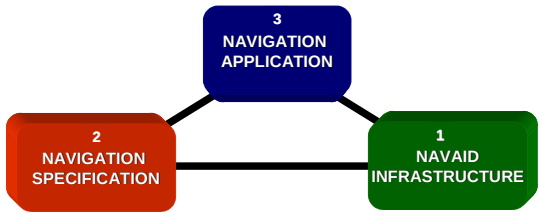
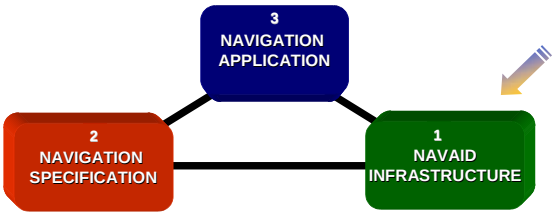
PBN
Performance Based Navigation

- PBN & Airspace Concepts -

Components of PBN Concept



Components of PBN Concept

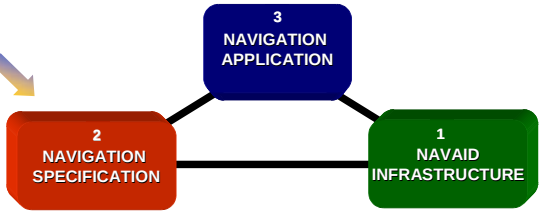


Components of PBN Concept
- Navaid Infrastructure -

- Ground-based Navigation Aids (Navaids)
  - VOR; DME; (Not NDB)
- Space-based Navaids
  - GNSS
    - GPS; Glonass; *future* Galileo

1
NAVAID INFRASTRUCTURE

Components of PBN Concept



Components of PBN Concept
- Navigation Specification -

International Navigation Specifications published in Volume II of PBN Manual

Aim is to limit number of Nav. Specs in global use

2
NAVIGATION SPECIFICATION

- What PERFORMANCE is required of the RNAV system?
- What Functionalities must RNAV system have to achieve *Performance*
- What Navigation Sensors must be integrated in RNAV system to achieve *Performance*
- What requirements are placed on the Air crew to achieve the required *Performance* from the RNAV system?

Accuracy
Integrity
Continuity
Availability

Document used by State as basis for developing Certification & Operational Approval

Components of PBN Concept - Navigation Specification -

International Navigation Specifications published in Volume II of PBN Manual

2 NAVIGATION SPECIFICATION

- PERFORMANCE
- Functionalities
- Navigation Sensors
- Air crew requirements

Previous RNP Concept

Document used by State as basis for developing Certification & Operational Approval

Components of PBN Concept - Navigation Specification -

2 NAVIGATION SPECIFICATION

International NS in Volume II of PBN Manual

- RNAV System PERFORMANCE

Document used by State as basis for Certification & Operational Approval

RNAV RNP

On-Board performance Monitoring and Alerting

Components of PBN Concept - Navigation Specification -

RNAV RNP

On-Board performance Monitoring and Alerting

- On-board performance monitoring and alerting does not only refer to 'containment' in the MASPS; 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 - Navigation Specification -

ICAO NAVIGATION SPECIFICATIONS

RNAV SPECIFICATIONS		RNP SPECIFICATIONS		
Designation RNAV 10 (RNP10) *For Oceanic and Remote Continental navigation applications*	Designation RNAV 5 RNAV 2 RNAV 1 *For En Route & Terminal navigation applications*	Designation RNP 4 *For Oceanic & Remote Continental navigation applications*	Designation Basic-RNP 2* Basic-RNP 1 Advanced-RNP 3* RNP APCH RNP AR APCH *for various phases of flight*	Designation RNP with additional requirements to be determined (e.g. 3D, 4D etc)

International NS in Volume II of PBN Manual

*Potential Nav Specs

Components of PBN Concept - Designation -

NAVIGATION APPLICATION

NAVIGATION SPECIFICATION

RNAV X
RNAV 10
RNAV 5
RNP X
B-RNP 1

NAVAID INFRASTRUCTURE

RNP APCH
RNP AR APCH

X = Navigation Accuracy in NM

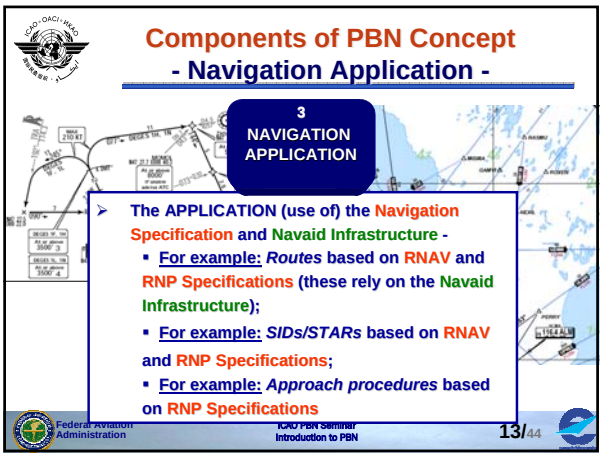
Components of PBN Concept

3 NAVIGATION APPLICATION

2 NAVIGATION SPECIFICATION

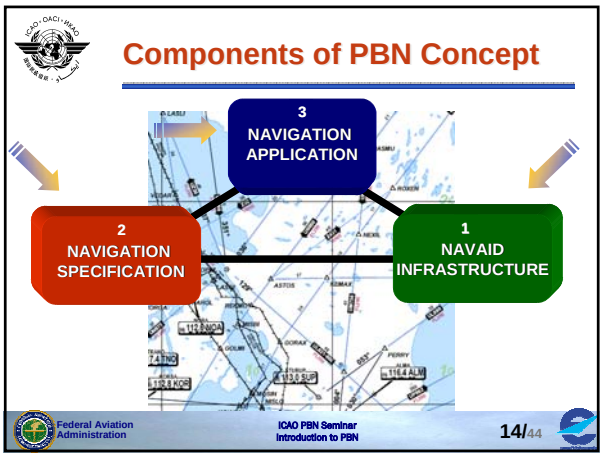
1 NAVAID INFRASTRUCTURE

Components of PBN Concept - Navigation Application -

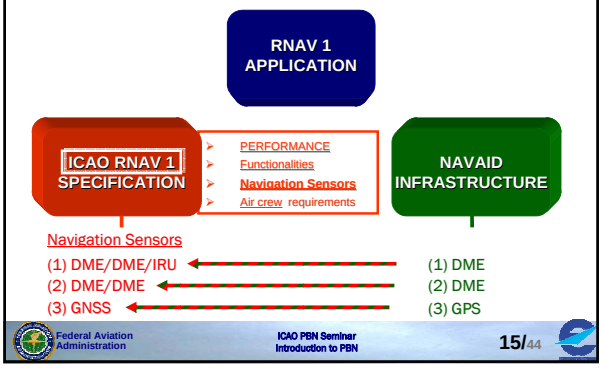


- The APPLICATION (use of) the Navigation Specification and Navaid Infrastructure -
  - For example: *Routes* based on RNAV and RNP Specifications (these rely on the Navaid Infrastructure);
  - For example: *SIDs/STARs* based on RNAV and RNP Specifications;
  - For example: *Approach procedures* based on RNP Specifications

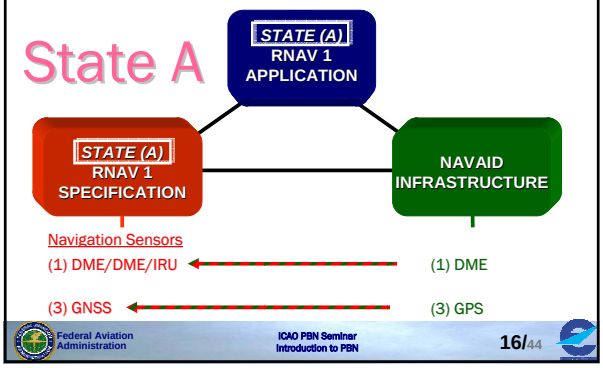
Components of PBN Concept



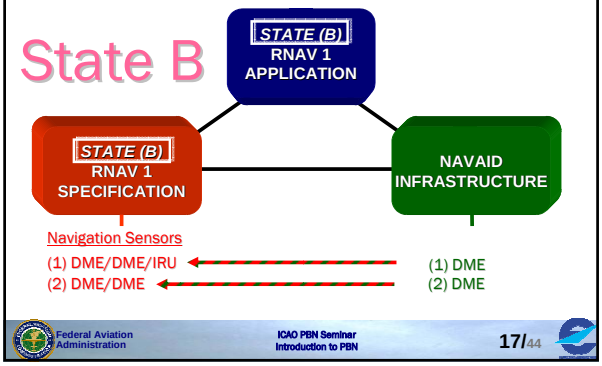
Example: RNAV 1 Specification



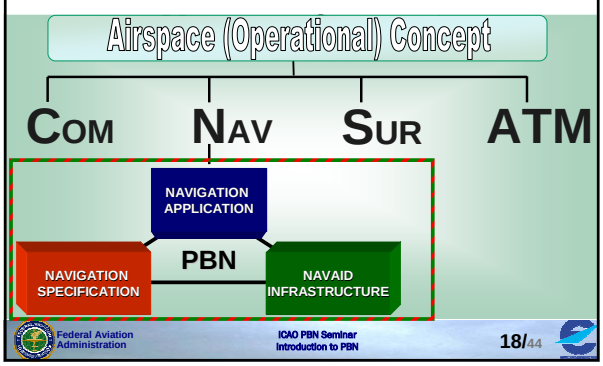
E.G: RNAV 1 Specification (A)



E.G: RNAV 1 Specification (B)

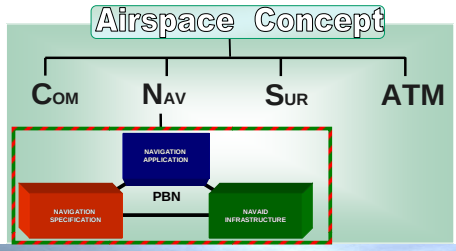


Context of PBN



Context of PBN

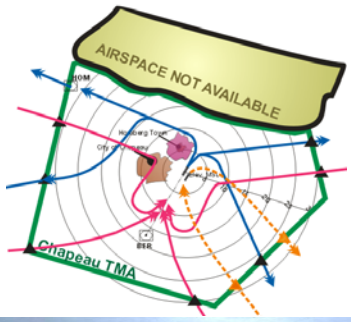
ICAO GLOBAL ATM CONCEPT



What is an Airspace Concept?

- General **Vision** or **Master Plan** for an airspace
- Geared towards **Strategic Objectives**
- Covers all air traffic system "**Enablers**"

What is an Airspace Concept?



Strategic Objectives

Answer the question: What Do We want to Achieve?

Safety? | Capacity? | Efficiency? | Environment? | Access?

Airspace Concept

Examples: Strategic Objectives

Safety	Capacity	Efficiency	Environment	Access
Reduce Controlled Flight into Terrain via lateral & vertical course guidance to runway	Increase number of air traffic routes to reduce congestion; accommodate projected growth	Reduce delays that result from excessive "levelling off" flight profiles	Reduce noise over sensitive areas	Improve airport and airspace access in all weather conditions

Airspace Concept

Airspace Concept: Enablers

Communications

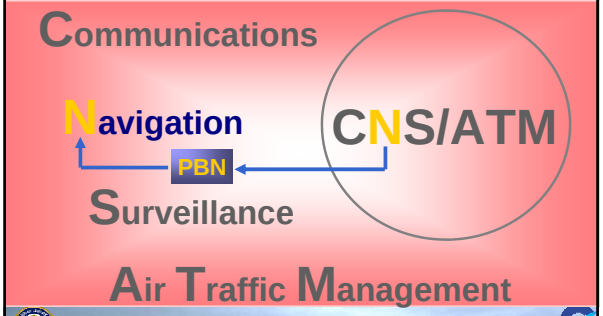
Navigation

Surveillance

CNS/ATM

Air **T**raffic **M**anagement

Airspace Concept: Enablers



Airspace Concept Development

Airspace Concept development requires the combined efforts of

- Air Navigation Service Providers ("Air Traffic");
- Regulators; and
- System Users

"STAKEHOLDERS"

To Do What?

Airspace Concept: Stakeholder Roles

Air Traffic Service Providers, Regulators and System Users:

1. **Identify** strategic objectives

Safety? Efficiency? Capacity? Environment? Access?

2. **Prioritise** strategic objectives

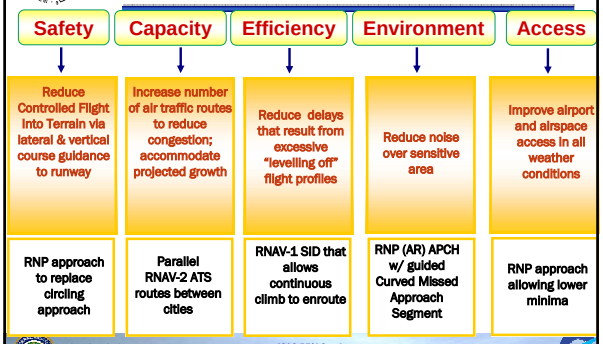
Safety? Capacity? Access? Efficiency? Environment?

3. **Address** enablers

CNS/ATM

Addressing Enablers

Objectives ➲ Implementation



Airspace Concept Use

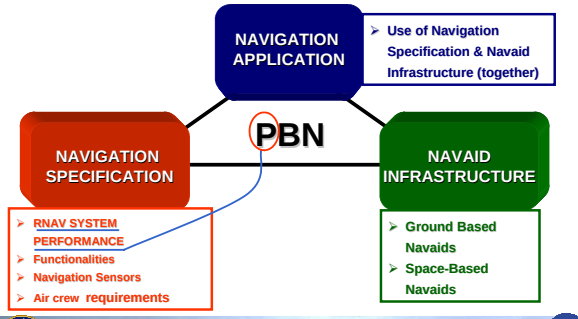
Airspace Concept development requires the combined efforts of

- Air Navigation Service Providers ("Air Traffic");
- Regulators; and
- System Users
- PANS-OPS specialist

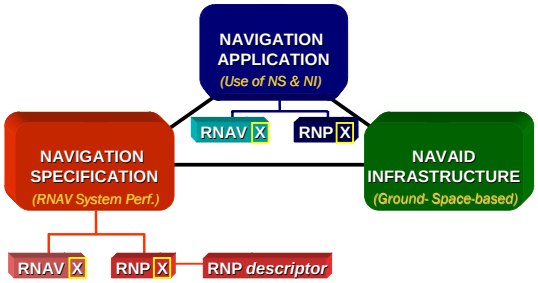
"STAKEHOLDERS"

To identify and prioritise **Strategic Objectives**, considering the entire CNS/ATM environment

Concept Summary (1)



Concept Summary (2)



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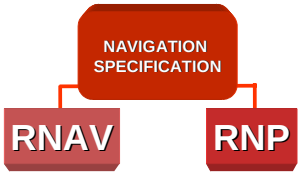
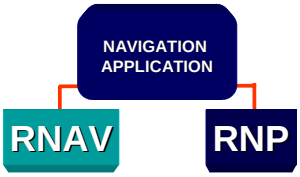
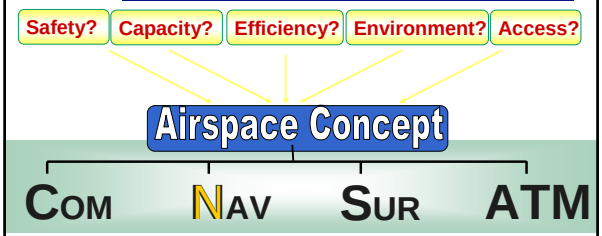


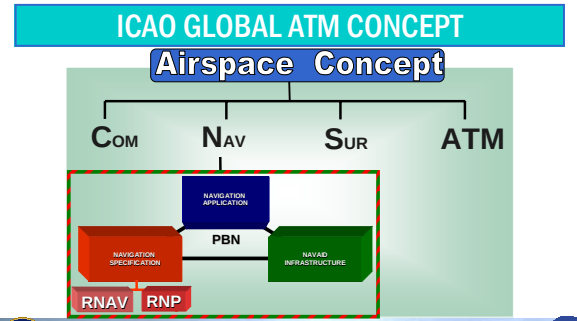
Concept Summary (3)



Airspace Concept Summary (1)



Airspace Concept Summary (2)



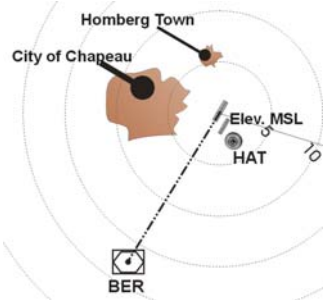
Case Study - Day 1

Case Study - Day 2

Case Study - Day 3

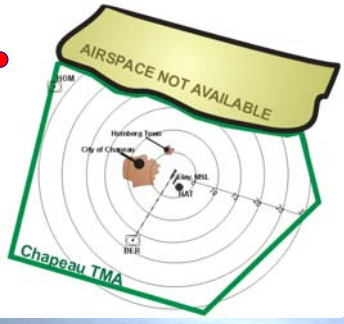
Case Study

Fictitious Airport (Does not exist!)



Case Study

Fictitious Airspace (Does not exist!)



Case Study

Fictitious Problems (Do not exist!)

- Accommodate increased traffic
- Minimise noise impact
- Develop and Instrument Approach Procedure

Case Study

- Next
  - Processes 1, 2, 3
  - Will make Reference to our Case Study
- At end of each day, will present Case Study

Audience Response System Questions