



Overview of PBN Nav Specs

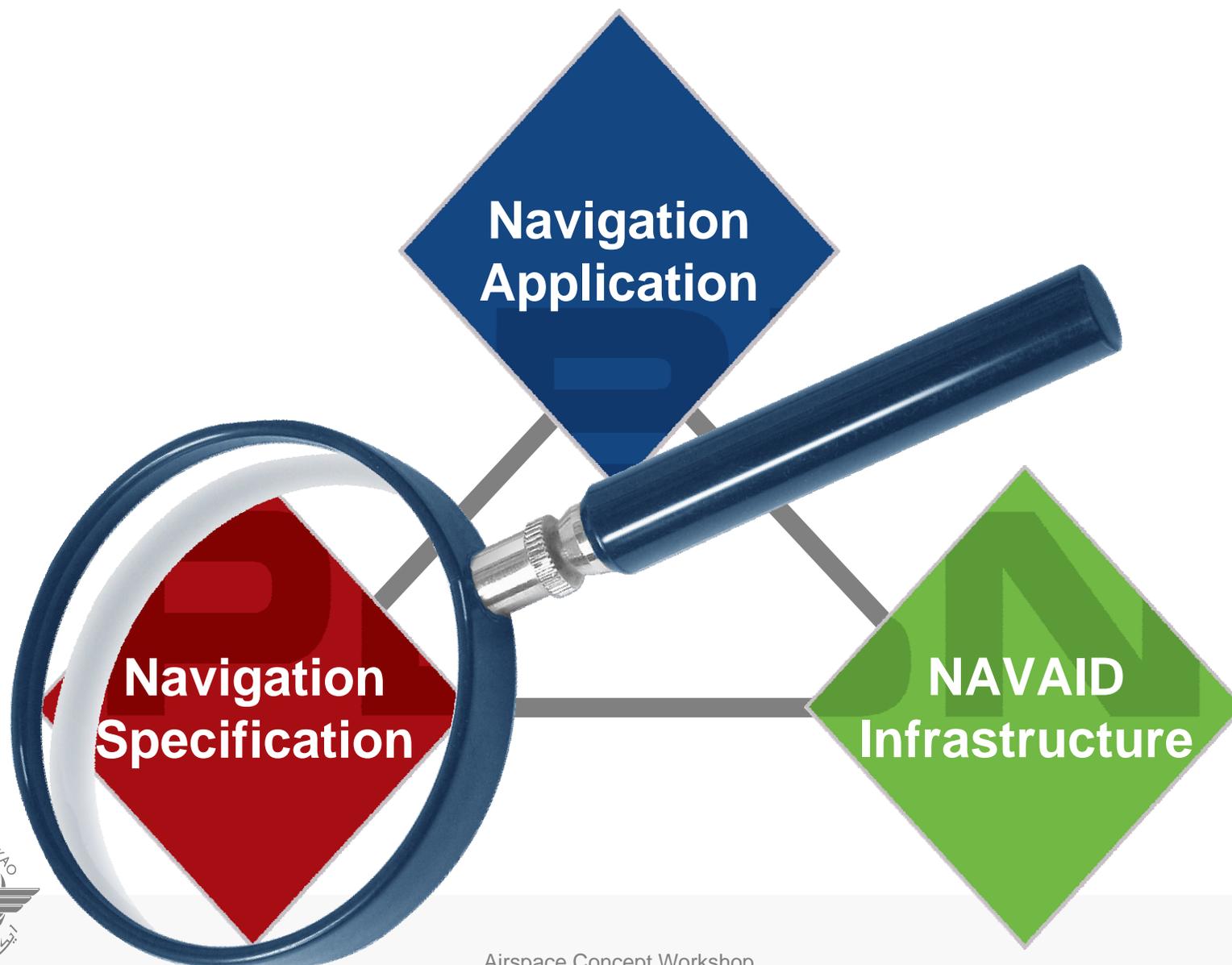
Module 3

European Airspace Concept Workshops
for PBN Implementation

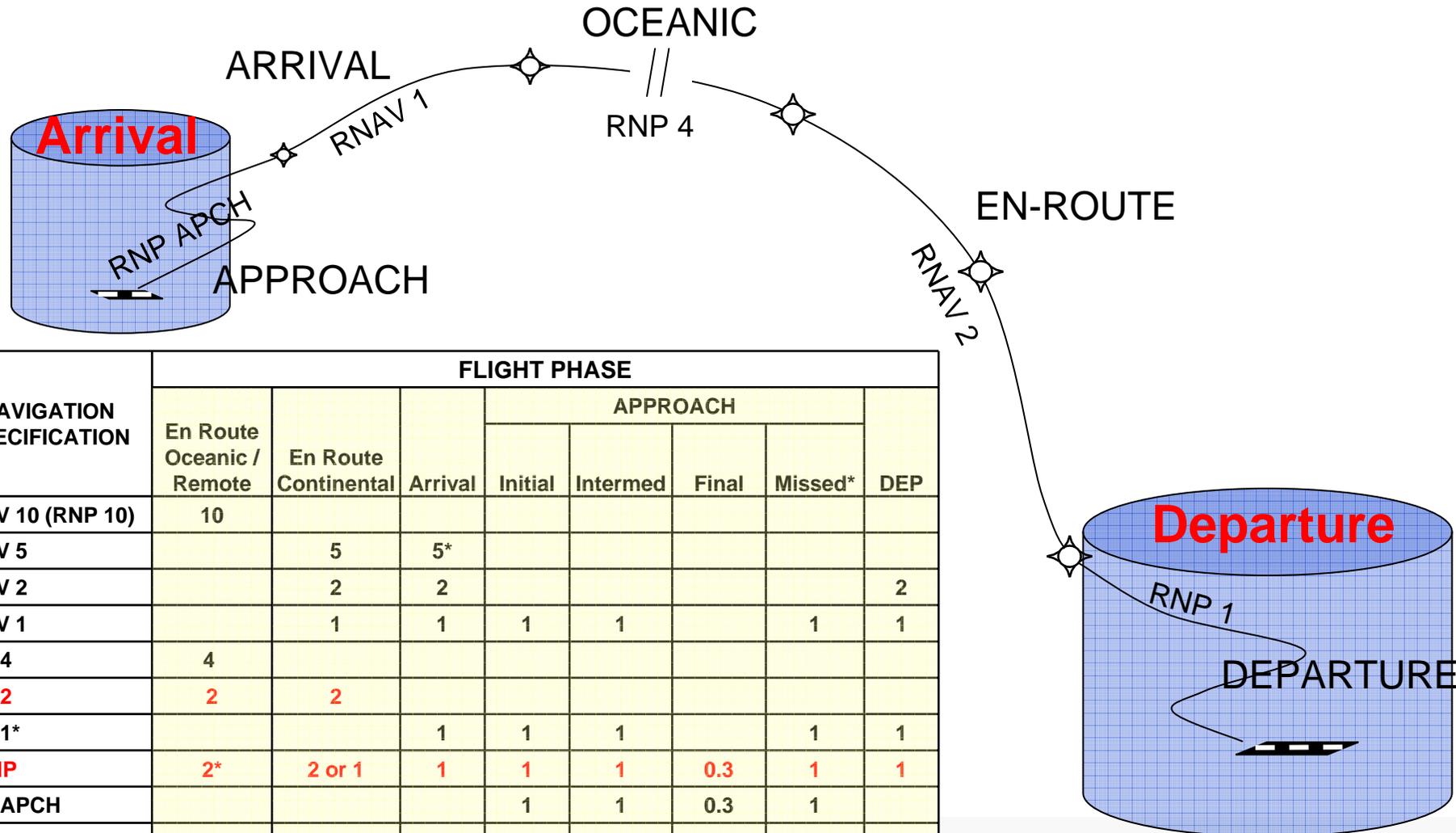
Learning Objectives

- By the end of this presentation you will:
 - Know where to find details of the Navigation Specifications.
 - Appreciate how the different Nav Specs relate to phases of flight.
 - Identify which sensor can support every Nav Spec.
 - Explain the aim of Advanced RNP (A-RNP).
 - State which Nav Specs support the Approach phase of flight.
 - Explain how, within PBN, vertical guidance can be provided for approach operations.

Components of PBN Concept



Use and Scope of Navigation Specification by Flight Phase



NAVIGATION SPECIFICATION	FLIGHT PHASE							
	En Route Oceanic / Remote	En Route Continental	Arrival	APPROACH				DEP
				Initial	Intermed	Final	Missed*	
RNAV 10 (RNP 10)	10							
RNAV 5		5	5*					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1*			1	1	1		1	1
A-RNP	2*	2 or 1	1	1	1	0.3	1	1
RNP APCH				1	1	0.3	1	
RNP AR APCH				1 - 0.1	1 - 0.1	0.3 - 0.1	1 - 0.1	
RNP 0.3		0.3	0.3	0.3	0.3		0.3	0.3

* Limitation on use – check PBN Volume II. Table II-A-1-1

Use and Scope of Navigation Specification by Flight Phase

PBN Manual includes airworthiness, operational and training guidance

NAVIGATION SPECIFICATION	FLIGHT PHASE							
	En Route Oceanic / Remote	En Route Continental	ARR	APPROACH				DEP
				Initial	Intermed	Final	Missed*	
RNAV 10 (RNP 10)	10							
RNAV 5		5	5*					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
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RNP APCH				1	1	0.3	1	
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RNP 0.3		0.3	0.3	0.3	0.3		0.3	0.3

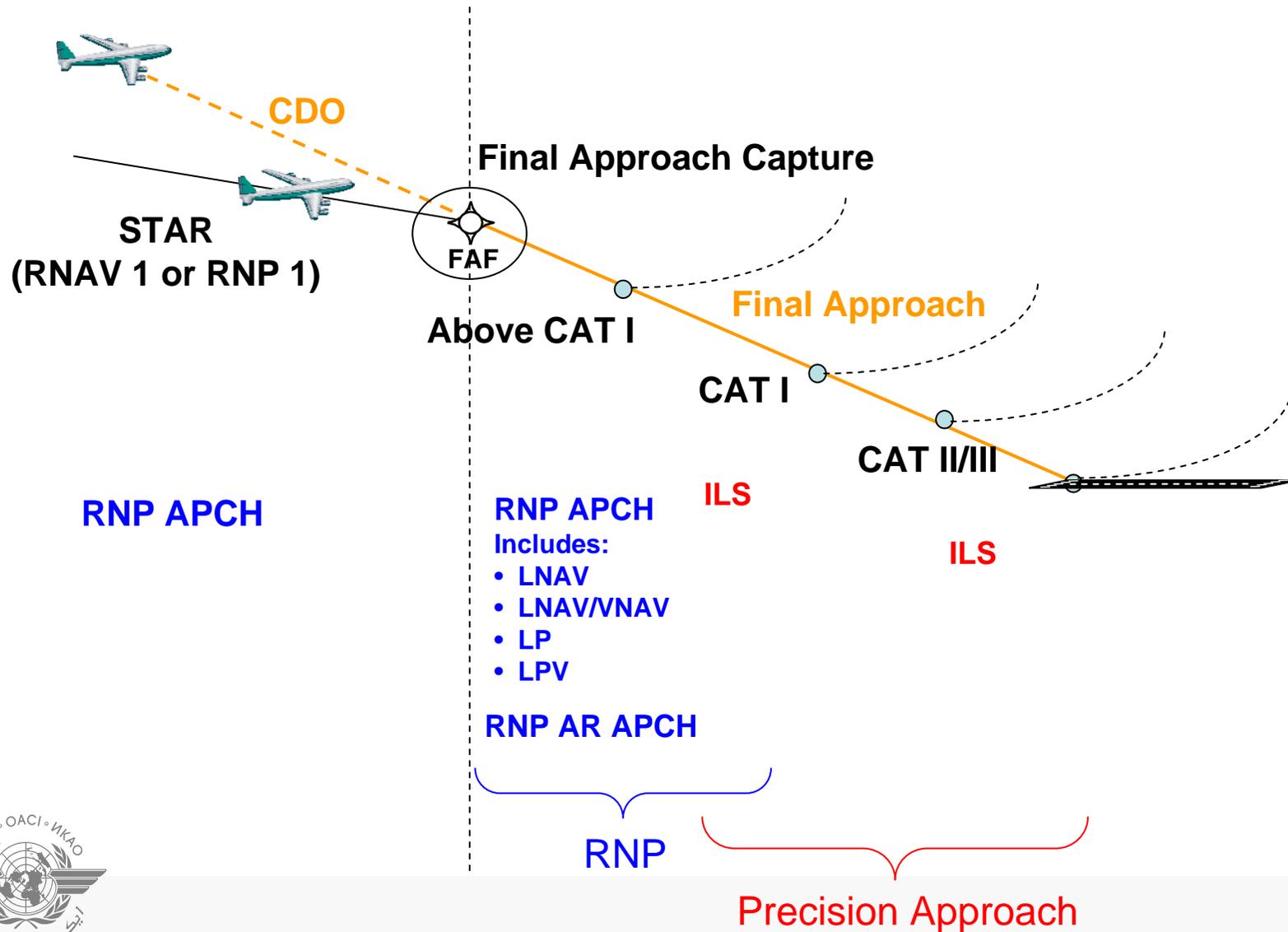
* Limitation on use – check against PBN Manual Volume II, Part A Table II-A-1-1

Avionics Supporting Specifications

	Permitted Sensors					AFCS Requirement
	GNSS	IRU	DME/DME	DME/DME /IRU	DME/VOR	AP/FD
RNAV 10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				FTE may be manually controlled by the pilot remaining within ½ full scale deflection of CDI with correct scaling for phase of flight
RNAV 5	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
RNAV 2/1	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
RNP 4	<input checked="" type="checkbox"/>					
RNP 2²	<input checked="" type="checkbox"/>					
RNP 1	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> ³			<input checked="" type="checkbox"/> ¹
A-RNP²	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> ³			<input checked="" type="checkbox"/>
RNP 0.3	<input checked="" type="checkbox"/>					<input checked="" type="checkbox"/>
RNP APCH	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/> ³	<input checked="" type="checkbox"/> ³		<input checked="" type="checkbox"/>
RNP AR APCH	<input checked="" type="checkbox"/>					<input checked="" type="checkbox"/>

1. Although the A-RNP Nav Spec does not explicitly state FD/AP the RF appendix does and RF is a requirement for A-RNP
2. For Oceanic/Remote Continental operations dual independent LRNS (providing Higher Continuity) are required
3. Only when authorised by a specific State. Based on an available DME infrastructure and appropriate aircraft capability

Approach and Landing Types



ICAO Recommendations

- ICAO (36th Assembly Oct 2007) resolved
 - States and planning and implementation regional groups (PIRGs) should complete a PBN implementation plan by 2009 to achieve:
 - Implementation of RNAV and RNP operations for en route and terminal areas according to established timelines and intermediate milestones; and
 - Implementation of approach procedures with vertical guidance (APV) (Baro-VNAV and/or augmented GNSS) for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows:
 - 30% by 2010
 - 70% by 2014.

ICAO Recommendations: 2010

- 37th ICAO Assembly (Oct 10):
- *Concerning APproach with Vertical guidance (APV), the resolution added:*
 - implementation of straight-in LNAV only procedures, as an exception, for instrument runways at aerodromes where there is no local altimeter setting available and where there are no aircraft suitably equipped for APV operations.

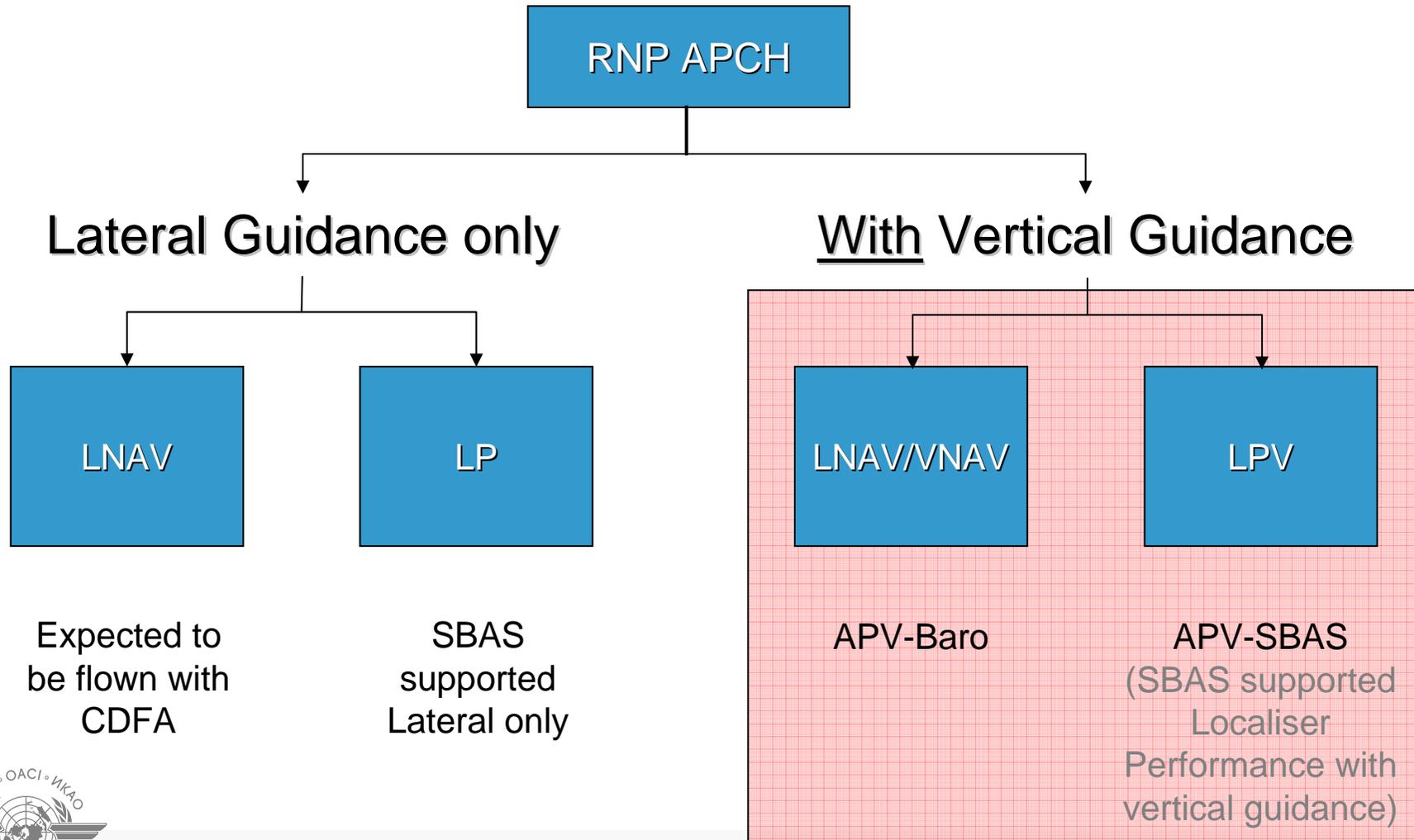
PBN Approach Terminology

- RNP APCH
 - Flown to **LNAV minima**
- RNP APCH with Baro-VNAV
 - Flown to **LNAV/VNAV minima**
 - Also called **APV Baro**
- RNP AR (Authorisation Required) APCH
 - Flown to **LNAV/VNAV minima but reduced terrain clearance**
- RNP APCH using SBAS augmentation
 - Flown to **LPV minima**
 - Called an **APV SBAS**
 - Potentially to DA/H of 200ft if airport equipped for ILS CAT I operations



There is a lot of room for confusion!

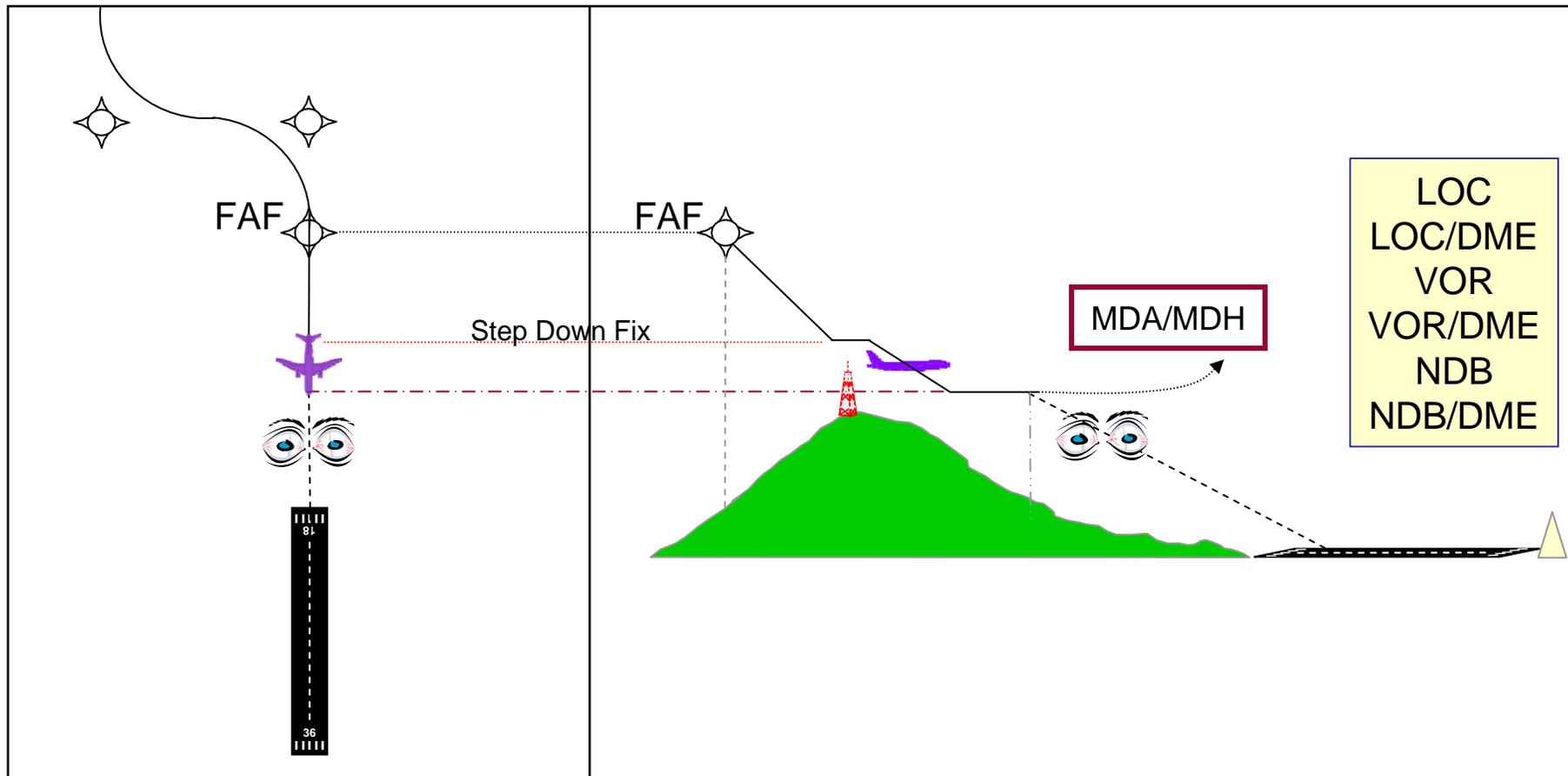
RNP Approaches: Vertical Guidance



Conventional NPA

LATERAL

VERTICAL

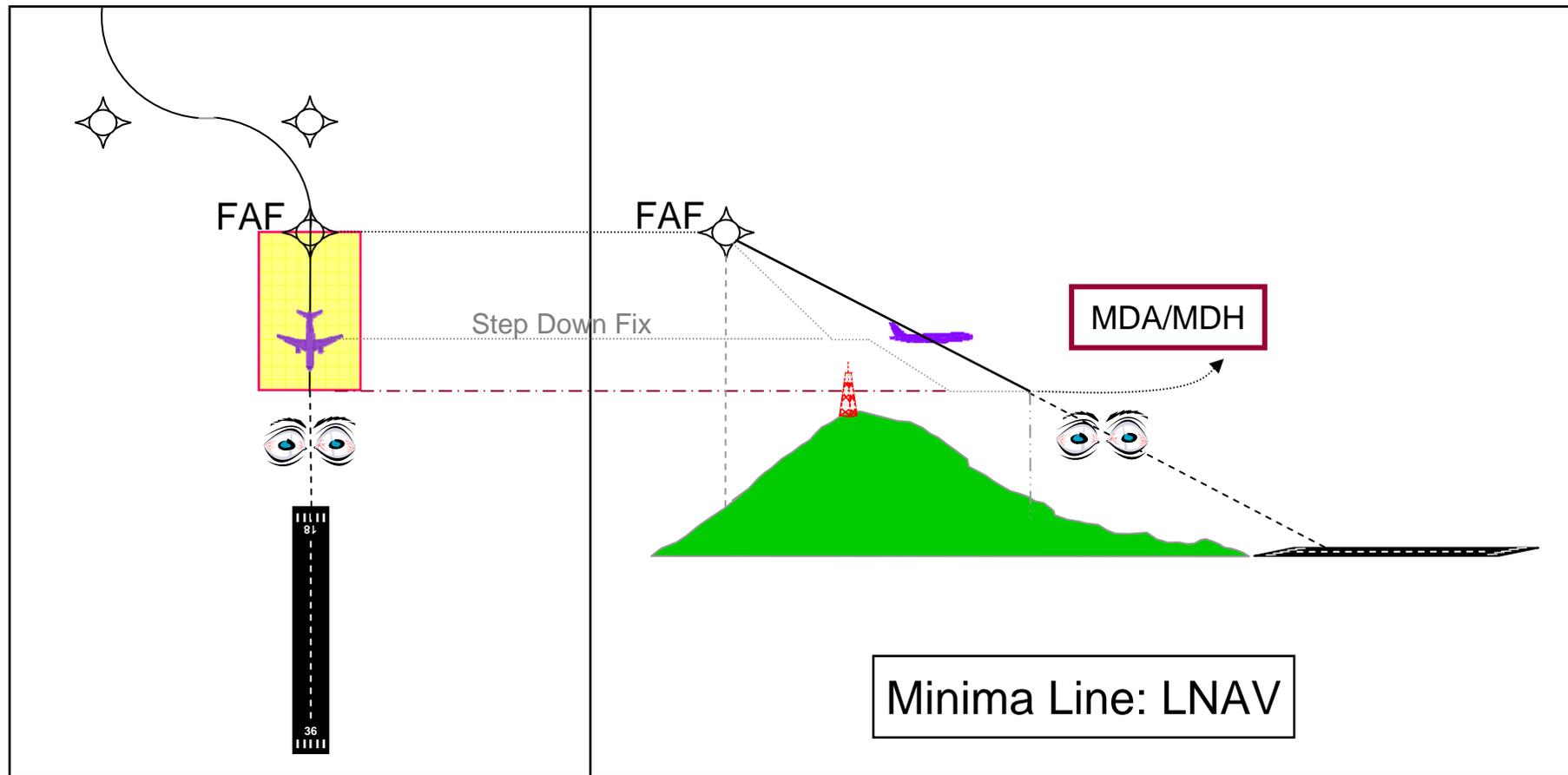


Description	System	Performance
<ul style="list-style-type: none"> ■ Approach conducted to a MDA/MDH ■ Lateral Guidance based on ground based NAVAIDS 	As Displayed	/

RNP APCH with CDFA

LATERAL

VERTICAL

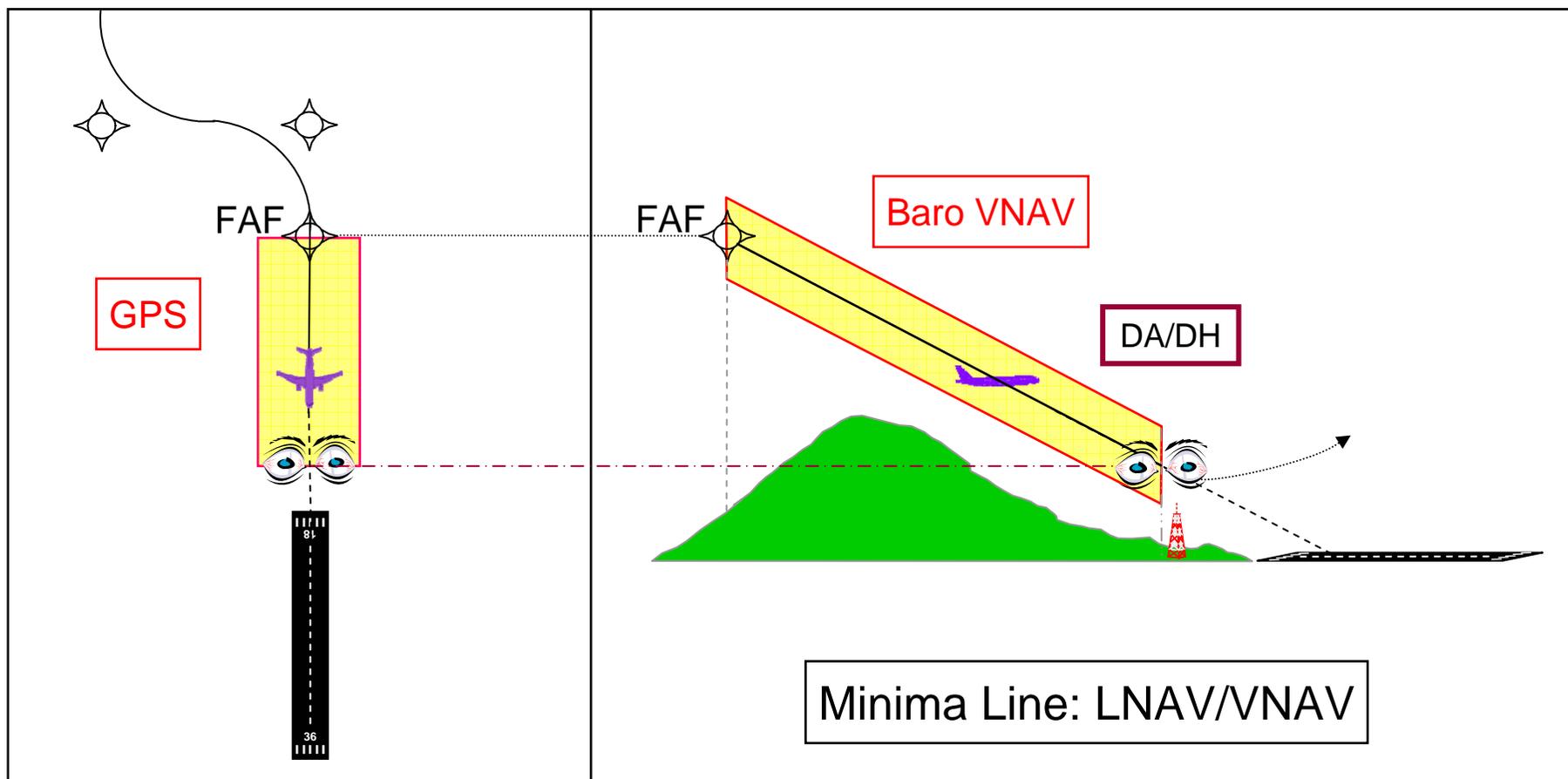


Description	System	Performance
<ul style="list-style-type: none"> Approach conducted to a MDA/MDH Lateral Guidance only based on GPS (with RAIM) 	GPS (RAIM)	0.3NM (95%)

APV Baro Approach

LATERAL

VERTICAL

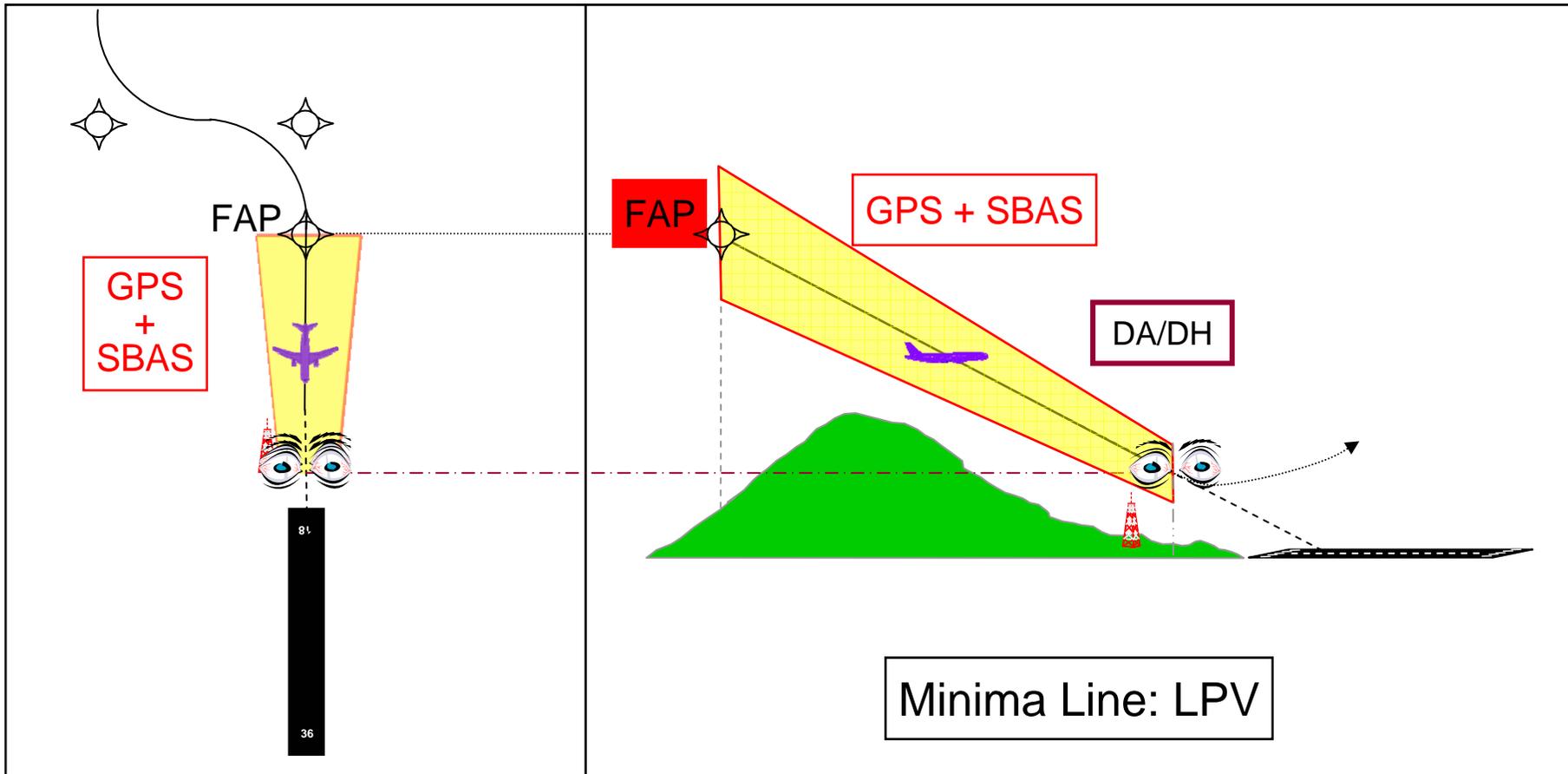


Description	System	Performance
<ul style="list-style-type: none"> ■ Approach conducted to Decision Altitude / Height ■ Lateral guidance based on GPS (with RAIM) and vertical guidance based on Baro 	GPS (RAIM) and Barometric altimetry	0.3NM (95%) VNAV: 20-27

APV SBAS Approach

LATERAL

VERTICAL



Description	System	Performance
<ul style="list-style-type: none"> ■ Approach conducted to a Decision Altitude / Height ■ Lateral and vertical guidance based SBAS 	GPS + SBAS	HAL: 40m VAL: 50m

EGNOS Availability – SoL SDD

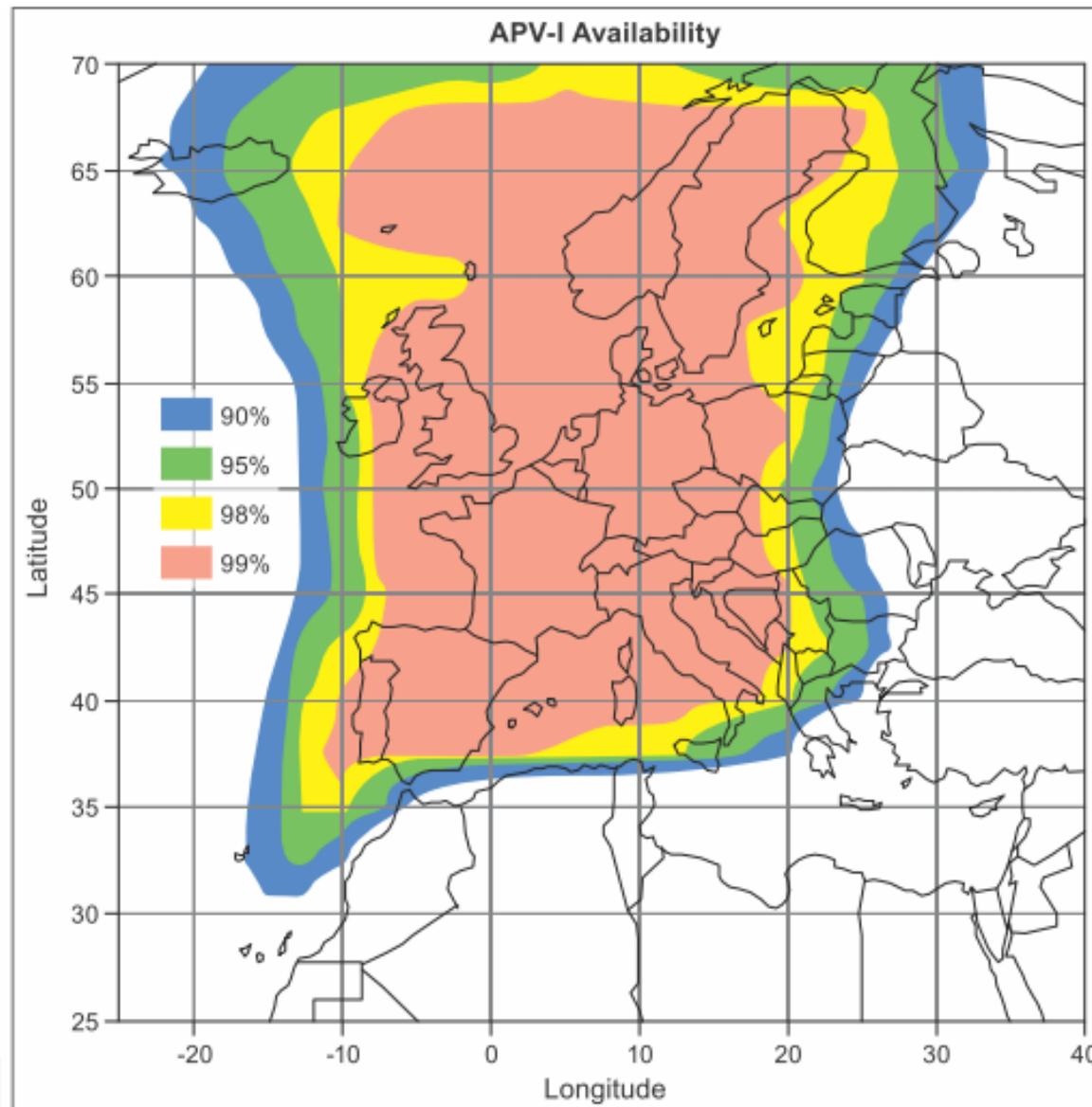


Figure 8. EGNOS APV-I availability

