Regional Seminar on MMEL/MEL and Special Operations

[Airbus Amber]

Organized by ICAO Regional Office for Western and Central Africa (WACAF)

Dakar - Senegal - from 30 June to 5 July 2025

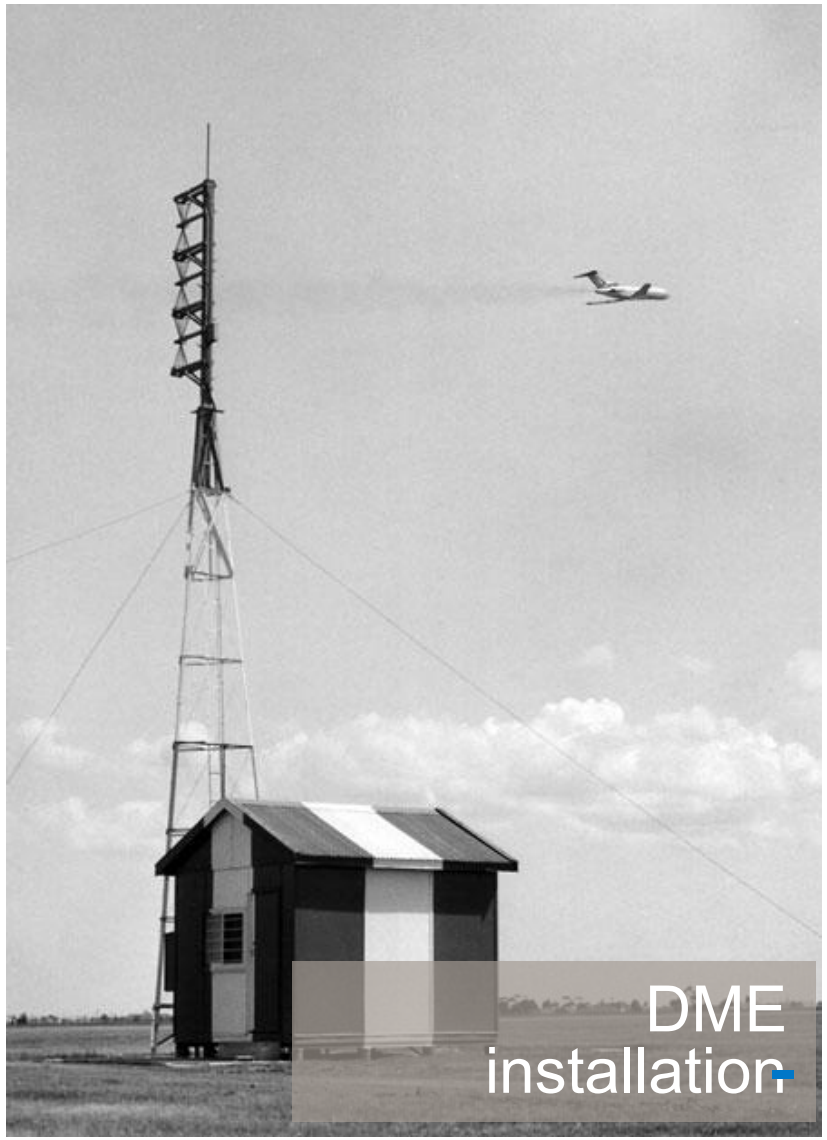
Approach Guidance Mode

Julien BERNAGE, AIRBUS Approach and Navigation Flight Ops specialist

AIRBUS

#1 A LITTLE BIT OF HISTORY

Up to 1970's- ILS and NAVAIDs era



DME installation

Based on ground facilities

VOR installation

DME: Distance Measurement Equipment
VOR: VHF Omni Range

Precision Approach: Instrument Landing System

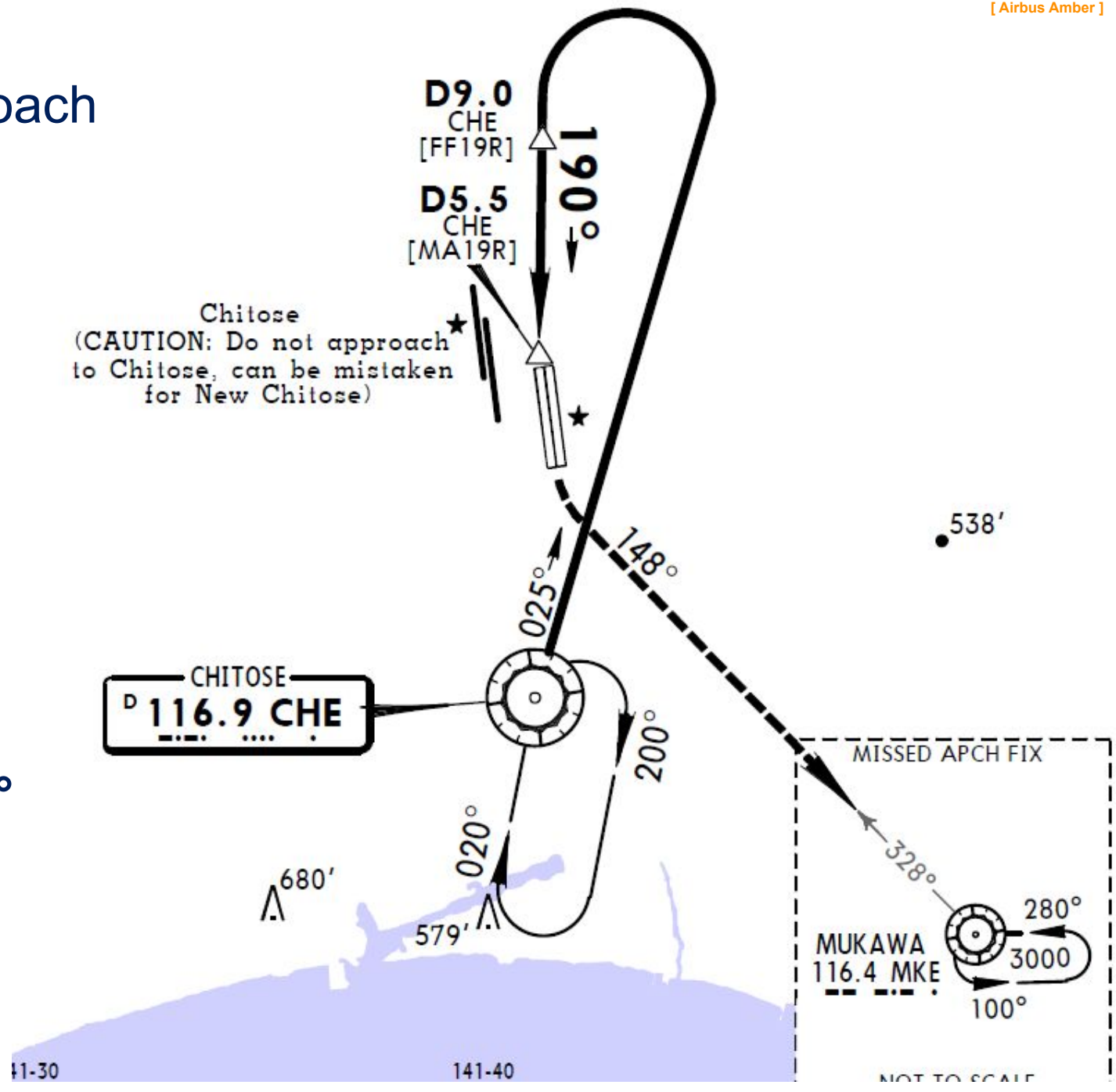
- **Lateral using LOC**
- **Vertical using G/S**

Conventional Non Precision Approach

- **Lateral trajectory**

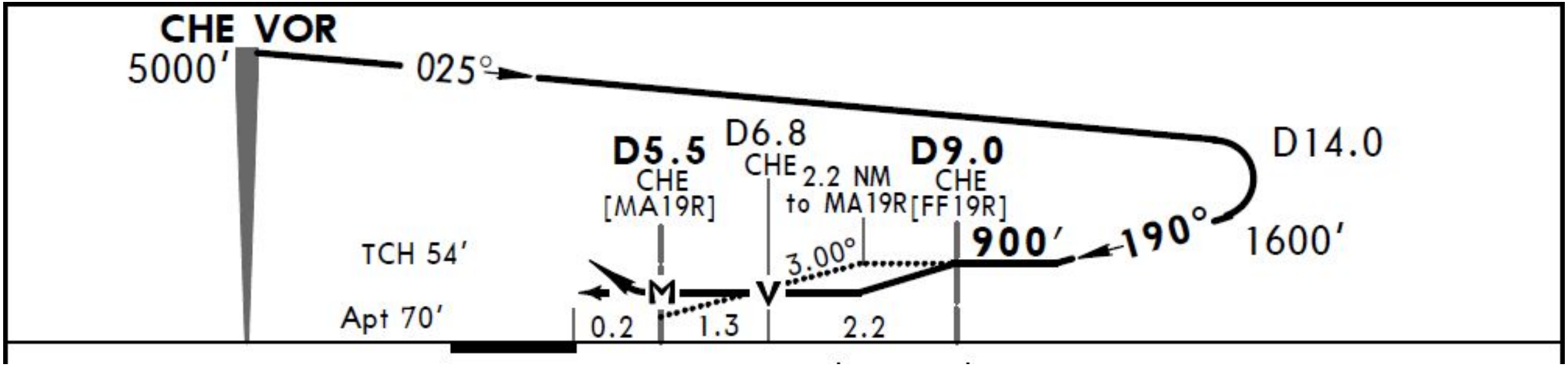
Using VOR and DME raw data to follow the entended trajectory

Procedure:
Overfly CHE
Outbound CHE Radial 25°
at 9NM from CHE turn left
Intercept Inbound CHE radial 190°



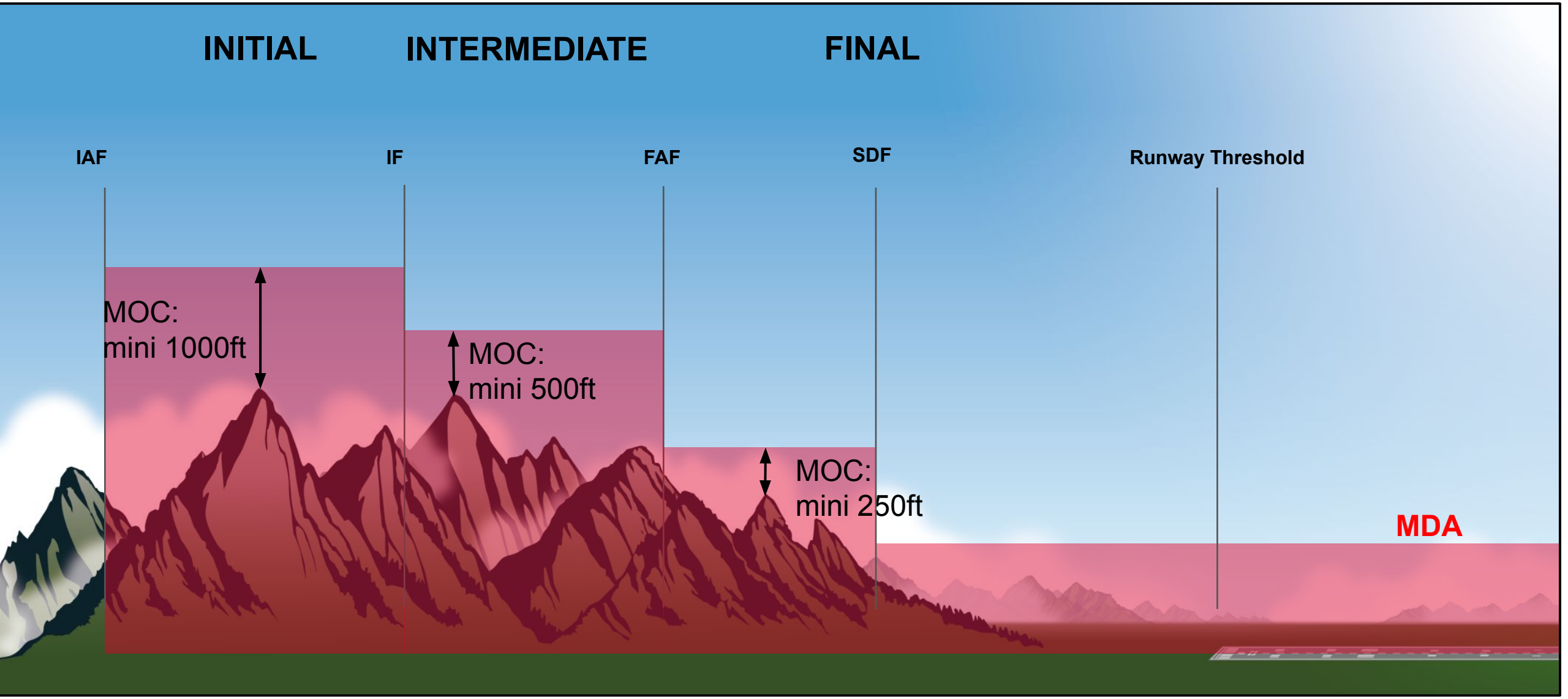
Conventional Non Precision Approach

- **Vertical**

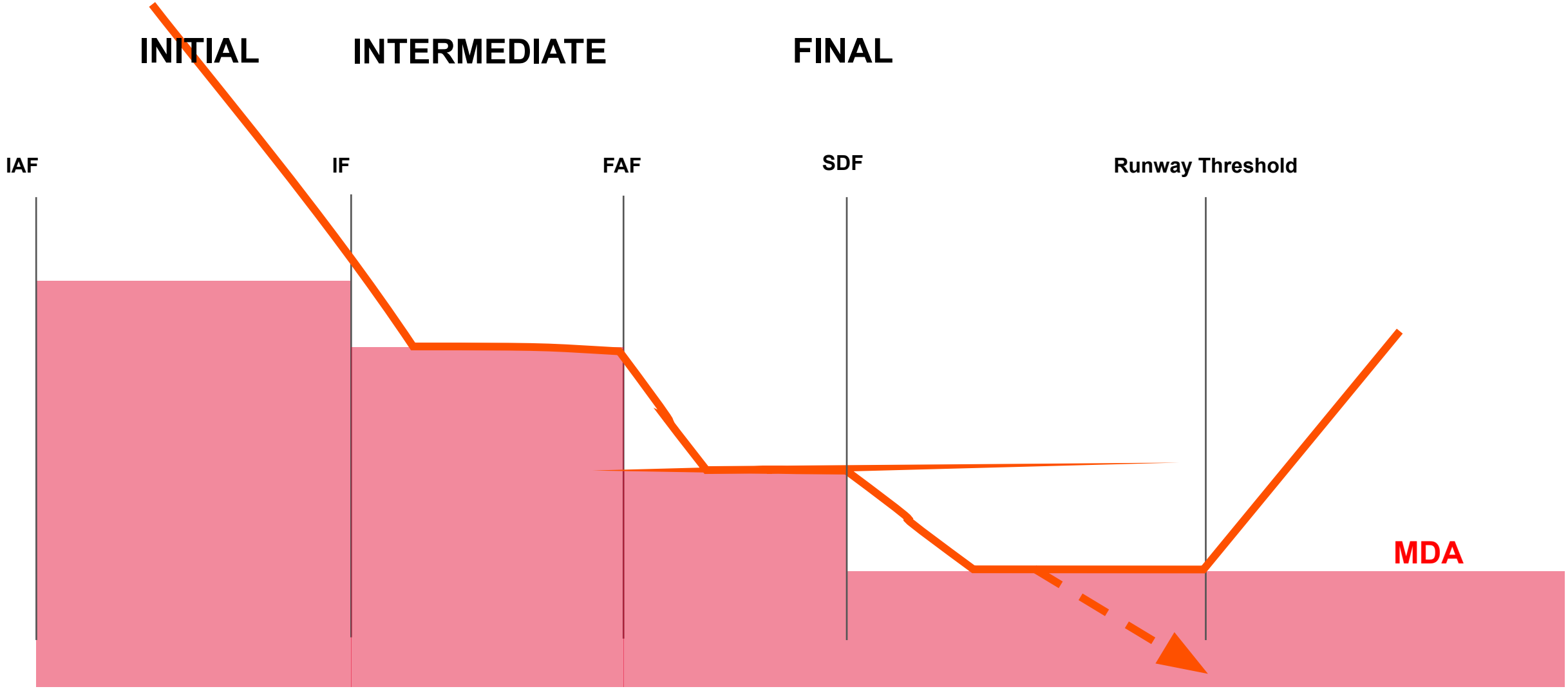


AIRBUS

Obstacle Clearance on Conventional



Dive and Drive technic



1980's - The Flight Management System and Inertial Reference System

FMS+IRS: revolution in the cockpit

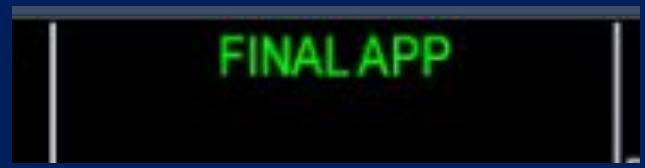
- **A/C position and Navigation Display**
  Map with Flight Plan and A/C symbol
- **RNAV(area navigation) concept**
  Waypoints in coordinate
- **Navigation Database**
  Storage of procedures and Waypoints
- **Lateral FPLN and guidance**
  Approach coded in Nav DataBase, selection
- **Vertical FPLN and Guidance** in Barometric

RNAV: aRea NAVigation

RNAV System

Onboard Landing System FINAL APP

FMS provides a guidance along a coded and defined lateral and vertical profile



But the vertical profile is **BAROMETRIC**

GPS □ Better quality in position but GPS altitude not used

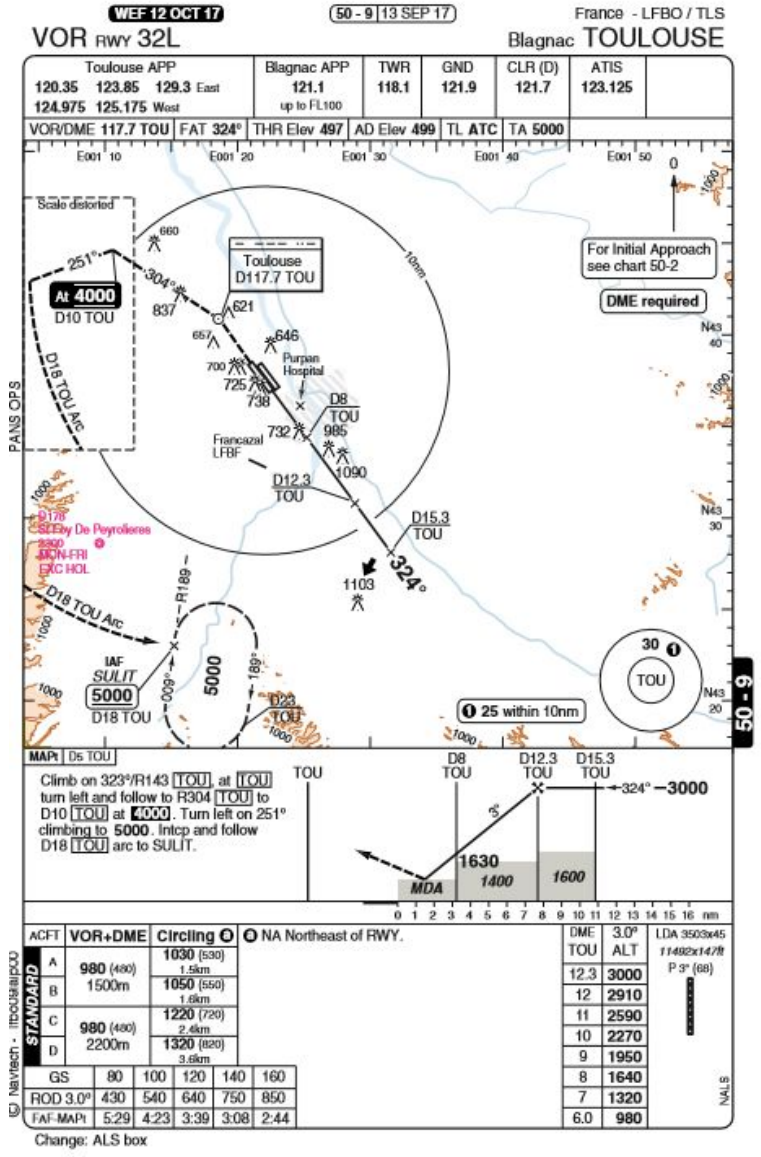
AIRBUS

Conventional Approach flown in RNAV

RNAV system

Conventional flown with RNAV principle

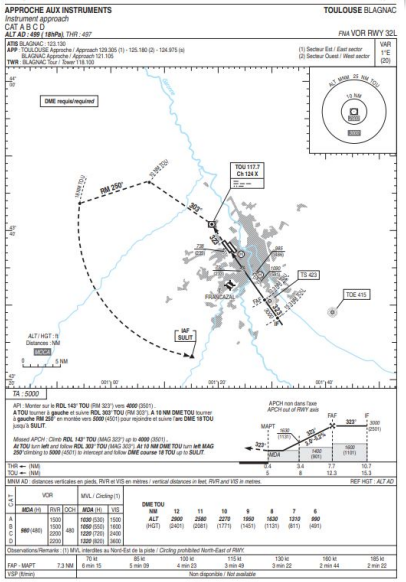
- **A/C flows what is coded in NDB with current position and no more raw data**



AIRBUS

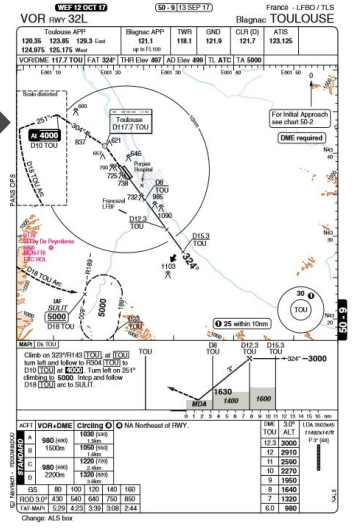
Conventional Approach flown in RNAV

AIP published by state

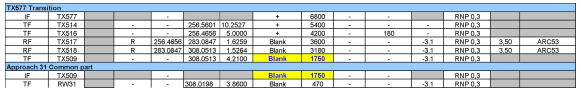


Coding by NDB provider

chart



coding table



The procedure is translated into data usable by FMS according to ARINC 424 requirements

- Waypoints defined by Lat/Long
- Legs between waypoints

FMS

FMS decodes the data from NDB in order to insert it into its FPLN.

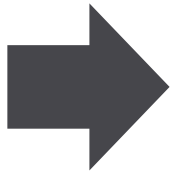
Localization toward its FPLN using the FMS position

AIRBUS

Conventional Approach flown in RNAV

AC 20-130 / AC 20-138

GPS considered as equivalent to NAVAIDS

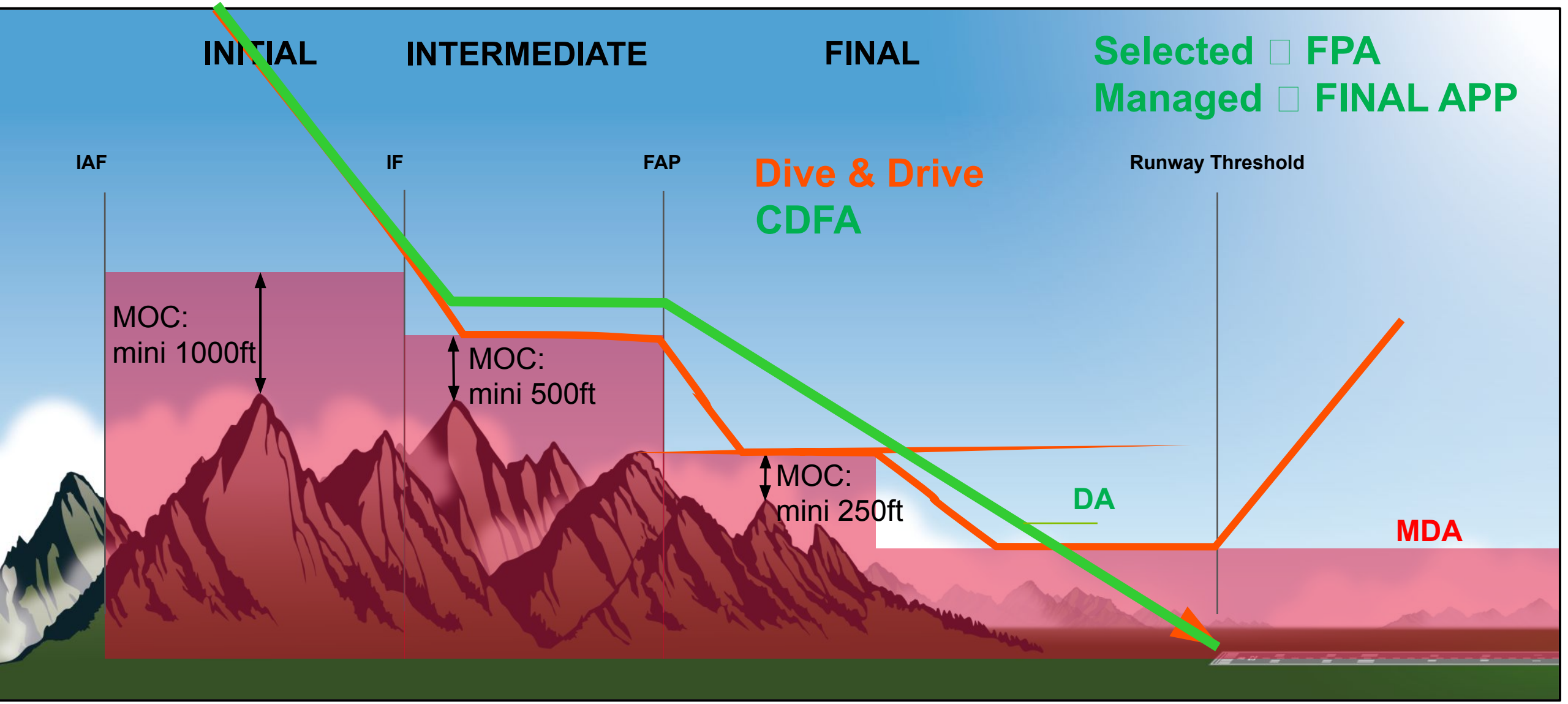


If GPS PRIMARY
No need to monitor RAW DATA

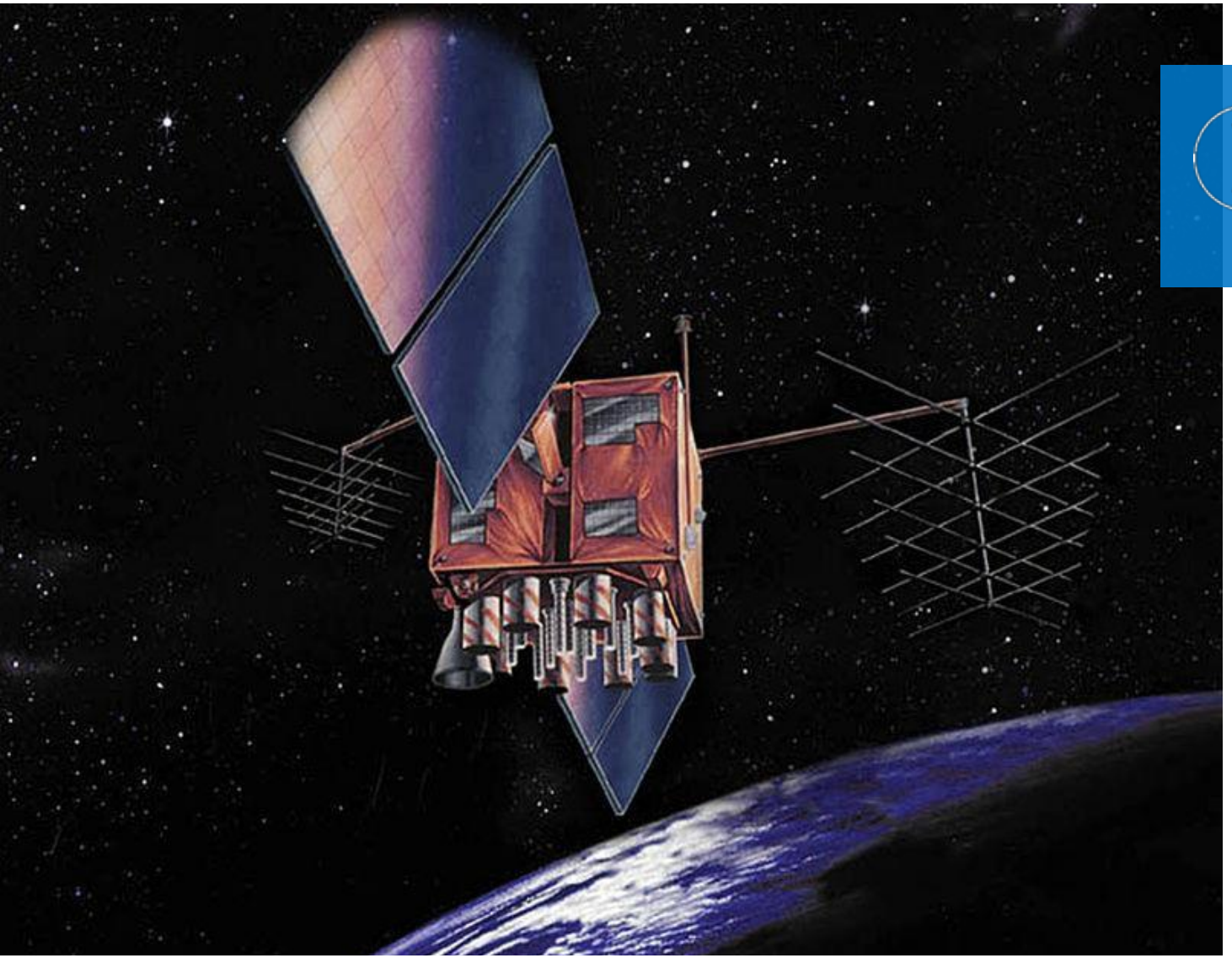
If GPS PRIMARY LOST

RAW DATA monitoring required

Barometric Vertical profile: From Dive & Drive to CDFA



1990’s - The GNSS – Global Navigation Satellite System



Bring precision and integrity on position

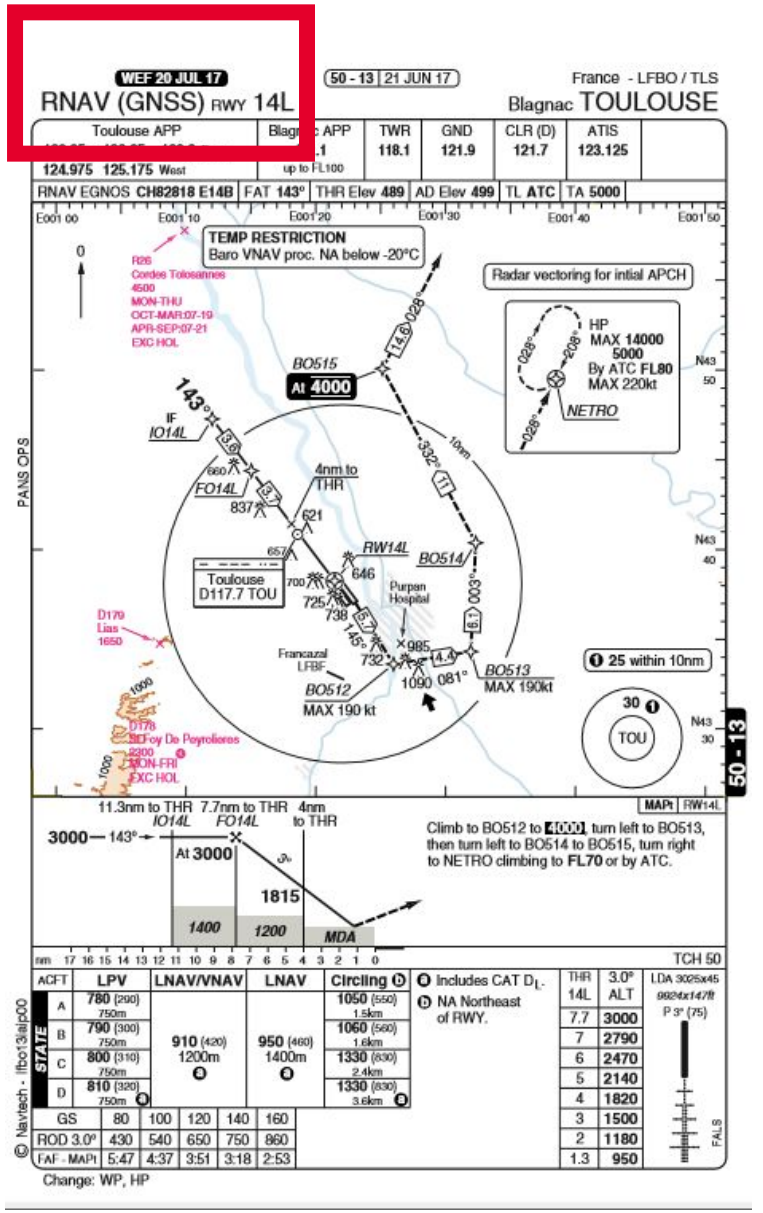
- **PBN concept**
  the Navigation Performance
- **RNAV(GNSS) / RNP APCH**
- **RNAV(RNP) / RNP AR**

PBN: Performance Based Navigation
RNP AR: required Navigation Performance with Authorization required

Conventional Approach to RNAV Approach

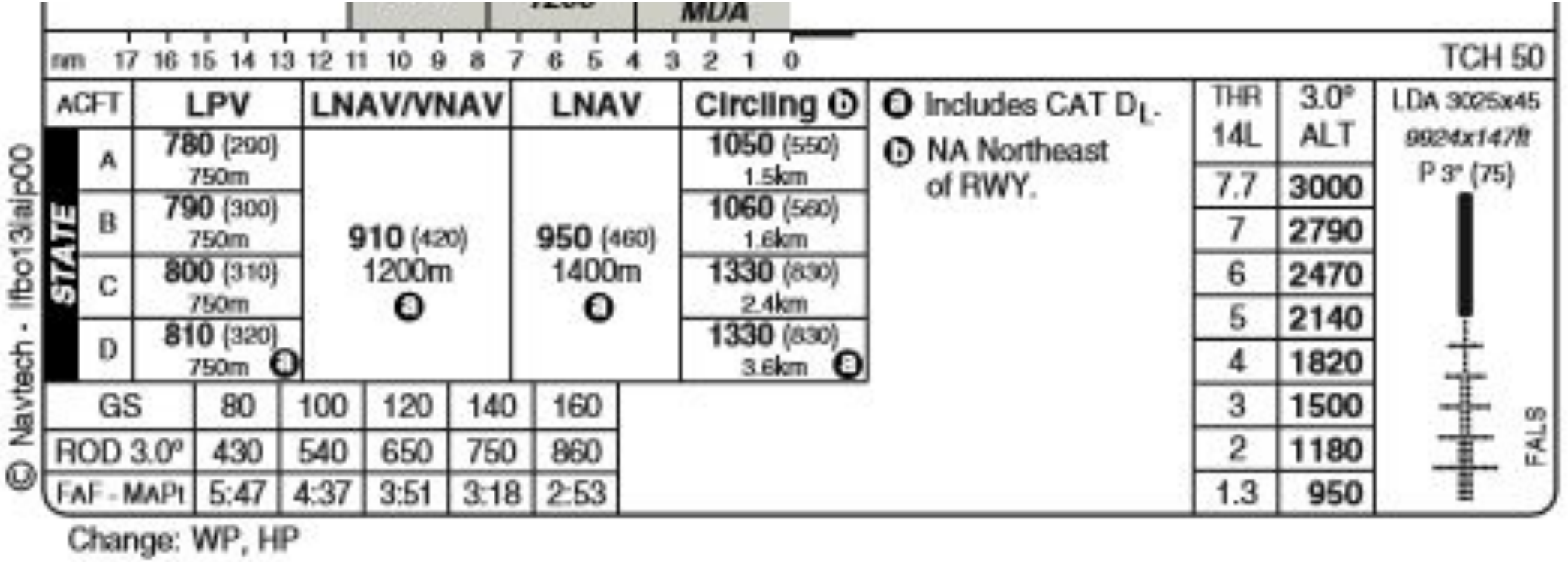
- **RNAV(GNSS) approaches instead of conventional approaches**

- **PBN concept for the lateral part:**
  - **RNP value of 0.3NM in straight final**
  - **RNP Value of 1NM in Initial, Intermediate and Missed Approach**



AIRBUS

RNP APCH / RNAV(GNSS) difference of minima



MDA

nm 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 — TCH 50

ACFT	LPV	LNAV/VNAV	LNAV	Circling ⓑ
A	780 (290) 750m	910 (420) 1200m ⓐ	950 (460) 1400m ⓐ	1050 (550) 1.5km
B	790 (300) 750m			1060 (560) 1.6km
C	800 (310) 750m			1330 (830) 2.4km
D	810 (320) 750m ⓐ			1330 (830) 3.6km ⓐ

GS	80	100	120	140	160
ROD 3.0°	430	540	650	750	860
FAF - MAPt	5:47	4:37	3:51	3:18	2:53

ⓐ Includes CAT D_{L-}

ⓑ NA Northeast of RWY.

THR 14L	3.0° ALT
7.7	3000
7	2790
6	2470
5	2140
4	1820
3	1500
2	1180
1.3	950

LDA 3025x45 9924x147ft P 3° (75) FALS

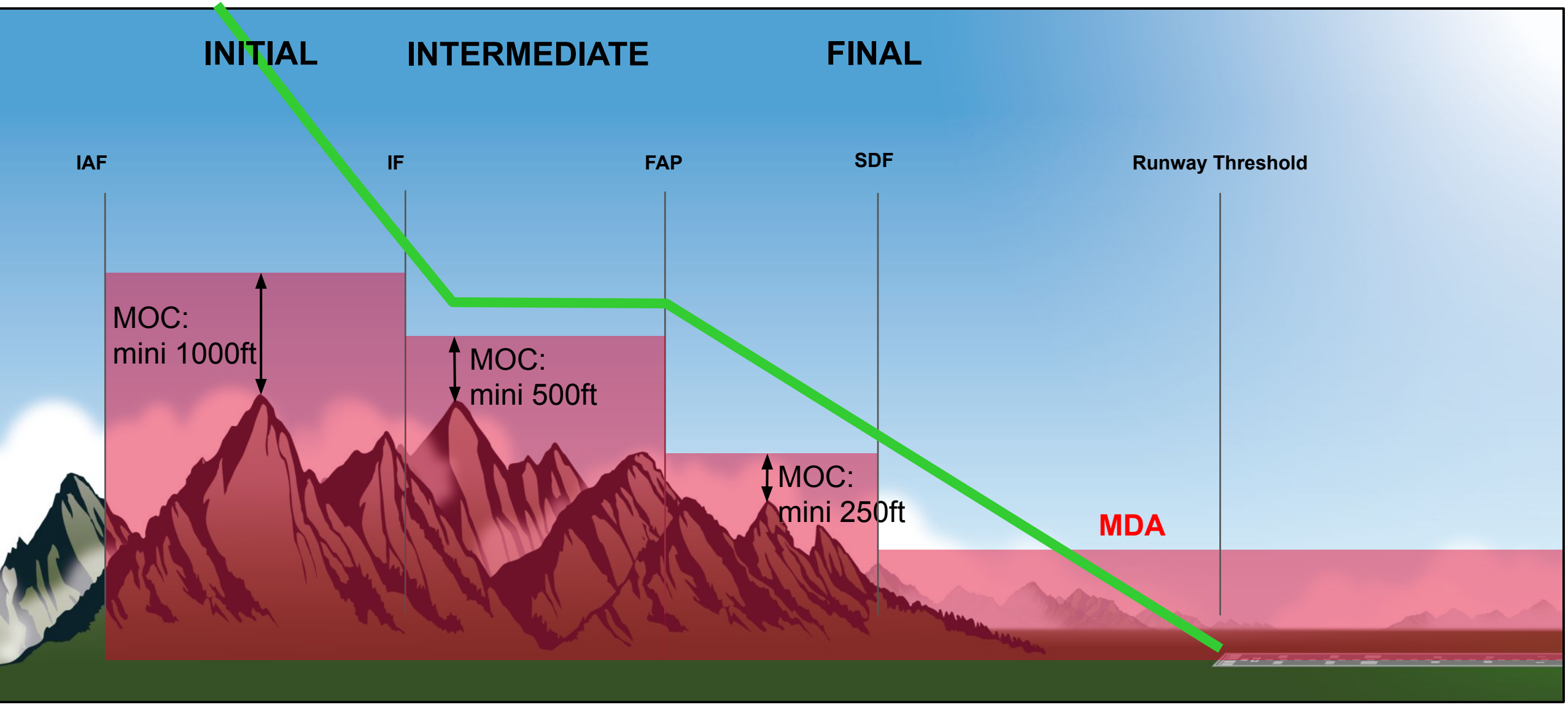
STATE

© Navtech - Ifbo13jalpC0

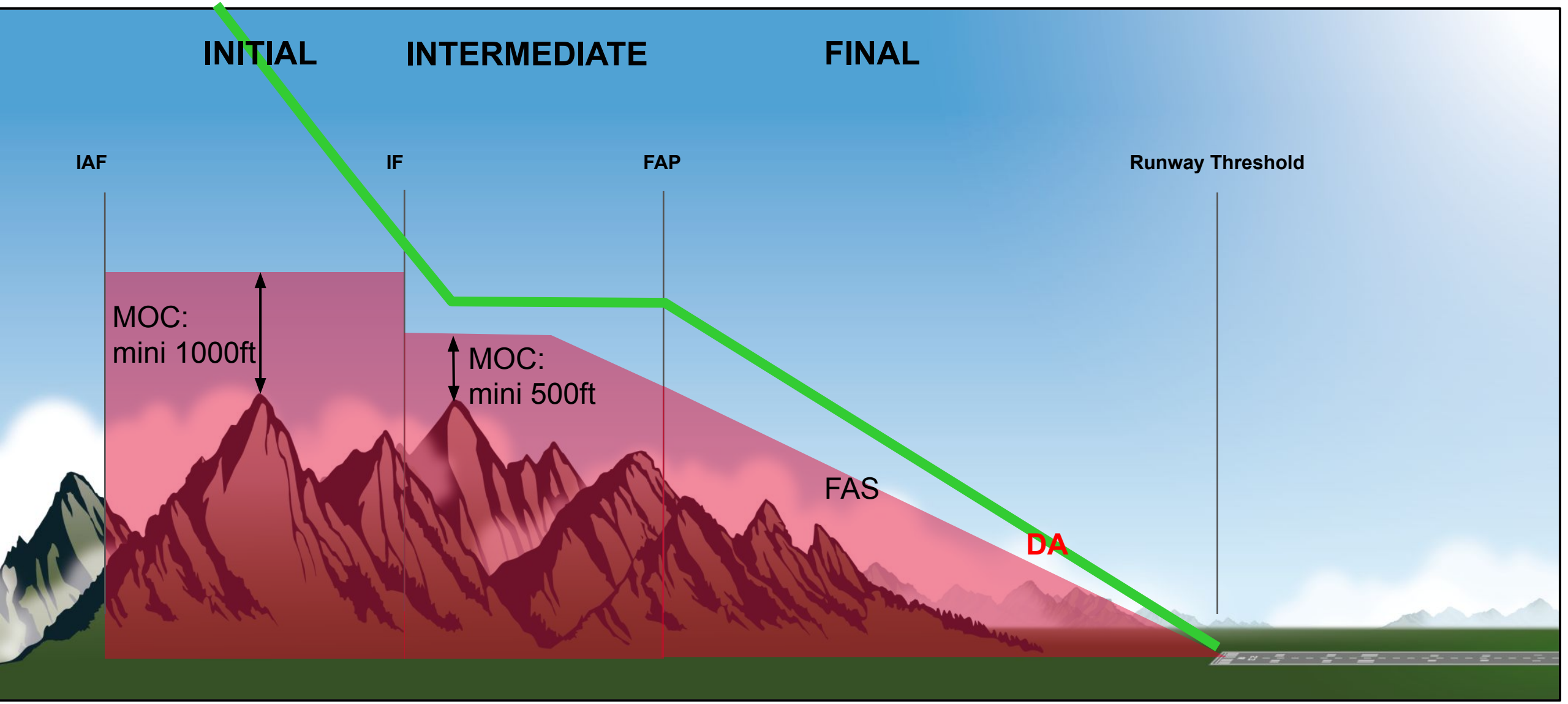
Change: WP, HP

AIRBUS

Obstacle Clearance on RNP LNAV straight-in (less 5°)



Obstacle Clearance on RNP LNAV/VNAV



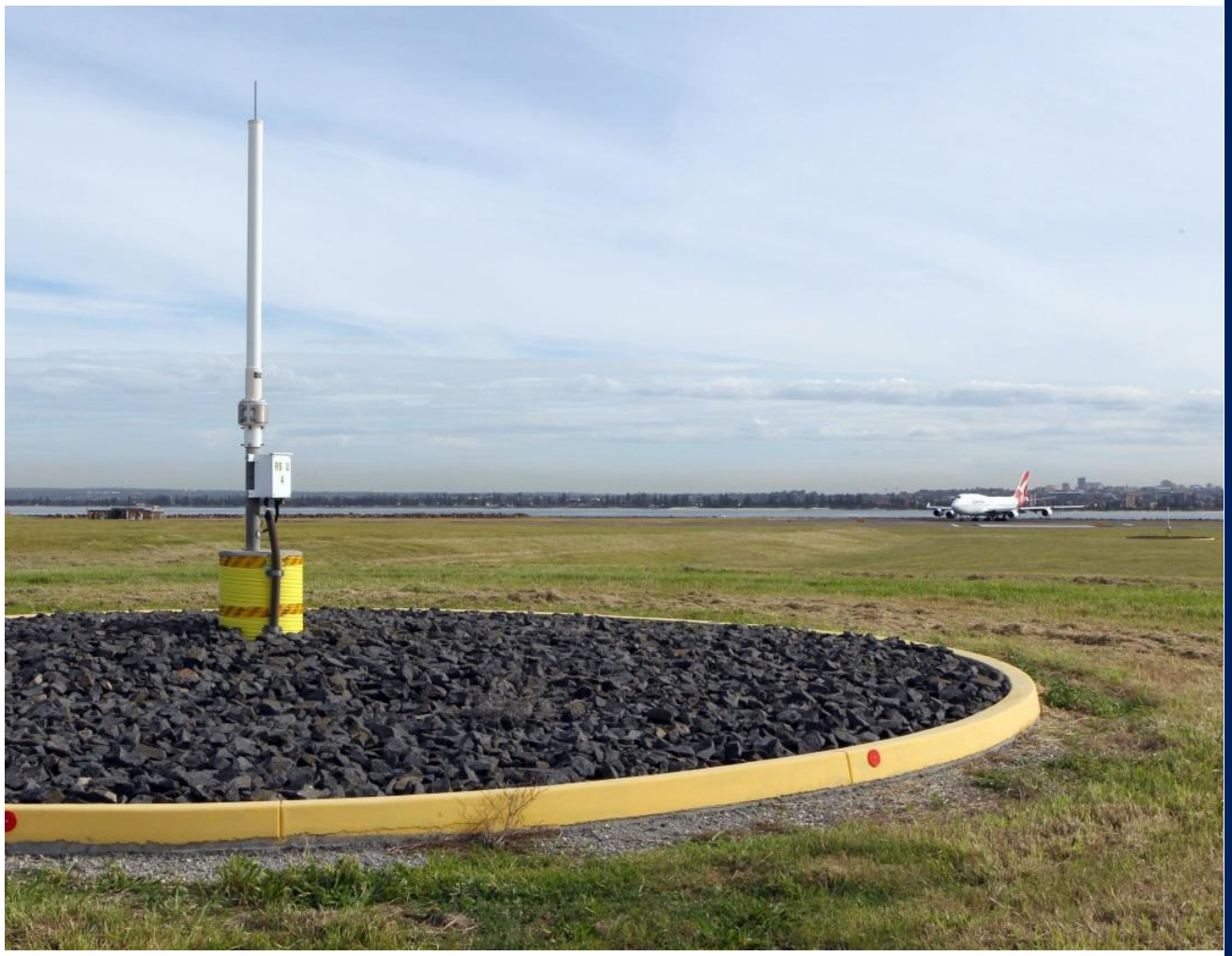
RNAV(RNP) / RNP AR

The ultimate solution for design

- **Turn after the FAF**
  on terrain challenging airports
- **Low RNP value**
  down to 0.1NM
- **Reduced margins**
  on protection areas

AR: Authorisation Required

Differential GPS concept

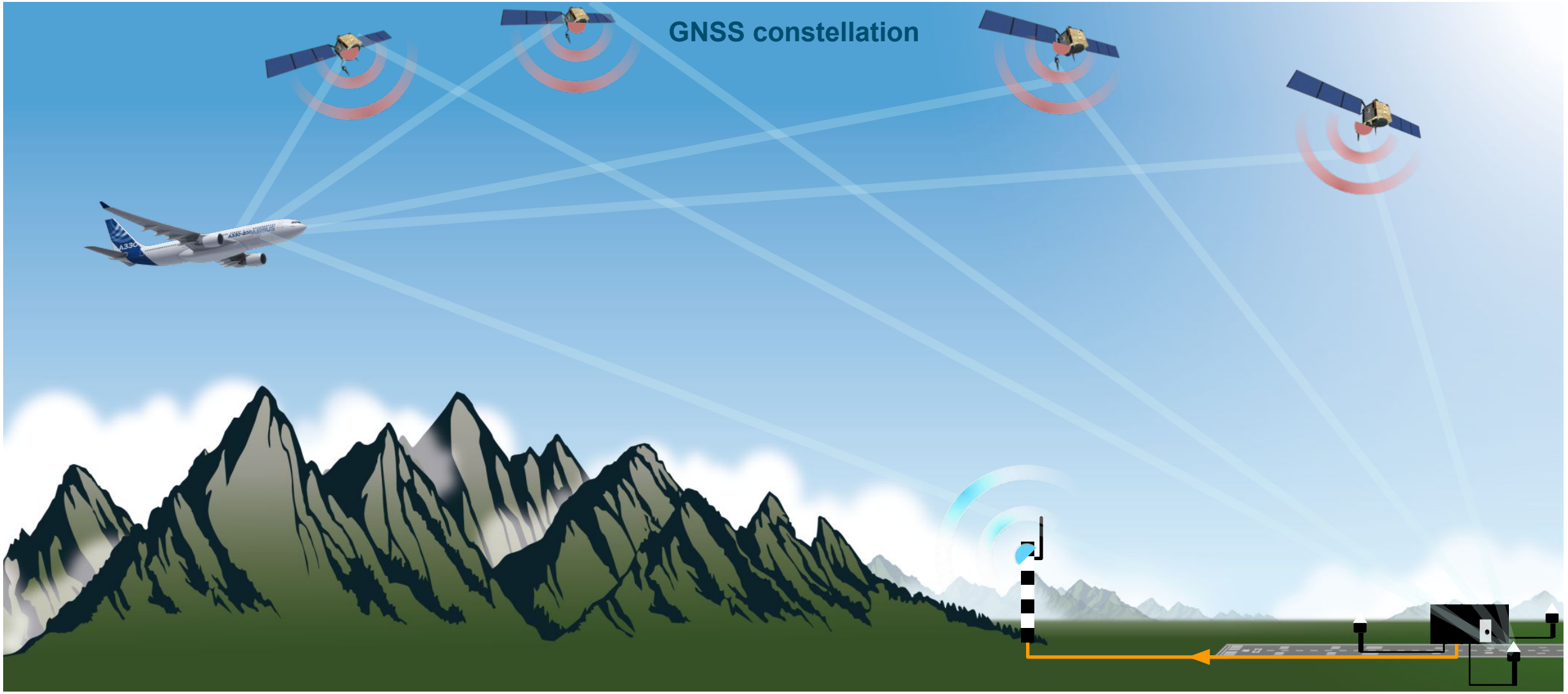


Augmentation of the Accuracy and Integrity

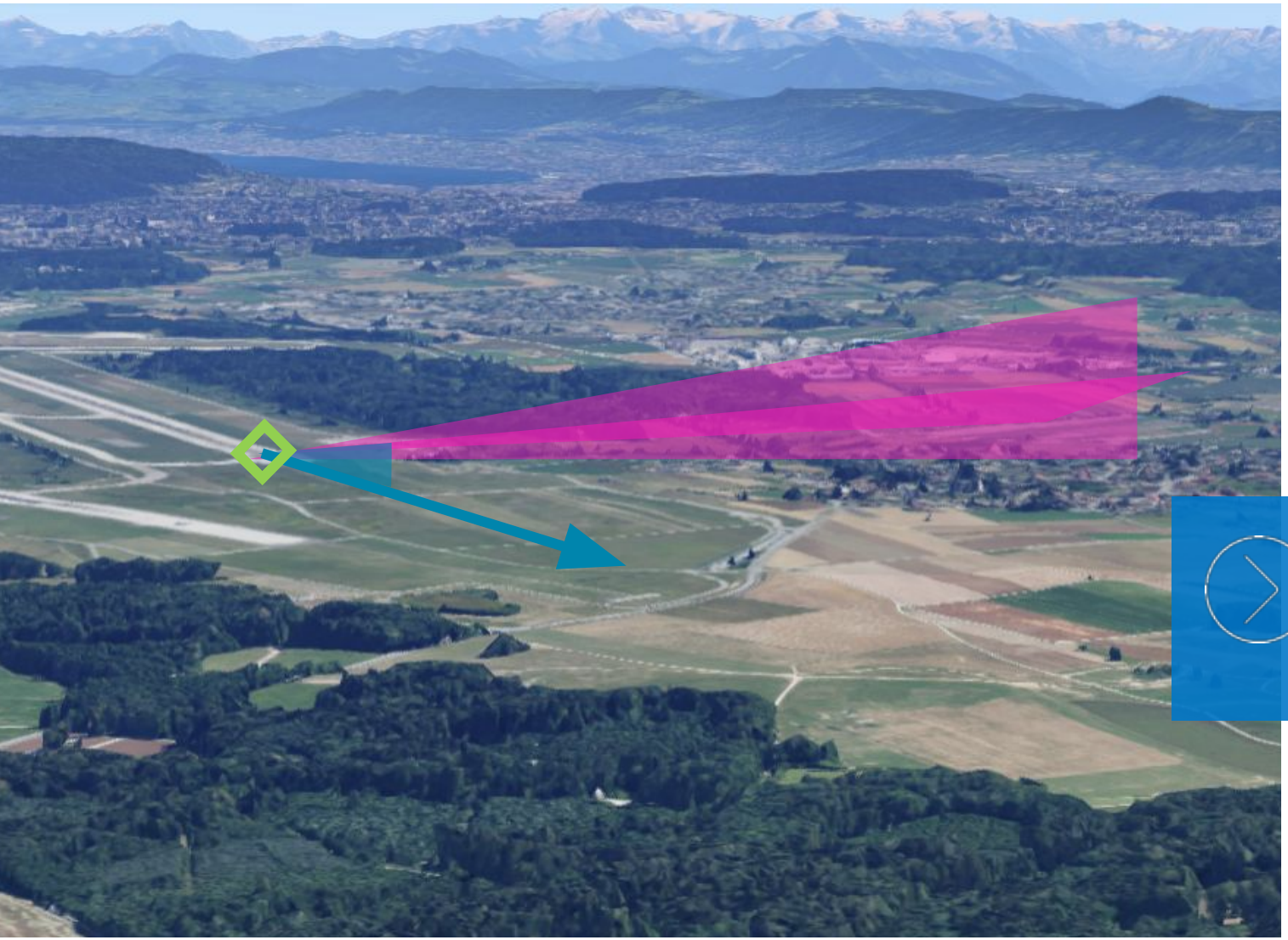
- GPS augmented position due to reference stations
- Vertical **GEOMETRICAL**
- 2 solutions:
  - GBAS GLS airbus solution
  - SBAS SLS airbus solution

GPS: Global Positioning System
GBAS: Ground Based Augmentation System
SBAS: Satelite Based Augmentation System

GBAS Landing System: GLS



GLS: Data transmitted to the A/C



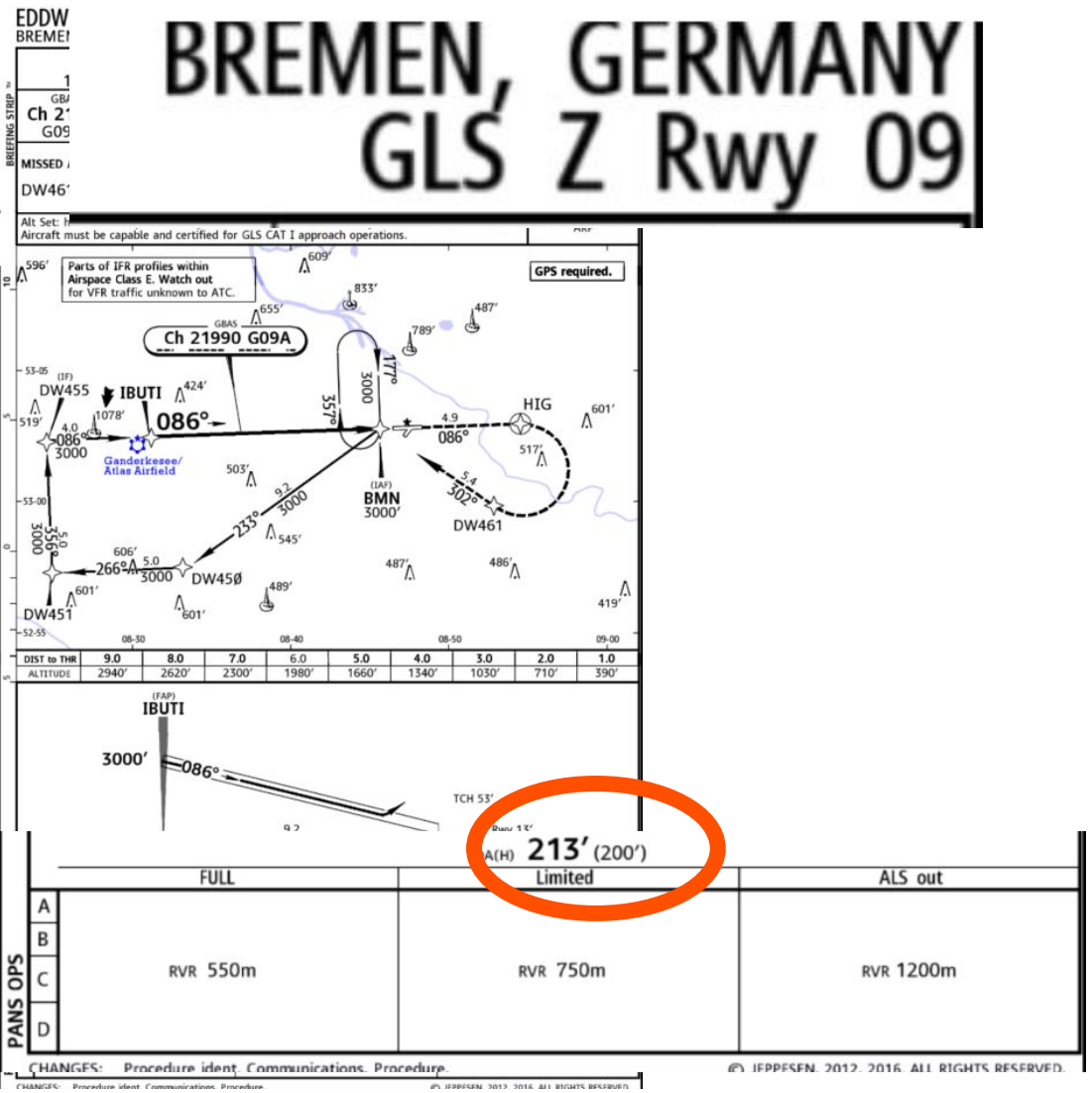
- **GPS augmented position by VHF**
- **Final Approach Segment data by VHF**
  - Anchor point coordinate
  - Course
  - Slope

MMR computes a virtual beam

- **Flown in G/S | LOC**
- **FMS not needed manual tuning possible**

MMR: Multi-Mode Receiver

GBAS on charts: GLS approach



- **Charted as GLS**
  - Angular protection **same as ILS**
  - **Geometric** vertical guidance
  - CAT I, CAT II available, CAT III under study

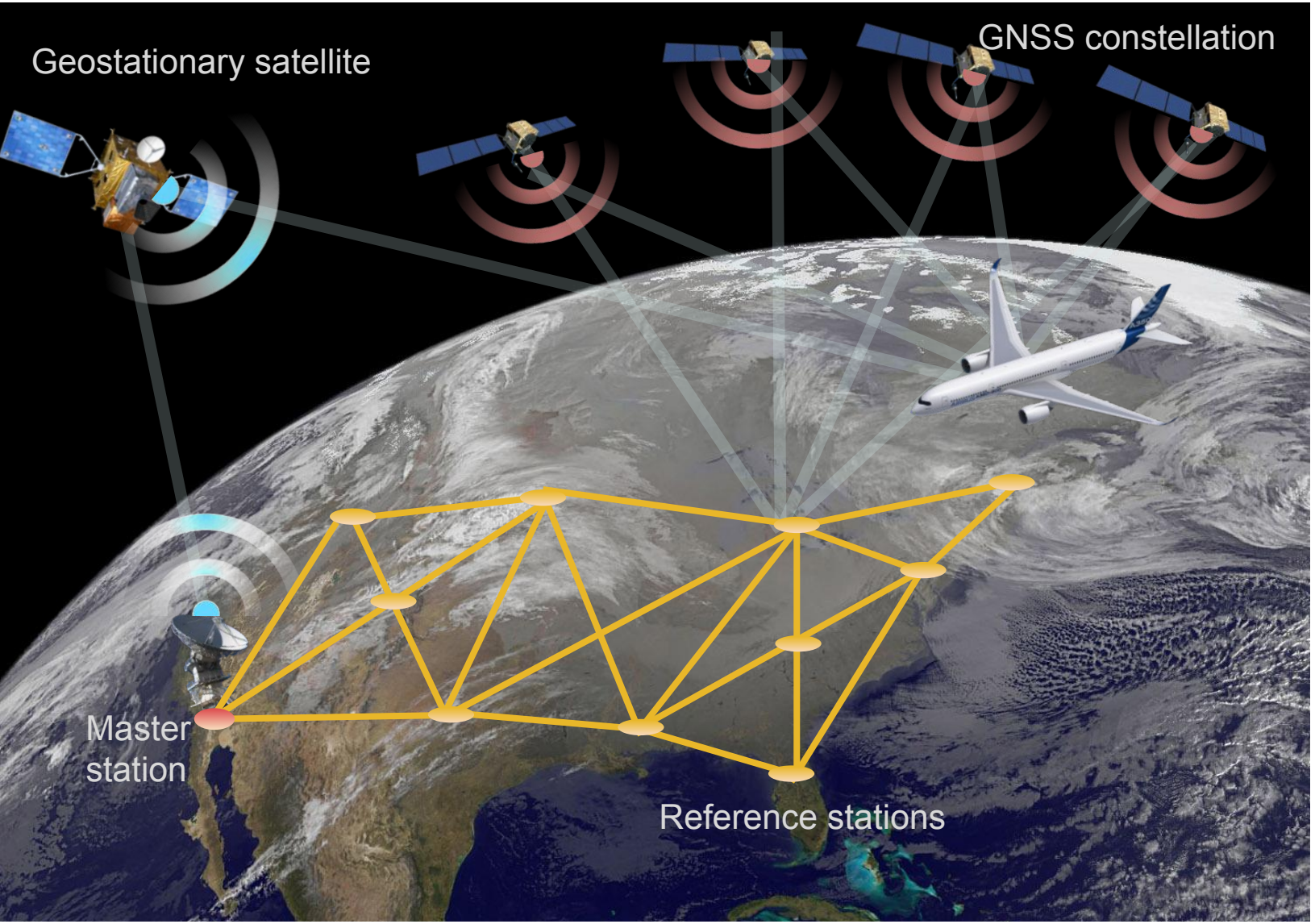
GLS approaches

- **Operational** (with dot: charts published)
- **Planned** Installations
- **Special Category, S-CAT I** (with dot: charts published)
- **Prototype/Research** (with dot: actively transmitting)

- **One station for all runways** with different channel
- **Customisation**
  - Displaced Threshold
  - Various slope
- **CAT I autoland capability** available on A380, 350, 330 and 320
- **CAT II autoland** available on A320
- **CAT III autoland** Under study

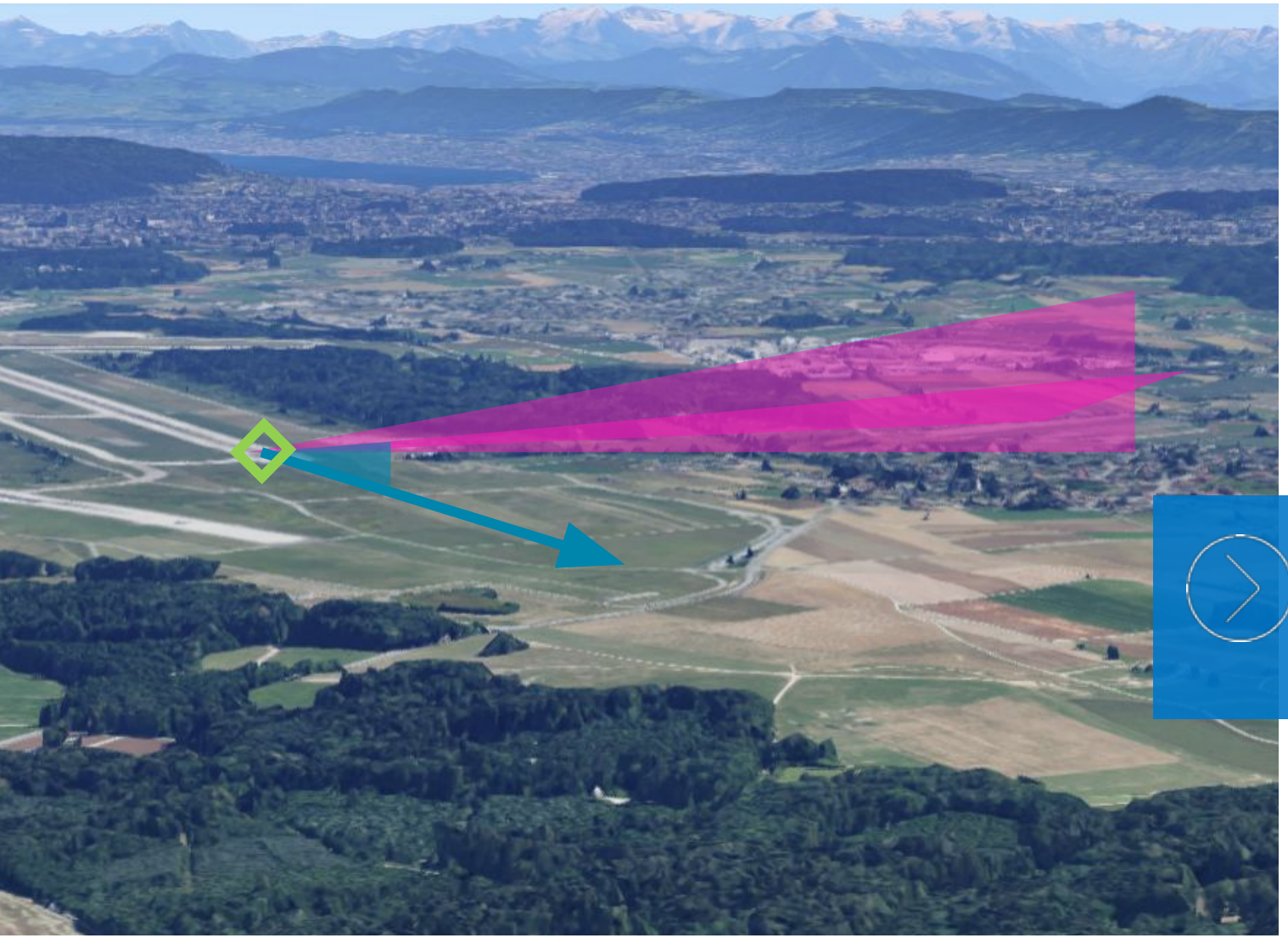
GLS
More and more deployed

Satellite Based Augmentation System



- **Wide Area Network**
  of reference stations
- **Transmission of the data**
  via geostationary satellite
- **A/C system computes a virtual beam**
  Angular geometric guidance

Data transmitted to the A/C

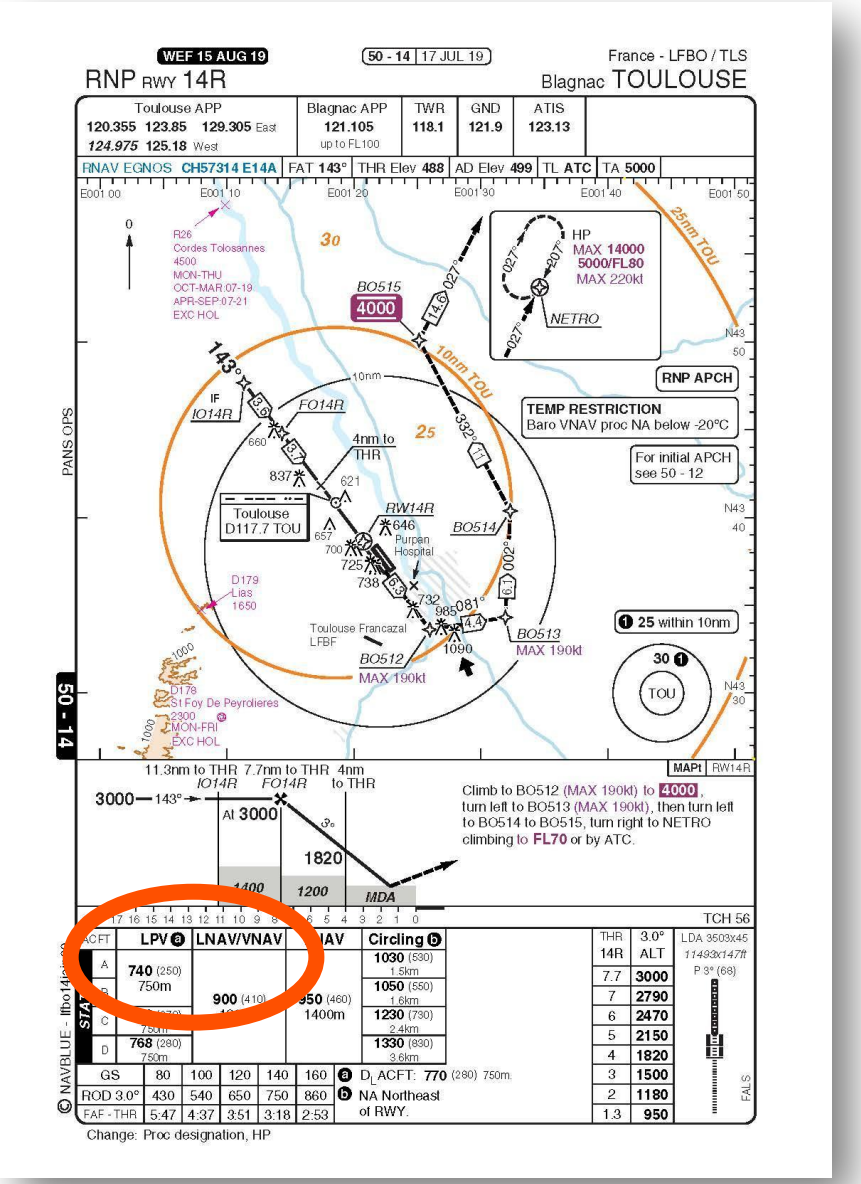


- **GPS augmented position by geostationary satellite**
- **Final Approach Segment data in NDB**
  - Anchor point coordinate
  - Course
  - Slope

MMR computes a virtual beam

- **Flown in G/S | LOC**
- **FMS needed (only for FAS data delivery)**

SBAS on charts: LPV minima

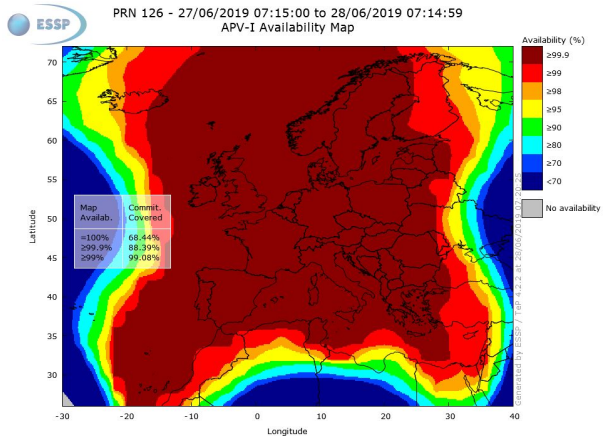


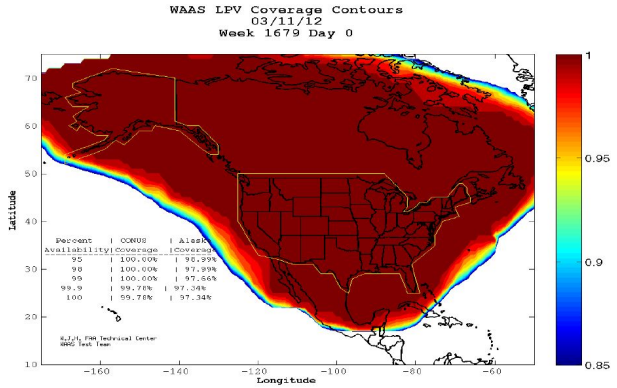
- **RNP with LPV minima**
- **RNP(GNSS) Approach BUT**
  - Angular protection (in addition to linear) **same as ILS**
  - **Geometric** vertical guidance
  - Minima down to **200 ft** (CAT I)

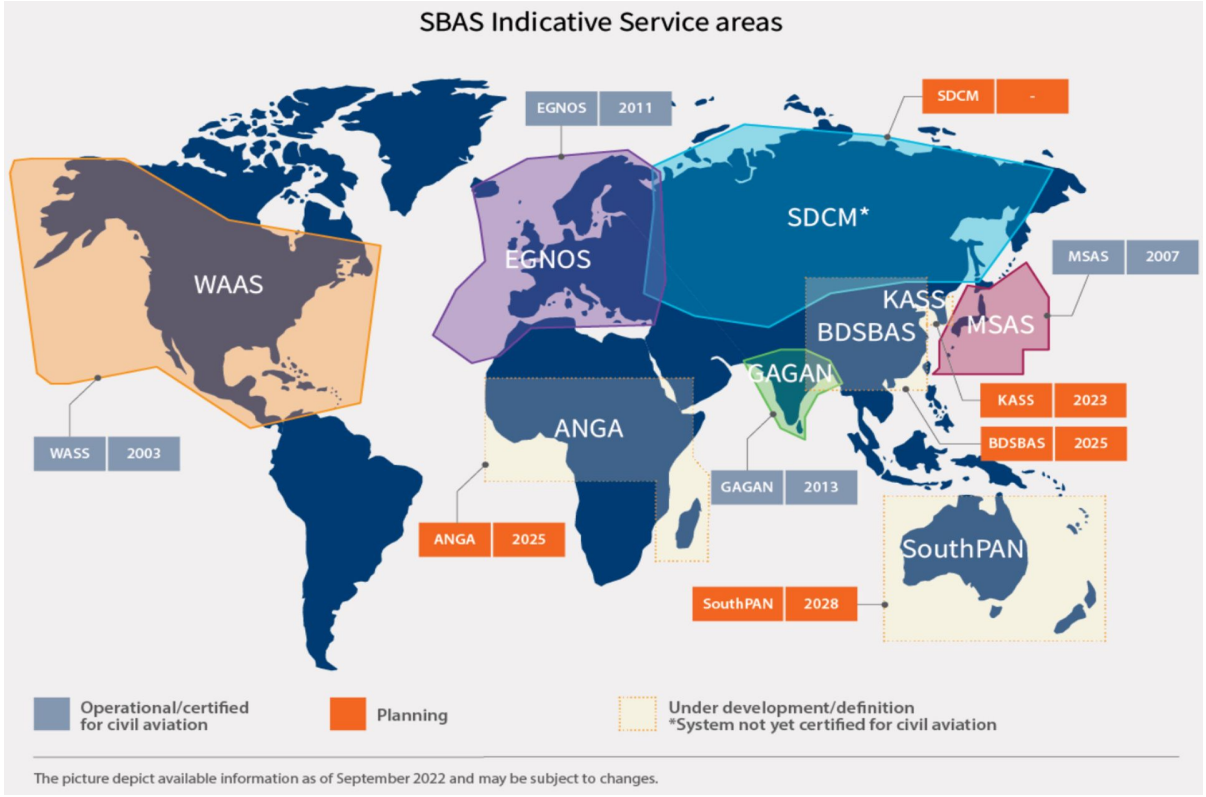
LPV: Localiser Performance with Vertical guidance

RNP APCH with LPV minima

- Equivalent to **CAT I**
- **Customisation** (as GLS): Displaced Threshold, Various slope
  - **No specific on-ground station** needed
- Need to be **in an SBAS area** (in US with WAAS, in Europe with EGNOS)
- **SLS CAT I Autoland** under study (certification planned in 2026 on A350)



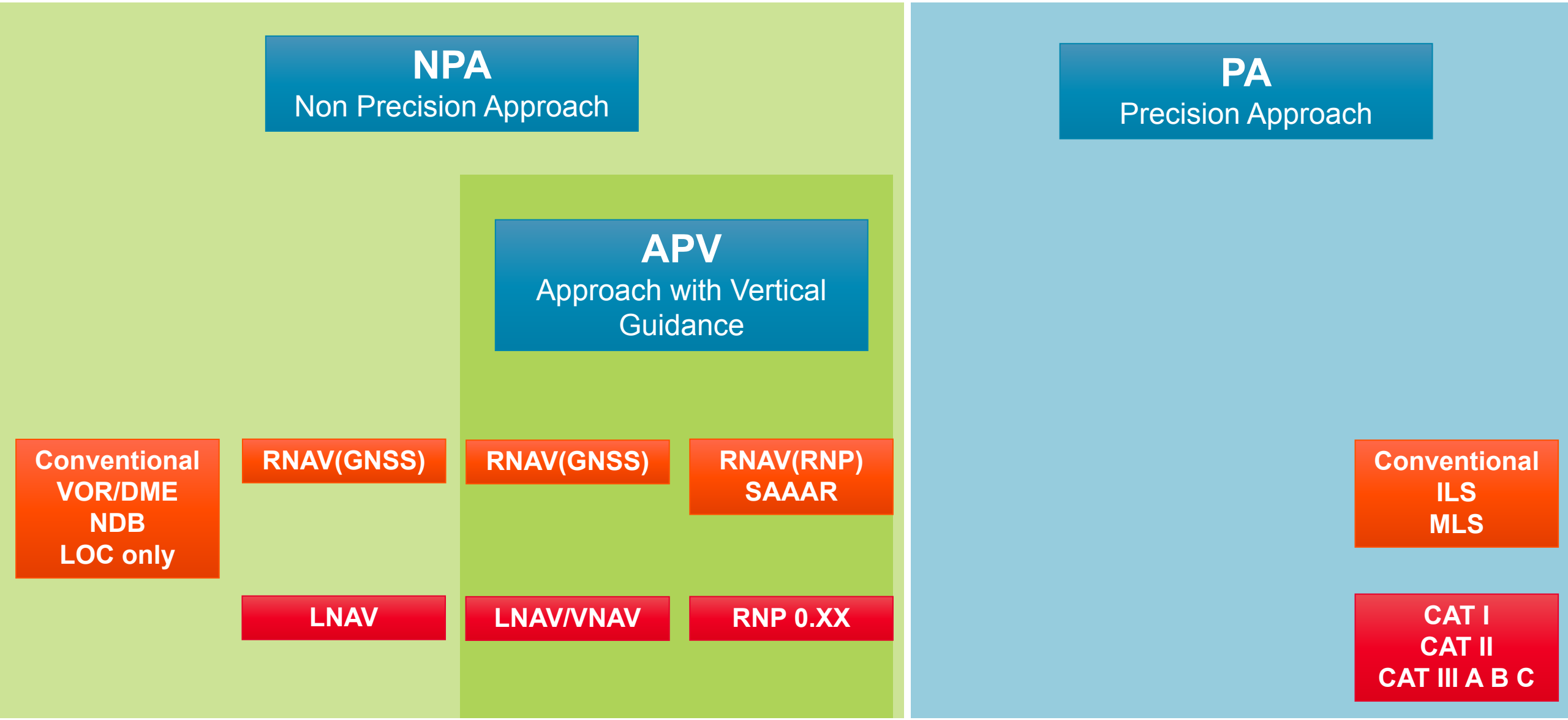




[Airbus Amber]

#2 ICAO APPROACH CLASSIFICATION

ICAO classification (before modification)



AIRBUS

ICAO classification

Type A
Minima ≥ 250ft

2D
Lateral

NPA
Non Precision Approach

- Conventional VOR/DME NDB LOC only
- RNP APCH
- LNAV
- LP

3D
Lateral and Vertical

APV
Approach with Vertical Guidance

- RNP APCH
- RNP AR APCH
- LNAV/VNAV
- RNP 0.XX
- LPV

Type B
Minima < 250ft

3D
Lateral and Vertical

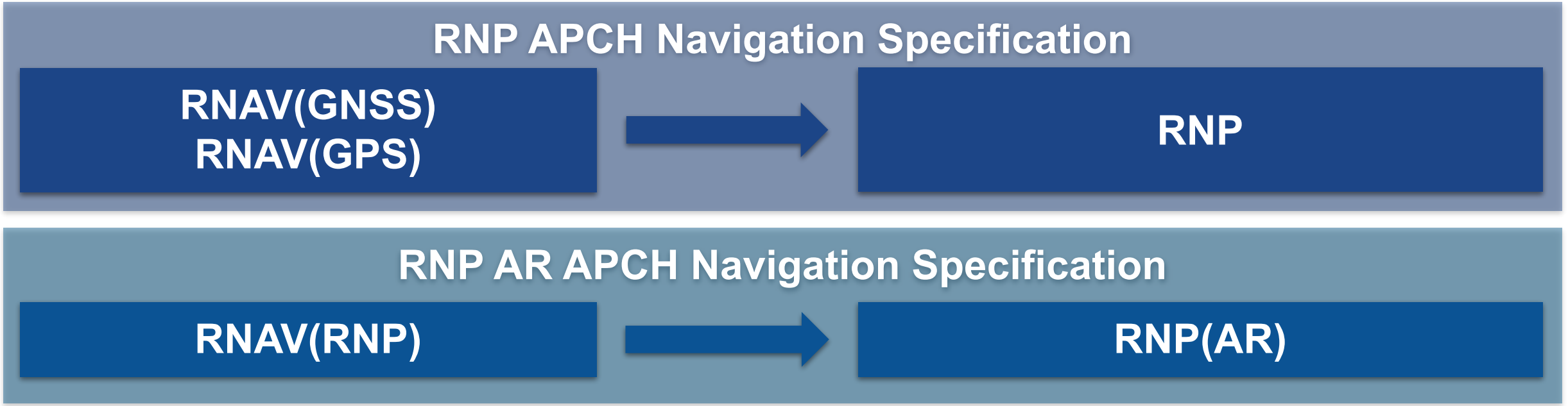
PA
Precision Approach

- RNP APCH
- GLS
- Conventional ILS MLS
- LPV 200
- CAT I CAT II CAT III
- CAT I CAT II CAT III

AIRBUS

Chart Naming changes for PBN

- **ICAO Circular 336** transition from **RNAV** to **RNP** approach chart identification



- **Not applicable for all states :** USA and Canada will never change and keep old naming

We will have to live with 2 different charting names for the same operation

Chart Naming changes for PBN: RNAV(GNSS) □ RNP

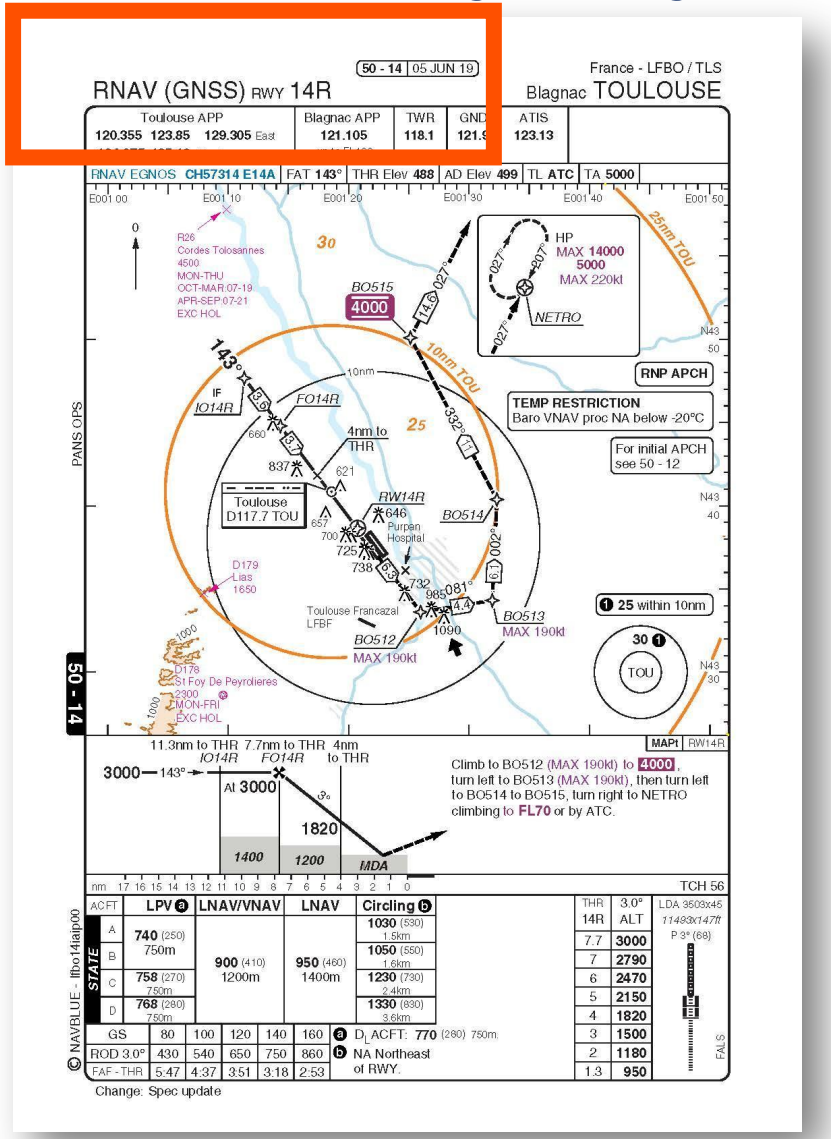
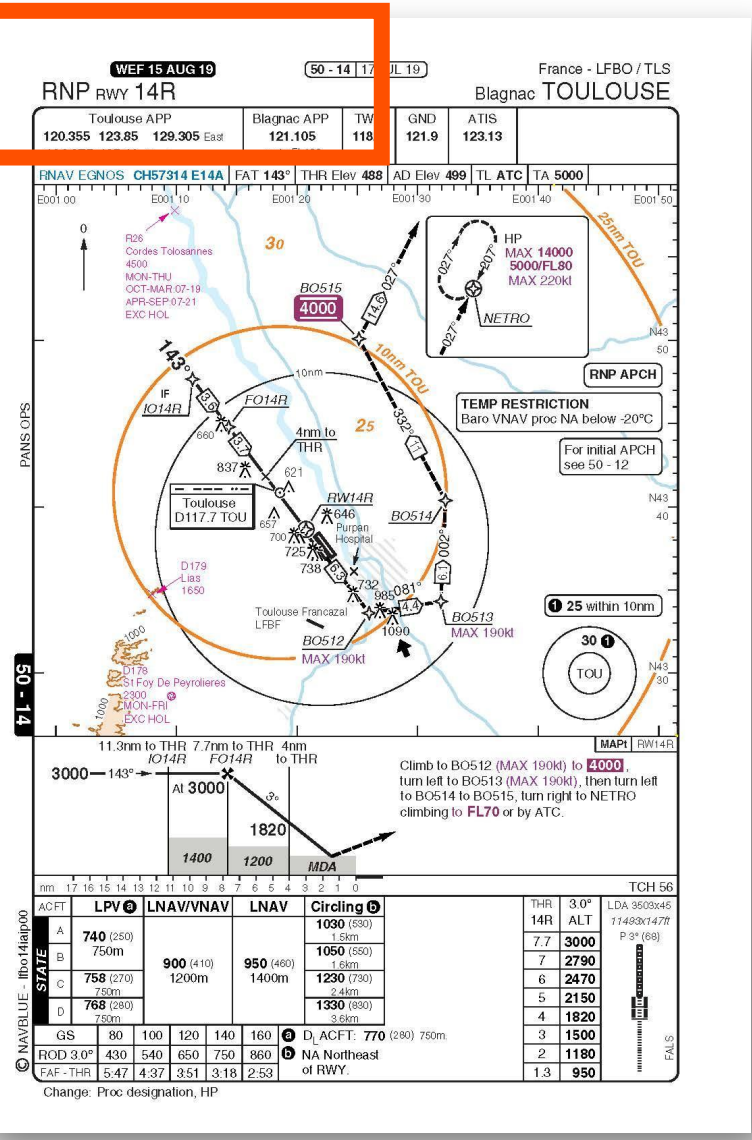


Chart naming change
ICAO circular 336



AIRBUS

Chart Naming changes for PBN: RNAV(RNP) □ RNP(AR)

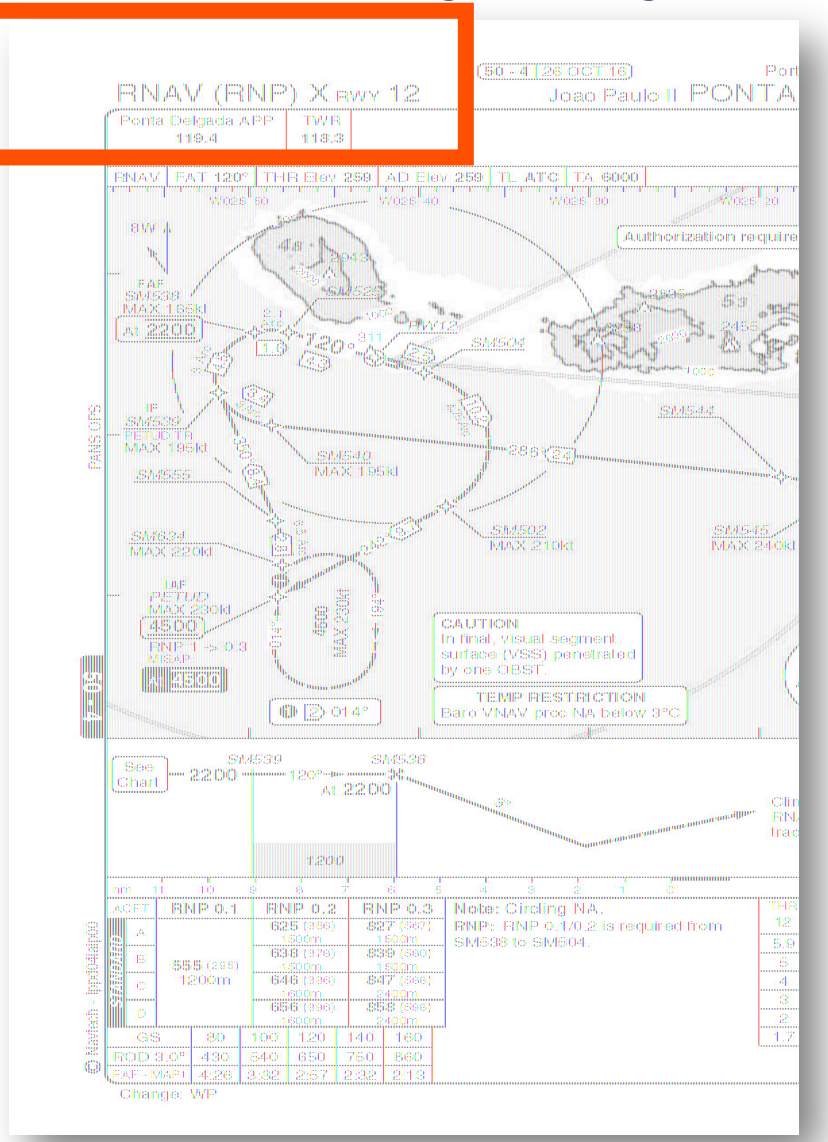
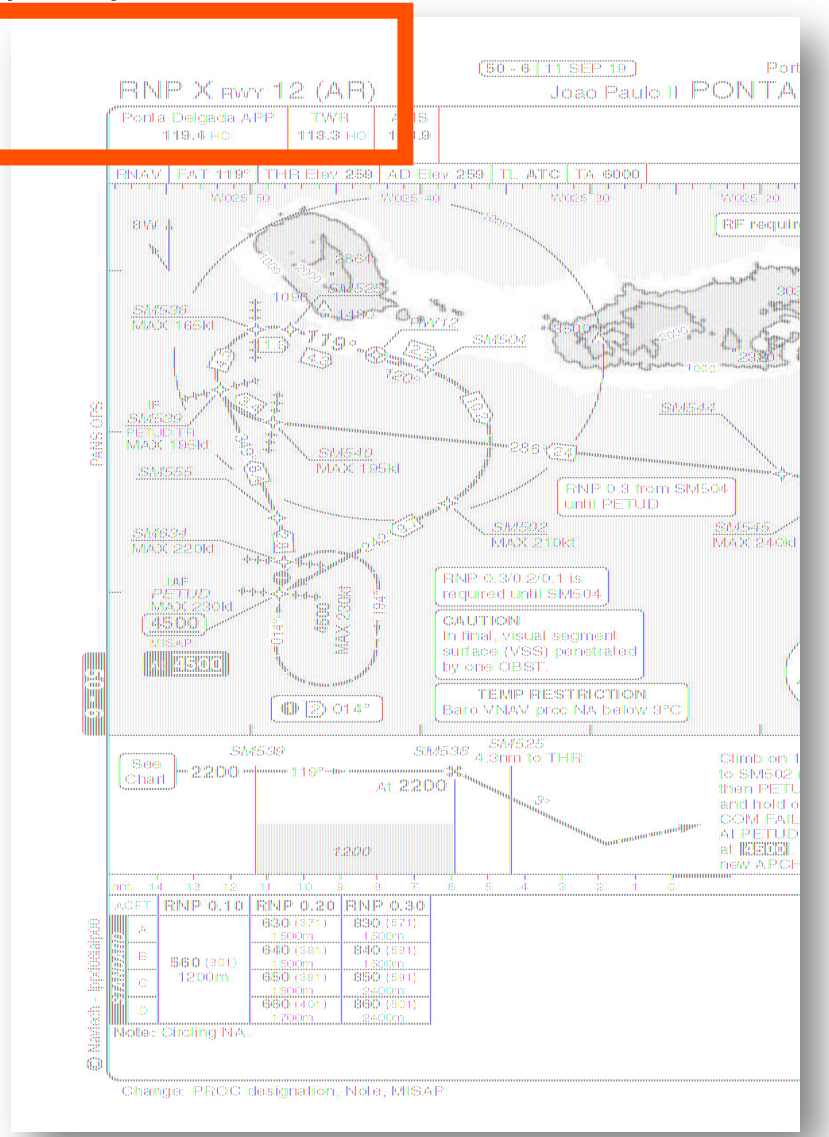


Chart naming change
ICAO circular 336



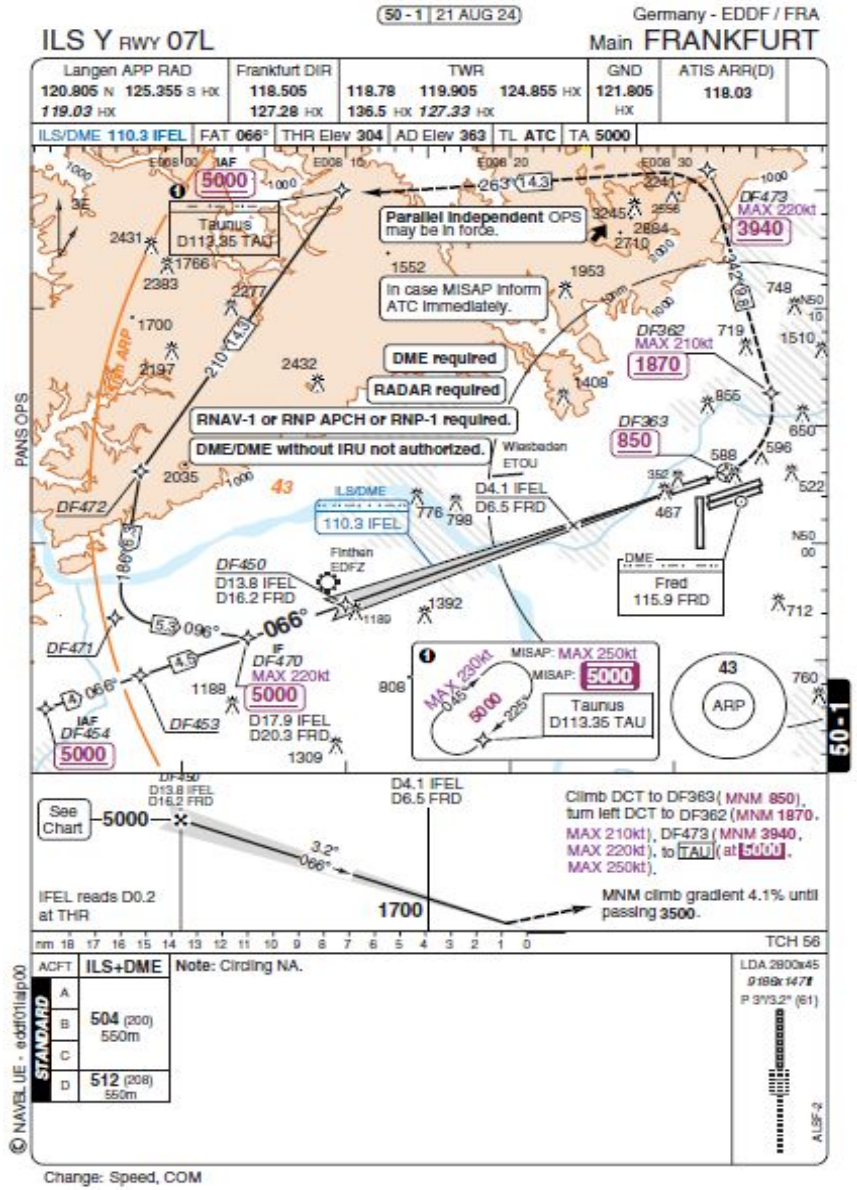
AIRBUS

#2 ALL THE DIFFERENT APPROACH TYPES - SUM UP

3D Published Approaches

3D APPROACH
Lateral and vertical guidance service proposed
+ information on distance

ILS	(ILS Technology)
GLS	(GBAS Technology)
RNP LPV	(SBAS Technology)
RNP LNAV/VNAV	(APV Baro VNAV)
RNP AR	(APV Baro VNAV)

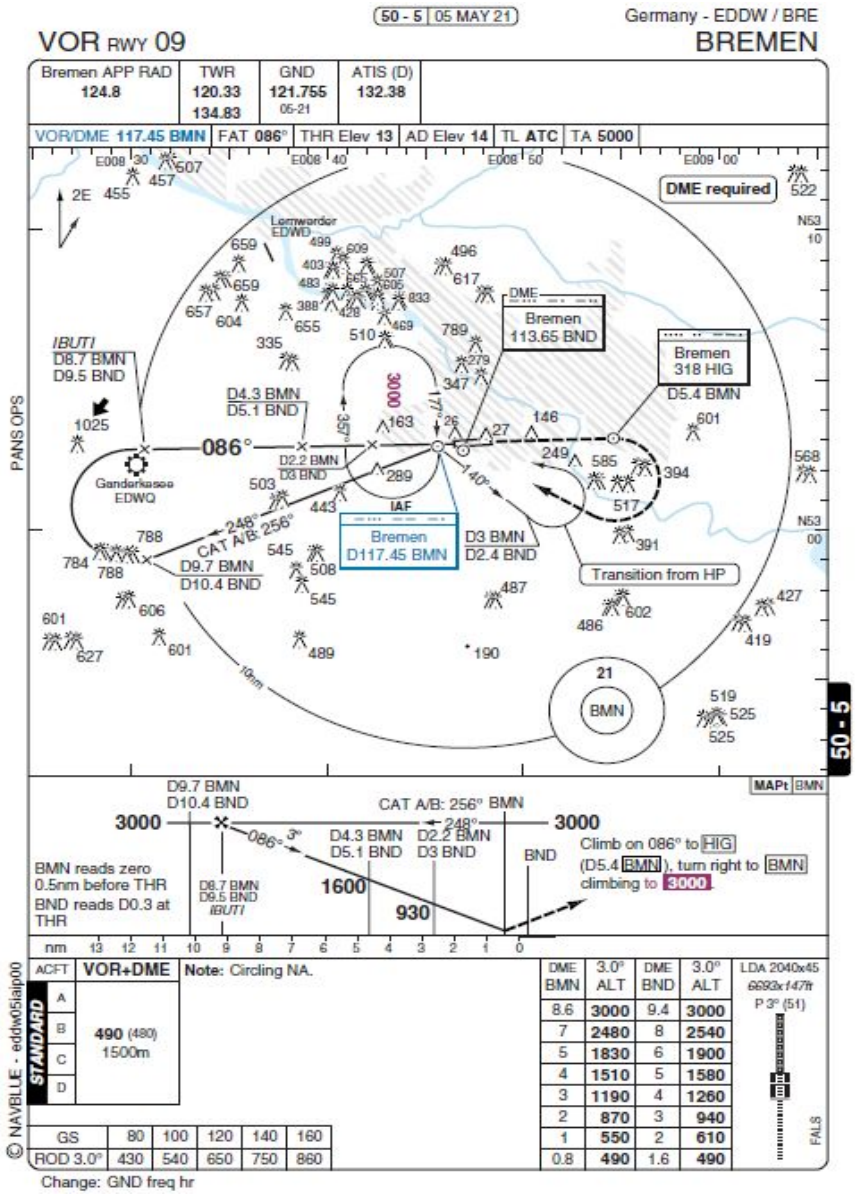


AIRBUS

3D vs 2D Published Approaches

2D APPROACH
Lateral guidance service proposed
+ information on distance

- LOC or ILS G/S OUT
- VOR
- NDB
- RNP LP
- RNP LNAV

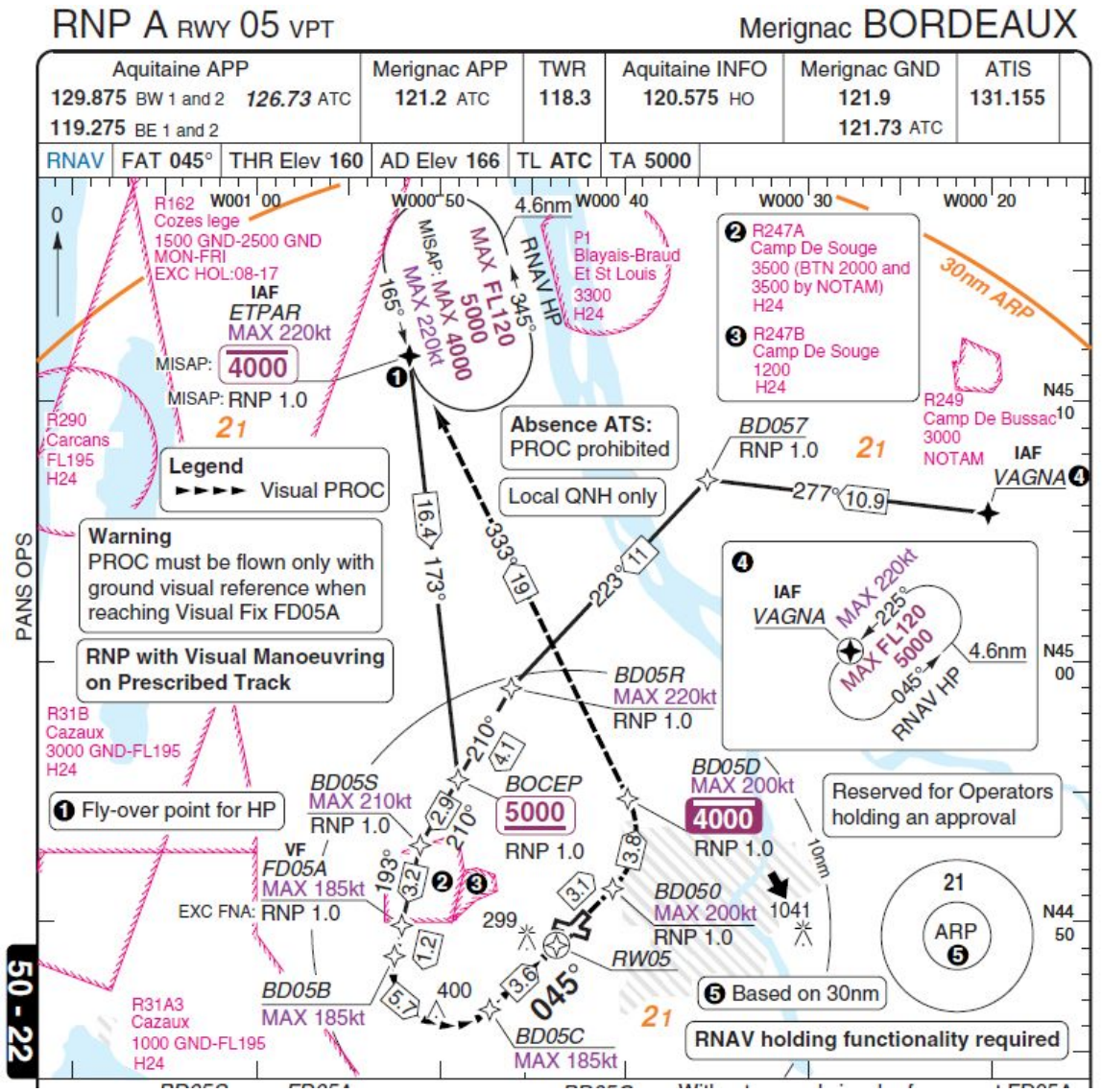


AIRBUS

Visual Published Approaches

VISUAL APPROACH
Approach performed Visually

- **VISUAL**
- **CIRCLE TO LAND**
- **RNAV Visual**
- **RNP (VPT)**
- **VPT after conventional proc**



AIRBUS

#3 APPROACH GUIDANCE MODES ON AIRBUS A/C

[Airbus Amber]

Airbus Guidance Mode Philosophy

Propose 3D Guidance for All Approaches
(via specific APPROACH GUIDANCE MODE)

Baro VNAV Guidance, as Advisory for 2D Approaches

Approach Selected
(via FMS)

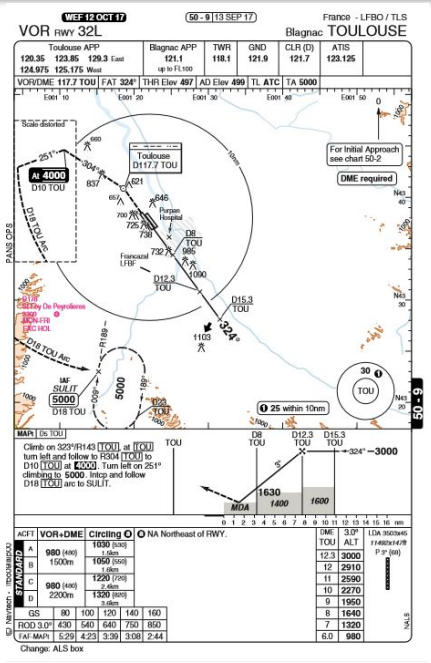
Arming via 

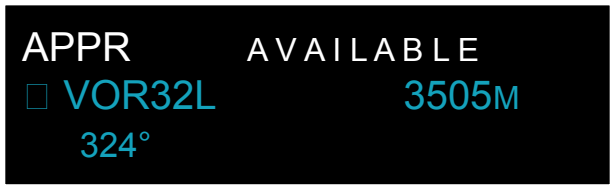
Push Button

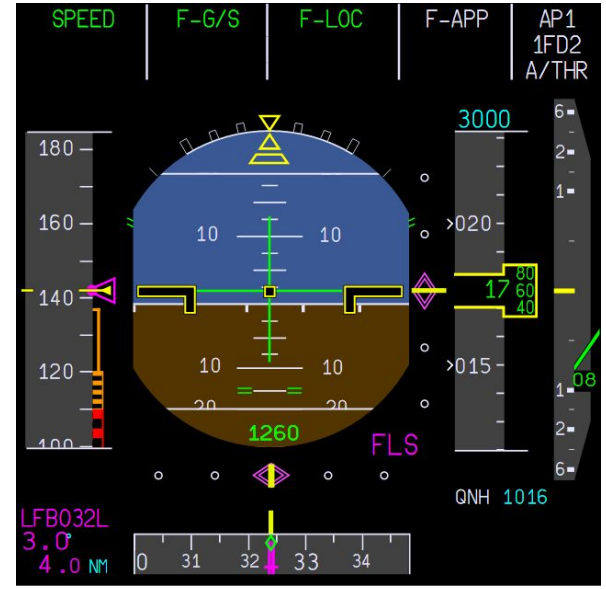
Approach guidance mode

Automatic selection by the FMS

Chart → **FMS selection** → **Guidance Mode**



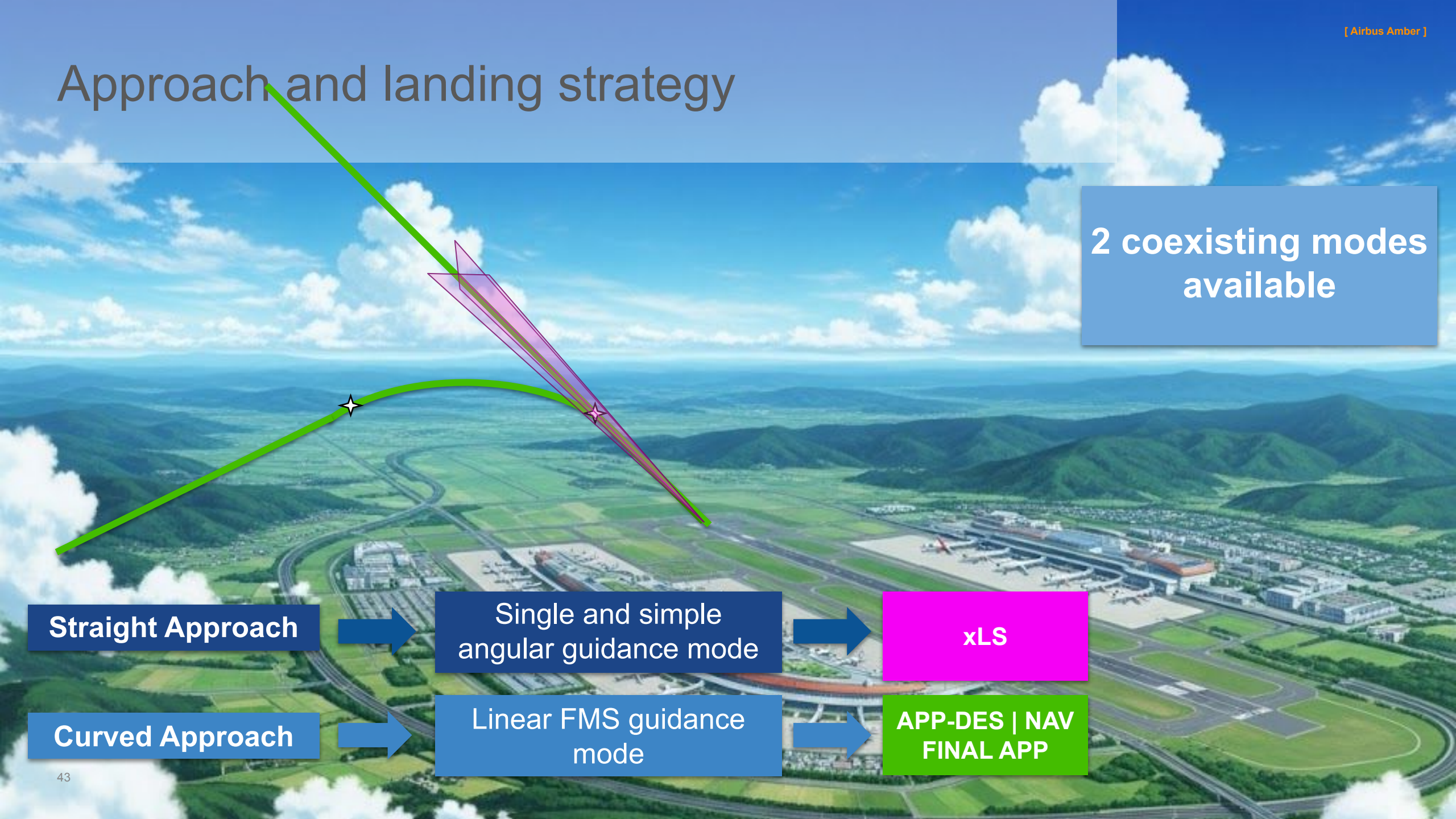




The FMS will propose the best available approach guidance mode

AIRBUS

Approach and landing strategy



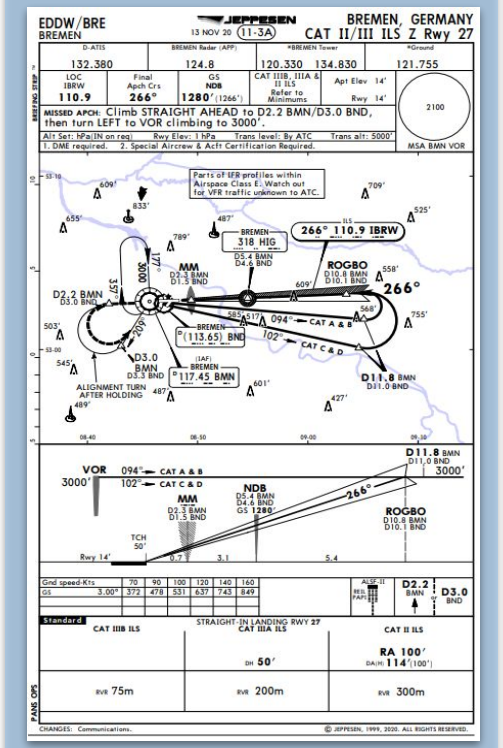
2 coexisting modes available

Straight Approach → Single and simple angular guidance mode → **xLS**

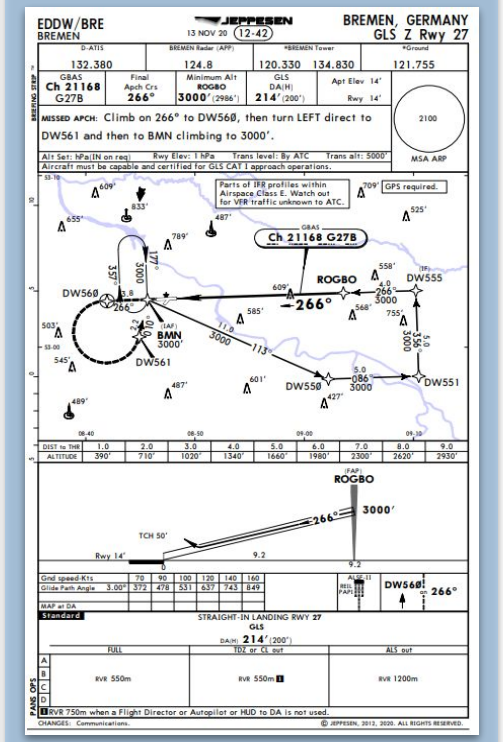
Curved Approach → Linear FMS guidance mode → **APP-DES | NAV FINAL APP**

Many Charts for straight approaches

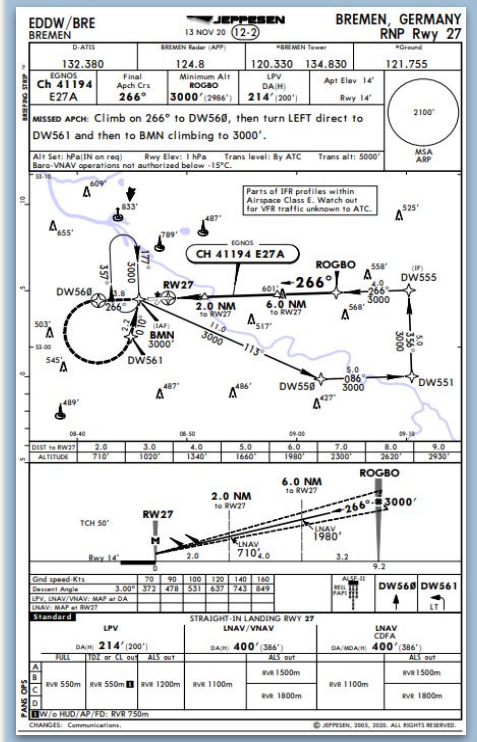
ILS Approach



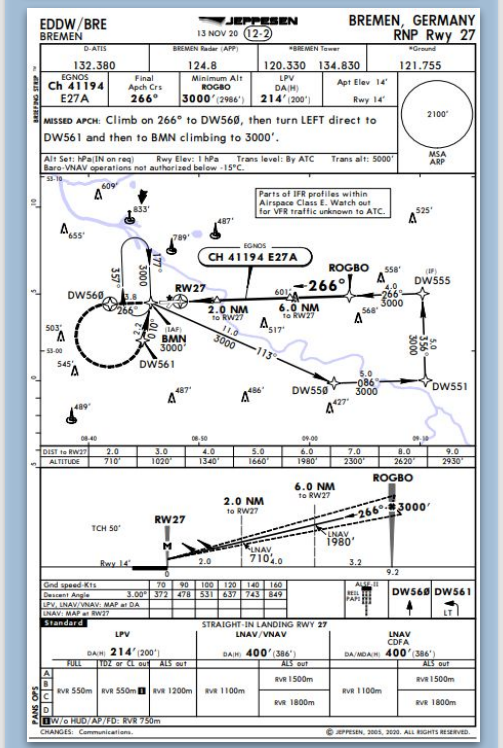
GLS Approach



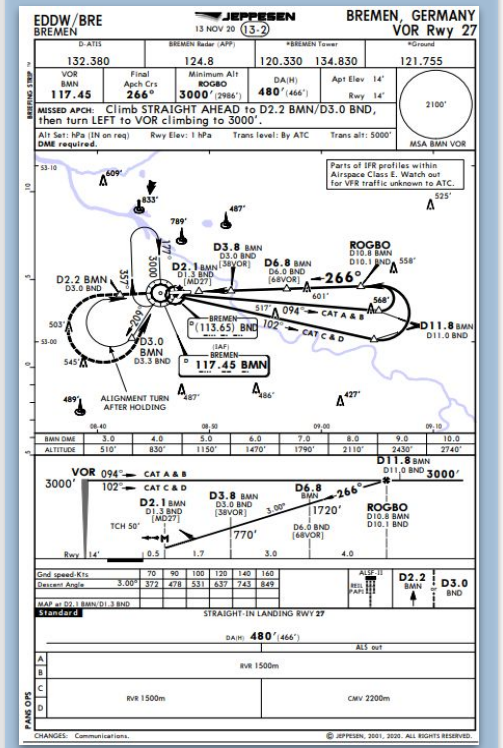
RNP Approach LPV



RNP Approach LNAV/VNAV LNAV



VOR Approach NDB Approach



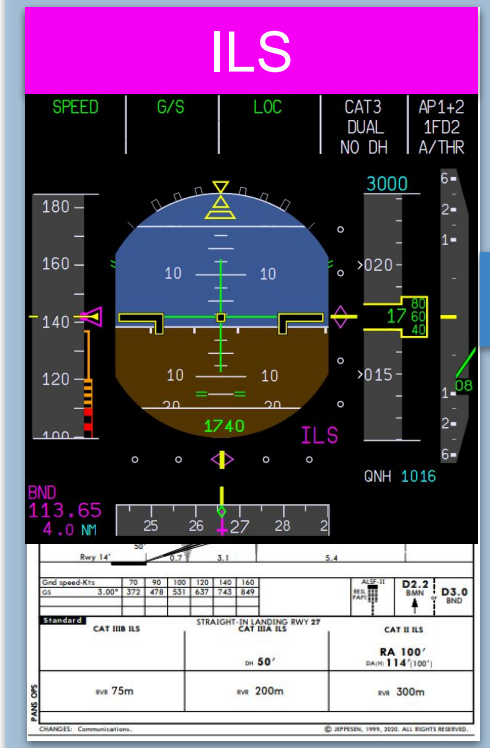
One unique solution ⇒ xLS

AIRBUS

Common HMI Based on ILS

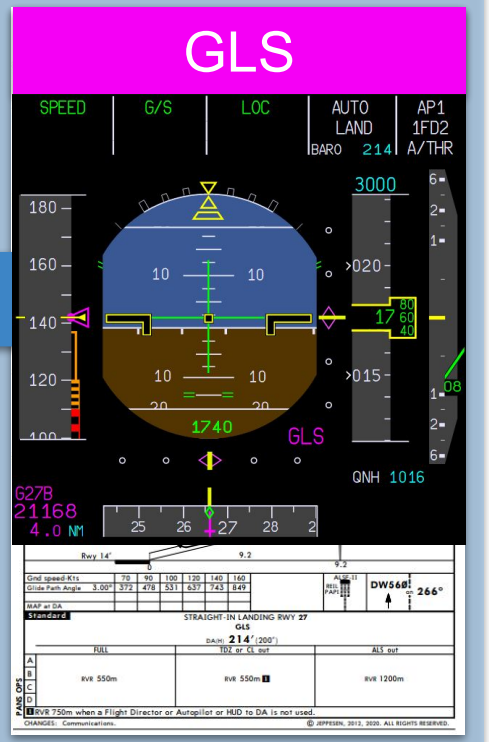
ILS Approach

ILS



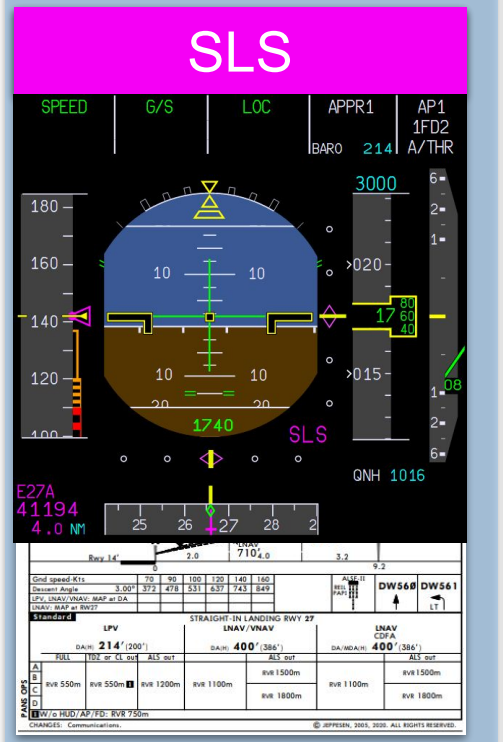
GLS Approach

GLS



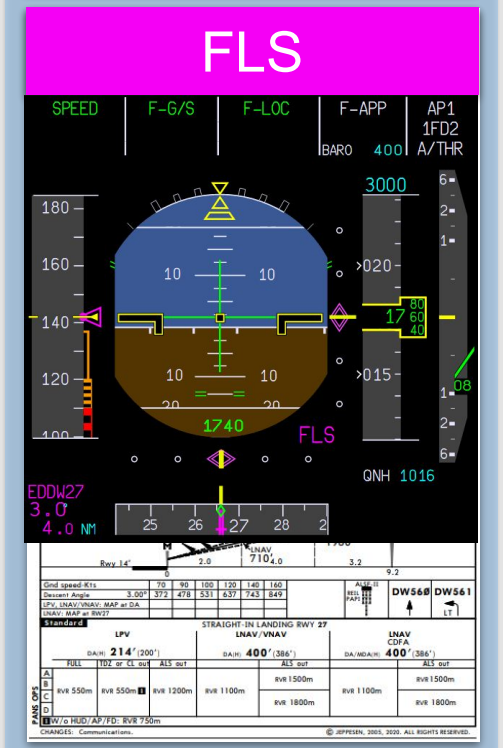
RNP Approach LPV

SLS



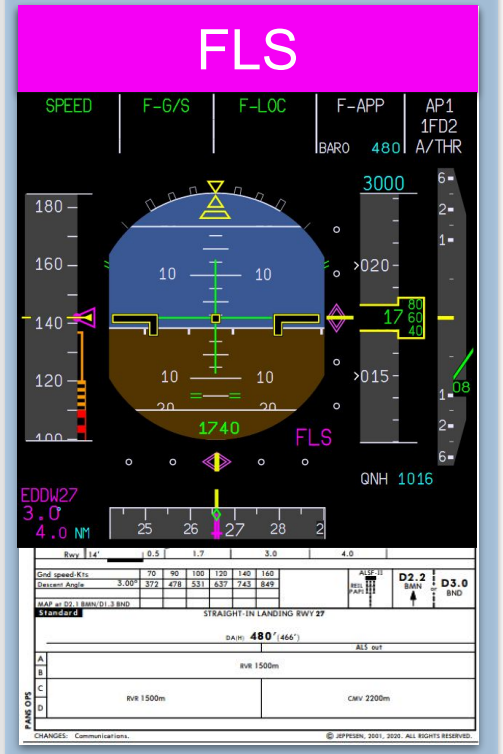
RNP Approach LNAV/VNAV LNAV

FLS



VOR Approach NDB Approach

FLS

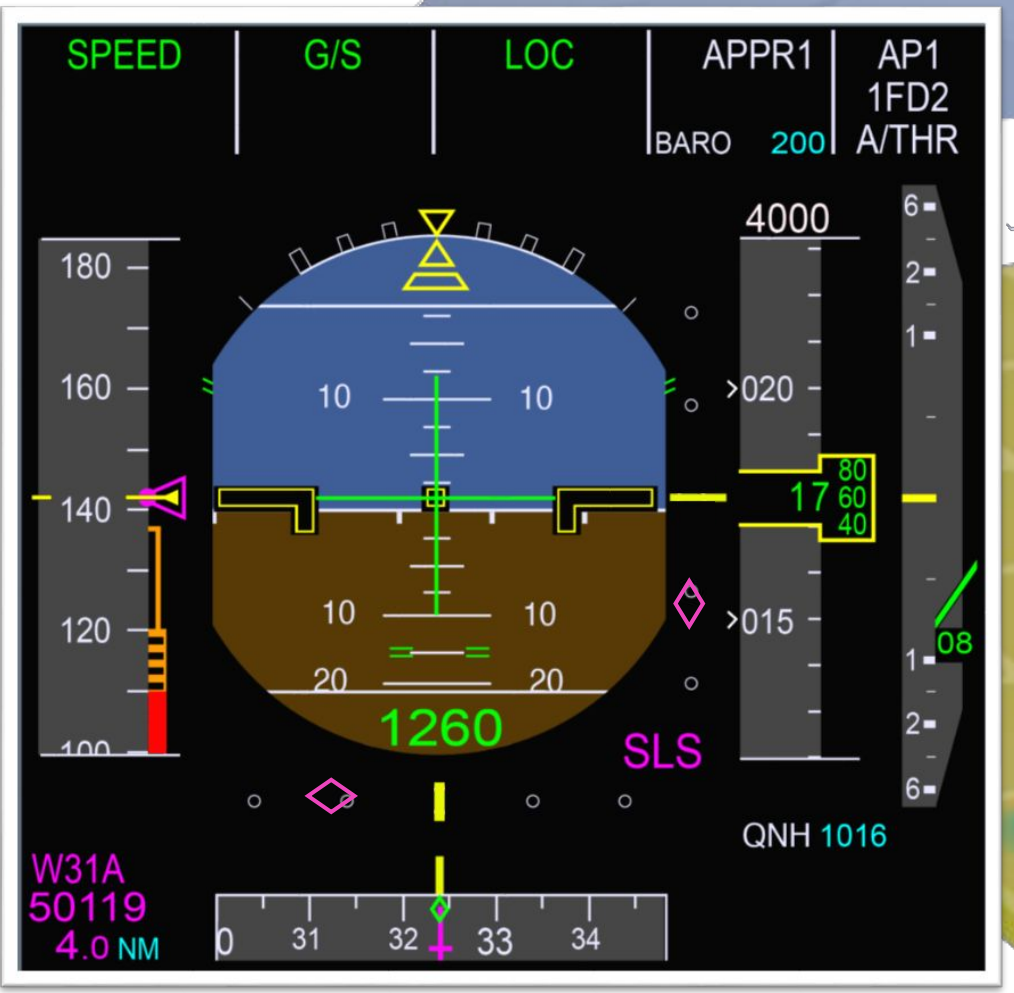


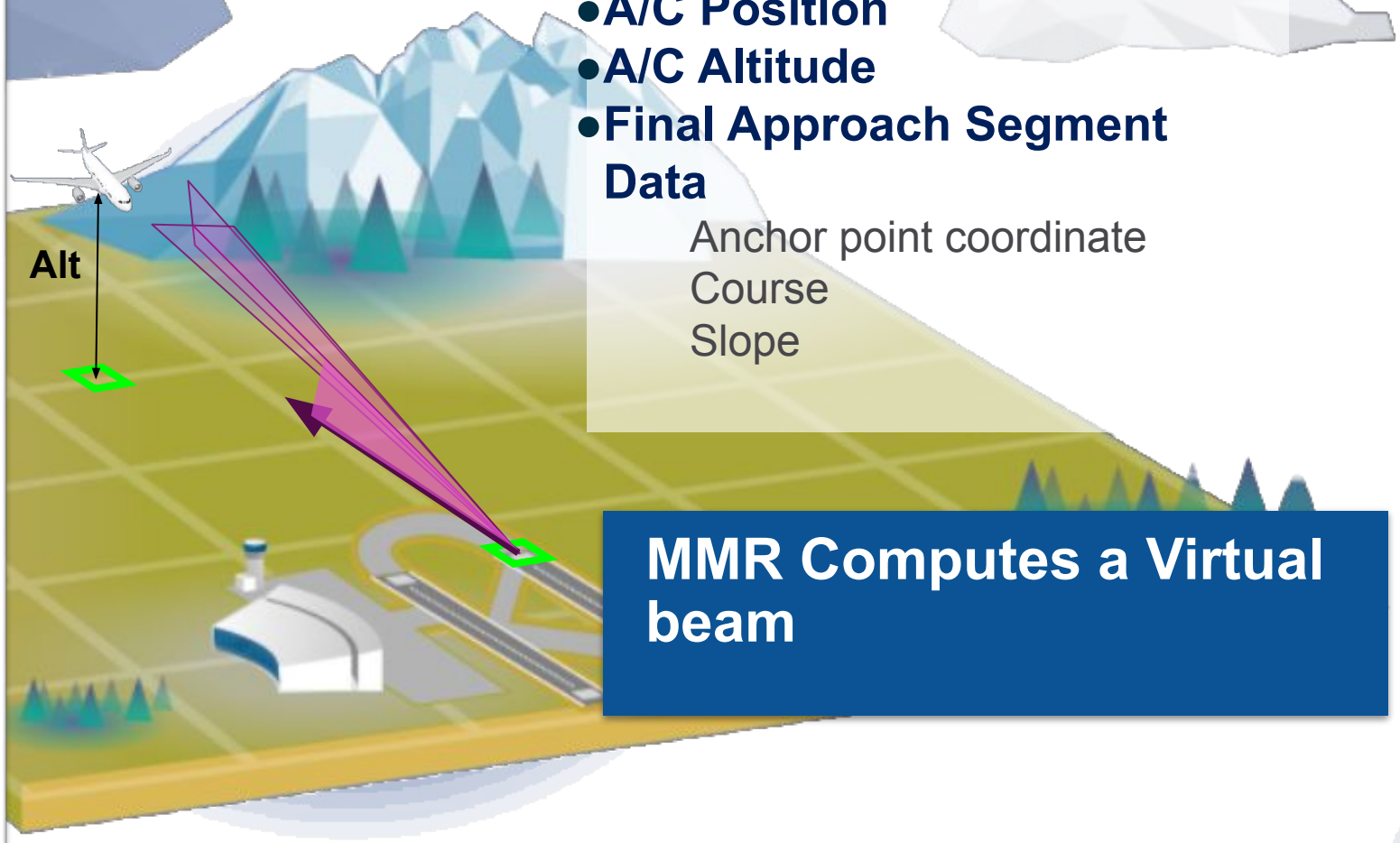
ILS = approx 83% of approaches

Propose the same pilot task than ILS (cognitive, flying technics)

AIRBUS

xLS Principle





- **A/C Position**
- **A/C Altitude**
- **Final Approach Segment Data**
  - Anchor point coordinate
  - Course
  - Slope

MMR Computes a Virtual beam

MMR: Multi-Mode Receiver

Same Architecture for Display and Guidance

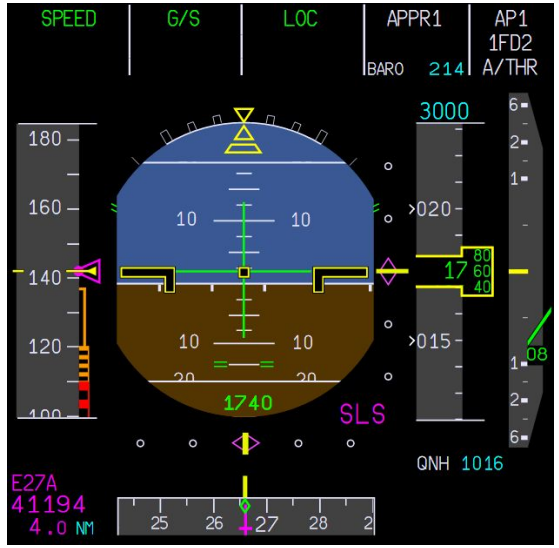
MMR

LOC and G/S Angular Deviation

Display

AP FD

Data from:
ILS
GBAS
SBAS
FMS



AP: AutoPilot
FD: Flight Director

AIRBUS

« x » LS

xLS = Approach Guidance Mode

ILS **GLS** **SLS** **FLS**

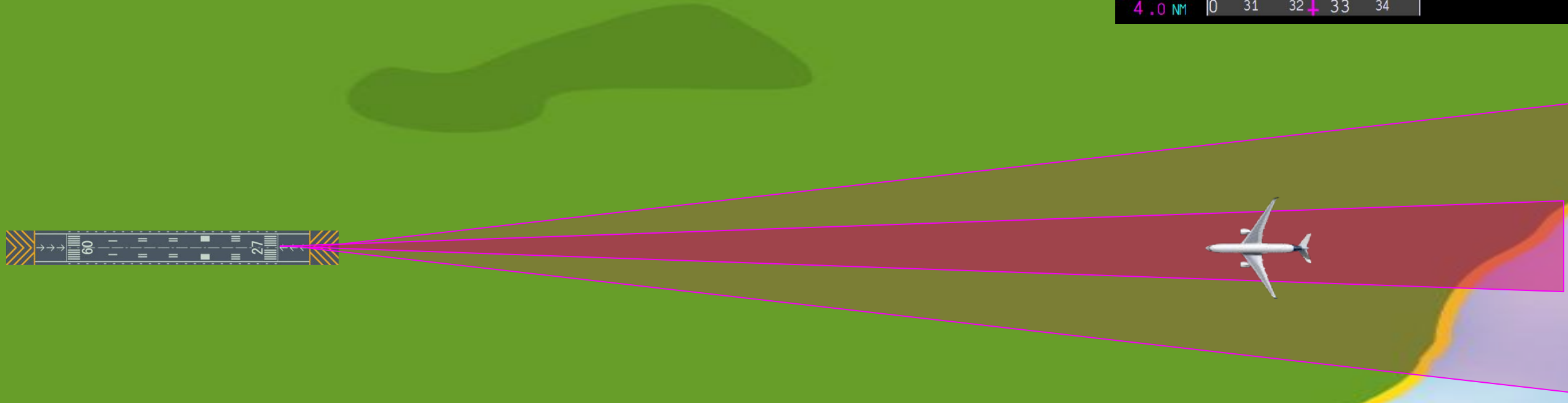
Provide guidance to fly all the types of straight approaches

Difference between various xLS modes is **the source** used for the deviations

xLS Guidance Mode availability

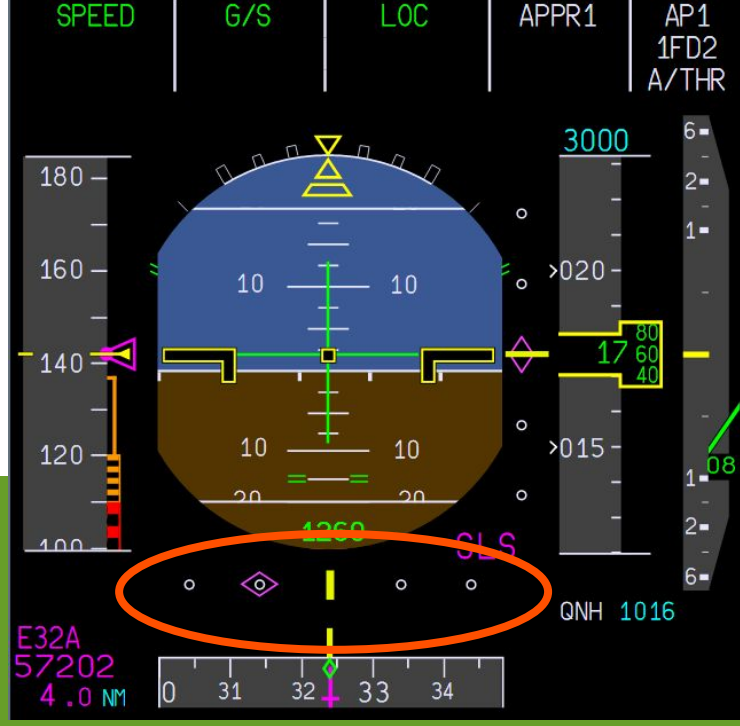
Approach type (Charts)	Approach Guidance Mode
ILS (LOC + G/S data)	**ILS**
GLS (GBAS)	**Mix LOC / FLS**
RNP LPV (SBAS)	**GLS**
LOC **ILS G/S OUT** (LOC + Baro advisory)	**SLS**
RNP LNAV/VNAV (GPS + Baro Mandatory) **RNP LNAV** (GPS + Baro advisory) **VOR** (VOR or GPS + Baro advisory) **NDB** (NDB or GPS + Baro advisory)	**FLS**
RNP AR (GPS + Baro Mandatory)	**No xLS**
Visual procedure (all advisory)	**No xLS**

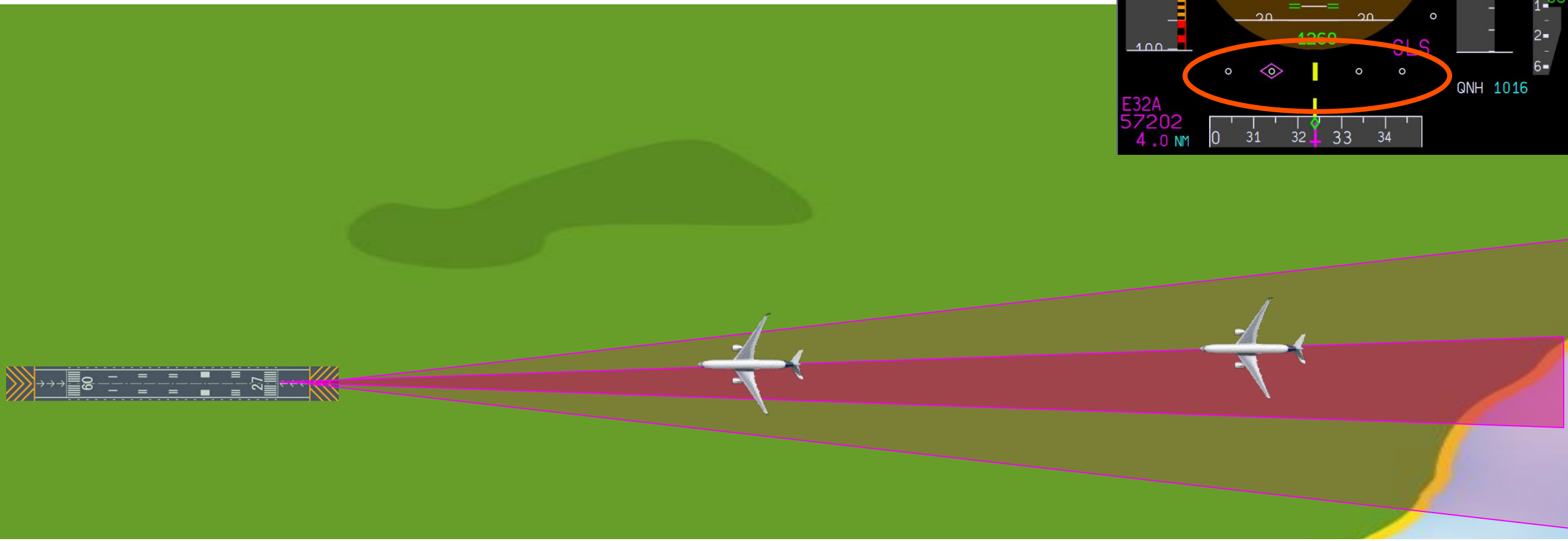
xLS : Angular guidance



[Airbus Amber]

xLS : Angular guidance

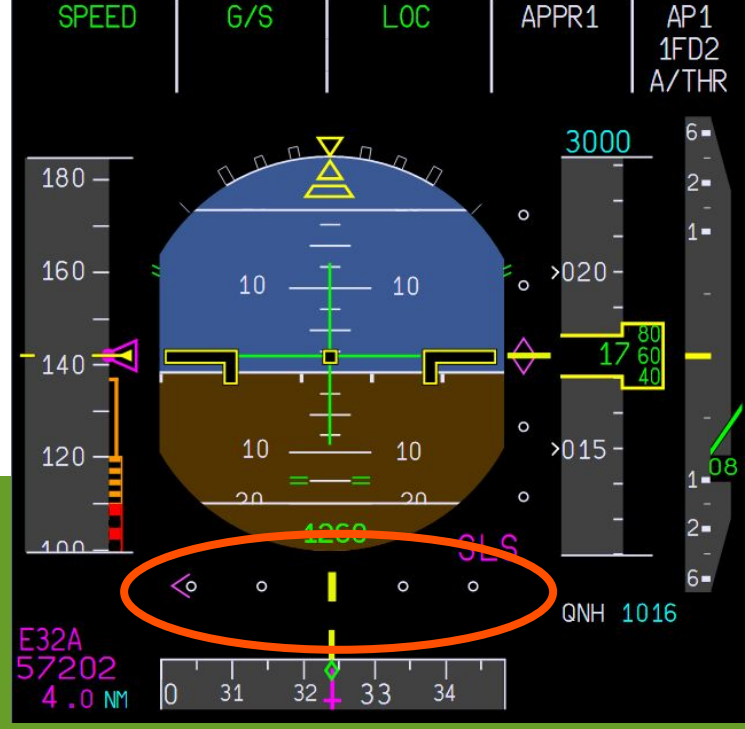


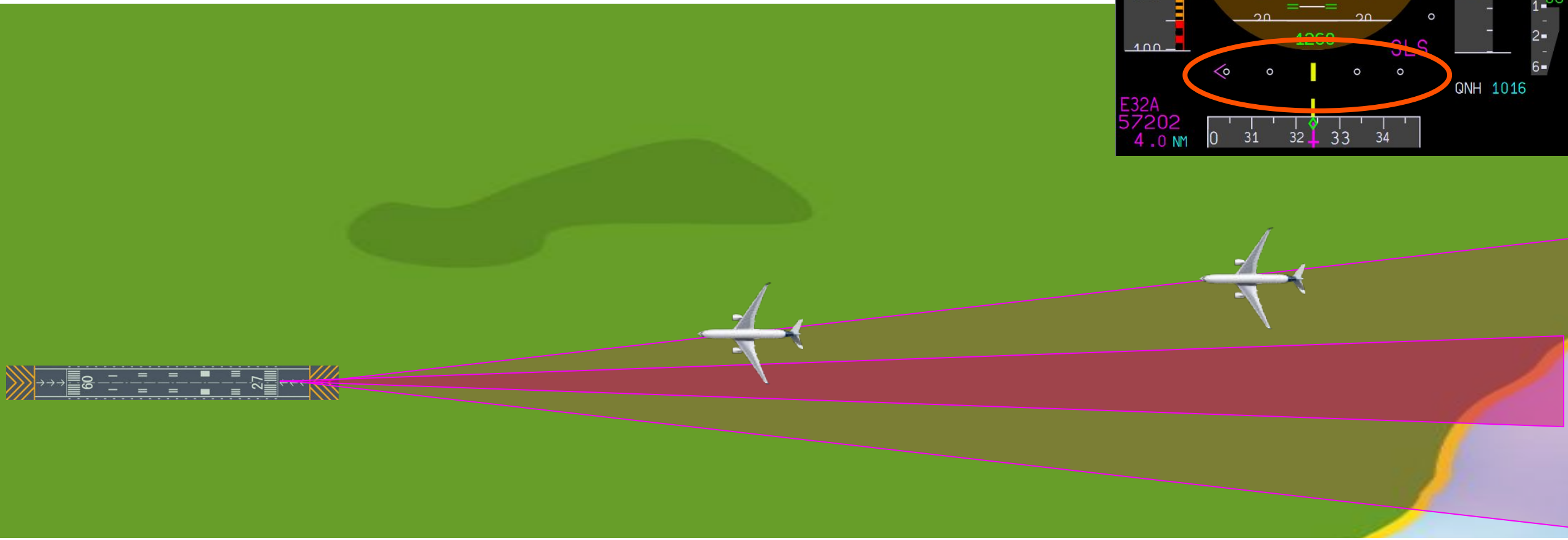


AIRBUS

[Airbus Amber]

xLS : Angular guidance





AIRBUS

Curved approaches

RNP AR Procedures

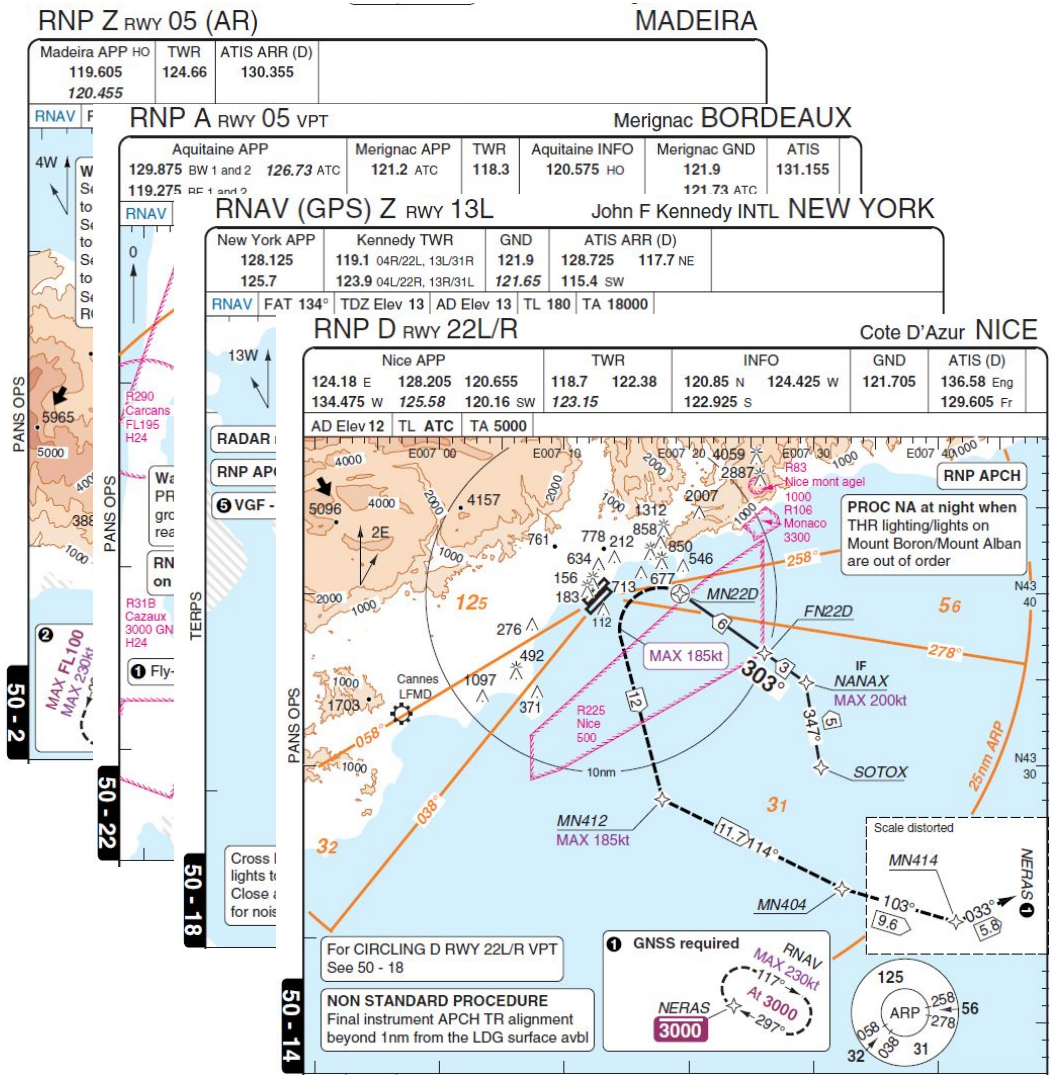
RNAV Visual / RNP(VPT)

IMC Procedure (VOR/NDB/RNP APCH) followed by a Visual Prescribed Track

NO FLS FOR THIS APPROACH

Linear FMS Guidance Mode

FINAL APP
APP-DES | NAV



VPT: Visual Prescribed Track

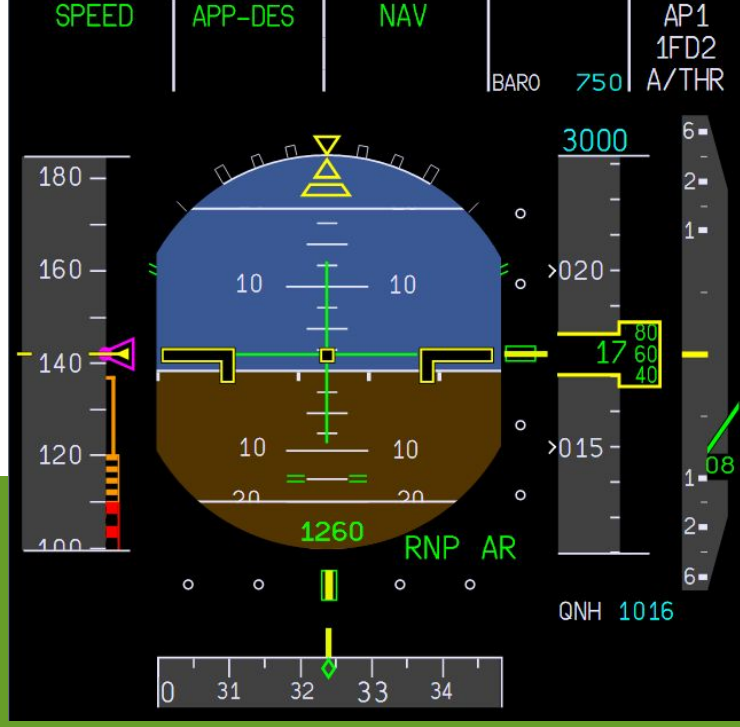
AIRBUS

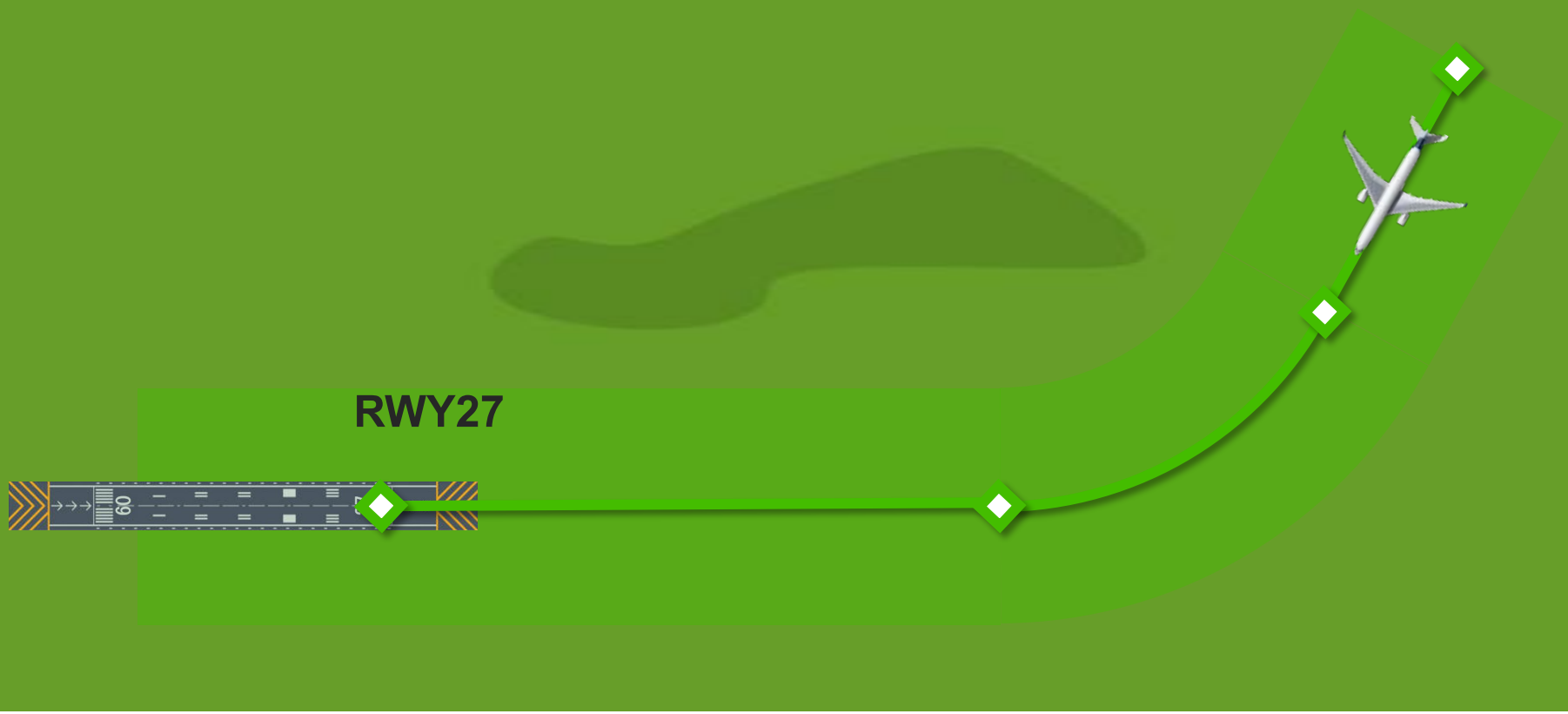
FINAL APP availability

Approach type (Charts)	Approach Guidance Mode
ILS (LOC + G/S data)	**No FINAL APP**
GLS (GBAS)	**No FINAL APP**
RNP LPV (SBAS)	**No FINAL APP**
LOC **ILS G/S OUT** (LOC + Baro advisory)	**No FINAL APP**
RNP LNAV/VNAV (GPS + Baro Mandatory) **RNP LNAV** (GPS + Baro advisory) **VOR** (VOR or GPS + Baro advisory) **NDB** (NDB or GPS + Baro advisory)	**FINAL APP**
RNP AR (GPS + Baro Mandatory)	**FINAL APP**
Visual procedure with Prescribed Track (all advisory)	**FINAL APP**

FINAL APP / NAV : Linear guidance

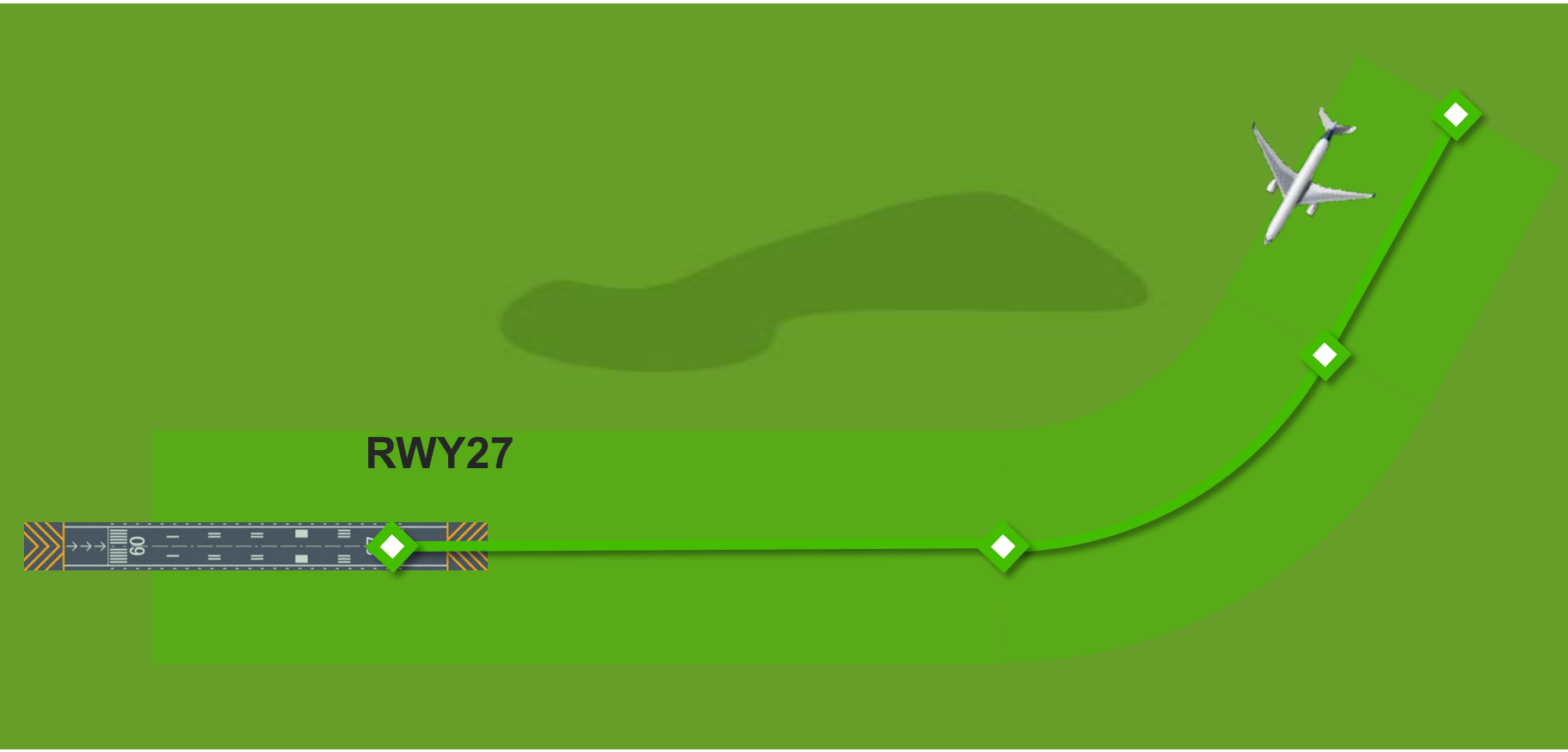
- **HPath law:** Objective is Lateral deviation = 0NM

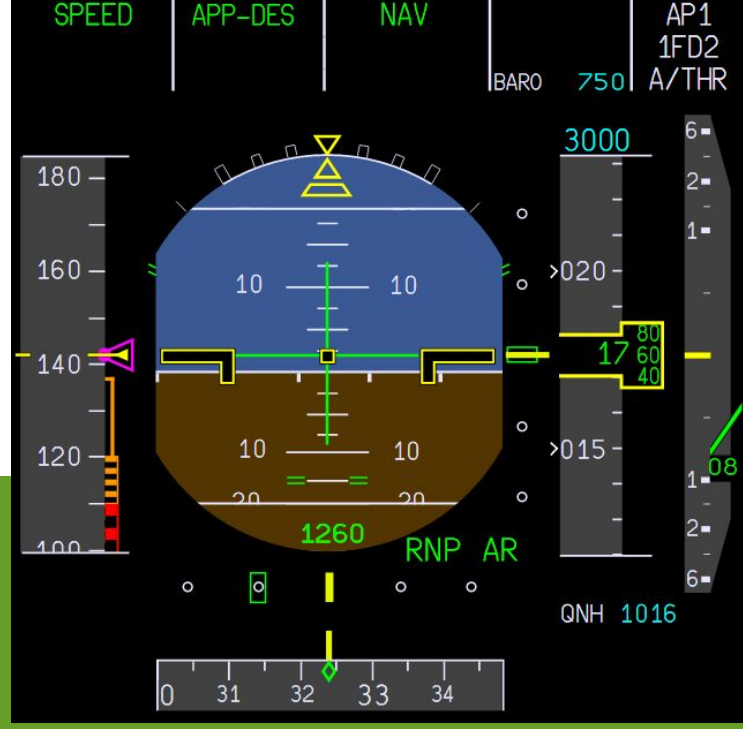




FINAL APP / NAV : Linear guidance

- **HPath law:** Objective is Lateral deviation = 0NM

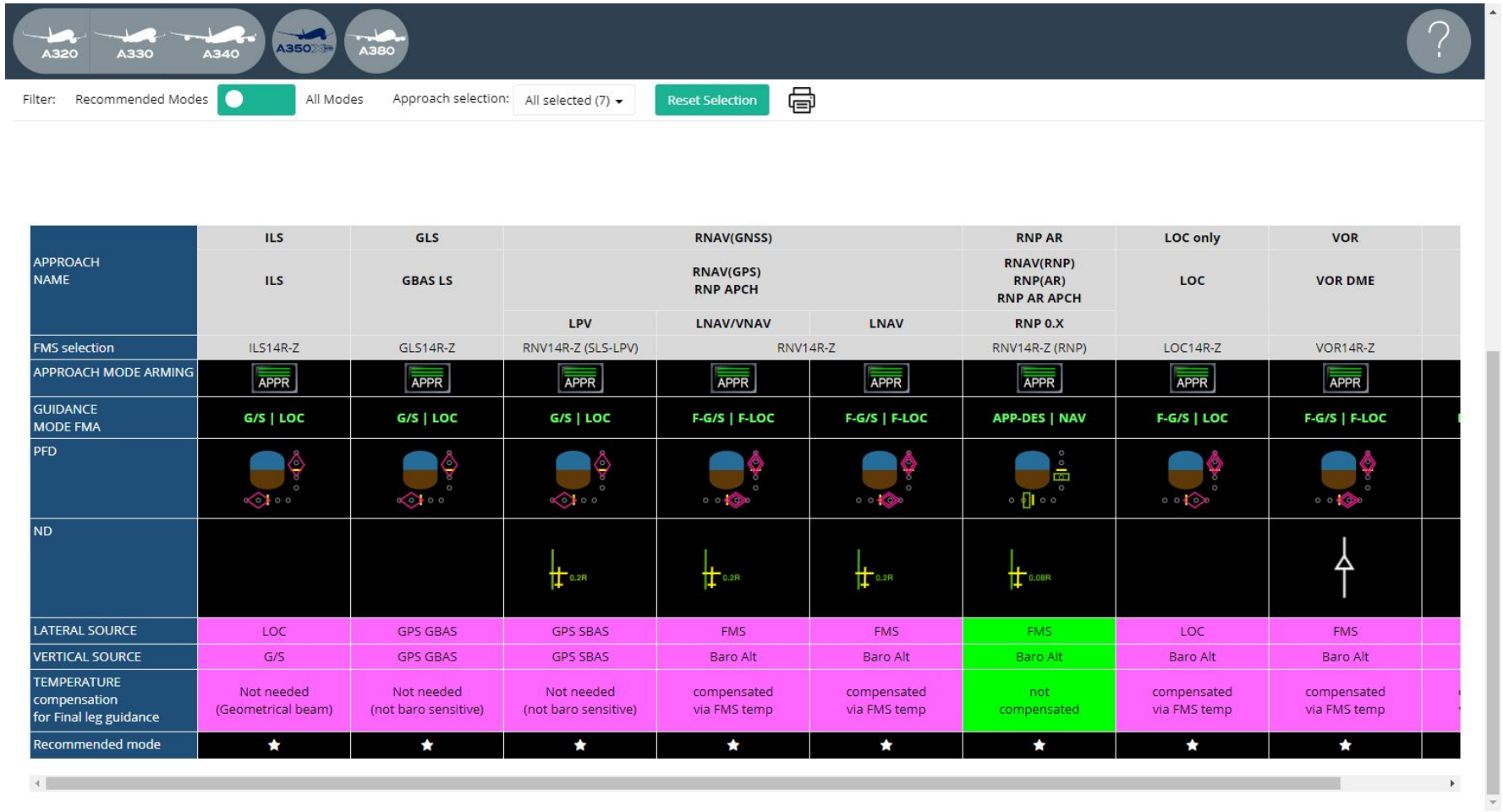




[Airbus Amber]

#4 APPROACH GUIDANCE MODES OPERATIONAL USE

Approach for pilot tool in Airbus WIN



APPROACH NAME	ILS	GLS	RNAV(GNSS)			RNP AR	LOC only	VOR	
	ILS	GBAS LS	RNAV(GPS) RNP APCH			RNAV(RNP) RNP(AR) RNP AR APCH	LOC	VOR DME	
			LPV	LNAV/VNAV	LNAV	RNP 0.X			
FMS selection	ILS14R-Z	GLS14R-Z	RNV14R-Z (SLS-LPV)	RNV14R-Z		RNV14R-Z (RNP)	LOC14R-Z	VOR14R-Z	
APPROACH MODE ARMING	APPR	APPR	APPR	APPR	APPR	APPR	APPR	APPR	
GUIDANCE MODE FMA	G/S | LOC	G/S | LOC	G/S | LOC	F-G/S | F-LOC	F-G/S | F-LOC	APP-DES | NAV	F-G/S | LOC	F-G/S | F-LOC	
PFD									
ND			0.2R	0.2R	0.2R	0.08R			
LATERAL SOURCE	LOC	GPS GBAS	GPS SBAS	FMS	FMS	FMS	LOC	FMS	
VERTICAL SOURCE	G/S	GPS GBAS	GPS SBAS	Baro Alt	Baro Alt	Baro Alt	Baro Alt	Baro Alt	
TEMPERATURE compensation for Final leg guidance	Not needed (Geometrical beam)	Not needed (not baro sensitive)	Not needed (not baro sensitive)	compensated via FMS temp	compensated via FMS temp	not compensated	compensated via FMS temp	compensated via FMS temp	
Recommended mode	★	★	★	★	★	★	★	★	

https://airbus-win.com/guidance-modes/

AIRBUS

Cross Reference Table

CROSS-REFERENCE TABLE

This table provides Guidance Modes that may be used depending on the Approach Type.

	Guidance Modes per Approach Type					
	LOC G/S	**F-LOC F-G/S**	**FINAL APP**	**LOC FPA or LOC B/C FPA** ◁	**NAV FPA**	**TRK FPA**
ILS / GLS ◁	Refer to APPR using LOC G/S	N/A	N/A	N/A	N/A	N/A
LOC ONLY ILS G/S OUT LOC B/C ◁	N/A	Refer to APPR using LOC F-G/S or LOC B/C F-G/S *(1)*	N/A	Refer to APPR using FPA Guidance	N/A	N/A
RNP or RNAV(GNSS) with LNAV/VNAV minima	N/A	Refer to APPR using F-LOC F-G/S *(1)*	Refer to APPR using FINAL APP *(1)*	N/A	Not Authorized	Not Authorized
RNP or RNAV(GNSS) with LNAV minima	N/A	Refer to APPR using F-LOC F-G/S *(1)*	Refer to APPR using FINAL APP *(1)*	N/A	Refer to APPR using FPA Guidance	Not Authorized
RNP or RNAV(GNSS) with LPV minima (with SLS ◁ **)**	Refer to APPR using LOC G/S	Not Authorized	Not Authorized	N/A	Not Authorized	Not Authorized
RNP or RNAV(GNSS) with LP minima (with SLS ◁ **)**	Not Authorized	Not Authorized	Not Authorized	Refer to APPR using FPA Guidance	Not Authorized	Not Authorized
VOR VOR-DME NDB NDB-DME	N/A	Refer to APPR using F-LOC F-G/S *(1)*	Refer to APPR using FINAL APP *(1)*	N/A	Refer to APPR using FPA Guidance	Refer to APPR using FPA Guidance
RNP(AR) or RNAV(RNP)	N/A	Not Authorized	Refer to APPR using FINAL APP for RNAV(RNP)	N/A	Not Authorized	Not Authorized

1. The FLS (F-LOC F-G/S) is the recommended guidance mode for this type of approach.

For Visual Approach, Refer to Visual Approach.

For Circling Approach, Refer to Circling Approach.

Note : The names of the approach and departure charts evolve. For convenience purposes the Cross-Reference table provides both names.
RNP is equivalent to RNAV(GNSS).
RNP(AR) is equivalent to RNAV(RNP).

--- END ---

AIRBUS

Approach Guidance mode proposed by the system

Approach type (Charts)	FMS Selection	Approach Guidance Mode
ILS	□ILS09L-Z	ILS
LOC ILS G/S OUT	□LOC09L-Y □ILS09L-Z	Mix LOC / FLS
GLS	□GLS09L-Z	GLS
RNP LPV	□RNV09L-Z (LPV)	SLS
RNP LNAV/VNAV RNP LNAV VOR NDB	□RNV09L-Z □RNV09L-Z □VOR09L-Z □NDB09L-Z	FLS (FINAL APP on Old A/C)
RNP AR	□RNV09L-Z	FINAL APP
Miscellaneous RNP VPT Specific geometry Visual procedures		FINAL APP

Minimum equipment to start

Minimum equipment to start

- 1 FMS in GPS PRIMARY
- 1 MCDU
- 1 FD
- 1 PFD
- 1 ND of PF side
- Both FCU channel

e.g. RNP APCH

Minimum equipment to start

External conditions

QNH setting

temperature correction

Wind limitation

Importance of QNH setting

FINAL APP **FLS**: **Barometric vertical guidance** ⇒ sensitive to QNH setting
if wrong QNH setting, wrong guidance, wrong minima

ILS, GLS, SLS : Geometric guidance ⇒ not sensitive to QNH setting
BUT wrong minima in Baro, wrong altimeter display

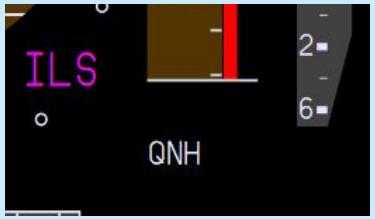
QNH Monitoring
FWC+EIS std

ALTSM-B Function

ECAM

NAV QNH NOT CORRECT
-QNH VALUE……..…….CHECK
(ALL SOURCES & ATC)

PFD



Provide a safety net regarding Wrong QNH setting threat

Minimum equipment to start

External conditions

QNH setting

temperature correction

Wind limitation

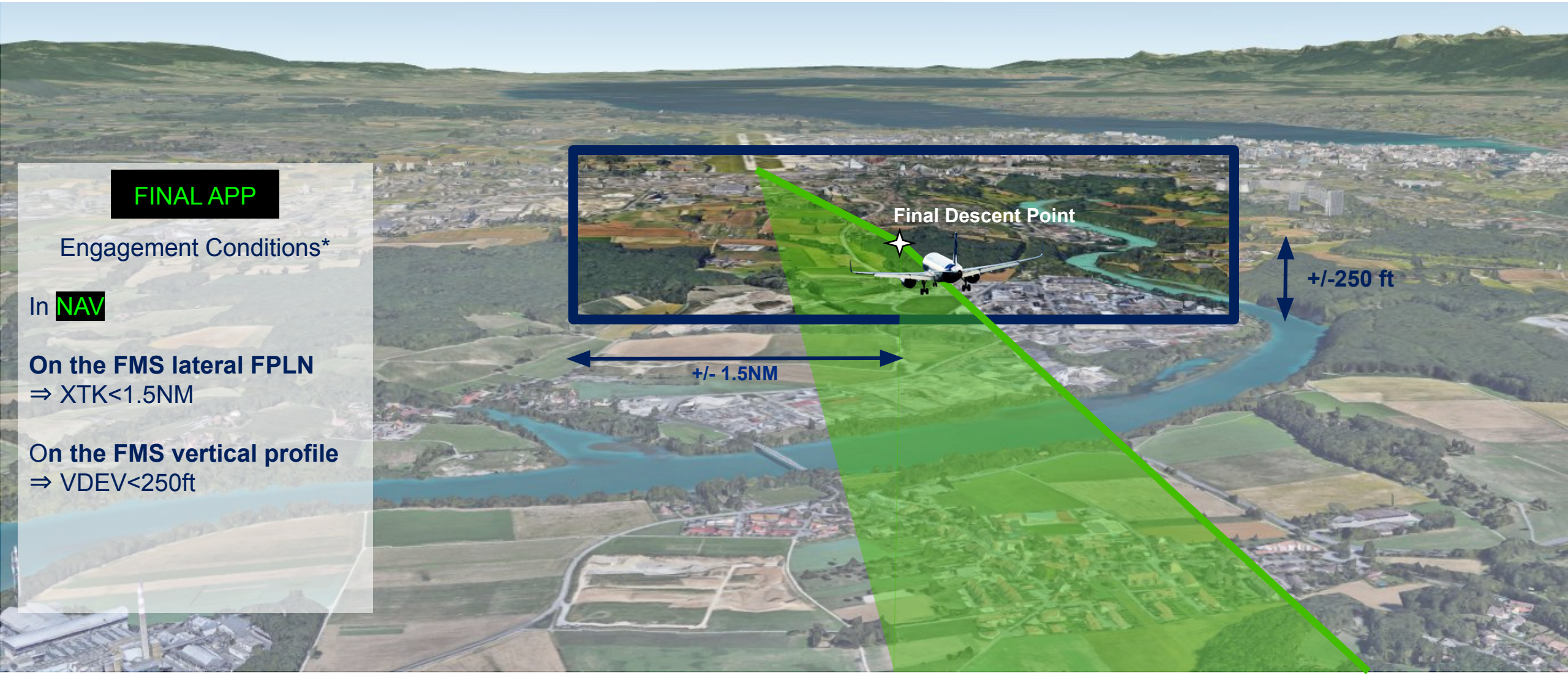
Minimum equipment to start

External conditions

Engagement conditions

The crew must pay attention to be located at the right place for final approach mode engagement

Example : FINAL APP capture zone

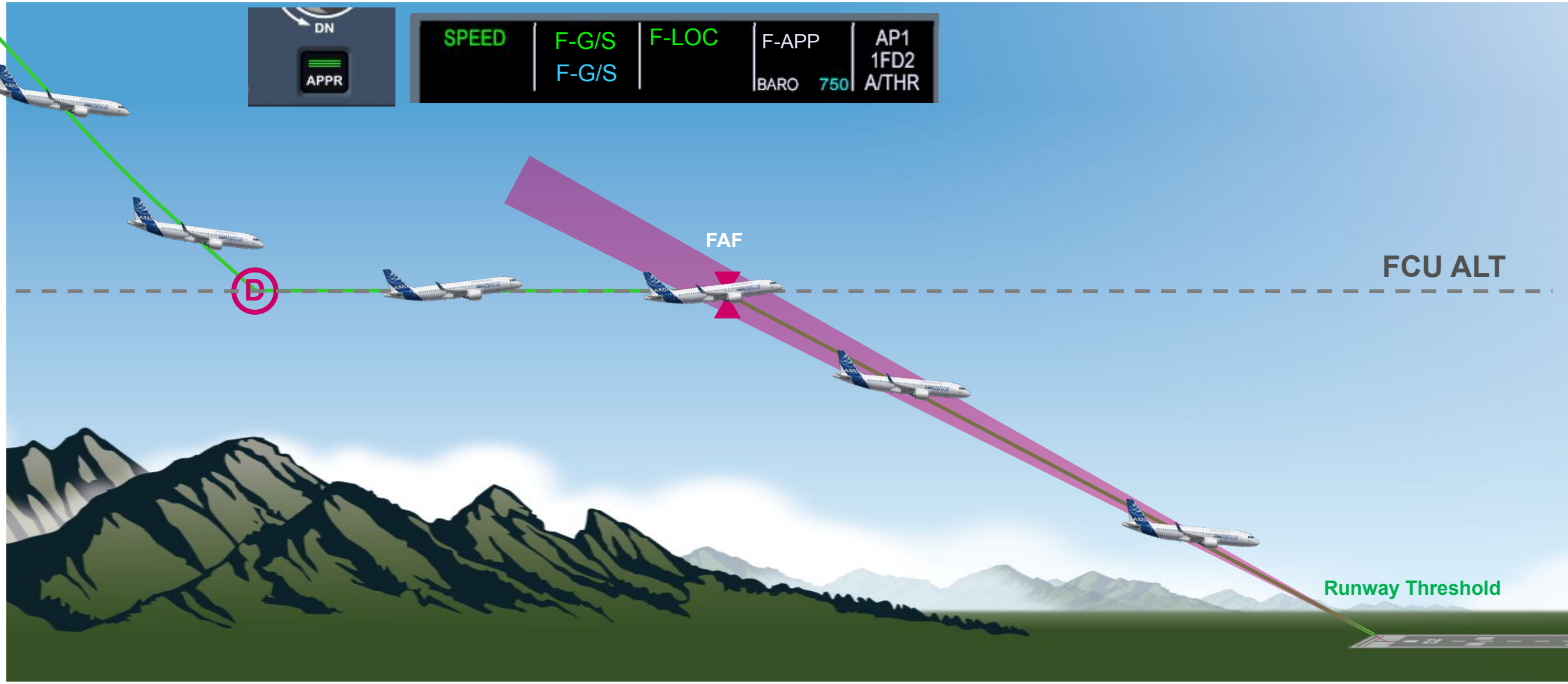


* simplified

AIRBUS

xLS capture

[Airbus Amber]



AIRBUS

Minimum equipment to start

External conditions

Engagement conditions

Deviations Monitoring

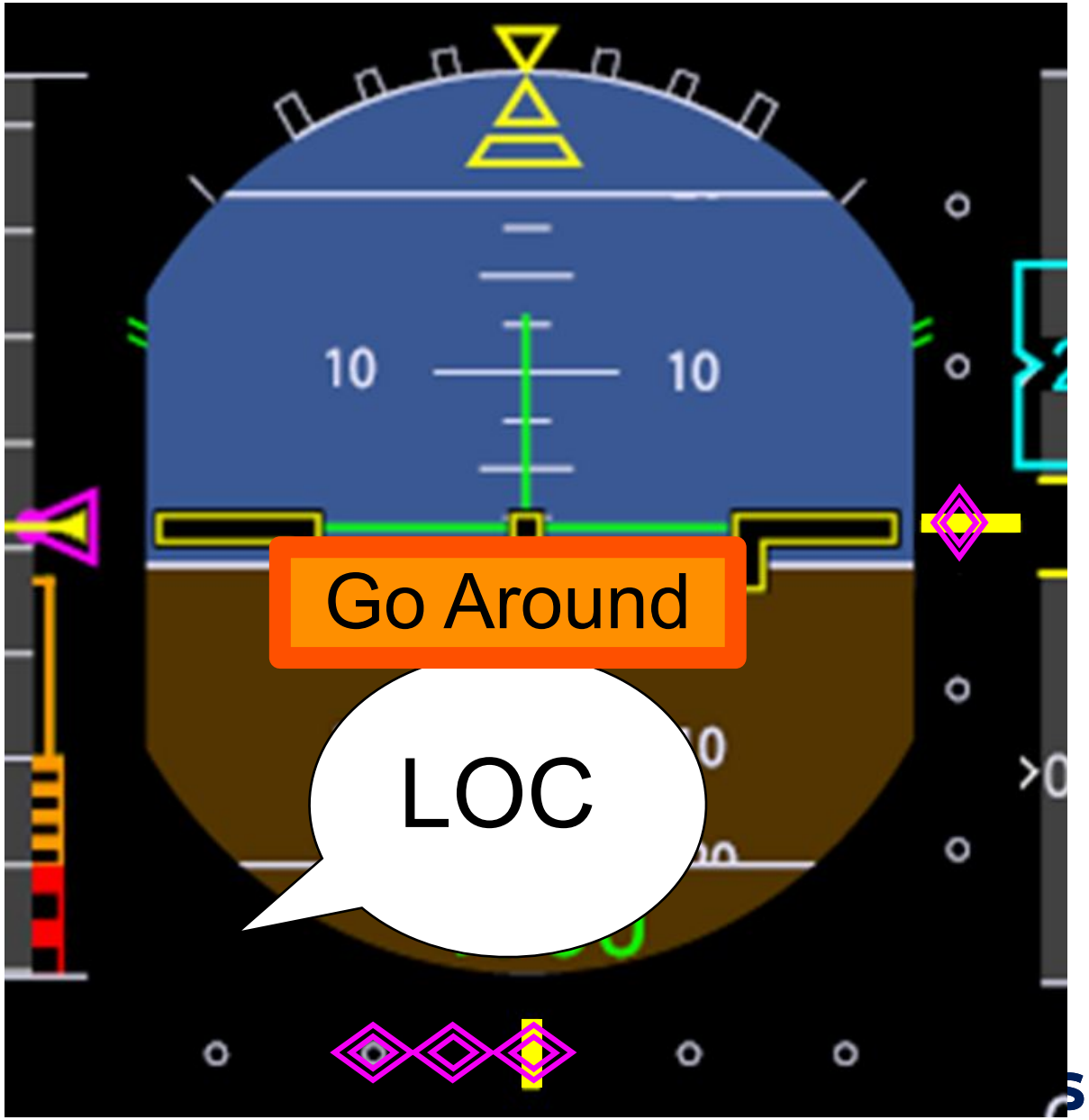
Lateral deviation monitoring for xLS

[Airbus Amber]

Laterally : Monitor F-LOC deviation

Crew Standard Callout : ½ dot

Go Around : 1 dot in RNP



Vertical deviation monitoring for xLS

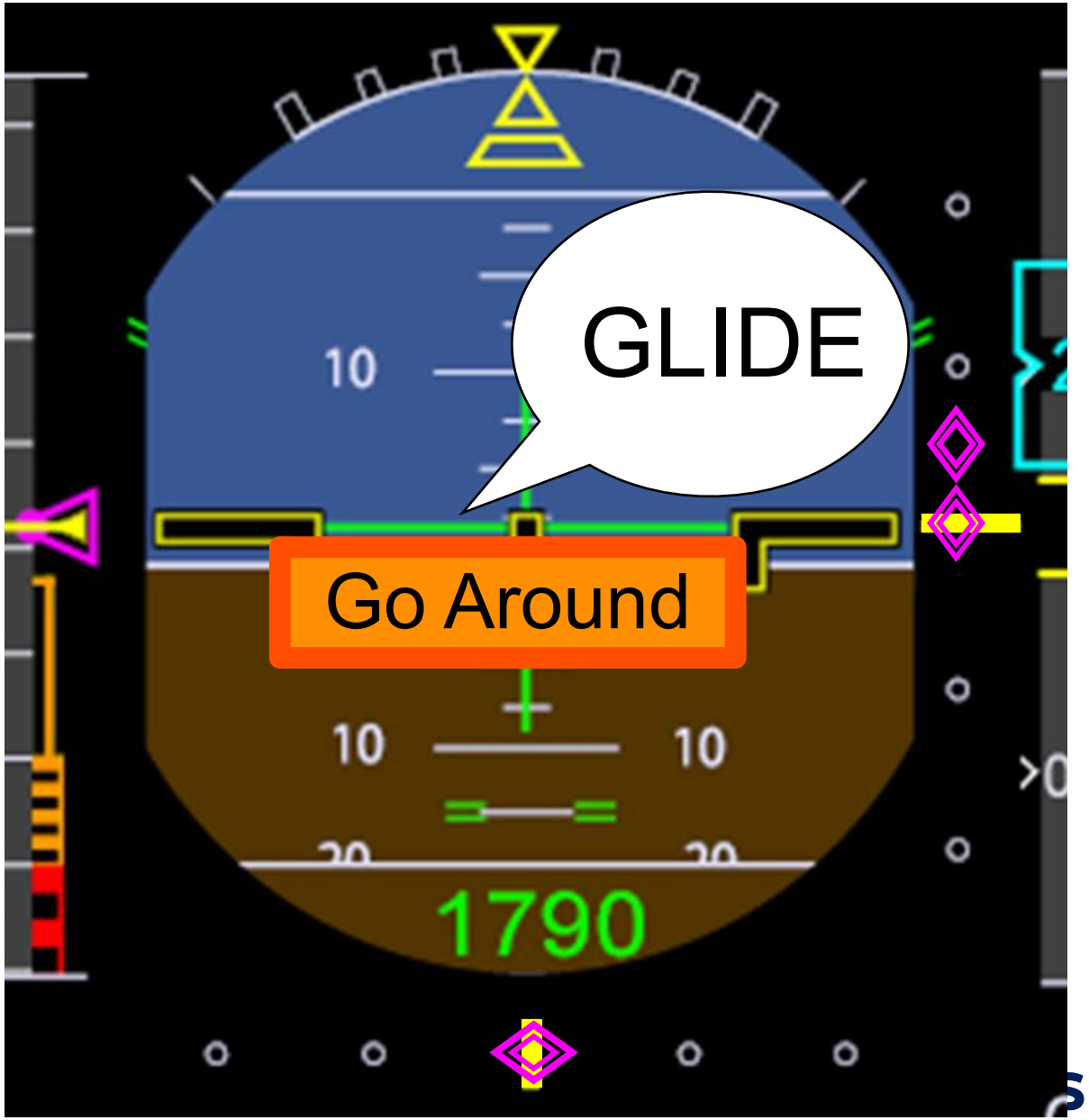
[Airbus Amber]

Vertically : Monitor G/S / F-G/S deviation

Crew Standard Callout: ½ dot

Go Around : ½ dot in RNP LNAV/VNAV

Altitude checks at FAF and SDF

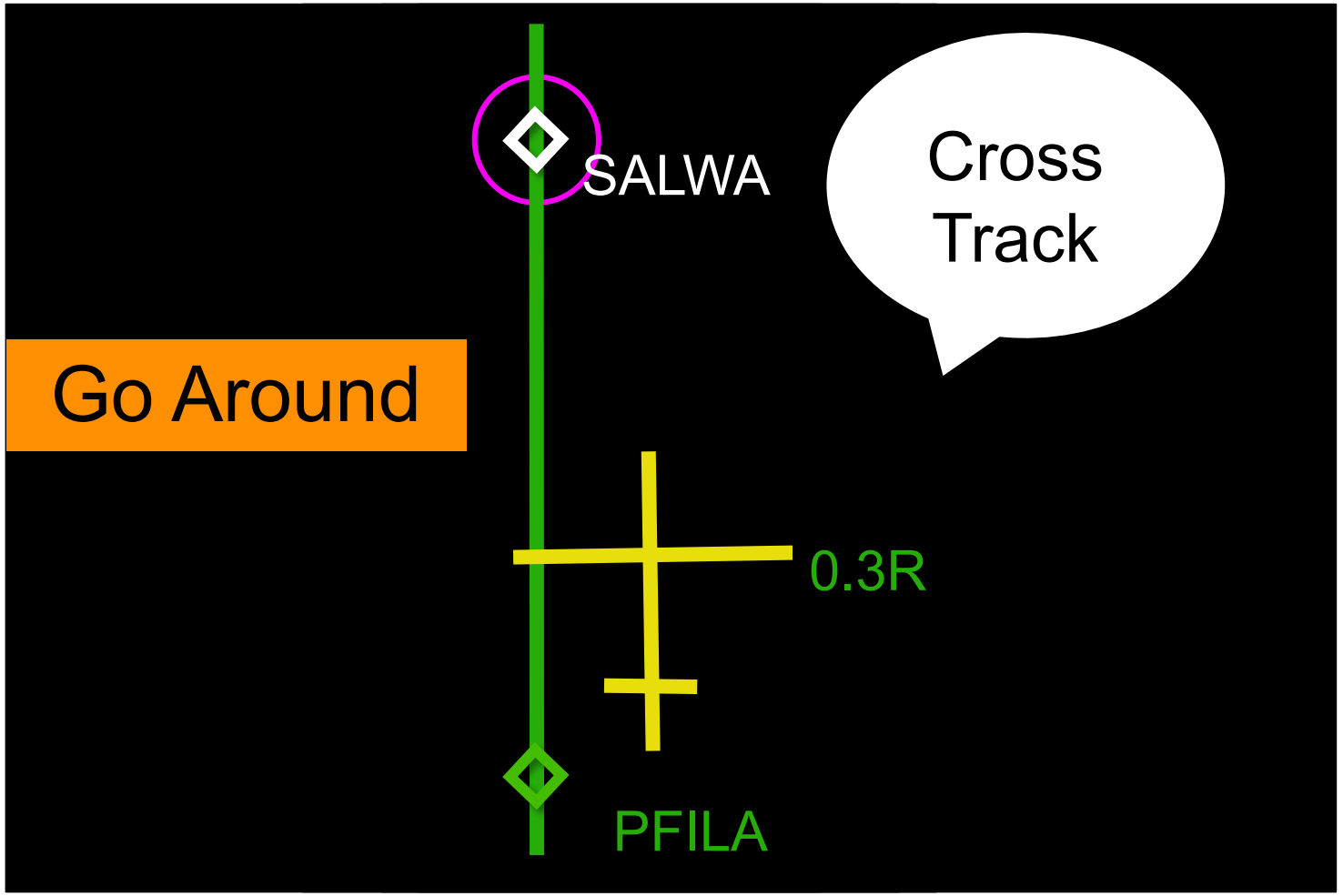


Deviation monitoring for FINAL APP in RNP APCH

Laterally : Monitor XTK

Crew Standard Callout :
“Cross Track” when XTK appears

Go Around : XTK reach 0.3NM



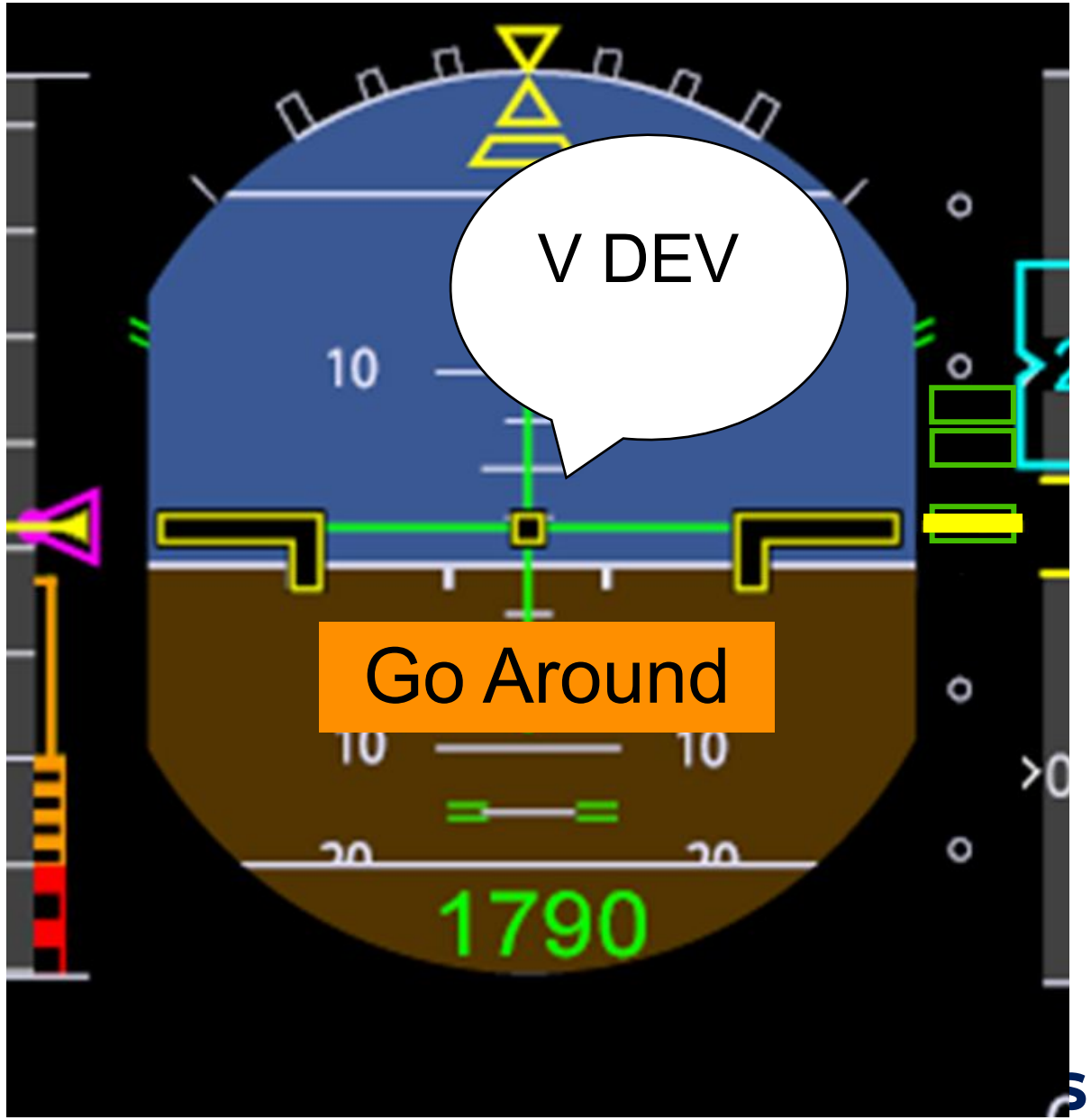
Deviation monitoring for FINAL APP / APP-DES | NAV in RNP APCH LNAV/VNAV

[Airbus Amber]

Vertically : Monitor V/DEV

Crew Standard Callout : V/DEV ½ dot below

Go Around : V/DEV ¾ dot = 75ft



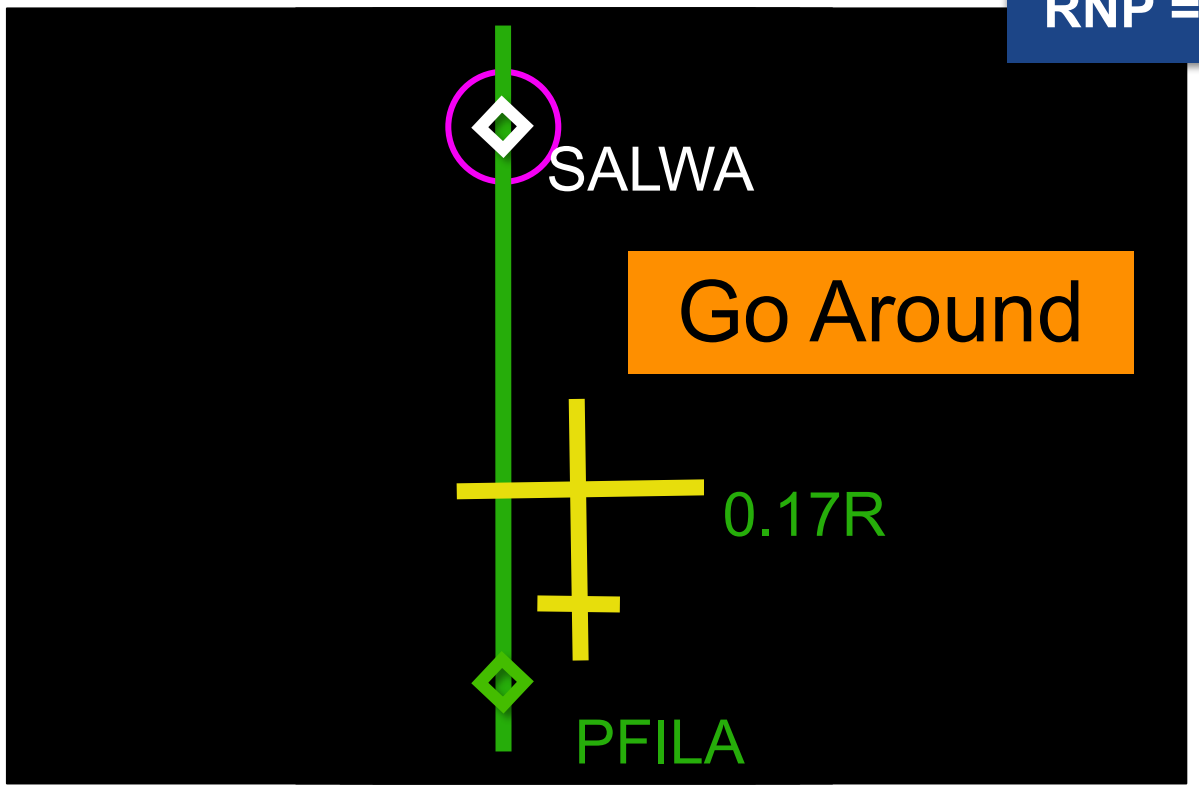
Deviation monitoring for FINAL APP / APP-DES | NAV in RNP AR

[Airbus Amber]

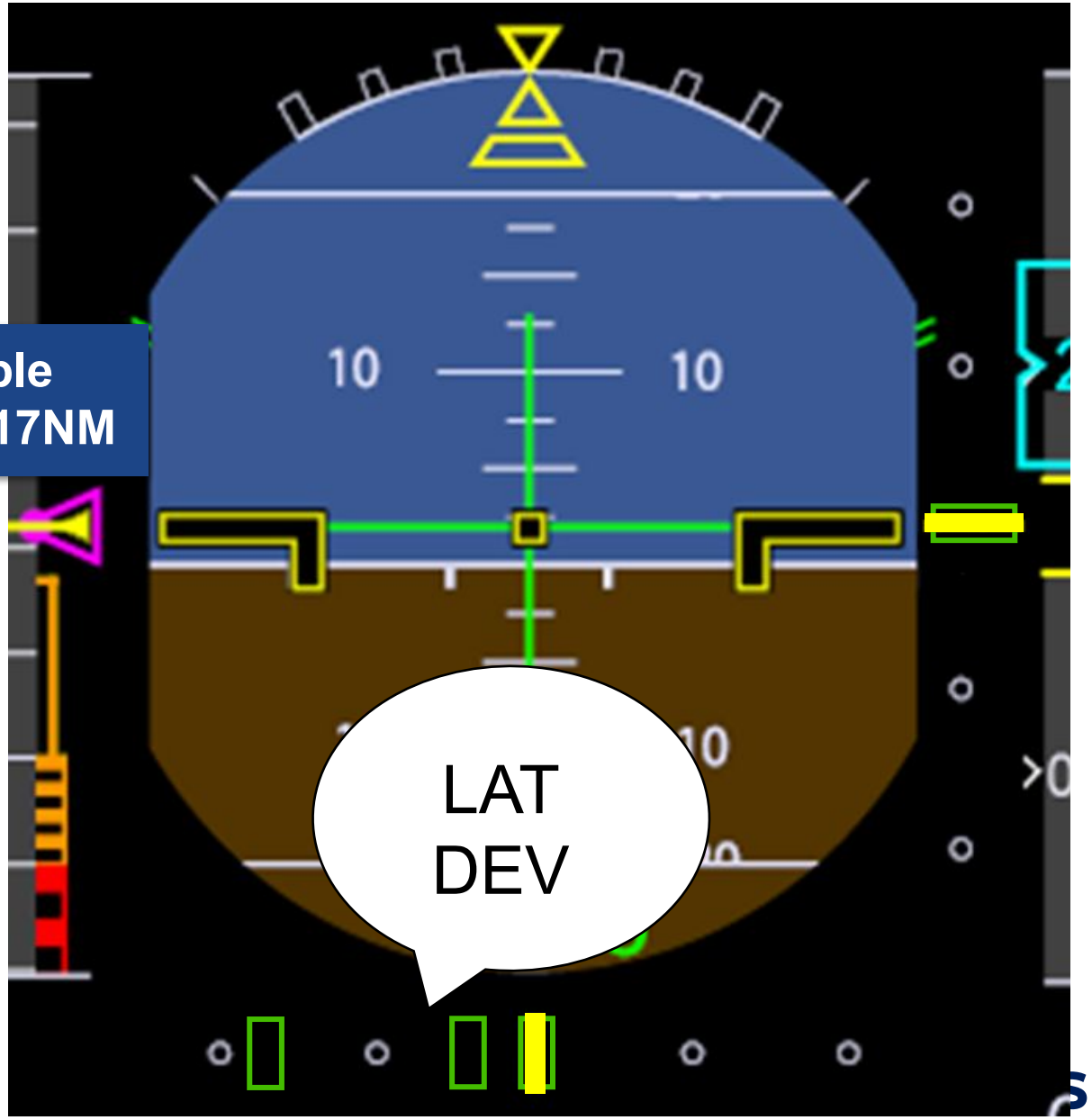
Laterally : Monitor L/DEV and XTK

Crew Standard Callout : L/DEV ½ dot

Go Around : XTK reach 1 RNP
excess dev on A350 / A380 batch 7



Example
RNP = 0.17NM



Deviation monitoring for FINAL APP / APP-DES | NAV in RNP AR

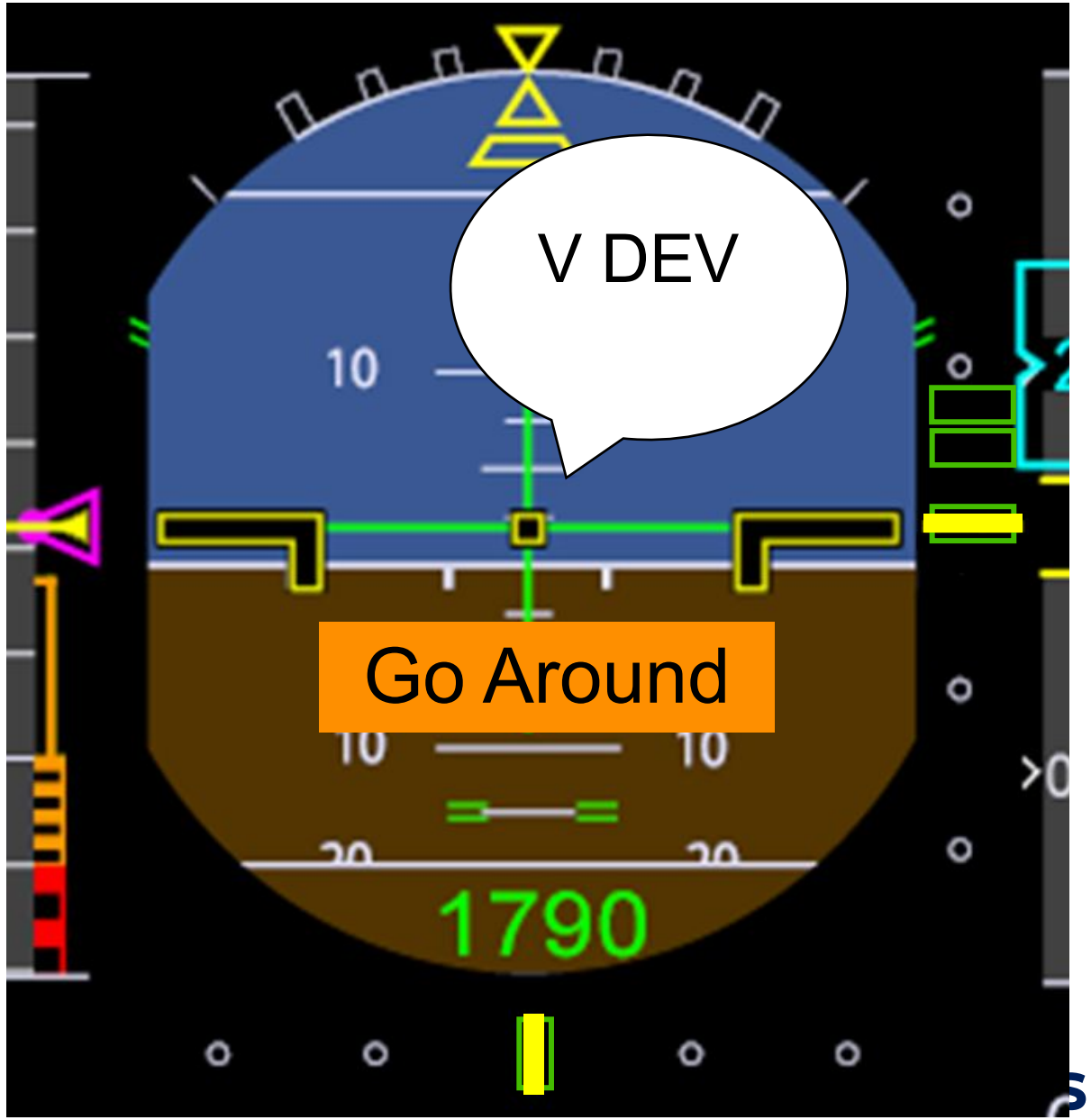
[Airbus Amber]

Vertically : Monitor V/DEV

Crew Standard Callout : V/DEV ½ dot below

Go Around : V/DEV ¾ dot = 75ft

excess dev on A350 / A380 batch 7



Minimum equipment to start

External conditions

Engagement conditions

Deviations Monitoring

Management of degraded Navigation

Navigation performance and Approaches

GPS/NAV PRIMARY LOST

LOSS OF INTEGRITY

- ➔ **RNP AR capability lost** (specific design on A350)
- ➔ **RNP APCH capability lost**
- ➔ **Crosscheck with raw data on conventional**
- ➔ **No impact on ILS/GLS/SLS** (specific alerting)

NAV ACCUR DOWNGRADED

LOSS OF ACCURACY

- ➔ **Raw data only for conventional**

Management of degraded Navigation in FLS: Approach capability on FMA

F-APP = **GPS PRIMARY**

F-APP+RAW = **GPS PRIMARY LOST**

On both side

- RNP APCH ⇒ Go Around
- VOR / NDB ⇒ Check with raw data

RAW ONLY = **NAV ACCUR DOWNGRAD**

On both side

- Do not use FLS guidance
- Raw data only for conventional

CONCLUSION

Conclusion

- Lot of various approach type
- 3D vs 2D service
- Airbus (and modern commercial A/C) proposes 3D guidance even when there is only 2D services based on advisory barometric vertical guidance.
- Automatic selection of the solution based on FMS selection
- Procedures:
  - Before the approach: Minimum equipment, QNH setting
  - During the approach: Monitoring of the lateral excursion and A/C position

Thank you

AIRBUS