that has reasonable NAVAID density.
 - 👉 NAVAIDs within 300 NM of each other.



Continental Enroute Nav Specs

African Flight Procedure Programme (AFPP)

□ There are **two main Nav Specs** applicable in this domain:

☞ **RNAV 5** and **RNAV 2**

□ RNAV 5 is the least efficient, based on twenty five-year old B-RNAV technology.

☞ B-RNAV implemented in ECAC on 23 April 1998.

□ **RNAV 2** is currently being implemented as the favourite 'enroute' Nav Spec.

□ RNP 2 (C), A-RNP and RNP 0.3 (H) may also be implemented here.



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RNAV 5 Implementation





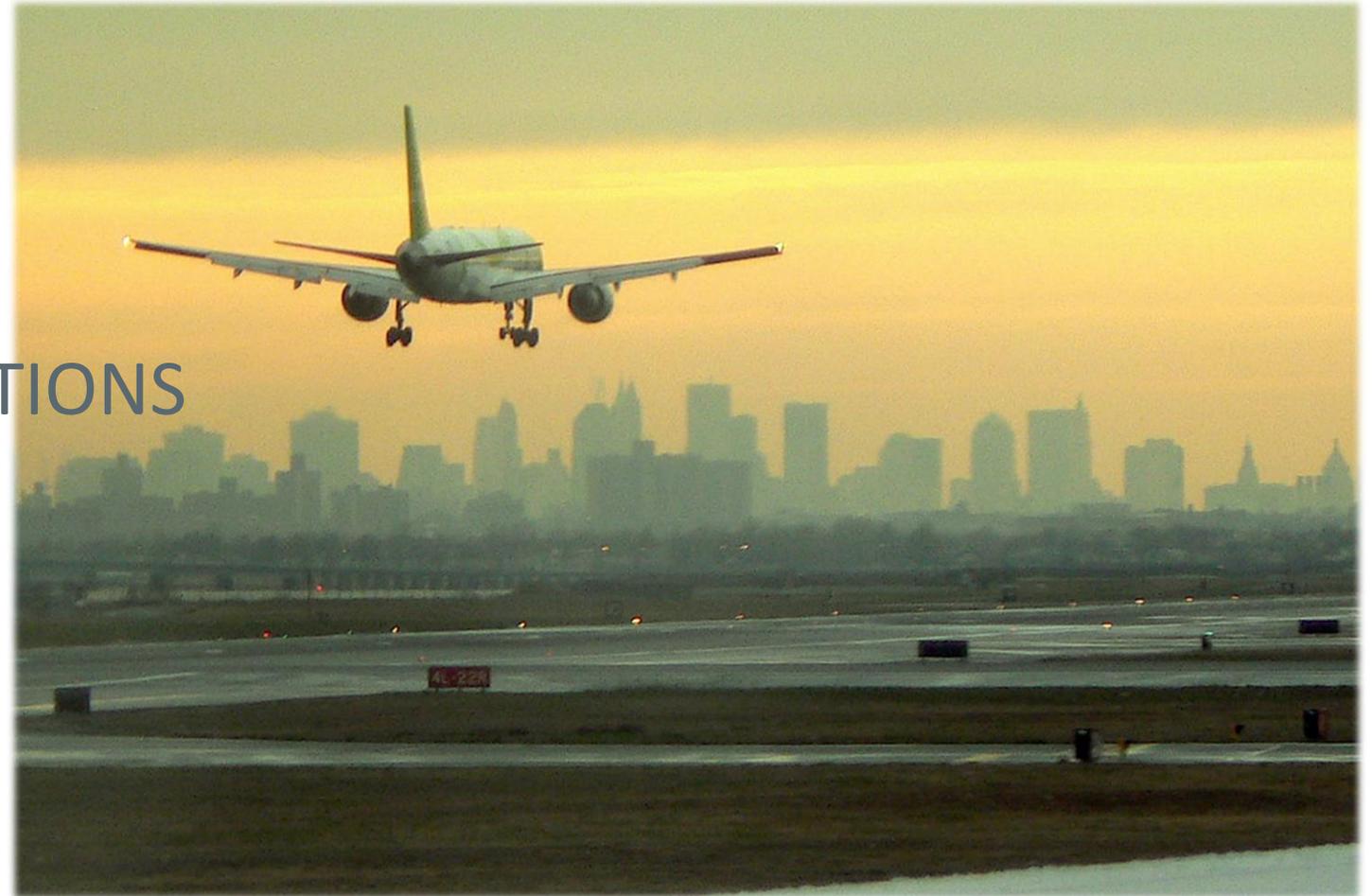
Enroute Nav, Com & Surveillance Requirements

African Flight Procedure Programme (AFPP)

| | NAV | COM | Surveillance |
|-------------------------------|--|-----------|--------------|
| RNAV 5 | VOR/DME DME/DME, INS DME/DME/IRU GNSS | HF VHF | No |
| RNAV 2 | DME/DME DME/DME/IRU GNSS | VHF | Yes |
| Future Implementations | | | |
| RNP 2 (C) | GNSS | VHF | No |
| A-RNP | GNSS | VHF | Yes |



NAVIGATION SPECIFICATIONS
**TERMINAL
AIRSPACE**



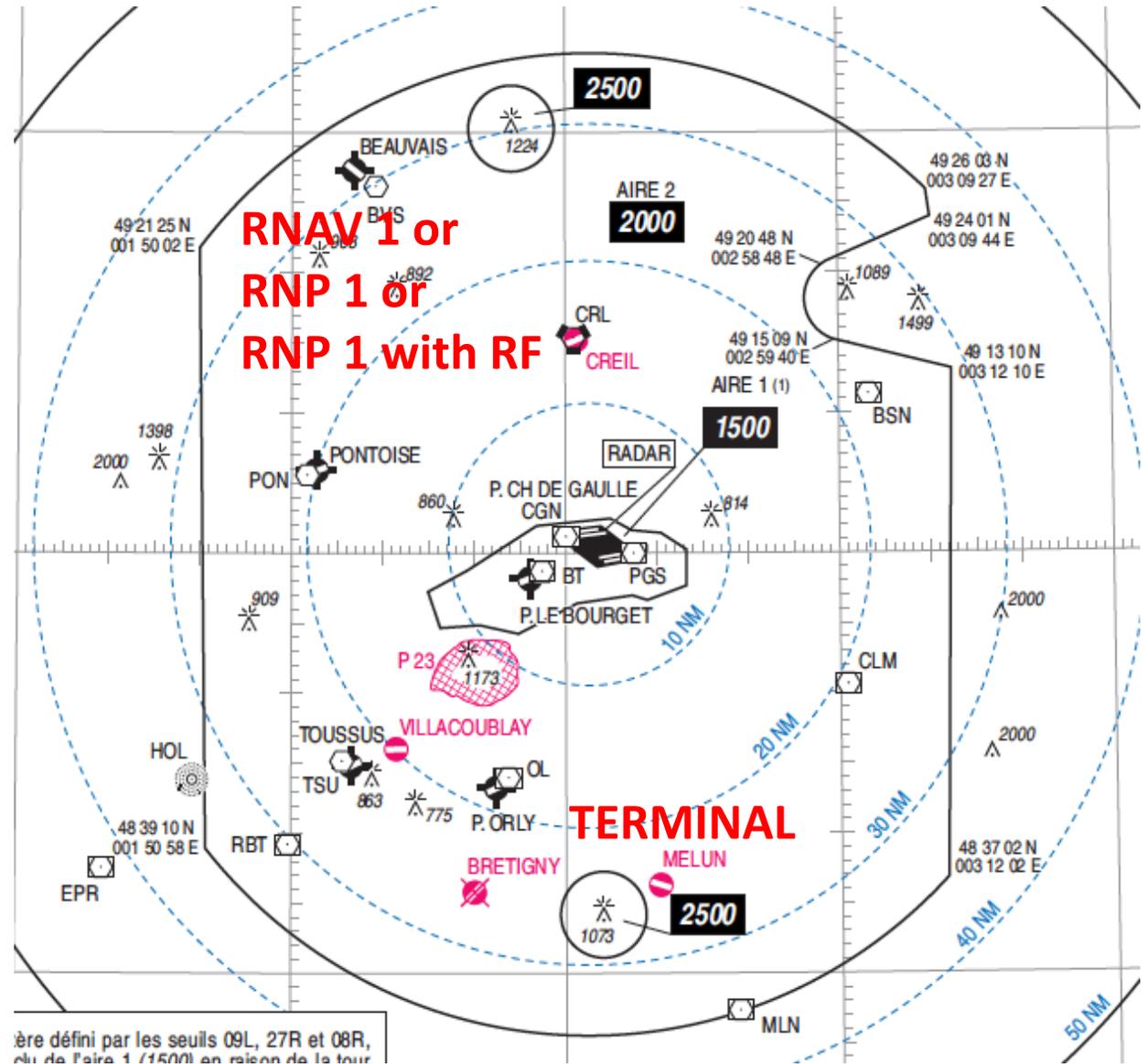


Terminal Nav Specs

African Flight Procedure Programme (AFPP)

- ❑ Terminal airspace applies to airspace around busy airports, typically under surveillance.
 - 👉 Some TMAs are in non-radar airspace.
- ❑ Terminal airspace will typically have reasonable NAVAID coverage.
 - 👉 ANSPs need to carry out a DME assessment to determine DME coverage;
 - 👉 VORs do not support terminal Nav Specs.

Terminal Nav Specs Implementation





Terminal Nav Specs

African Flight Procedure Programme (AFPP)

- ❑ **Two main Nav Specs are applicable in this domain:**
 - ☞ **RNP 1, and RNAV 1.**
- ❑ As of now, **RNAV 1** is the predominant Nav Spec being used for STARs and SIDs:
 - ☞ RNAV 1 implementation requires surveillance.
- ❑ **Radius to Fix turns (RF)** can be applied with **RNP 1 STARs or SIDs only** (not **RNAV 1**);
- ❑ If your State has not yet implemented any RNAV 1 STARs or SIDs, you should **proceed directly to RNP 1 STAR and SID implementation.**
- ❑ **A-RNP** is planned to be implemented in very busy TMAs where tight route spacing based on RNP 0.3 NM performance might be required.
- ❑ And let's not forget that RNP 0.3 (H) can also be implemented here.



Terminal CNS requirements

African Flight Procedure Programme (AFPP)

| | NAV | COM | Surveillance |
|------------------------|--------------------------------|-----|--------------|
| RNAV 1 | DME/DME DME/DME/IRU GNSS | VHF | Yes |
| RNP 1 | GNSS | VHF | No |
| Future Implementations | | | |
| A-RNP | GNSS | VHF | Yes/No |
| RNP 0.3 | GNSS (SBAS) | VHF | No |



NAVIGATION SPECIFICATIONS
APPROACH





Approach Nav Specs

African Flight Procedure Programme (AFPP)

❑ RNP APCH:

- ➡ Majority of PBN approaches are based on this Nav Spec,
- ➡ Capable & approved aircraft can also fly to LNAV/VNAV and LPV minima on RNP APCH (if WAAS equipped).

❑ RNP AR APCH:

- ➡ Now more than 500 implementations worldwide, 76 in Canada;
- ➡ Some of the first were in Juneau (USA), Kelowna (Canada), Palm Springs (USA), Quito (Peru), Queenstown (New Zealand).

❑ More about approach Nav Specs in next presentation.



Nav Specs
SUMMARY





Summary

- General Information regarding Nav Specs
 - PBN Manual, Vol II, Part B for information on PBN implementation
- Oceanic/Remote Nav Specs
 - In airspace with no or limited NAVAIDs – RNAV 10 & RNP 4
- Enroute Nav Specs
 - If it's not Oceanic/Remote or Terminal... it's Enroute!
- Terminal Nav Specs
 - RNAV 1, RNP 1 and A-RNP



Comprehension Check

African Flight Procedure Programme (AFPP)

1. What are the two main Nav Specs intended for application in Oceanic/Remote airspace?
2. What communication and surveillance equipment is required by RNP 4?
3. What is meant by En-route airspace?
4. List all Nav Specs applicable in Enroute airspace.
5. Which Nav Spec requires surveillance as part of Terminal airspace implementation?
6. How can STARs and SIDs based on RNP 1 be made more efficient?



Questions:

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