



ICAO

RECONNECTING THE WORLD



Controlled Flight Into Terrain (CFIT) Workshop

Lagos, Nigeria

From 9 to 11 October 2023

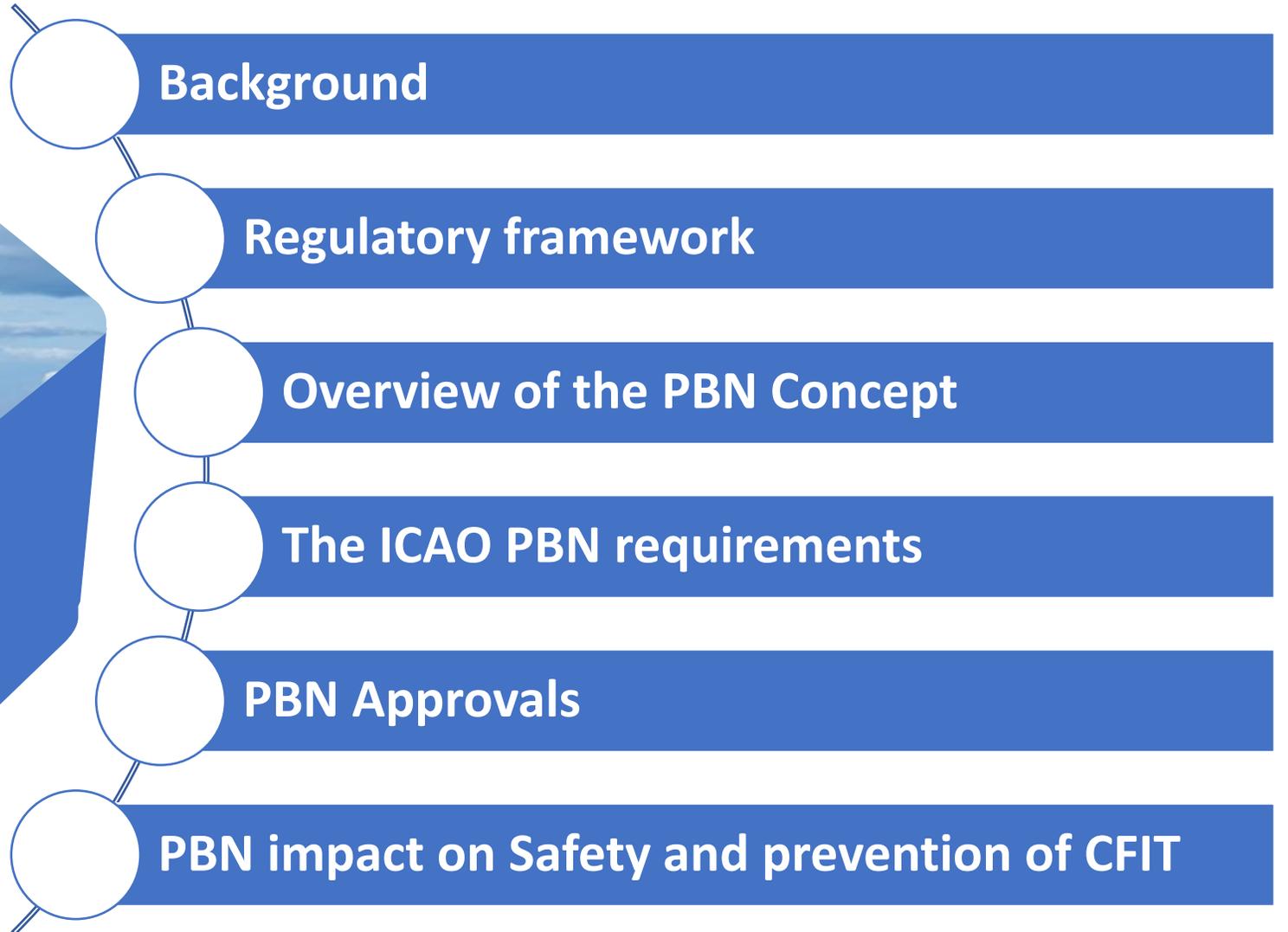


Performance-based Navigation (PBN) impact on Flight Operations





Outline

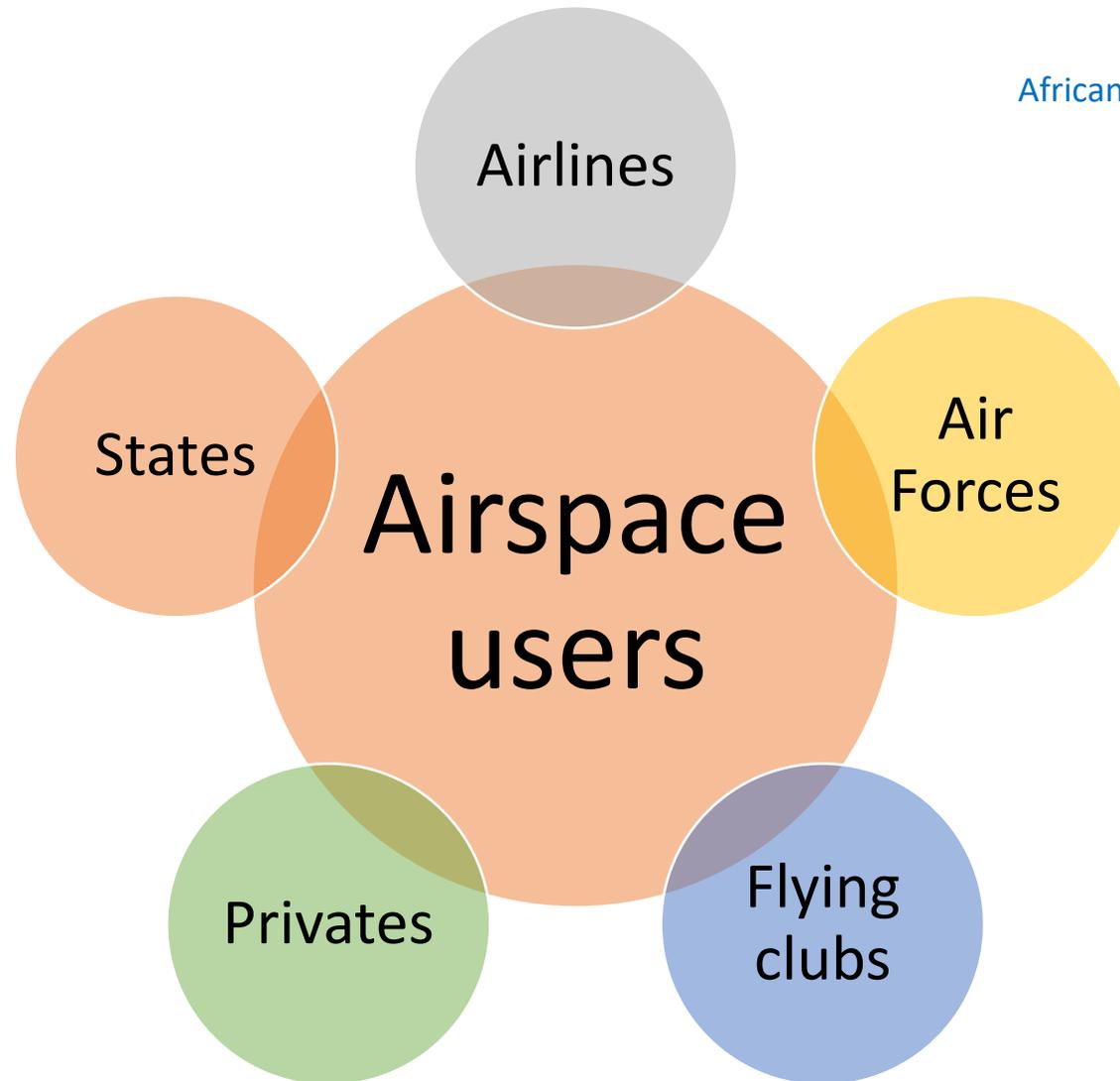




Background

African Flight Procedure Programme (AFPP)

Airspace users





Background

African Flight Procedure Programme (AFPP)

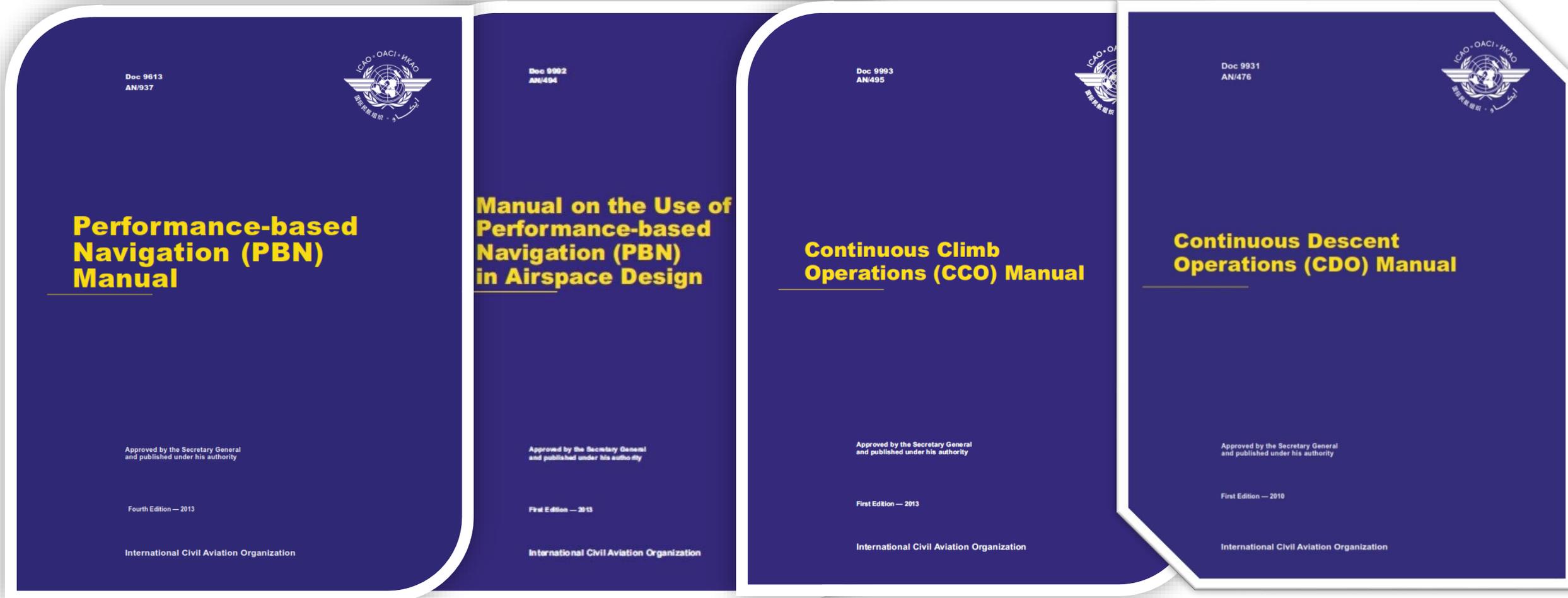
- ❑ Air navigation is always facing many challenges:
 - ☞ Growing demand - airspace congestion;
 - ☞ Growing fuel efficiency requirements;
 - ☞ Growing environmental requirements;
 - ☞ Flight efficiency demands.
- ❑ Most could be met with the existing technology and many and many attempts were made:
 - ☞ RNP Concepts during the 90s;
 - ☞ RNAV concepts.
- ❑ But standardization and operational requirements appeared to be essential

ICAO therefore issued the PBN concept in 2008 given its multiple benefits..



Regulatory framework

African Flight Procedure Programme (AFPP)





Overview of the PBN Concept

African Flight Procedure Programme (AFPP)

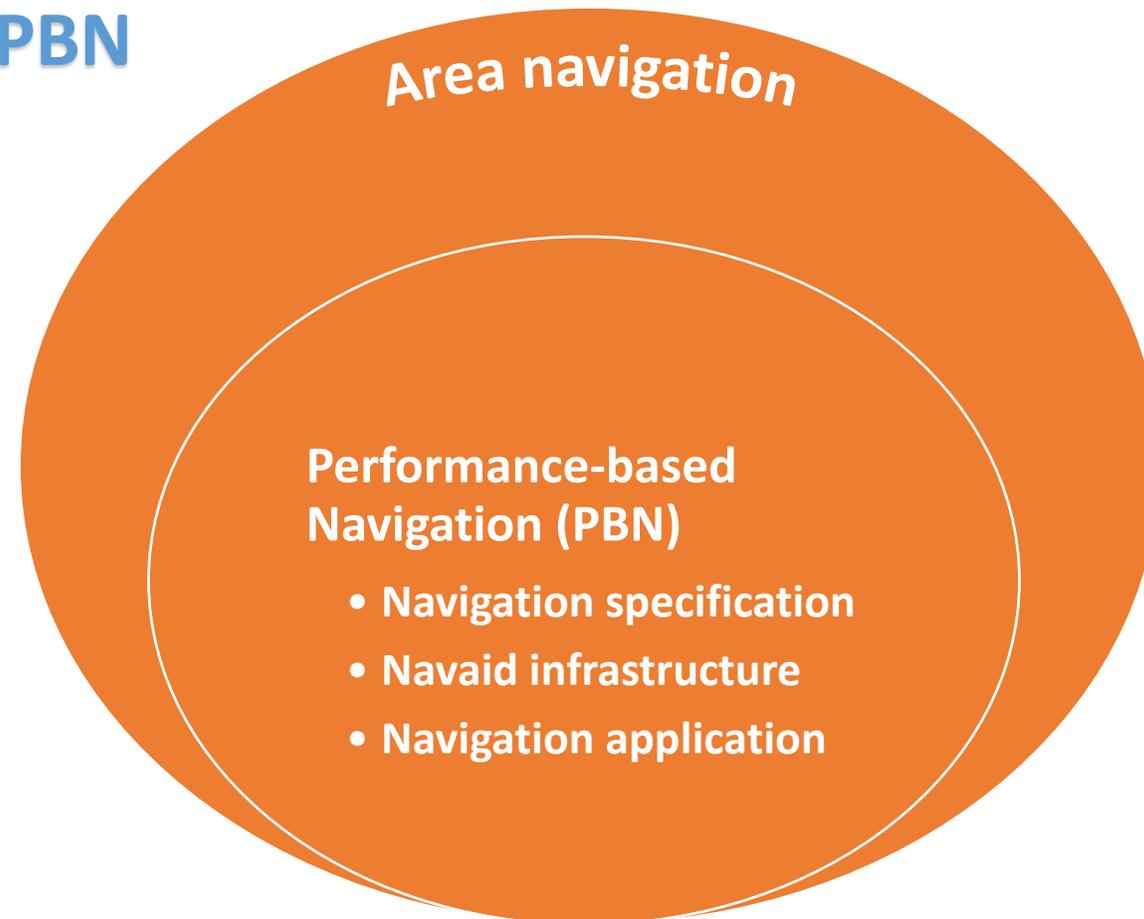
- ❑ PBN is a globally harmonized transition to sensor-specific navigation to performance-based navigation:
 - 👉 Same design criteria;
 - 👉 Same airspace design principles....
 - 👉 Same operational approval;
 - 👉 Same pilot procedures;
 - 👉 Same ATC separation;
 - 👉 Same phraseology.



Overview of the PBN Concept

African Flight Procedure Programme (AFPP)

Context of the PBN





Overview of the PBN Concept

African Flight Procedure Programme (AFPP)

Navigation specification (Navspec)

□ A navigation specification:

☞ Details the required system performance in terms of:

- Accuracy, integrity, and continuity.

☞ Includes requirements on the communications, navigations and surveillance infrastructures, ATC and pilots training, ATC support tools, ATS system monitoring and AIP publication.

☞ On-board functionalities.

☞ Navigation functional requirements.

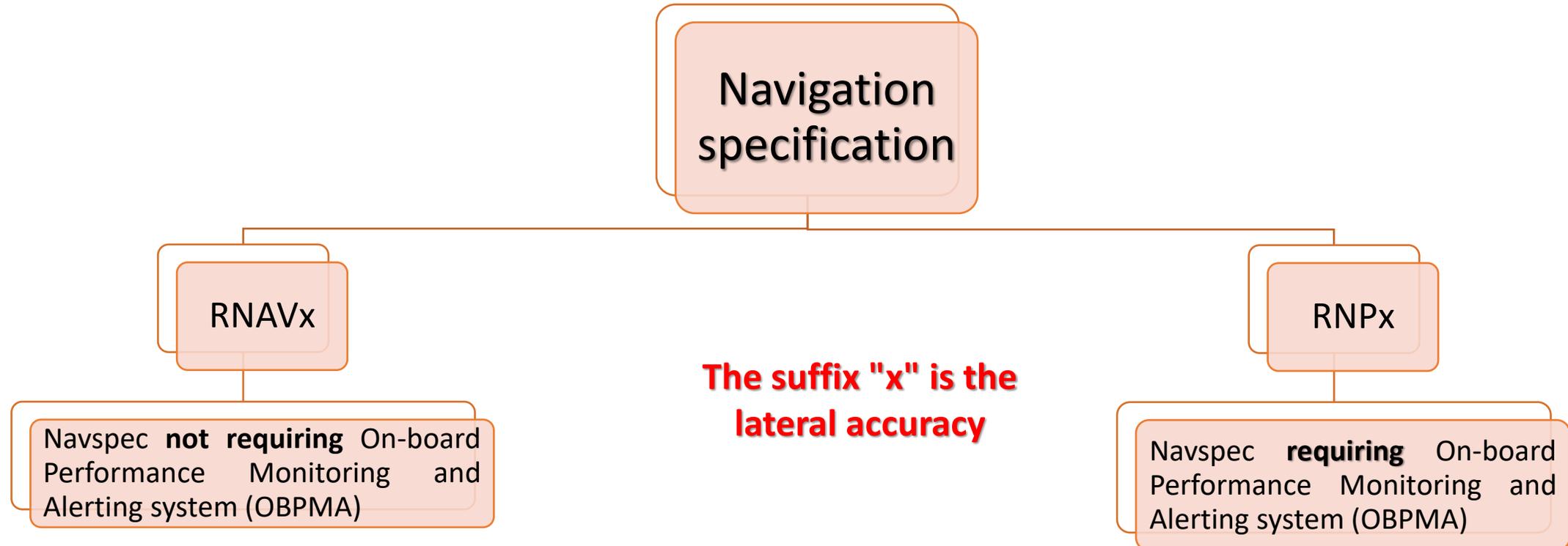
□ Navigation specification are developed for all areas of operation.

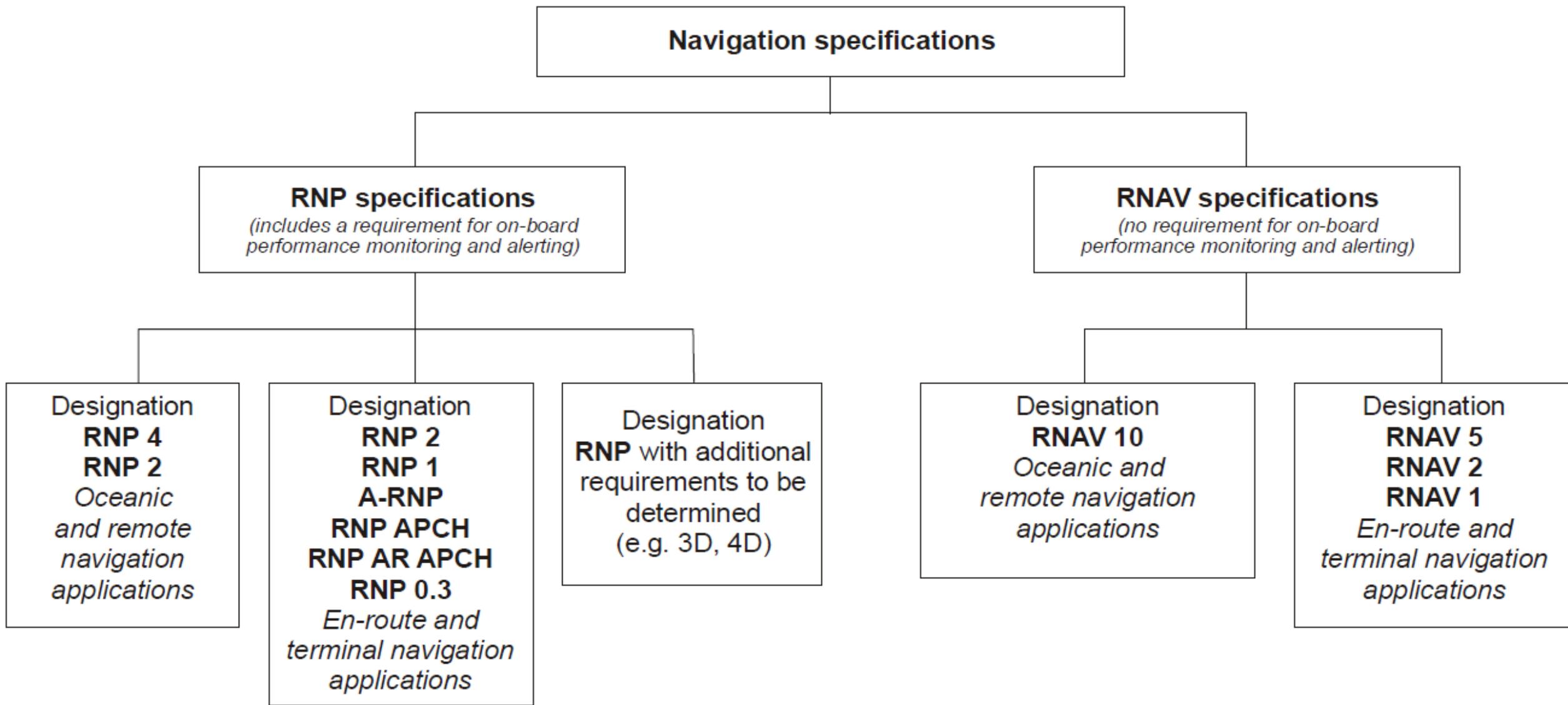


Overview of the PBN Concept

African Flight Procedure Programme (AFPP)

Navigation specification (Navspec)







Overview of the PBN Concept

African Flight Procedure Programme (AFPP)

Navaid infrastructure

□ Ground-based :

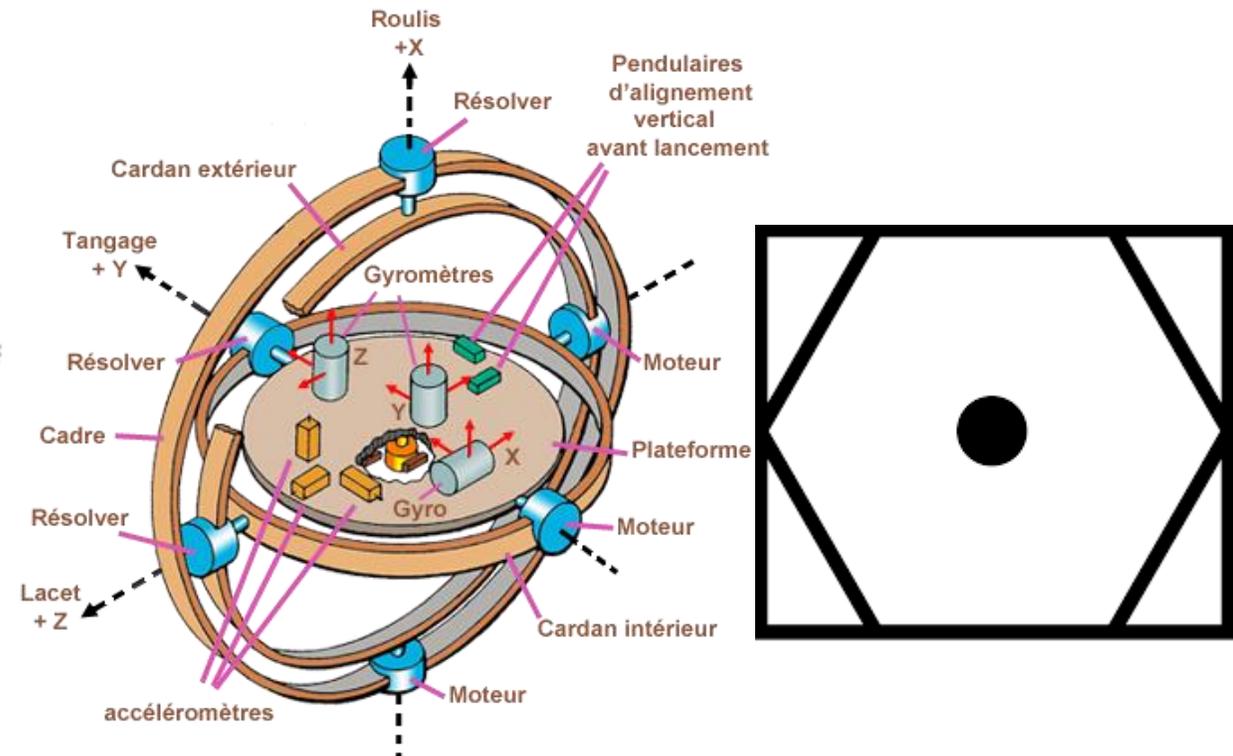
☞ VOR-DME, DME/DME, ~~NDB, VOR~~

□ Space-based :

☞ GNSS

□ Self-contained:

☞ INS/IRS





Overview of the PBN Concept

African Flight Procedure Programme (AFPP)

Navigation application

PBN application :

- **Use of PBN navigation specification and Navaid infrastructure on a given area of operation:**
 - Eg: Use of RNP 1 navspec based on GNSS in terminal operation (SID/STAR).

Four (04) areas of operation (flight phases):

- **En-route Oceanic or remote continental;**
- **En-route continental;**
- **Terminal;**
- **Approach.**



Overview of the PBN Concept

African Flight Procedure Programme (AFPP)

Navigation applications

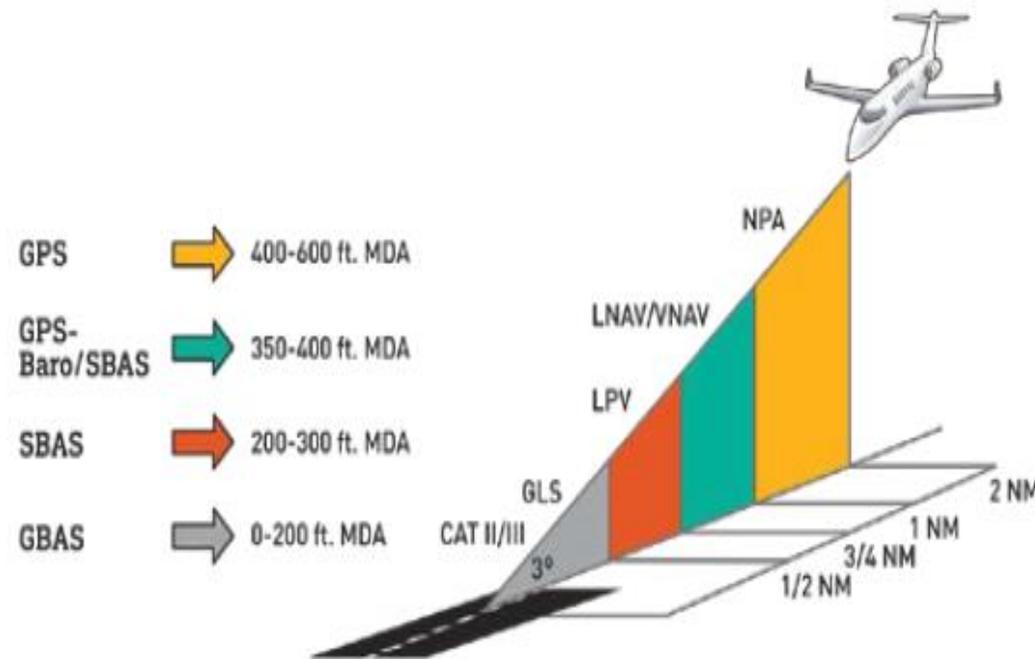
Navigation Application	Navigation Specification	
	RNP	RNAV
Oceanic and Remote	RNP 4, RNP 2, A-RNP	RNAV 10
Continental	RNP 2, A-RNP, RNP 0.3	RNAV 5, 2, 1
Terminal	RNP 1, A-RNP, RNP 0.3, RNP AR	RNAV 5, 2, 1
Approach	RNP APCH, RNP 0.3, A-RNP 0.3, RNP AR	



Overview of the PBN Concept

African Flight Procedure Programme (AFPP)

PBN benefits



- Shorter routes;
- Flight efficiency;
- Increased airspace capacity;
- Environment free;
- Reduction of fuel consumption;
- Enhance flight safety and even ... Security
- Improve operational return;
- Reduce pilots and controller workload;
- Predictable and repeatable flight tracks,
- ..



Overview of the PBN Concept

African Flight Procedure Programme (AFPP)

PBN benefits

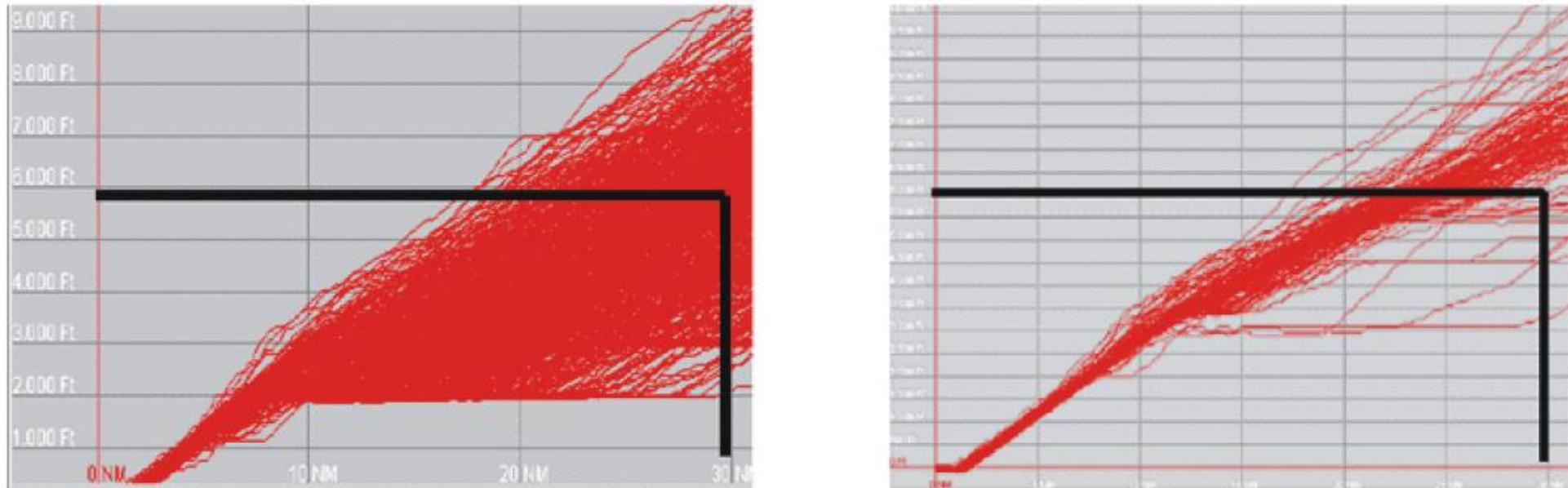


Figure 2-1. Comparison of actual aircraft profiles with and without CD Operations



Overview of the PBN Concept

African Flight Procedure Programme (AFPP)

PBN benefits





The ICAO PBN requirements

African Flight Procedure Programme (AFPP)

- ❑ The first step is the setting up of a national PBN implementation plan and then:
 - ☞ Design of PBN routes, and flight procedures:
 - Arrival (STARs)
 - Approach (IAP), and
 - Departure (SIDs).
- ❑ PBN operations shall be approved by States:
 - ☞ Regulatory approval for the flight procedures;
 - ☞ Operational approval for the aircraft and the crew.



PBN Approvals

African Flight Procedure Programme (AFPP)

What is a PBN
Operational Approval?

Does it include
approval of routes?

What is a PBN
regulatory Approval?

How do I *approve*
PBN Ops?





Regulatory approval

- ❑ PBN flight procedures shall be designed using the ICAO relevant documents and the design shall follow the Quality Assurance Manual (Doc. 9906) requirements;
- ❑ Prior to their effective implementation, the flight procedures shall be formally approved by the State to grant that the following ICAO requirements are met:
 - ☞ The data used in the design;
 - ☞ The design team for the competency and skills (Doc. 9906, vol. 1);
 - ☞ The flight validation pilots and the flight validation service provider (Vol. 6);
 - ☞ The design and charting automated solution (Vol. 3);
 - ☞ The design process compliance (Vol. 1 and 5).



PBN Approvals

African Flight Procedure Programme (AFPP)

Operational approval

- ❑ PBN operational approval authorizes PBN operations:
 - 👉 In a designated airspace;
 - 👉 On a specified route;
 - 👉 On a PBN approach.
- ❑ Up to Three States/Regulatory bodies can be involved:
 - 👉 State of Design/Manufacture;
 - 👉 State of registry;
 - 👉 State of the operator.



PBN Approvals

African Flight Procedure Programme (AFPP)

Other requirements

Other air operators requirements for conducting PBN operations:

- 👉 Operations manual;
- 👉 Flight crew operating procedures, training and competency;
- 👉 Checklists (Crew Review Cards);
- 👉 MEL;
- 👉 Database management;
- 👉 Dispatch;
- 👉 ...



PBN impact on Safety and prevention of CFIT

African Flight Procedure Programme (AFPP)

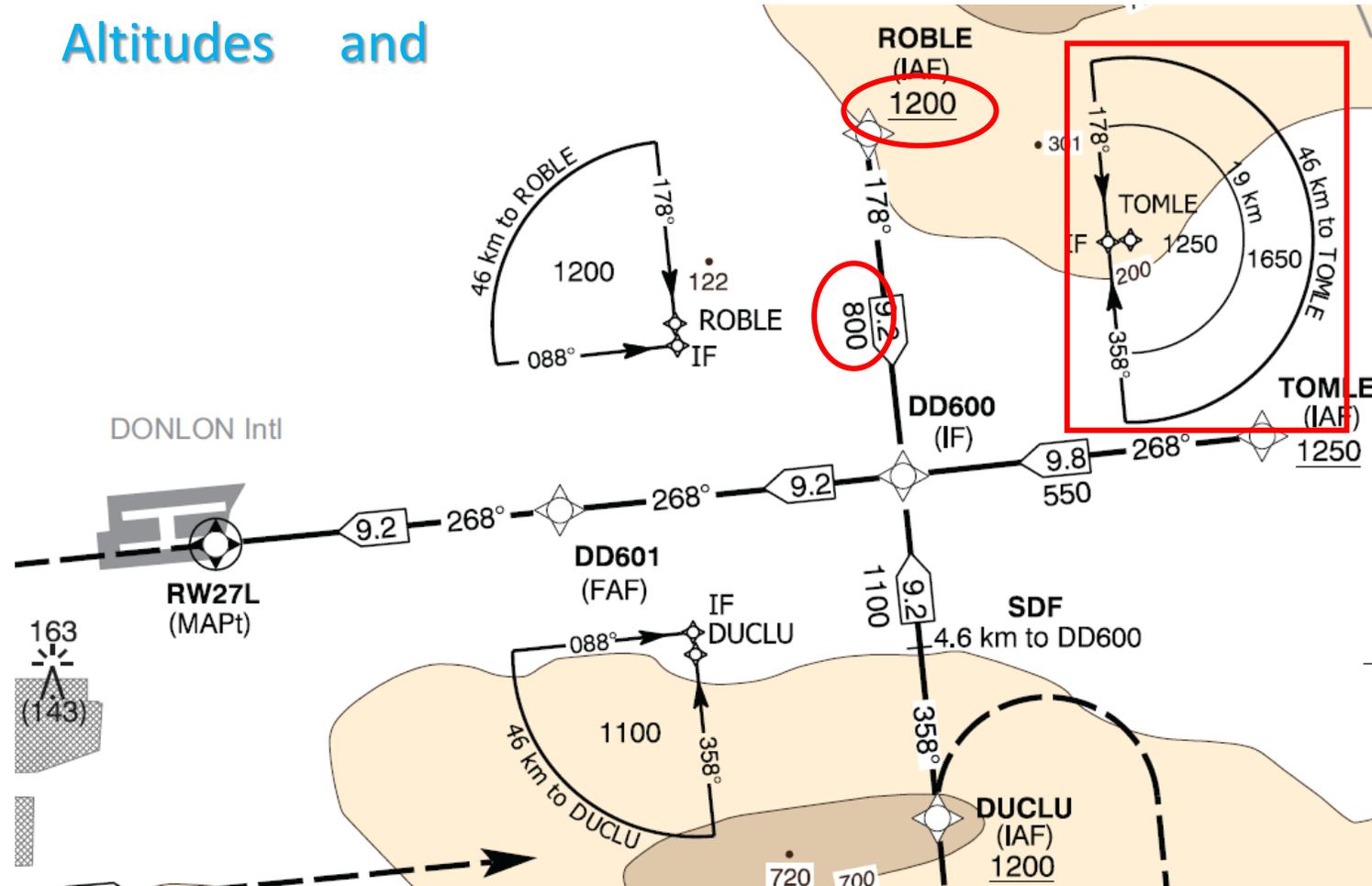
- ❑ CFIT type accidents represents a high percentage in the aviation accidents and incidents and causes the maximum of victims;
- ❑ Generally occurs in the arrival and approach phases;
 - ☞ Approaches without vertical guidance in final approach are the main cause of the CFITs:
- ❑ ICAO CFIT safety initiatives:
 - ☞ Introduction of the APV baro-VNAV (2001);
 - ☞ Other PBN vertically guided approaches (LPV, GLS);
 - ☞ Terminal arrival Altitude with T/Y bar concept proposed in 2004;
 - ☞ Introduction of Procedure altitudes/heights;
 - ☞ Depiction of Minimum Obstacle Clearance altitudes (MOCA).



PBN impact on Safety and prevention of CFIT

African Flight Procedure Programme (AFPP)

- TAAs, Procedure Altitudes and MOCA

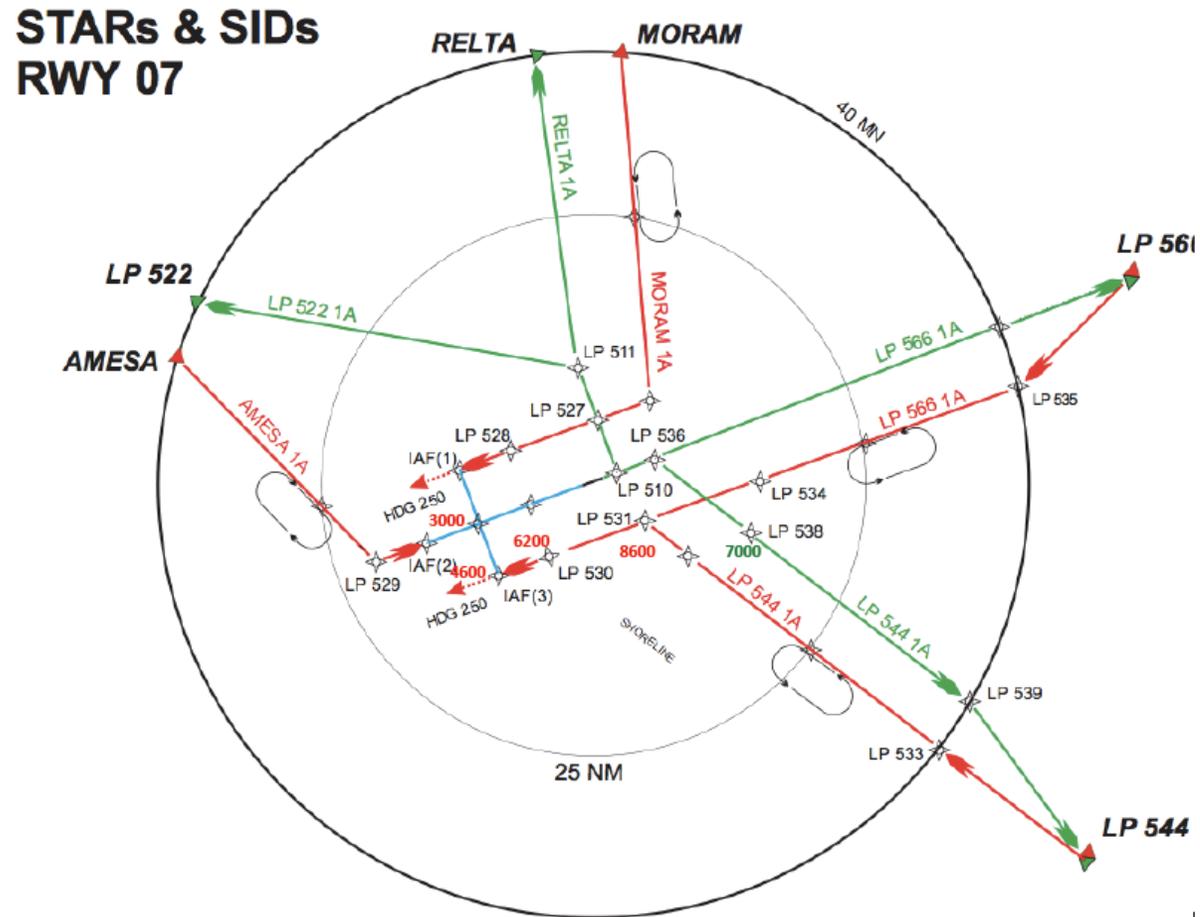




PBN impact on Safety and prevention of CFIT

African Flight Procedure Programme (AFPP)

Continuous Descent and continuous Climb Operations (CCO/CDO)





PBN impact on Safety and prevention of CFIT

African Flight Procedure Programme (AFPP)

Parallel unidirectional Routes

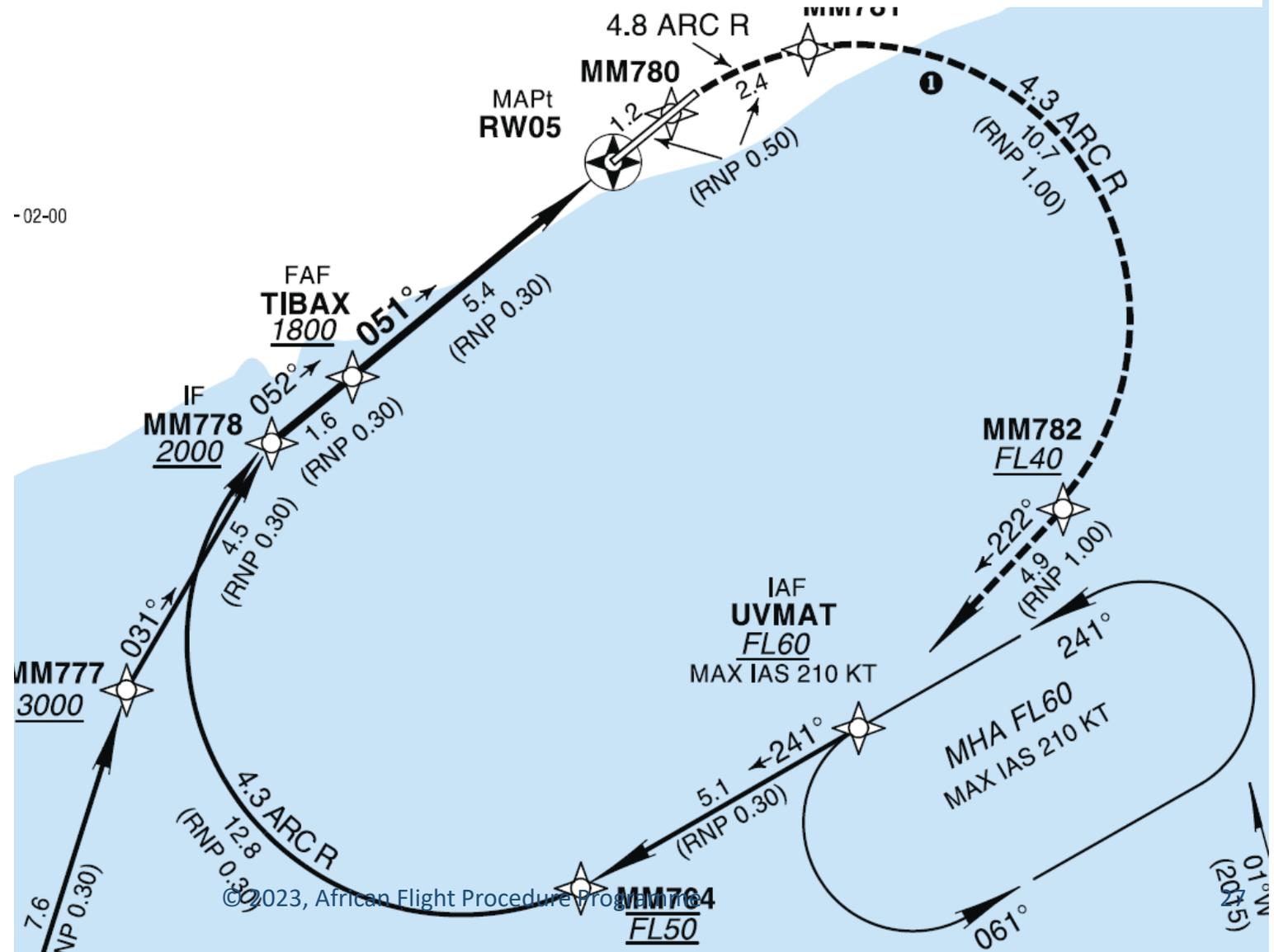




PBN impact on Safety and prevention of CFIT

RNP AR approaches

For Security reasons only!!!





Thank You!

Questions?

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