

AIRBUS HELICOPTERS

Helicopters status on LPV capability
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A DUCOLLET NAVIGATION SENIOR EXPERT

AIRBUS HELICOPTERS

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AIRBUS HELICOPTERS FLEET

H125

H130

H135

EC145/ H145

AS365N3+ and H155

H120

Light (CS27) to heavy (CS29) helicopters

Civil and/or military

Covering a wide range of mission (oil&gas, HEMS, Search and rescue, police, law enforcement, personal and business aviation…)

H160

NH90 (via NHIndustries)

Tiger

Super Puma (H225/H215..)

H175

Why LPV on helicopter

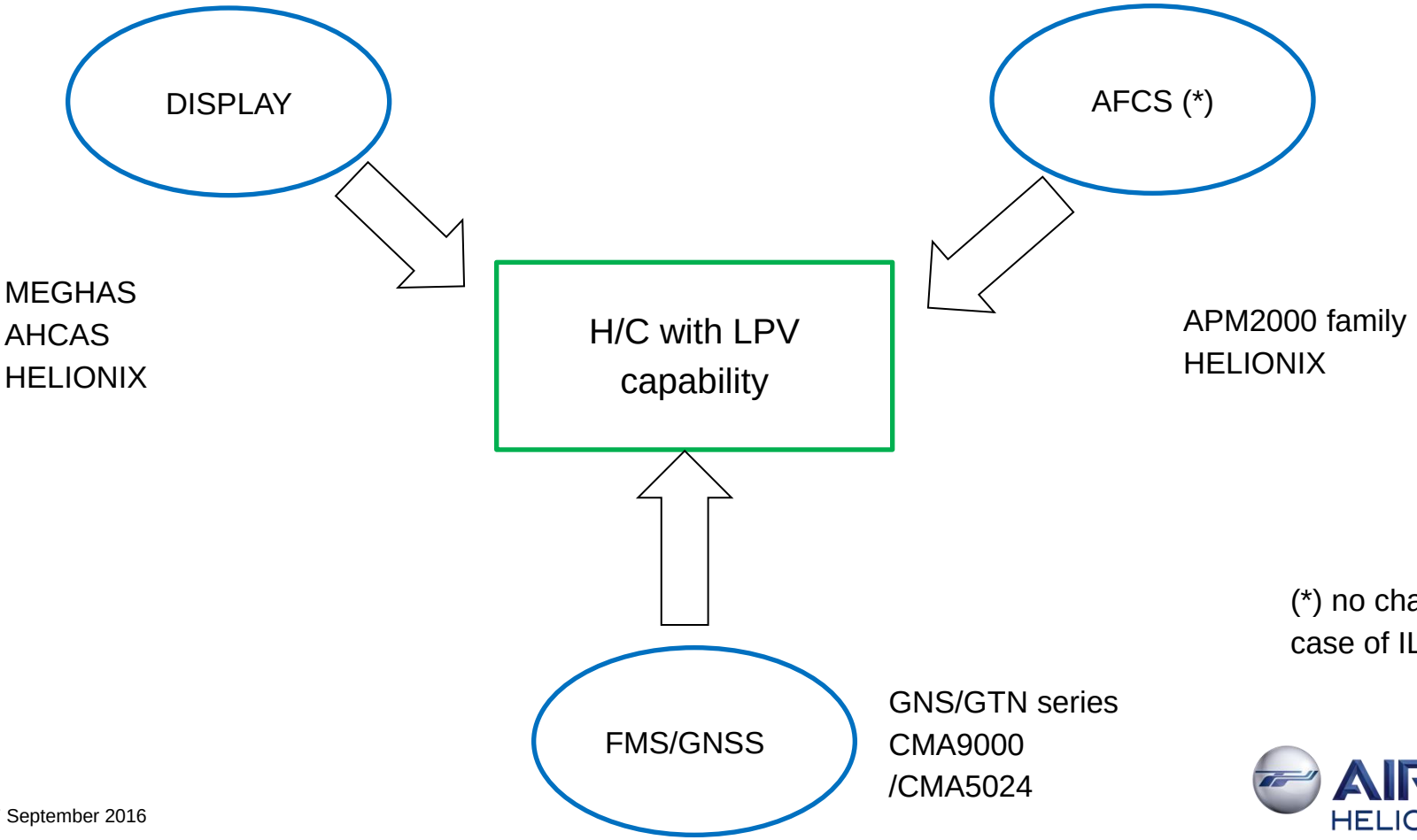
- It allows approach on small airport / heliport w/o need of ground infrastructure as ILS
- ILS decommissioning
- More and more LPV approaches are published, in area of SBAS coverage
- Steep approach capability for helicopters (close to 10°) allowing
  - noise abatment in high density populated area
  - approach in environment with obstacle
- PinS allowing approach on a point and then proceed VFR or visually to a landing pad

- Main mission segments asking for LPV
  - HEMS
  - oil&gas

- Emerging demand from military customers (Europe…)

LPV integration and avionics impact

LPV implementation requires modification of avionics system



(*) no change in case of ILS like

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LPV implementation types

LPV implementation type	Caracteristics	Avionics impact
ILS like	During RNP APCH , manual transition required between ‘en route’ format and ILS format based on LPV equipment deviations, close to the approach	No change of AFCS Minor change of display using the ILS input
Full LPV	During RNP APCH automatic transition to LPV equipment deviations	Change of AFCS (*), with improved performance Change of display

When LPV capability is provided, LNAV/VNAV using GNSS as altitude source is also added

(*) geometric path is used instead of angular deviation as performed on ILS guidance

LPV implementation strategy

- LPV implementation will depend on H/C
  to be retrofitted
  or new H/C

- No LPV on H/C which are no more manufactured, due to avionics HW and SW high upgrade cost
  - AS 332L2 with IFDS avionics suite (end 80's beginning 90's)
  - AS 332 MK1 with MFD225 display (end 90's), and AS355
- LPV as ILS like on avionics suite where capabilities of development are limited
  - BK117C-2, H135 with MEGHAS avionics (mid 90's), H155
- Full LPV on avionics where development are going on or new avionics
  - H225e (possible retrofit of H225 in this standard) with AHCAS avionics
  - H145/BK117D2 with HELIONIX avionics
  - H135 with HELIONIX avionics
  - H175 with HELIONIX avionics
  - H160 with HELIONIX avionics

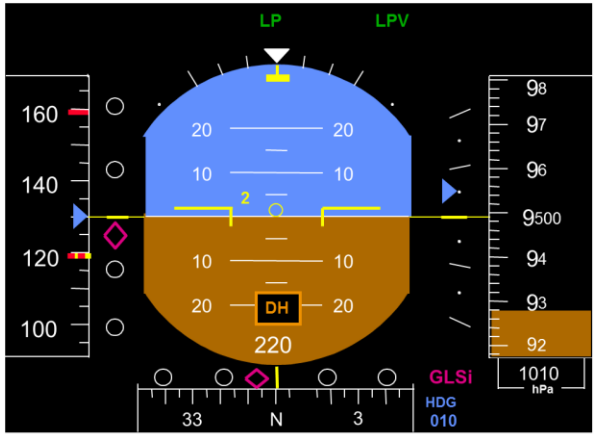
No LPV

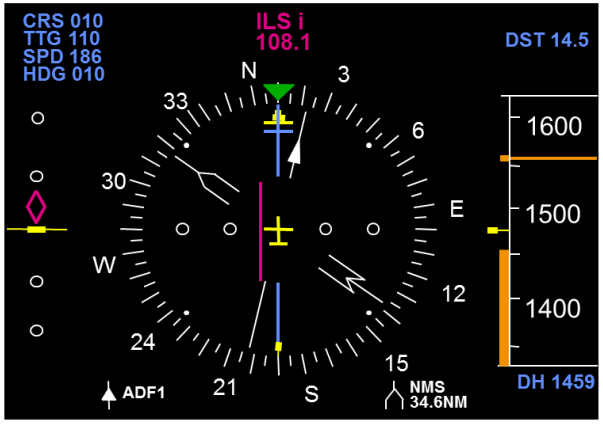
Cockpit of a AS 332L2
with IFDS

Cockpit of a AS365 with
MFD255

LPV implementation as ILS like

Cockpit of an H145 with MEGHAS

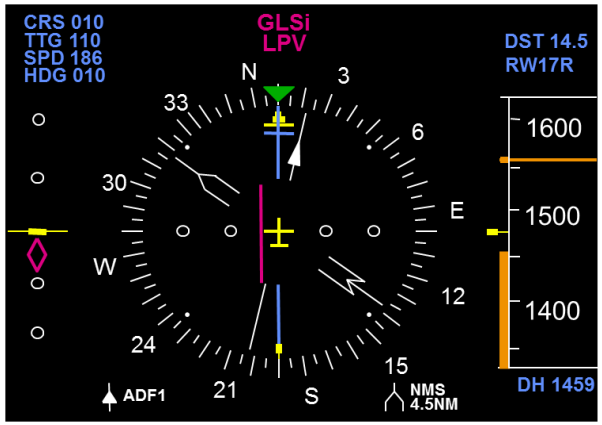




Display with ILS

Minor changes vs ILS display (add Level of Service..)

No AFCS change



Display with LPV

LPV : full implementation

H225 cockpit
with AHCAS
(8”x6”)

AFCS upper modes

Angular deviation

Level of service
NAV source
SBAS status
approach data

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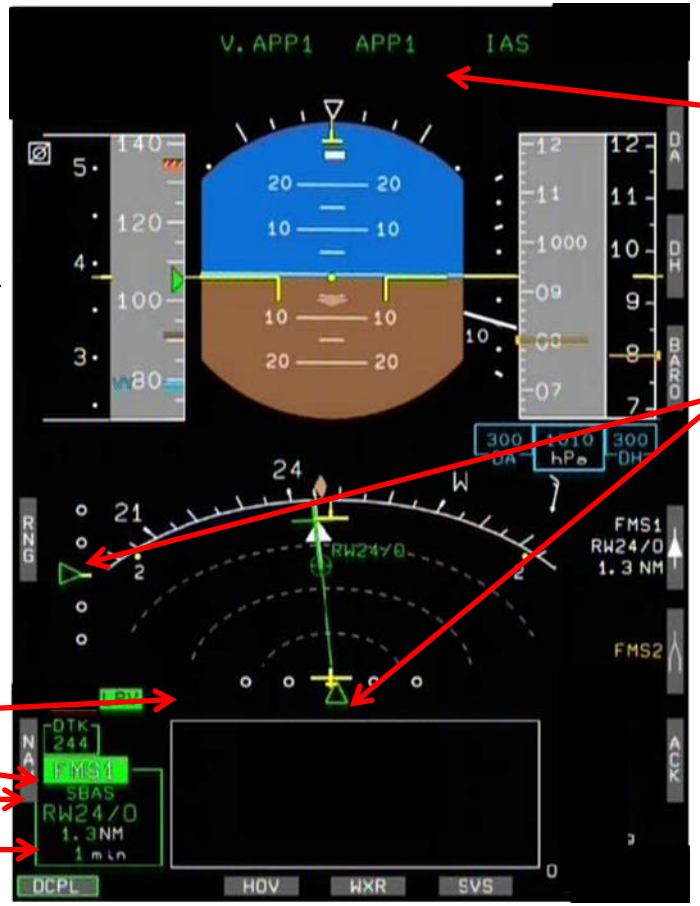
LPV : full implementation

H145 cockpit with
HELIONIX (display 6''x8'')



FM for LPV

- LPV capability provided with dual GNSS and dual FM
- LPV guidance performed by the GNSS (due to DAL B)
- Development performed mainly with two FMS/GNSS

GARMIN FMGPS (GNS/GTN series) example

GNS430W

GTN750

CMC Electronics
FMS CMA9000 + GPS CMA5024

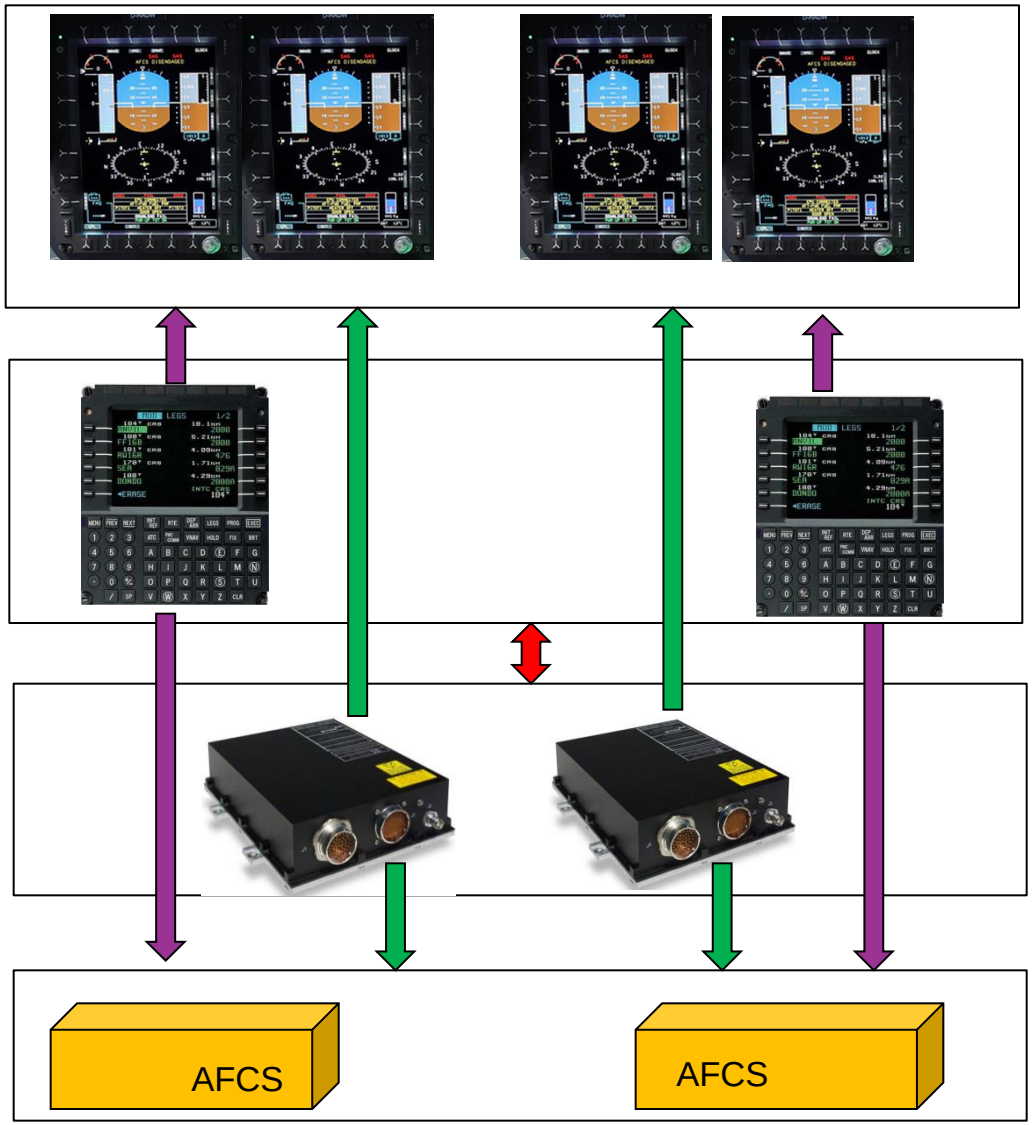
LPV : family concept

- Implementation on different platforms
  - example

	H145/H135	H160/H175	H225
DISPLAY	HELIONIX	HELIONIX	AHCAS
AFCS	HELIONIX	HELIONIX	APM2010
FMS	GTN750	CMA9000	CMA9000

- Family concept is kept and maximum reuse is performed
- Interchangeability of FMS is made easier

Typical architecture for full LPV



- Dual GNSS, dual FMS
- Any MFD connected to both FM and both GNSS
- Any AFCS connected to both FM and both GNSS
- Automatic reconfiguration in case of equipment FM/GNSS failure
- Only one FM/GNSS (monitored by x-FM/GNSS) is displayed
- GNSS performs the LPV approach, from FASDB provided by FM

Certification performed in front of EASA guidance materials AMC20-28, and CRI for steep approach

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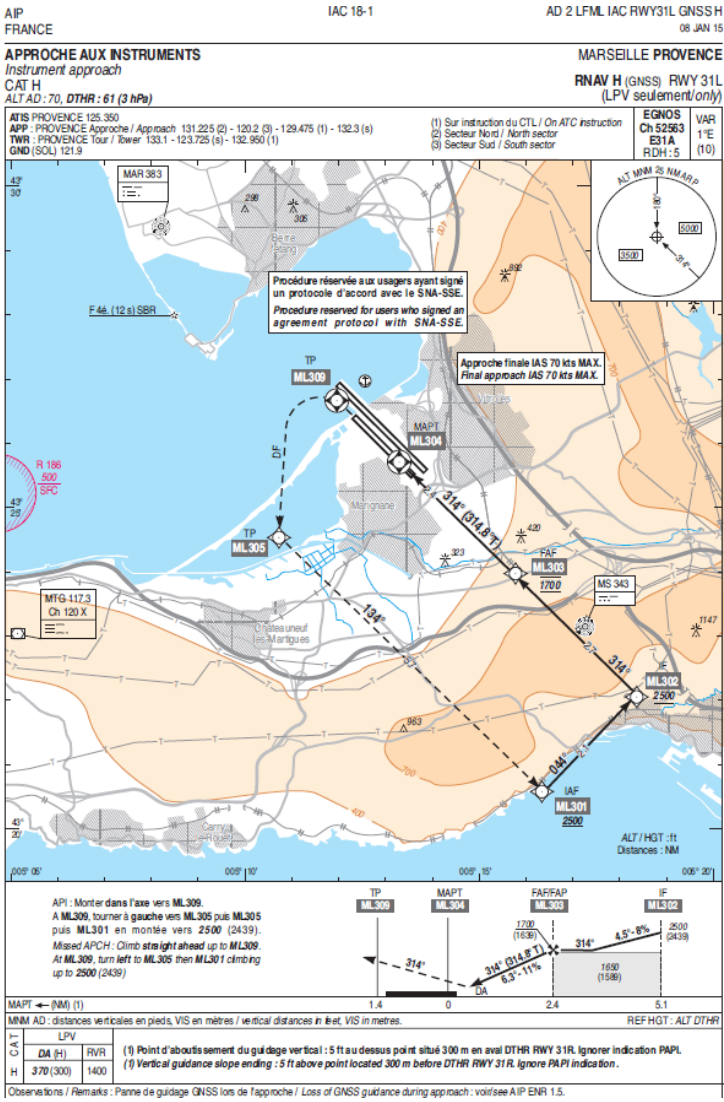
Challenge of LPV implementation

- **Procedures**
  - Procedure evolution including introduction of course change at FAF
- **Regulation**
  - AMC20-28 EASA available in 2012
  - CRI for steep approach
- **Economical**
  - Transition to dual system
  - Impact on legacy fleet for retrofit
  - Full LPV requiring display modification and AFCS change for several avionics suite (display/AFCS/FM)
  - Many customers not under SBAS coverage
- **Technical**
  - Antenna installation (for robustness to structure masking especially at high latitudes)
  - Multipath (small ground plane on helicopter)
  - Side impact on avionics (TAWS…)
  - Configuration of system for area out of SBAS coverage and without LPV

LPV verification / certification

- Verification tests performed on rig
  - Simulated flights with real avionics system (FMS, AFCS, display)
  - GNSS constellation simulator connected to the GNSS via the antenna input
  - Nominal cases test
  - Degraded cases test (equipment failure or discrepancies, GNSS constellation), and assessment of system reconfiguration

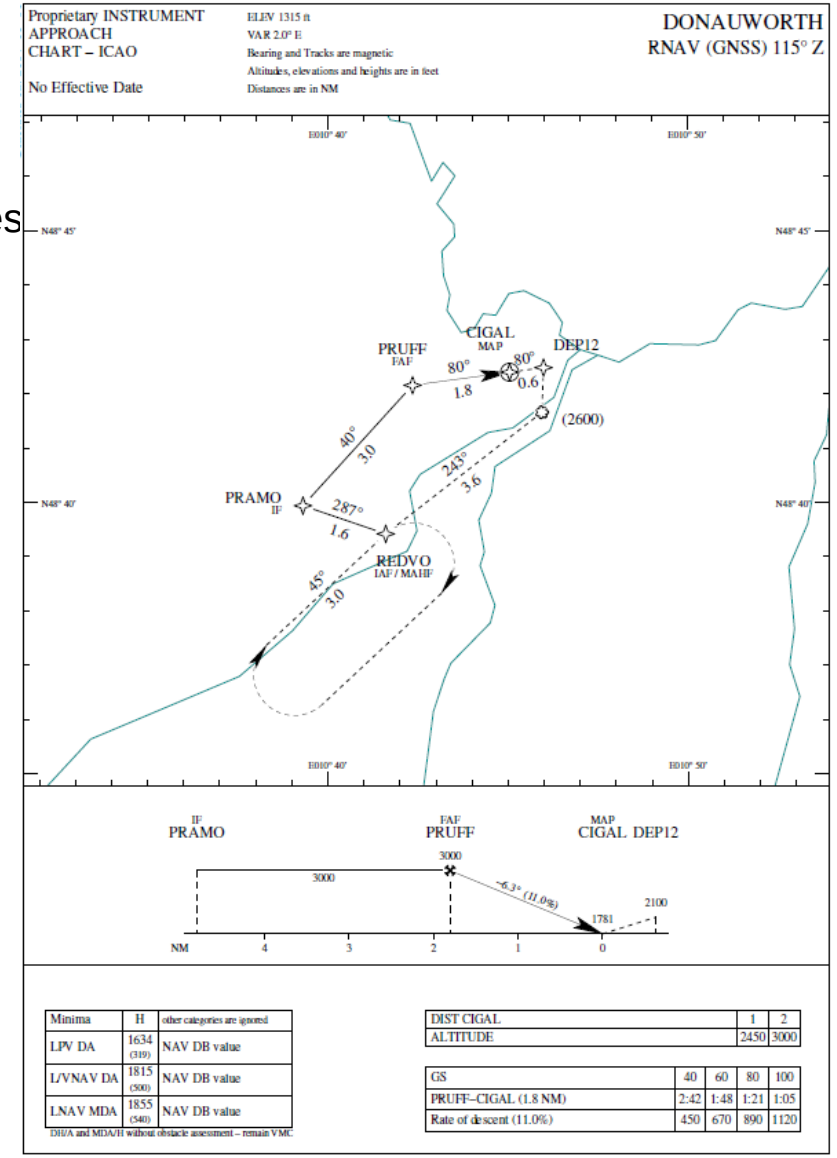
- Verification tests performed in flight
  - Several tenth of hours of flight required
  - Different slopes, different wind conditions and different course relative to final approach
  - Existing procedures or Airbus Helicopters defined procedures compliant with ICAO but at a location in a dedicated test area close to Airbus Helicopters premises of Marignane
  - Recently approaches LPV published on Marseille



LPV verification / certification

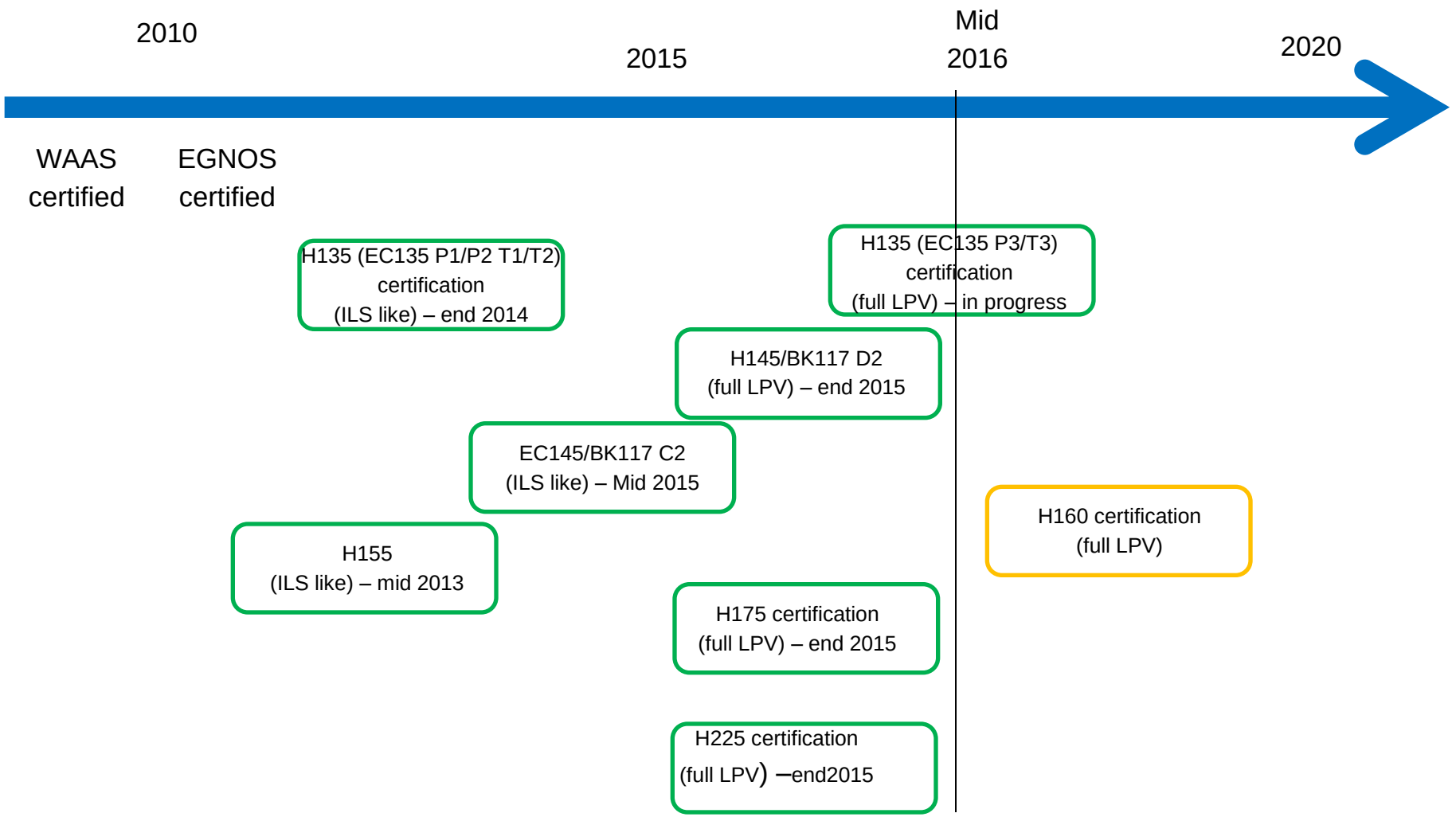
- In Donauworth, publication of several LPV procedures for testing for test and demonstration including steep approach of 10°, standard maximum slope of 6.3°, and with course change at FAF

Donauworth view of landing area



LPV approach example
Not in the runway axis
Slope : 6,3°
FAF at 3000ft

LPV implementation on helicopter fleet



Airbus Helicopters – Fleet status

HC	FMS	Basic Avionics	LPV type	Slope	Course change at FAF	Date of approval
EC135	GNS430W	MEGHAS	ILS like	<6°	no	Q4 2010 (STC)
H135 (P1/T1, P2/T2)	GTN750	MEGHAS	ILS like	<6.3°	yes	Q4 2014
H135 (P3/T3)	GTN750	HELIONIX	Full LPV	<10°	yes	Planned Q4 2016
BK117C2	GNS430W	MEGHAS	ILS like	<6.3°	no	Q4 2010 (STC)
BK117C2	GNS430W	MEGHAS	ILS like	<6.3°	yes	Q2 2015
BK117D2 / H145	GTN750	HELIONIX	Full LPV	<10°	yes	Q4 2015
EC155	GNS400W	MEGHAS	ILS like	<6°	no	Q2 2014 (STC)

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Airbus Helicopters – Fleet status

HC	FMS	Basic Avionics	LPV type	Slope	Course change at FAF	Date
H160	CMA9000	HELIONIX	Full LPV	<10°	Yes	
H175	CMA9000	HELIONIX	Full LPV	<10°	Yes	Q4 2015
H225 (note 1)	CMA9000	HELIONIX	Full LPV	<6,3°	Yes	Q4 2015

- NOTE 1 : with H225e (upgrade of H225 including avionics)
- Studies initiated for military helicopters as NH90
- Some HC may remain without LPV (example AS 332 L2)
- Some HC manufactured as H215, LPV not yet initiated

Possible wayahead

- LPV procedures for increased operational benefit on airport

PinS LPV procedures for HEMS, SNI approaches

- Study on benefit for helicopter missions : approaches on oil rig, or on wind farm

- Transition to multiconstellation/multifrequency receiver (GNSS L5, GALILEO, GLONASS (Russian mandate), BEIDOU..), impact on avionics, and associated operational benefit (better integrity, better availability, low RNP,…), A-PNT (Alternate Positioning)

- PBN implementation
  - Low IFR routes – RNP 0.3
  - RNP-AR
  - A-RNP

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ACRONYMS

AFCS	Automatic Flight Control System
CRI	Certification Review Item
DAL	Design Assurance Level
EGNOS	European Geostationary Navigation Overlay Service
FASDB	Final Approach Segment Data Block
FMS	Flight Management System
GNSS	Global Navigation Satellite System
HEMS	Helicopter Emergency Medical Service
PBN	Performance Based Navigation
PinS	Point in Space
RNP	Required Navigation Performance
RNP-AR	RNP Authorization Required
SNI	Simultaneous Non Interfering
TAWS	Terrain Awareness and Warning System
WAAS	Wide Area Augmentation System

LPV status of Airbus Helicopters aircraft

H145

H160

END OF PRESENTATION