

MODULE 2:

Navigation Specifications

Outline

Objective:

→ To understand Navigation Specifications

Content:

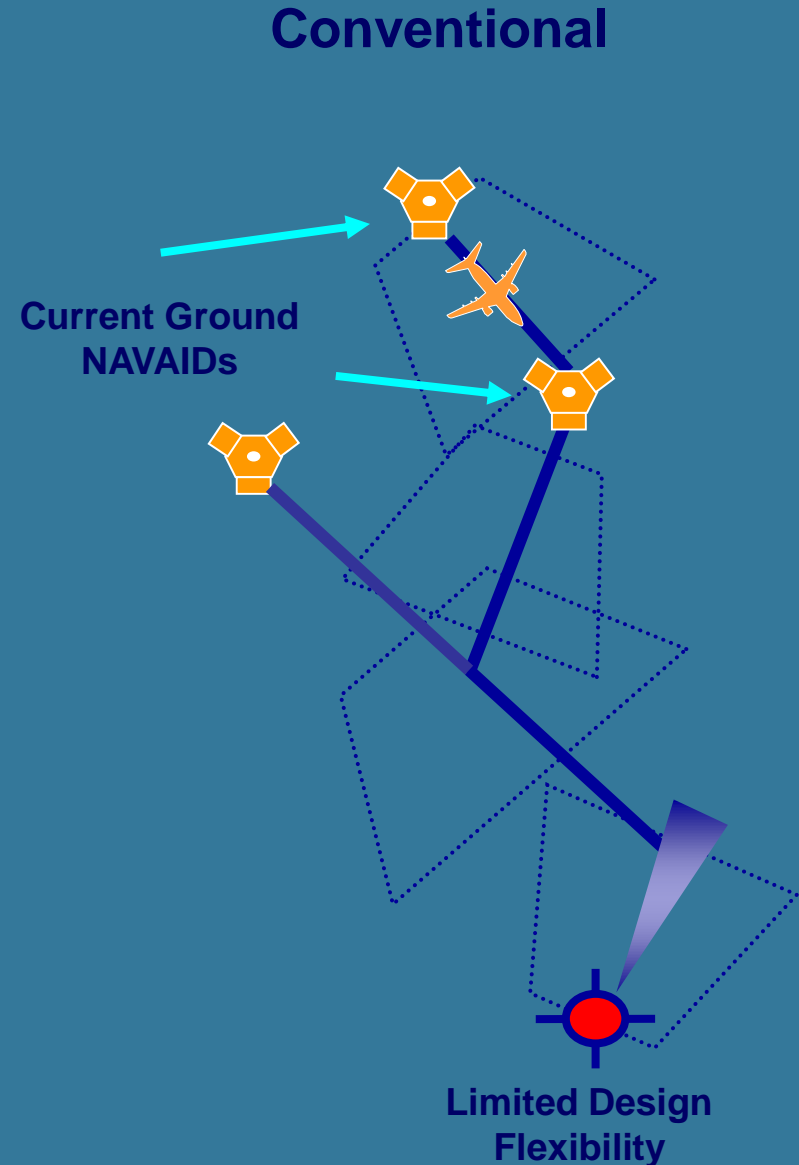
→ History of Navigation

→ Navigation Specifications

→ Operational Approvals

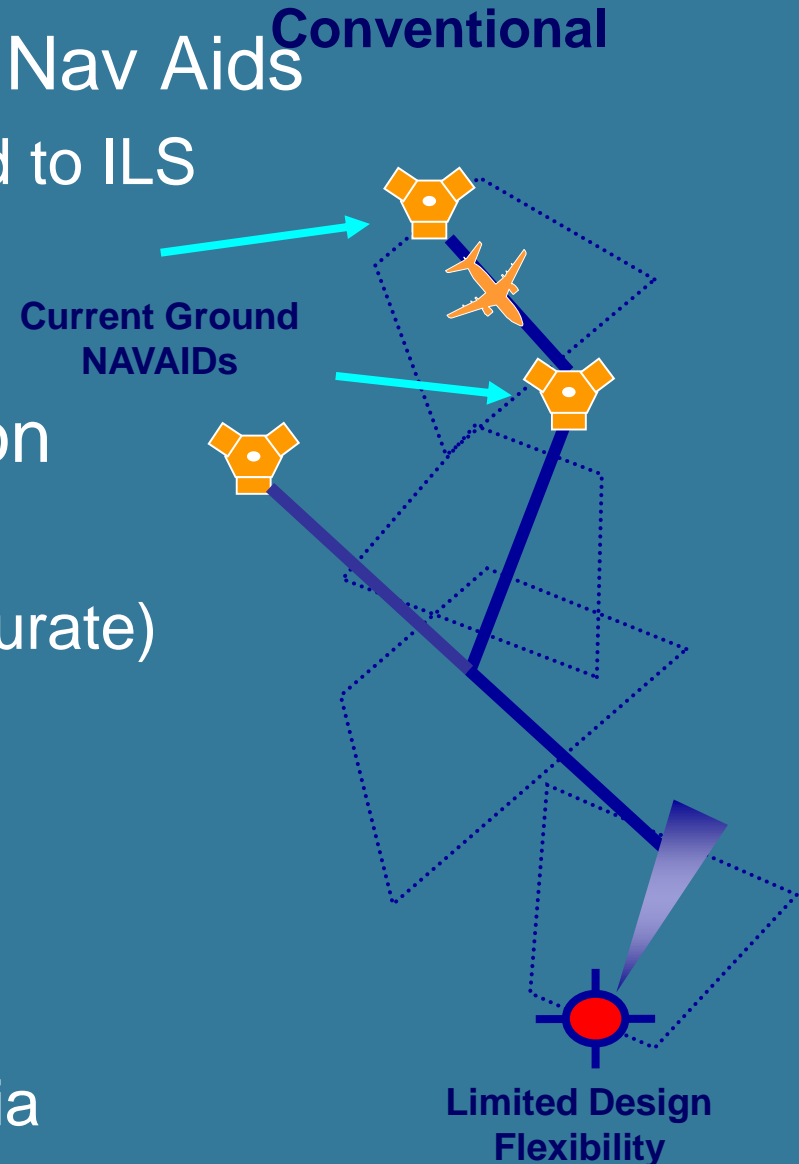
→ RNAV and RNP Specifications

→ Containment



History of Navigation

- Aircraft Navigation based on Nav Aids
 - Fly Route – Nav Aid to Nav Aid to ILS
- Accuracy sets limit of knowledge of aircraft position
 - Accuracy of Nav Aid
 - Angular splay (further less accurate)
 - No inherent Integrity check
- Implications:
 - Route Spacing
 - Flight Procedure Design Criteria
 - ATC (Procedural) Separation Standards



History of Navigation

→ Nav Aids

→ NDB – Non Directional Beacon

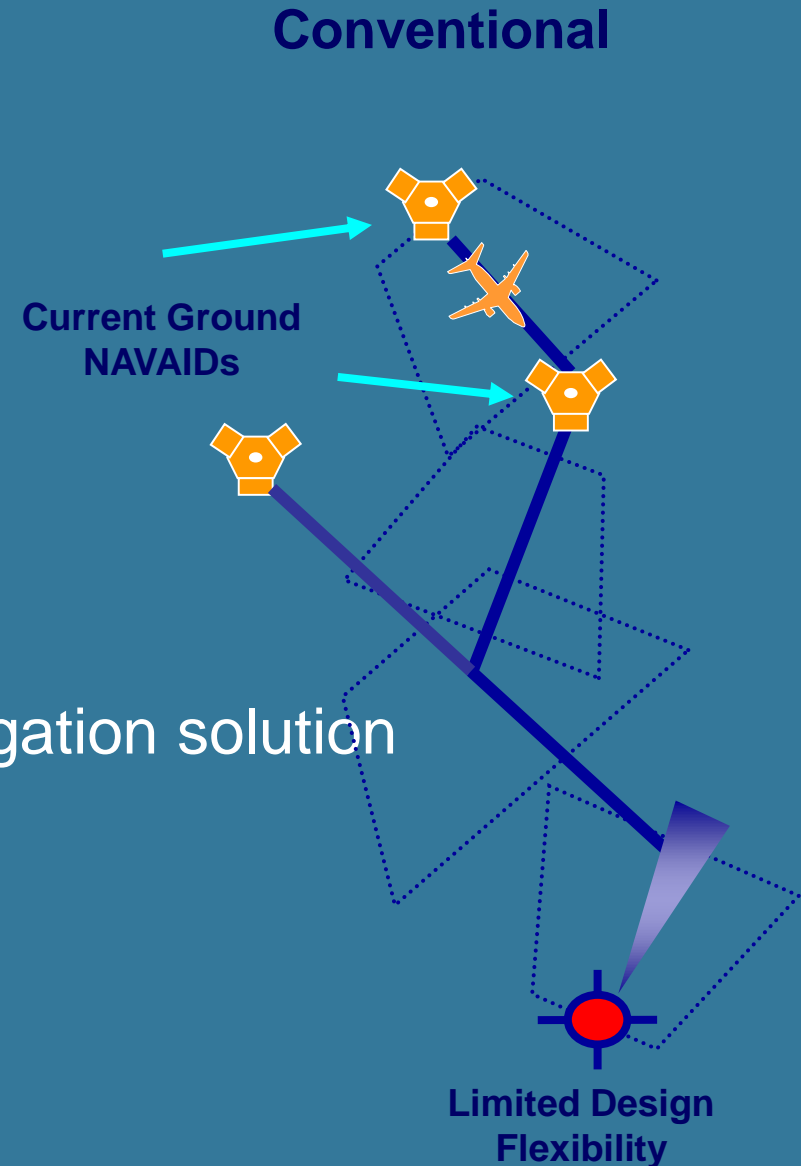
– VOR

→ DME

→ ILS

→ Implications:

→ Pilot was a big part of the navigation solution





→ Transition - Route Nav to Area Nav

→ New ops:

→ Long haul wind surf

→ User Preferred Route/Trajectory

→ Curved Approach

→ Noise minimisation and placement

→ Refinement of existing ops:

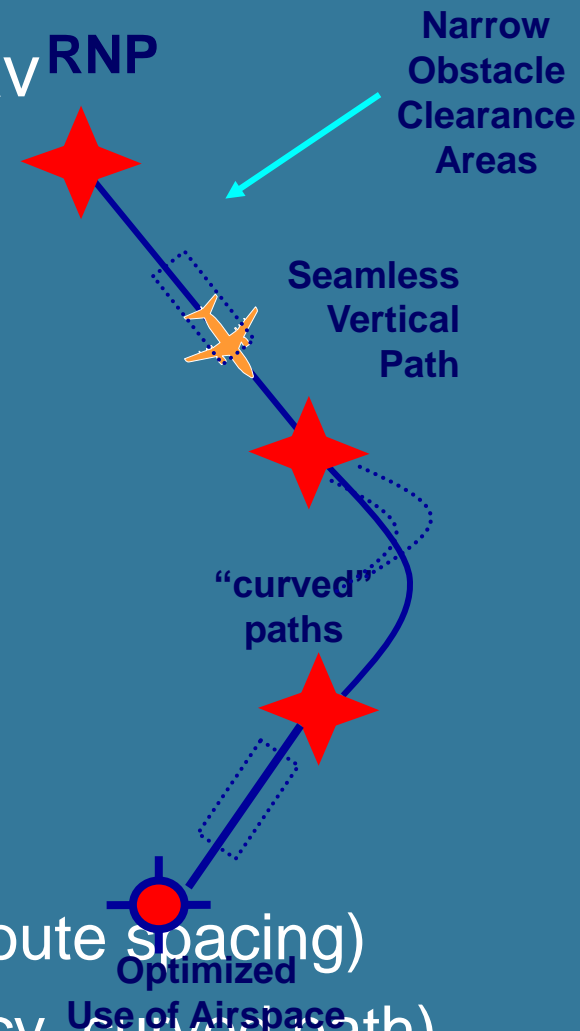
→ Direct Track

→ Flexibility in Route Design (smaller route spacing)

→ Optimised SIDs and STARs (accuracy, curved path)

→ Arrival Optimisation (descent profile, Req Time of Arrival)

→ Reduced Fuel consumption/emissions





PBN Navigation Specifications:

What is a Navigation Specification?

Navigation specification. A set of aircraft and aircrew requirements needed to support Performance-based Navigation operations within a defined airspace. There are two kinds of navigation specification:

RNAV specification. A navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV, e.g. RNAV 5, RNAV 1.

RNP specification. A navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP, e.g. RNP 4, RNP APCH.

Note.— Volume II of this manual contains detailed guidance on navigation specifications.

Performance-based navigation. Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

*Note.— Performance requirements are expressed in navigation specifications in terms of **accuracy**, **integrity**, **continuity** and functionality needed for the proposed operation in the context of a particular airspace concept. **Availability** of GNSS SIS or some other NAVAID infrastructure is considered within the airspace concept in order to enable the navigation application.*

RNAV SPECIFICATIONS

Navigation Specification	Containment	Updating	GNSS Required	Existing Previous Spec	Area Used	Route Spacings	Communications Surveillance
RNAV 5	5NM	DME/DME VOR/DME GNSS	No	RNP 5	Enroute	16.5N (uni) 18NM (bi)	Direct speech Yes
RNAV 2	2NM	DME/DME DME/IRU GNSS	No	BRNAV/FAA RNAV A	Terminal		Direct speech Yes
RNAV 1	1NM	DME/DME DME/IRU GNSS	No	PRNAV/FAA RNAV B	Terminal	7NM	Direct speech Yes

RNP SPECIFICATIONS

Navigation Specification	Containment	Updating	GNSS Required	Existing Previous Spec	Area Used	Route Spacings	Communications Surveillance
RNP 10	10NM	GNSS	Yes	RNAV 10	Oceanic or Remote Continental	50NM	No No
RNP 4	4NM	GNSS	YES	NIL	Oceanic Continental enroute	30NM	DCPC Yes: ADSC
RNP 2	2NM	GNSS	YES	NIL	Remote Continental enroute		No No
RNP 1	1NM	GNSS	YES	NIL	Terminal	7NM	No No

Navigation Specification	Containment	Updating	GNSS Required	Existing Previous Spec	Area Used	Route Spacings	Communications Surveillance
RNP APCH	1NM/0.3NM	GNSS	YES	RNAV(GNSS)	Terminal	N/A	NO

Navigation Specification	Containment	Updating	GNSS Required	Existing Previous Spec	Area Used	Route Spacings	Communications Surveillance
RNP 10 (?)	10NM	GNSS	Yes	RNAV 10	Oceanic or Remote Continental	50NM	No No
RNAV 5	5NM	GNSS	YES	RNP 5	Enroute	16.5N (uni) 18NM (bi)	Direct speech Yes
RNAV 1	1NM	DME/DME DME/IRU GNSS	No	PRNAV/FAA RNAV B	Terminal	7NM	Direct speech Yes
RNP 1	1NM	GNSS	YES	NIL	Terminal	7NM	No No
RNP APCH	1NM/0.3NM	GNSS	YES	RNAV(GNSS)	Terminal	N/A	NO

- ▶ Distance between tracks 19NM (eg USUNO and UTRIS)
- ▶ Aircraft *MUST* be on track to provide separation even with surveillance failure

OPERATIONAL CONSIDERATIONS FOR RNAV 5

PBN Navigation Specifications:

- What is the difference between RNAV and RNP?

On board monitoring and alerting!

Two values are used:

RNP: Required Navigation Performance

ANP: Actual Navigation Performance



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LNAV AND VNAV DEVIATION SCALES

FIGURE



REVIEW:

HISTORY OF NAVIGATION

RNAV AND RNP NAV SPECS

DIFFERENCE BETWEEN RNAV AND RNP

CONTAINMENT VALUES