PBN
Performance Based Navigation Concept

سخنران: حبیب داوودی دانا

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PBN

Performance Based Navigation

Concept

Definitions

- **Area navigation (RNAV):** A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained navigation aids, or a combination of these.

- **RNAV system:** A navigation system which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these. A RNAV system may be included as part of a Flight Management System (FMS).

Definitions

- **Required navigation performance (RNP):** A statement of the navigation performance necessary for operation within a defined airspace.

- **RNP System:** An area navigation system which supports on-board performance monitoring and alerting.

Definitions

- **Performance Based Navigation (PBN):**
  Performance Based Navigation specifies system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.
  Performance requirements are defined in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular Airspace Concept.

Definitions

- **Global Navigation Satellite System (GNSS):** A world-wide position and time determination system, that includes one or more satellite constellation, aircraft receivers, and augmentations as necessary to support the required navigation performance for the actual phase of operation.

Satellite constellation + Aircraft Receivers+ Augmentation

Satellite constellation

- The three core satellite constellations are:
  - GPS (provided by US)
  - GLONASS (provided by Russia)
  - GALILEO (will be provide by Euro)

Augmentation

- ABAS (Aircraft Based Aug. System)

  Uses avionics on board aircraft
- SBAS (Satellite Based Aug. System)

  Uses ground monitoring stations, then delivers corrected information via GEO sat
- GBAS (Ground Based Aug. System)

  Uses ground monitoring stations, then via a VHF data broadcast

ABAS

- ABAS can support en-route up to NPA, also GNSS approach
- ABAS augments and/or integrates GNSS information with information available on-board the aircraft.

SBAS

- SBAS support En-route and Terminal RNAV operations (up to cat I) and comprises:

- A network of ground reference stations
- Master stations to process collected data
- Uplink stations to send SBAS messages to GEO satellites

SBAS

- Four SBASs being developed :
  - EGNOS (European)
  - GAGAN (Indian)
  - MSAS (Japanese)
  - WAAS (U.S)

GBAS

- For a precision approach service to provide deviation guidance for a final approach segments .
- A GBAS installation will typically provide corrections that support approaches to multiple runways at a single airport .

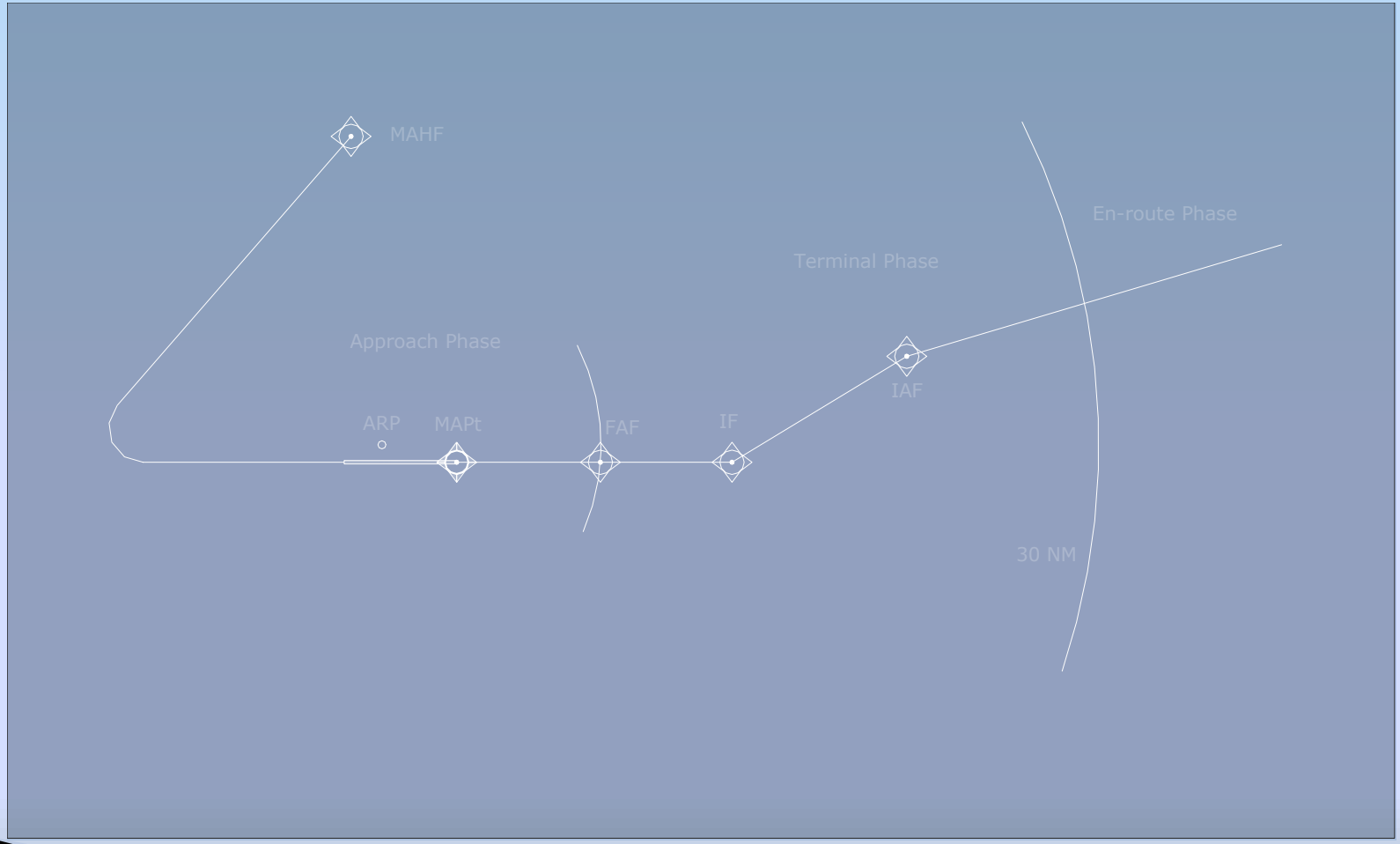
GBAS

- Precision approach service (CAT I)
- GBAS positioning service
- MAX range up to 20 NM

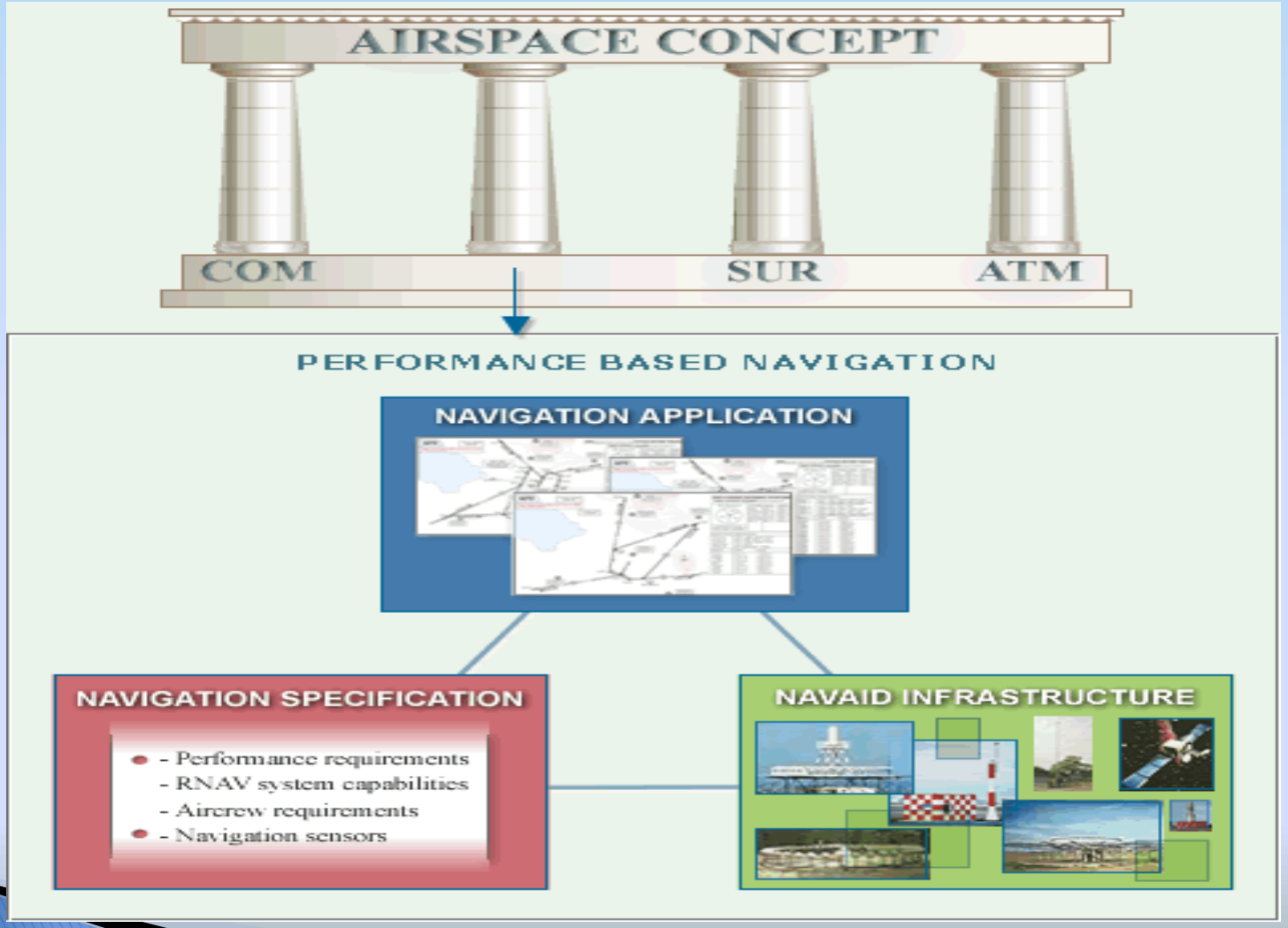
Phases of Flight

- En-route Phase: Out of 30 NM from ARP
- Terminal Phase: From 30 NM up to FAF
- Approach Phase: From FAF up to the end of Missed approach procedure

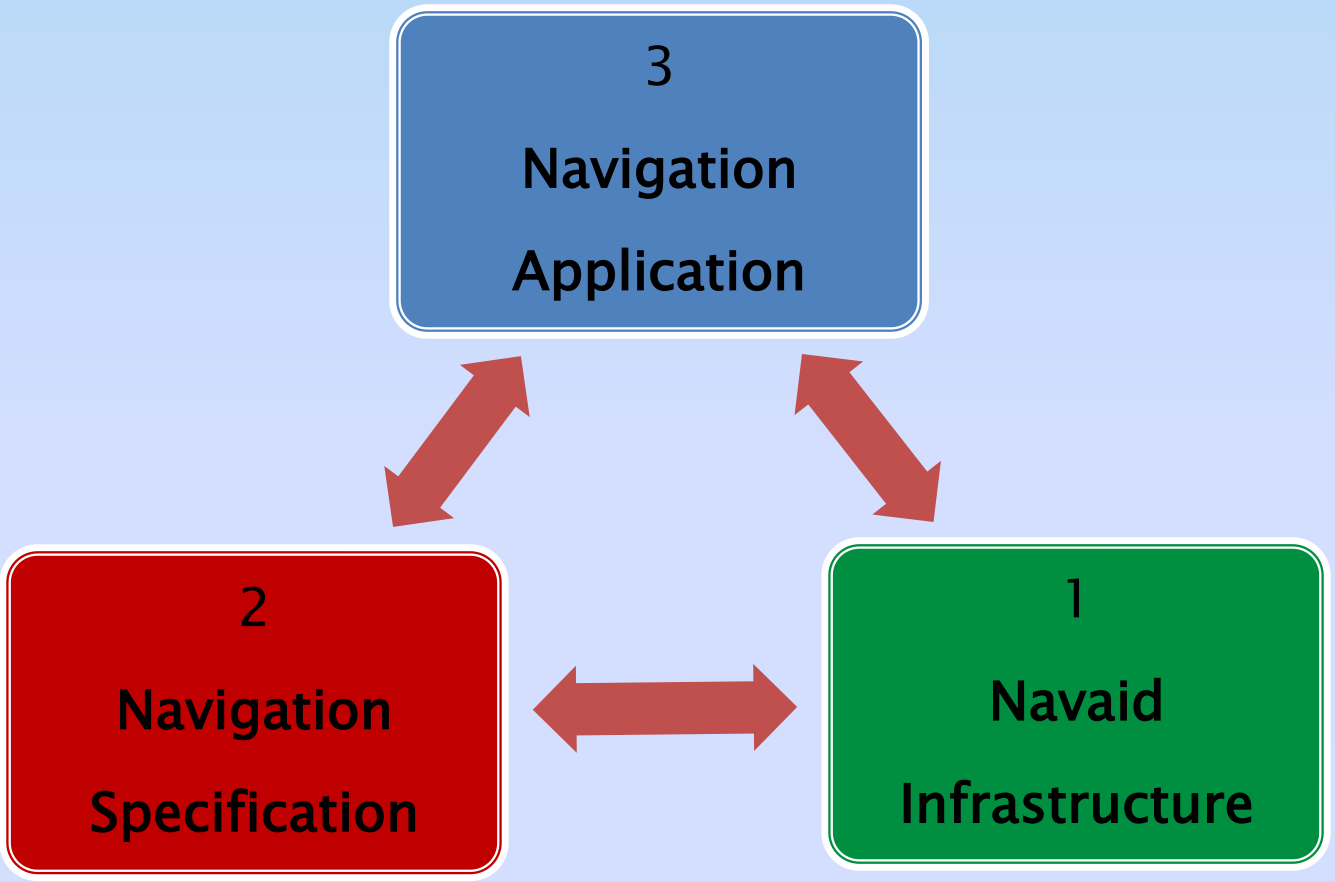
Phases of Flight



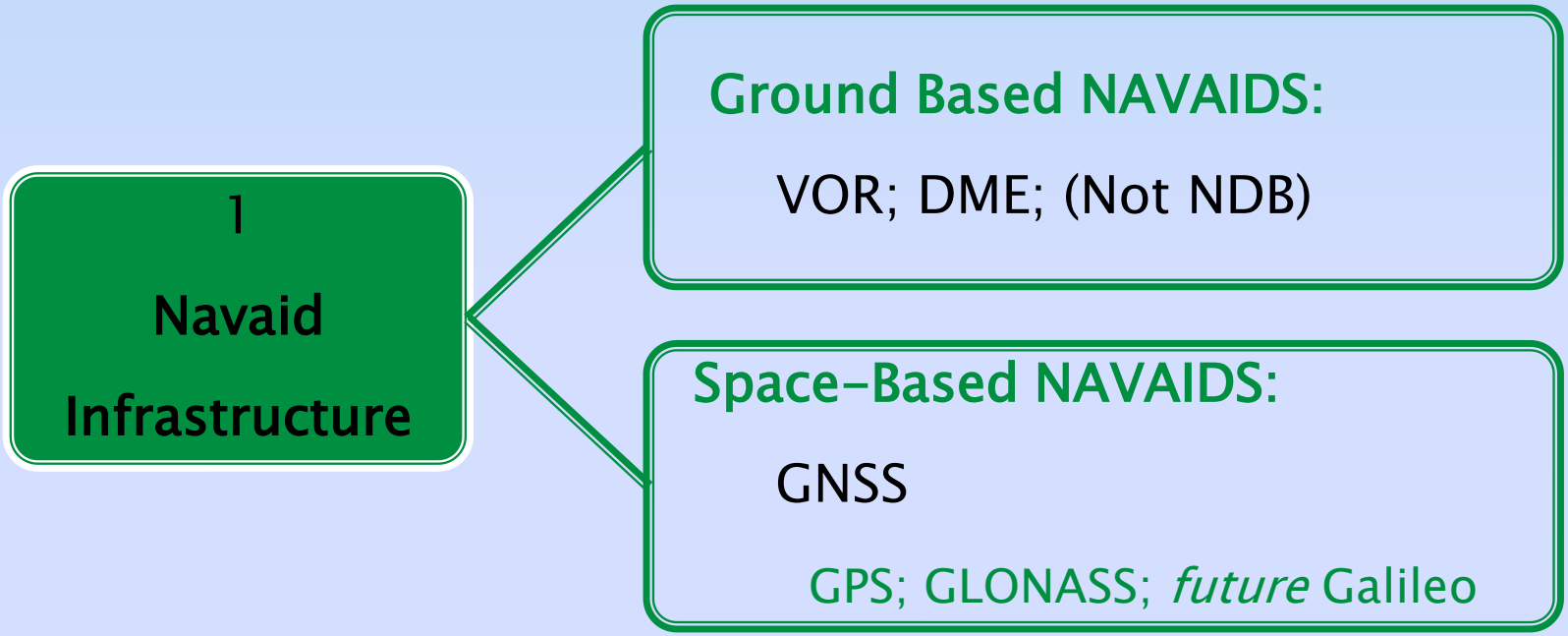
Context of PBN



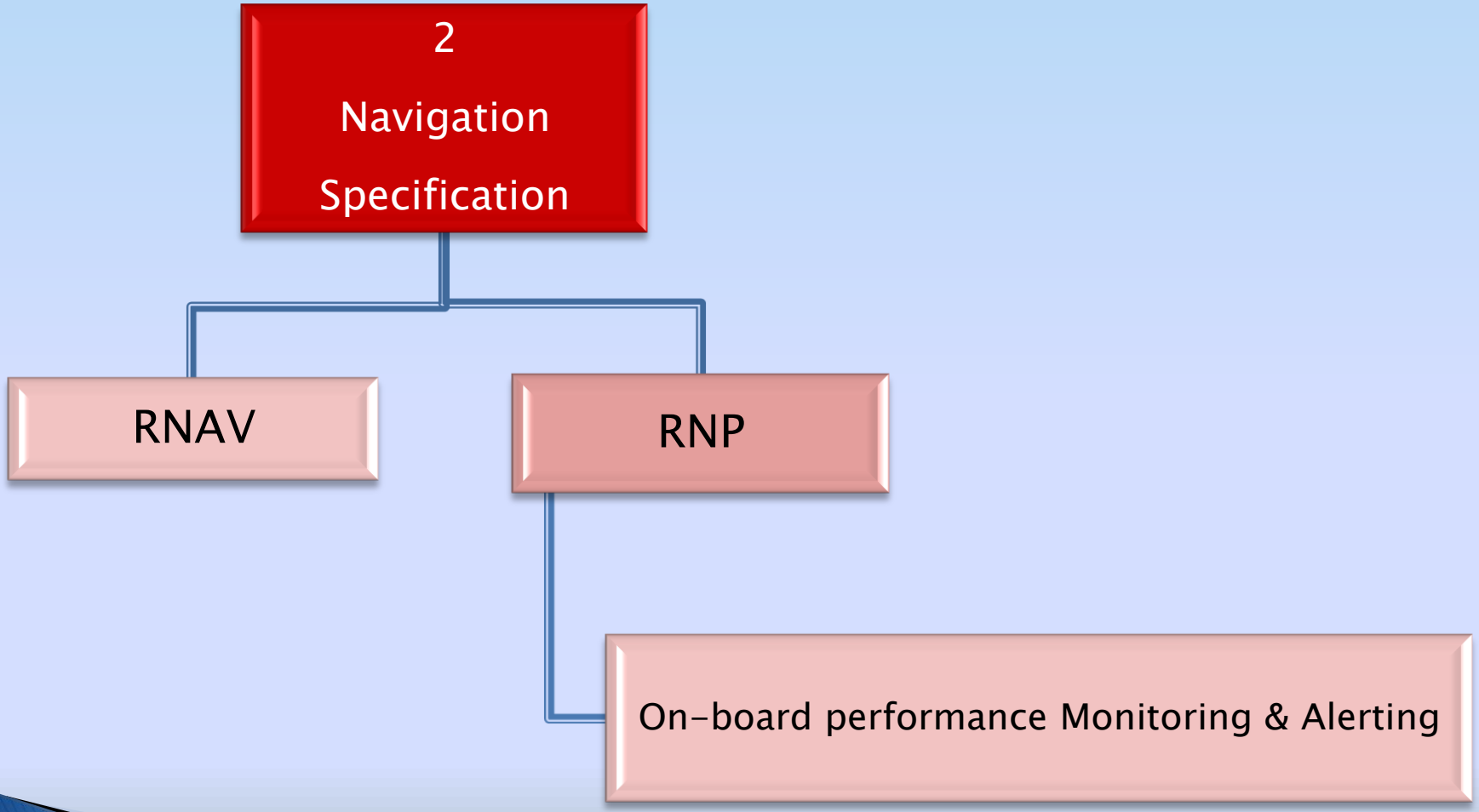
Components of PBN Concept



Components of PBN Concept



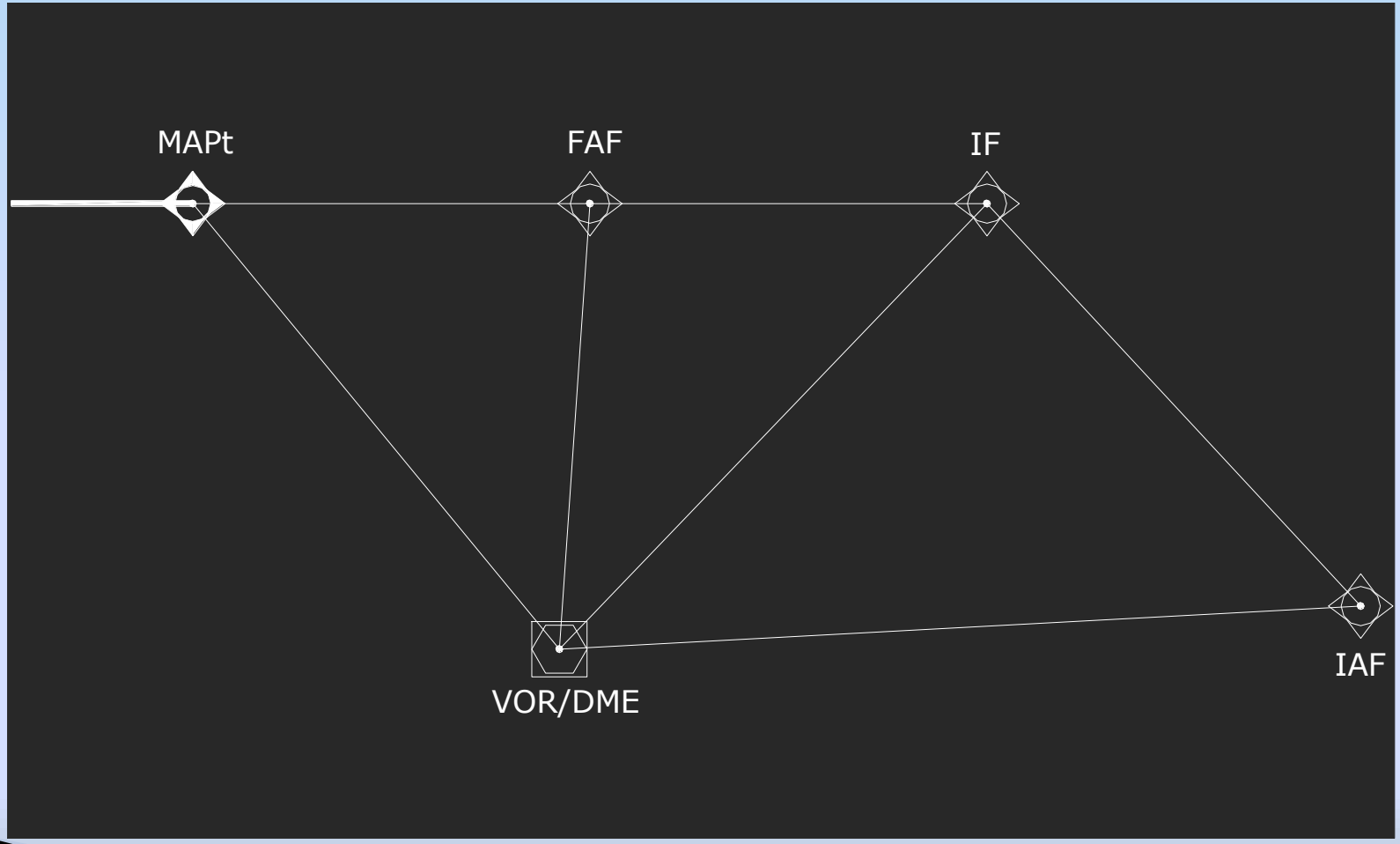
Components of PBN Concept



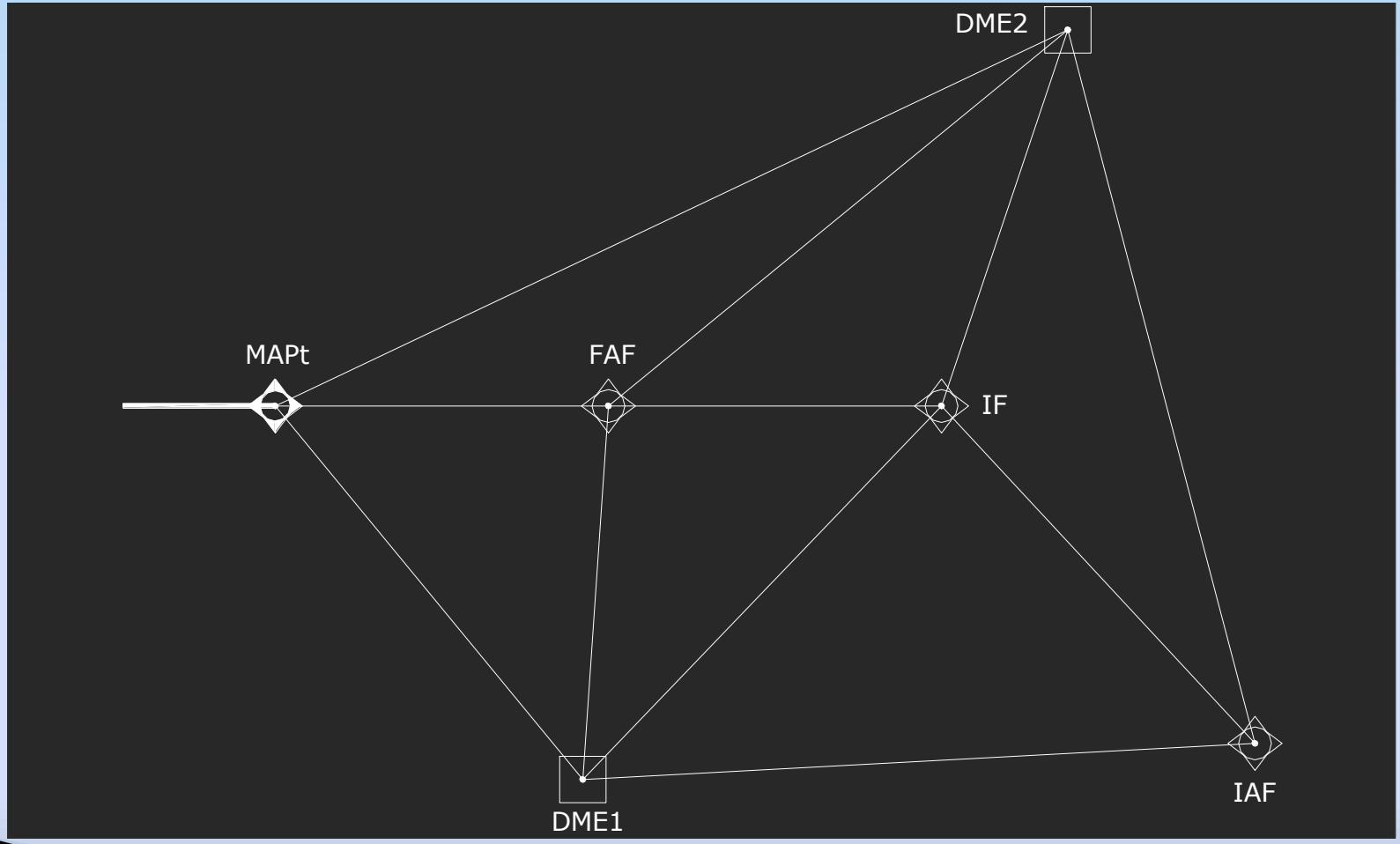
RNAV

- VOR/DME (Only One Facility)
- DME/DME (At least Two Facility)
- GNSS

VOR/DME



DME/DME



GNSS

- State should evaluate 4 essential criteria :
  - Accuracy
  - Integrity (including time to alert)
  - Continuity
  - Availability

RNP CONCEPT

- Statement of the navigation performance accuracy necessary for operations within a defined airspace
- Developed by the ICAO FANS committee and belong to CNS/ATM plan

RNP CONCEPT

Difference between RNAV and RNP Applications

- RNAV applications assume aircraft operations on any desired flight path in the coverage of station-reference NAVAIDS or within the limits of the capability of self contained aids, or a combination of these.

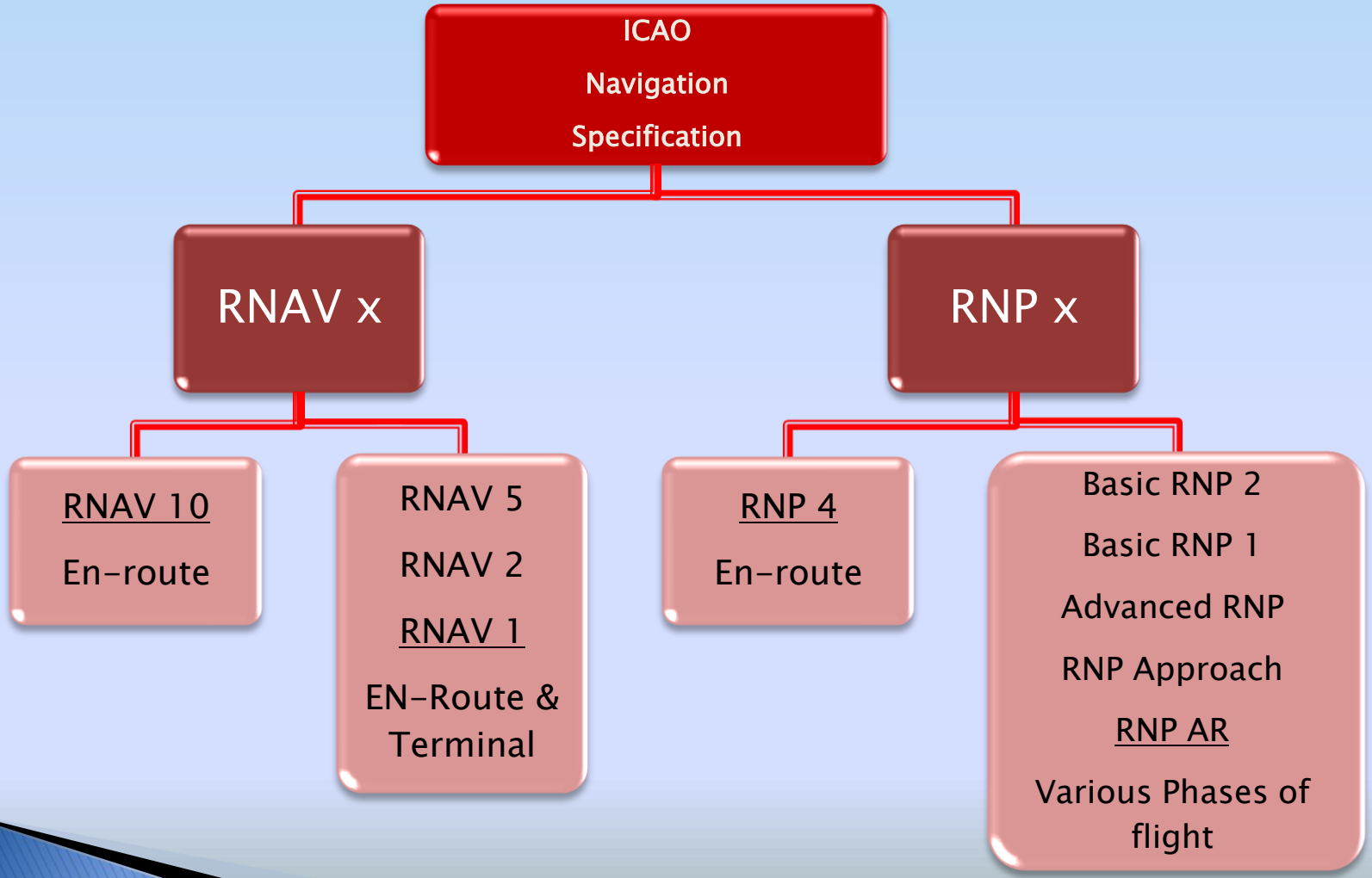
- RNP applications are RNAV applications requiring onboard performance ***MONITORING*** and ***ALERTING***

Components of PBN Concept

- on-board performance monitoring and alerting does not only refer to containment Annex 11 or PANS-OPS.

- On-board performance monitoring and alerting allows the air crew to detect that the RNP system is not achieving the navigation performance required of the RNP system

Components of PBN Concept



Components of PBN Concept

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Navigation

Application

The Application (use of) the Navigation Specification and Navaid Infrastructure

- For example: Routes based on RNAV and RNP Specifications (these rely on the Navaid Infrastructure);
- For example: SIDs/STARs based on RNAV and RNP Specifications;
- For example: Approach procedures based on RNP Specifications

Example: RNAV 1 Specification

RNAV 1
Application

ICAO
RNAV 1 Specification

(1)VOR/DME
(2)DME/DME
(3)GNSS

Navaid
Infrastructure

(1)VOR/DME
(2)DME
(3)GPS

Example: RNAV 1 Specification

State A

State A
RNAV 1
Application

State A
RNAV 1 Specification

Navaid
Infrastructure

Navigation Sensors

(1)VOR/DME — (1)VOR/DME

(3)GNSS — (3) GPS

Example: RNAV 1 Specification

State B

State B
RNAV 1
Application

State B
RNAV 1 Specification

Navaid
Infrastructure

Navigation Sensors

(1)VOR/DME
(2) DME/DME

(1)VOR/DME
(2) DME

References

- PBN Manual (Doc9613)
- PANS – ATM (Doc 4444)
- PANS – OPS (Doc 8168)
- Web Sites:

  www. Icao.int/PBN

  www.faa.gov
- Cairo PBN Seminar

Questions