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# PBN Performance Based Navigation

– Review of Day 2 –

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1



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## PBN Concept Reminder

```

    graph TD
      NA[NAVIGATION APPLICATION  
(Use of NS & NI)]
      NS[NAVIGATION SPECIFICATION  
(RNAV System Perf.)]
      NAID[NAVAID INFRASTRUCTURE  
(Ground- Space-based)]
      RNAV[RNAV X]
      RNP[RNP X]
      RNP_desc[RNP descriptor]

      NA --- NS
      NA --- NAID
      NS --- RNAV
      NS --- RNP
      RNP --- RNP_desc
  
```

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## PBN Concept Reminder

- In each Navigation Specification, requirements are placed on the RNAV system
  - Performance required for accuracy, integrity, continuity and availability
  - Functions available to achieve required performance
  - Navigation sensors to achieve required performance
  - Flight crew procedures to achieve required performance
- RNP specifications require on-board performance monitoring and alerting...RNAV specifications do not

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## System Performance Error Components

- Lateral navigation errors (95%)
  - 3 main errors: PDE, NSE and FTE

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## Application of On-board Performance Monitoring and Alerting

- Performance monitoring
  - Aircraft (or aircraft and pilot in combination)
  - Required to monitor TSE
  - Provides an alert if accuracy requirement is not met, or if probability is larger than  $10^{-5}$  that TSE exceeds 2x accuracy value
- Net effect of RNP navigation specifications is to bound TSE distribution
  - PDE negligible; FTE known; NSE varies

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## Navigation Specifications

NAVIGATION SPECIFICATION	FLIGHT PHASE							
	EN ROUTE OCEANIC / REMOTE	En Route Continents	ARR	Initial	Interm.	Final	MSSED	DEF
RNAV 10 (RNP 10)	█							
RNAV 5		█						
RNAV 2			█					
RNAV 1				█	█			
RNP 4							█	
BASIC-RNP 1								█
RNP APCH								█
RNP AR APCH								█

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6

## Navigation Specifications

NAVIGATION SPECIFICATION	FLIGHT PHASE							
	En Route OCEANIC REMOTE	En Route Continental	ARR	APPROACH				DEP
				Initial	Interim	Final	MISSED	
Day 2	■	■	■	■	■	■	■	■
Day 3	■		■	■	■	■	■	■

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## Next – Day 3....

- Approach Navigation Specifications (RNP APCH and RNP AR APCH)
- Data Origination & Management and WGS84
- Development and Validation of Procedures

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8