

# Airbus Fleet Readiness for GBAS/SBAS

GBAS/SBAS Implementation Workshop  
Seoul, Republic of Korea, 3-5 June 2019

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3<sup>rd</sup> June 2019

**AIRBUS**

# Airbus Fleet Readiness for GBAS/SBAS

- Introduction: aircraft ready for all Straight-In approach types
- Airbus xLS concept
  - FLS
  - SLS
  - GLS
- Airbus Fleet Readiness review for A320/A330/A350/A380
- Landing Capabilities Roadmap: What's next?
  
- A220 Fleet Readiness Review for GBAS/SBAS
  
- ATR Fleet Readiness Review for GBAS/SBAS

# Introduction:

## Reminders of all Straight-In approaches

- 3 main categories: **PA** & **APV** & **NPA**
  - ILS CAT 1 and Cat 2/3 Autoland
  - NAVAIDS based approaches with lateral guidance (VOR, VOR/DME, NDB, LOC only)
  - APV with Lateral & vertical guidance
- GNSS: NPA & APV
  - With lateral guidance to **LNAV/LP** minima
  - With lateral & vertical guidance to **LNAV/VNAV** minima
- GNSS with SBAS: APV & PA
  - With lateral and vertical guidance to **LPV minima** (down to 200 ft = Cat 1 equivalent)
- GBAS stations as precision approaches
  - In service at Cat 1 minima with Autoland
  - Cat 2 reachable
  - Cat 3 GBAS approaches – next step

### Technology

ILS

GBAS

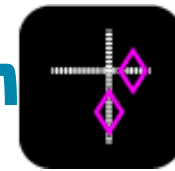
SBAS

GNSS

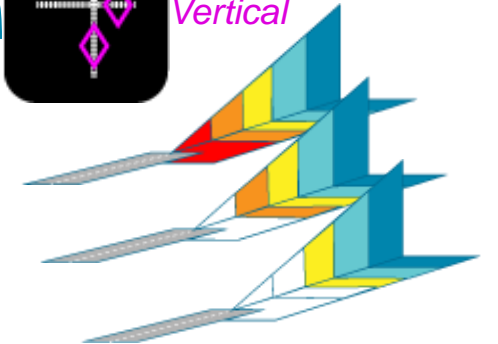
Conventional Nav aids

### PRECISION

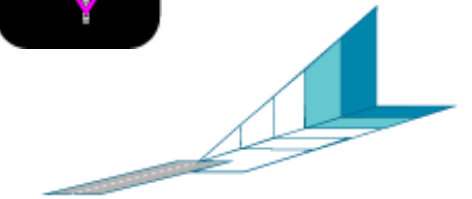
Cat 1 Cat 2 Cat 3



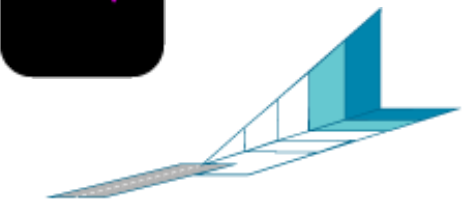
Lateral  
Vertical



Lateral  
Vertical



Lateral



### APV

LPV minima (250 ft ≥ DH ≥ 200 ft)

LPV minima (DH ≥ 250 ft)

### Non Precision

LNAV/VNAV minima

LNAV / LP minima

LOC only, VOR/DME, ...

Function available on Airbus aircraft

Standards Ready – not industrially launched



# Introduction:

## Airbus Strategy for Straight-In approaches

### New approach capabilities

implemented with minimum operational impact

- ILS as reference: a concept called **xLS**.
- **xLS** applies to:
  - All approaches with Precision Approach service
  - Straight-In NPAs, to benefit from ILS look-alike HMI (FLS description)

Airbus Aircraft ready to fly **any** approach types with the built-in **xLS** concept

### Technology

### PRECISION

Cat 1    Cat 2    Cat 3

ILS

GBAS

SBAS

ILS

GLS

SLS

xLS Concept


FLS

Conventional Nav aids

LNAV minima  
LP minima

LOC only,  
VOR/DME, ...

 Function available on Airbus aircraft

 Standards Ready – not industrially launched

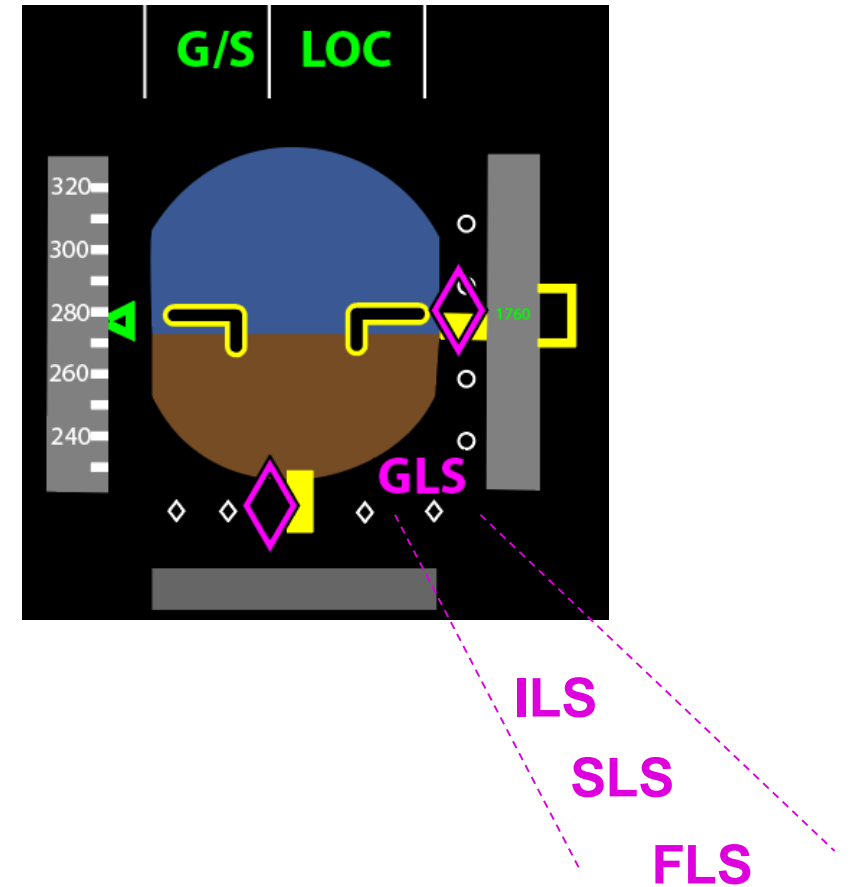


# Introduction:

## Airbus Strategy for Straight-In approaches

- **Benefits**

- Reduced Crew training
- flexibility: e.g. easy swapping from ILS32L to RNAV32R

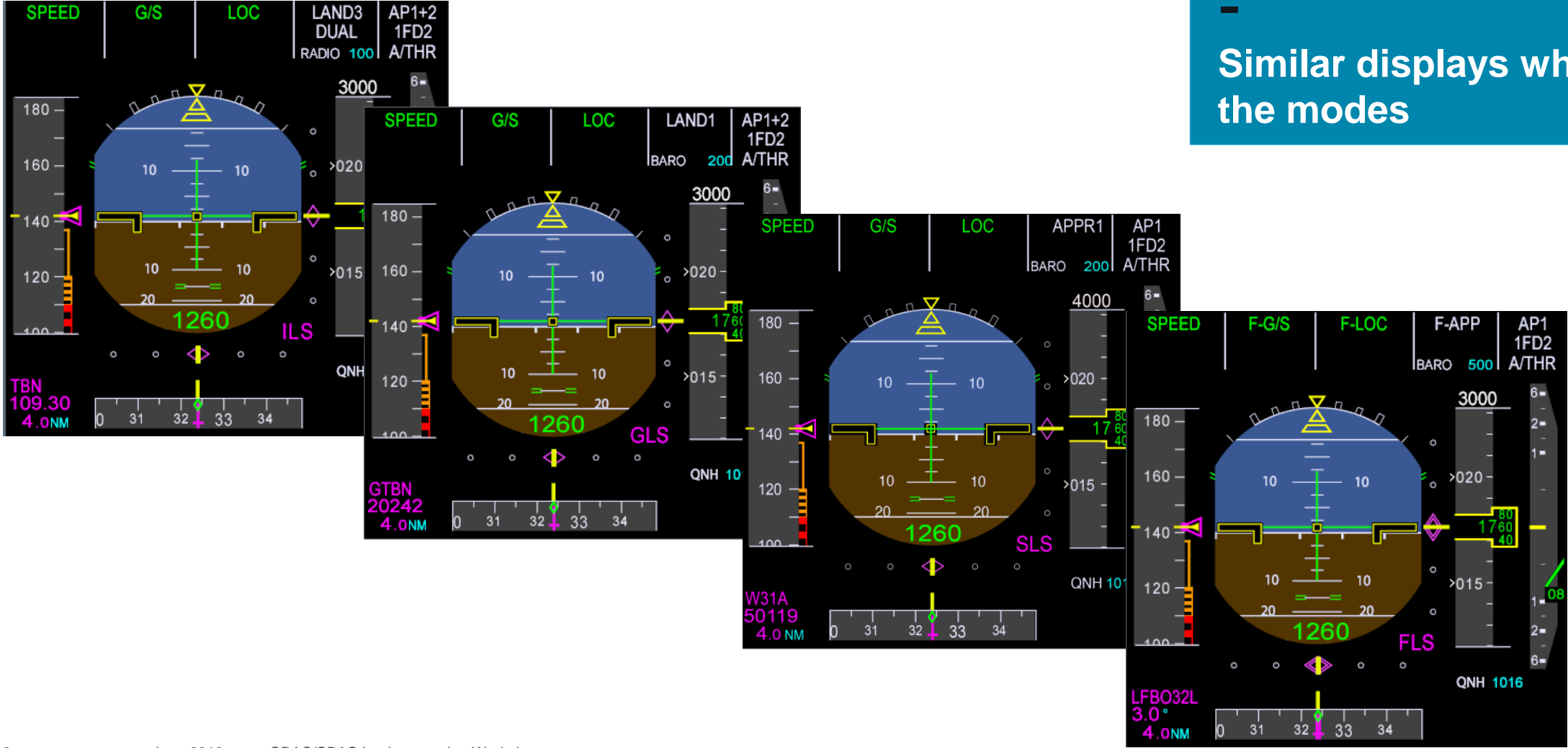


- Same ILS-lookalike HMI for all kinds of approach types
- Flying the deviations (diamonds)



# Introduction: Airbus Strategy for Straight-In approaches

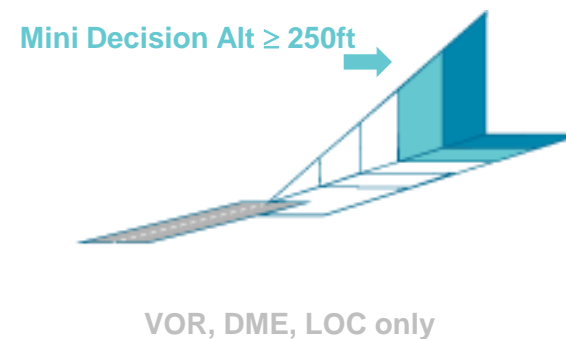
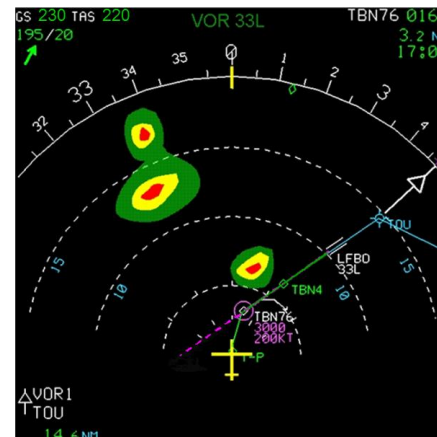
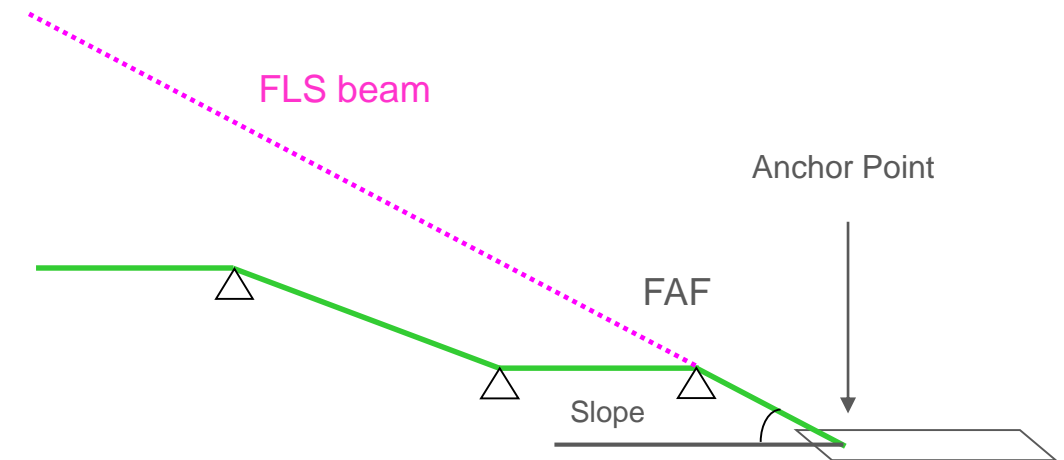
ILS look-alike HMI  
 -  
 Similar displays whatever the modes



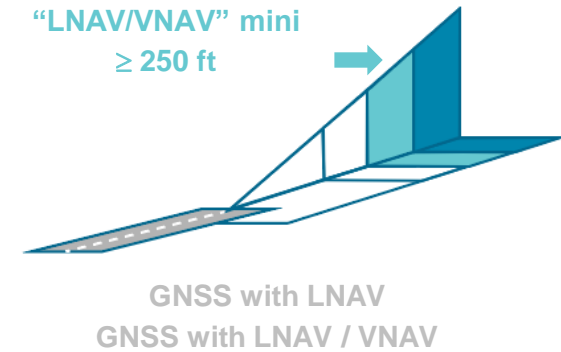
# Airbus xLS concept:

## Flying Non-Precision Approaches / Focus on FLS

- FLS allows conducting existing **Non Precision Approaches** (VOR, VOR/DME, NDB, NDB/DME, RNAV, LOC only) in a similar manner **as Precision Approaches (ILS)** with similar display, guidance & alerts.
- The aircraft is guided along a **“virtual” beam** computed by the FMS, **corrected from temperature**.
- Standard **ILS laws** used by the AP/FD for guidance.



VOR, DME, LOC only

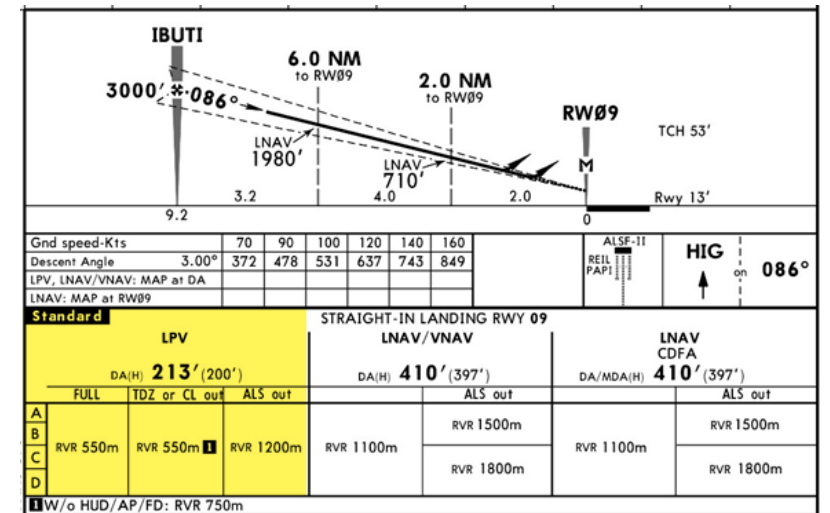
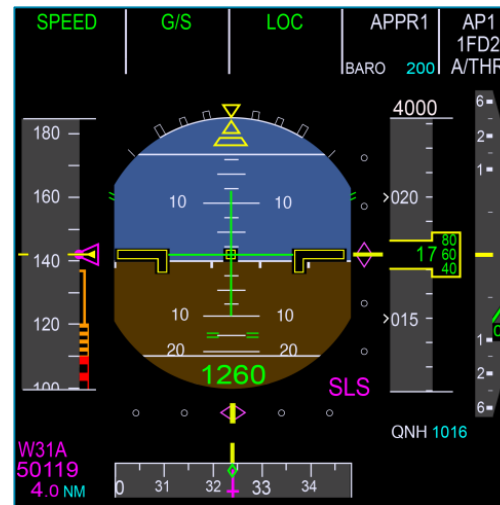


GNSS with LNAV  
GNSS with LNAV / VNAV

# Airbus xLS concept:

Reaching the “equivalent CAT 1” GNSS approaches with LPV minima – Focus on **SLS**

- Thanks to this technology based on differential GPS, it is possible to fly **RNAV (GNSS) approaches** in an **ILS look-alike** way:
  - With **geometric vertical guidance**  
*(no issue with QNH setting error and baro VNAV in cold temperature)*
  - Down to **LPV minima**  
*(performance equivalent CAT I ILS: down to 200 ft)*





# Airbus xLS concept:

GBAS capability / Focus on **GLS**

- Technology based on differential GPS to fly **GLS approach** in an **ILS look-alike** way down to **CAT I minima with Autoland**

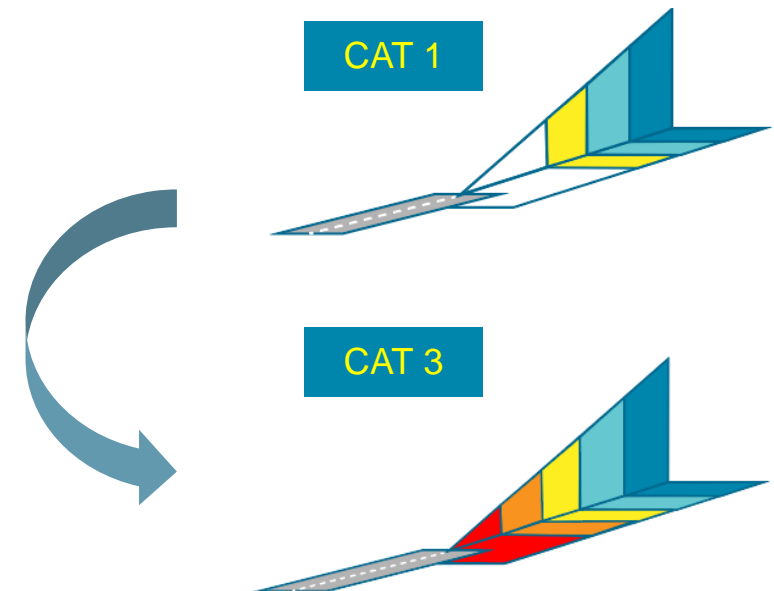
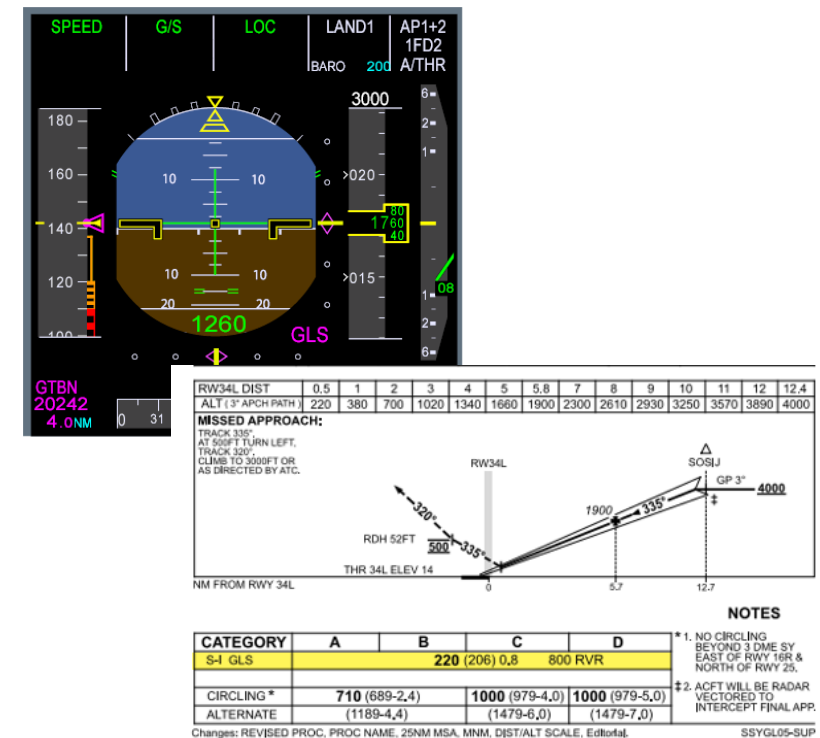
- **GLS Cat 2 Extension – European project:**

- GLS Autoland trials performed with Lufthansa & DFS with specific GBAS Cat 1 ground stations fitted with SBAS receivers in order to get GLS Cat 2 Airworthiness approval by 2019

- **GLS Cat 3:**

- Airbus has completed R&T and standardization for **GLS CAT III/III**
- \*GAST-D stations needed to reach Cat 3
- Hardware provisions in new MMR

• **Momentum is now on ground side...**



\*GAST: GBAS Approach Service Type  
 MMR: Multi-Mode Receiver

# Airbus Fleet Readiness review for A320/A330/A350/A380

SLS & GLS: Two complementary Satellite Based Autoland capabilities

## Future

**SLS Cat I & Cat II with autoland**  
**GLS Cat II & Cat III with autoland**

A320

2009: GLS Cat I with autoland  
2019: GLS Cat II with autoland  
2019: Five SLS autoland performed on A320NEO  
2020: SLS Cat I

A350

2014: GLS Cat I with autoland  
2014: SLS Cat I

A330

2014: GLS Cat I with autoland  
2021: SLS Cat I

**Beluga-XL: 2020: SLS Cat I**

A380

2008: GLS Cat I with autoland  
2021: SLS Cat I

GBAS & SBAS are GNSS  
GLS: GBAS Landing System  
SLS: SBAS Landing System

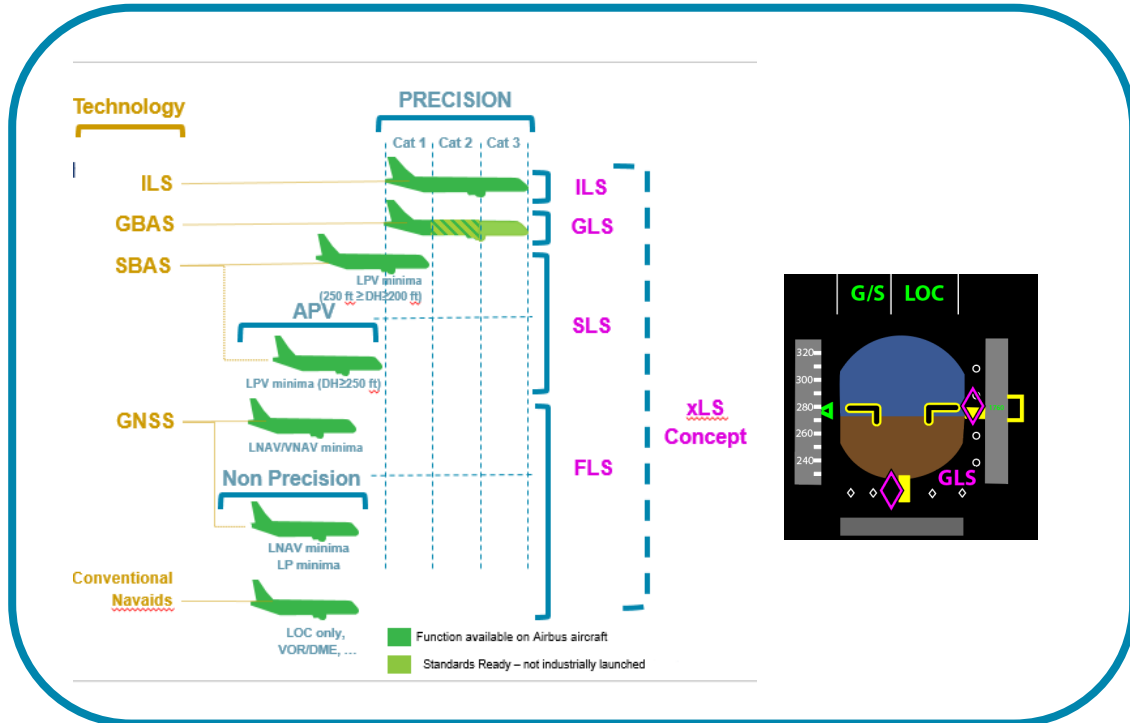
**AIRBUS**

# Airbus Fleet Readiness review for A320/A330/A350/A380

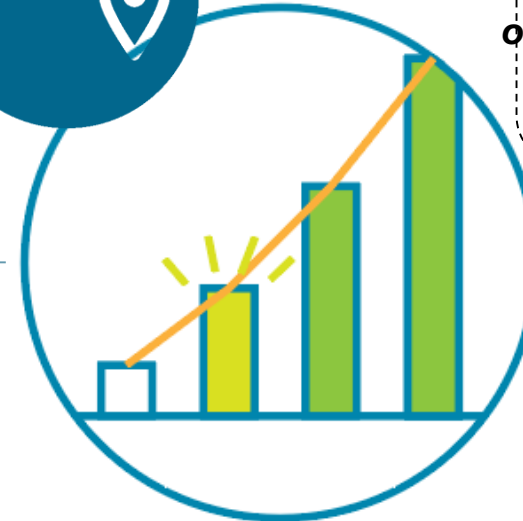
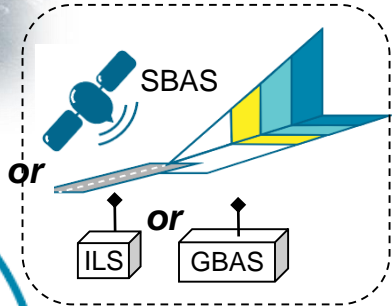
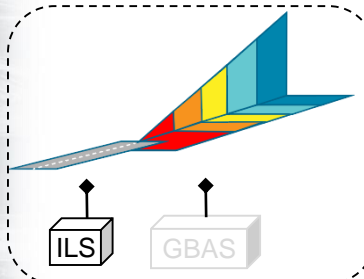
	A320	A330	A350	A380
<b>ILS</b> With Autoland	Basic	Basic	Basic	Basic
<b>GLS</b> Cat I (With Autoland)	Option	Option	Option	Option
<b>SLS</b>	2020 Option	2020 Option	Option	2021 Option
<b>FLS</b>	Option	Option	Basic	Basic

# Landing Capabilities Roadmap: What's next?

Airport Commissioning roadmaps are key



Aircraft ready with **xLS** Concept



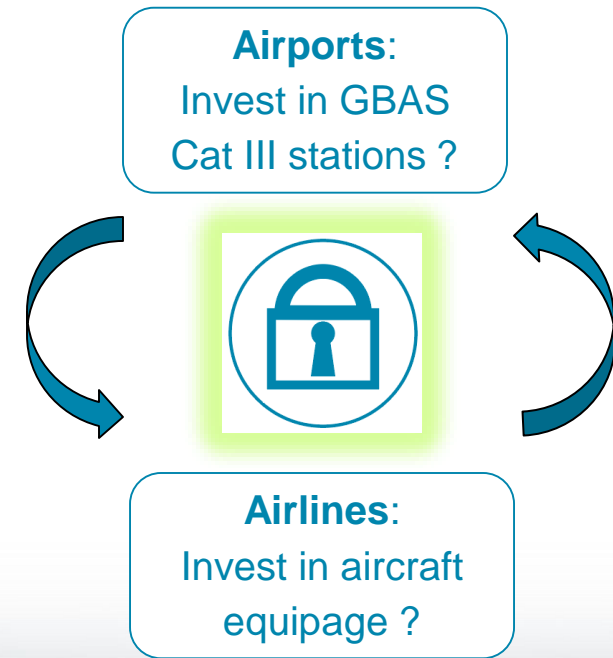
**Airport Commissioning roadmaps need  
Critical mass is key for Airspace users to equip  
e.g. GBAS Alliance project launch**

# Landing Capabilities Roadmap: What's next?

## GBAS Alliance project

- **GBAS Technology is ready but Deployment is a challenge**
  - Indisputable benefits but collective effort is required to deploy the technology
- **GBAS Alliance project proposal:**
  - Airbus, Indra, DFS, ENAV, ENAIRE and PANSAs are proposing to build a **deployment project** of GBAS in Europe CAT II/III for Europe
  - Objectives:
    - Deploy a critical mass of GBAS CAT II/III ground stations;
    - Develop the business case for airspace users to equip their aircraft based on incentive mechanisms
    - Setting up a regulatory framework for both air and ground actors

*Kick-off discussion June 2019*

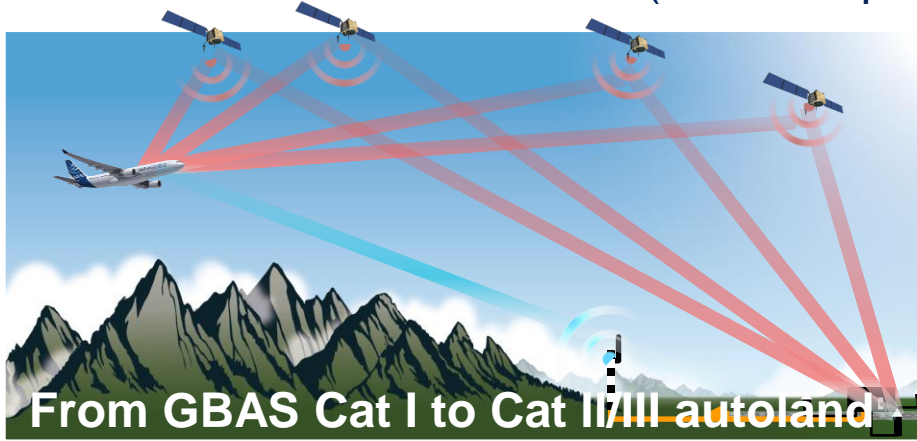


# Landing Capabilities Roadmap: What's next?

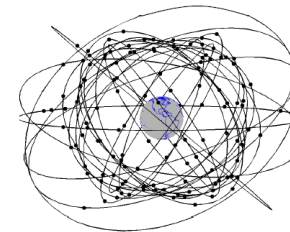
SLS and GLS evolutions towards DFMC GNSS (Dual Frequency Multi-Constellation)



Single Frequency GPS



DFMC GNSS towards 2020-2030



Core constellations



SBAS augmentations



BDSBAS KASS

New MMR & GNSS antenna  
Potential cockpit impacts



New Mandates & Regulations



# Landing Capabilities Roadmap: What's next?

SLS and GLS evolutions towards DFMC GNSS (Dual Frequency Multi-Constellation)



Single Frequency GPS



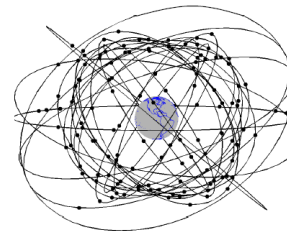
DFMC GNSS towards 2020-2030



GBAS alliance enables solid GBAS technology adoption by airports accelerating aircraft equipage

SBAS becomes a true worldwide system using a unique industry standard, harmonized regulations and States mutual acceptance

SBAS augmentations



SLS is usable worldwide with SBAS recognized autoland capable

# A220 Fleet Readiness Review

Reminder of A220 fleet



**A220-300**

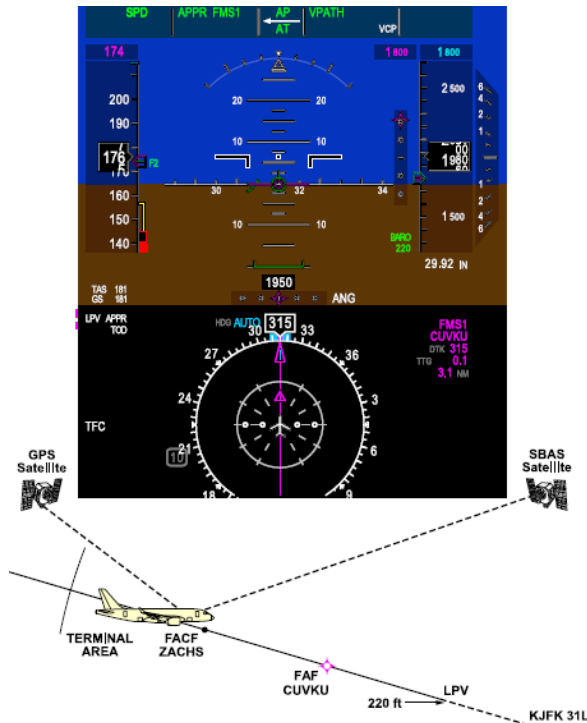
**A220-100**

- The first A220 was delivered to SWISS in June 2016 LPV certified



# A220 Fleet Readiness Review

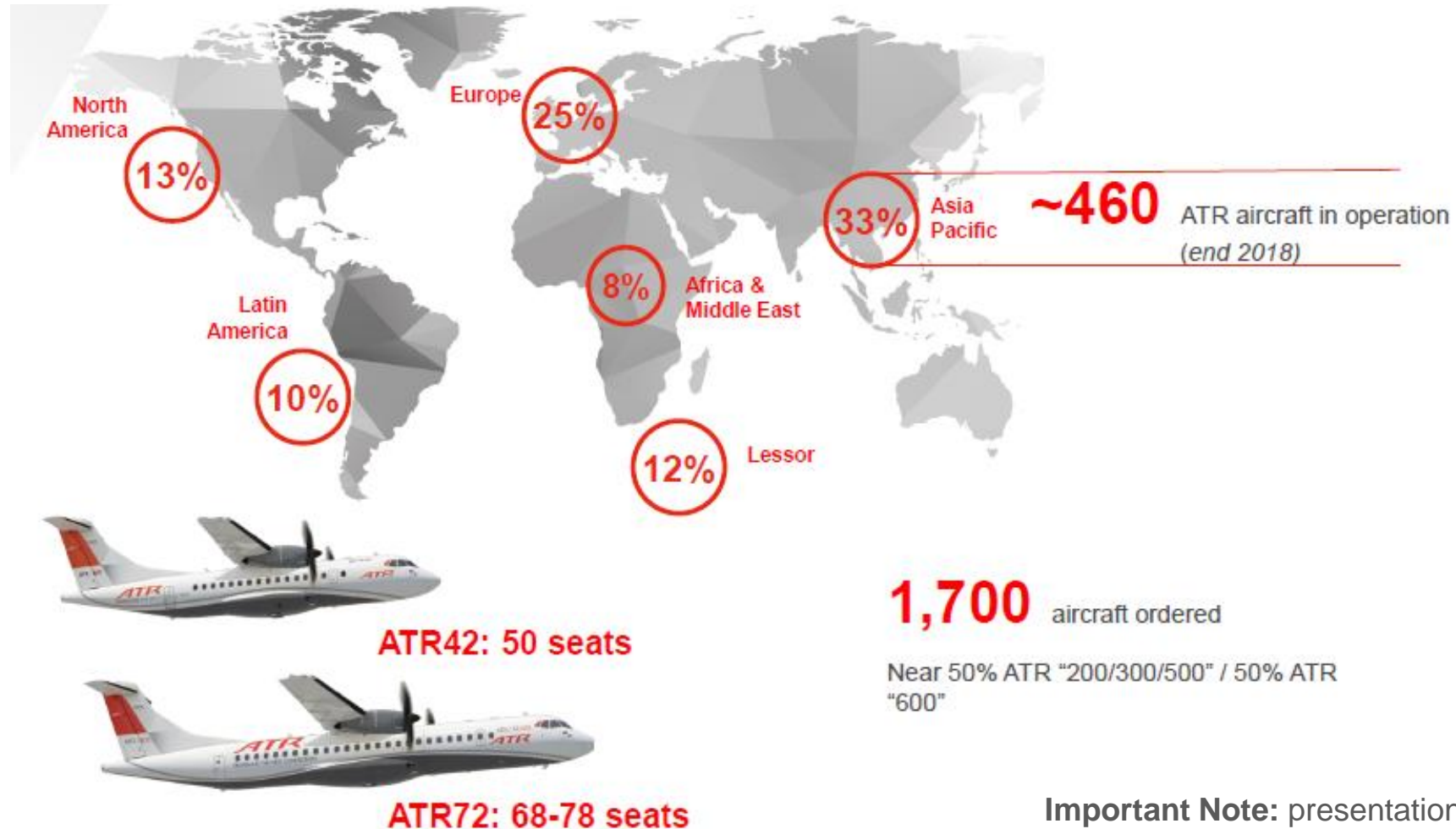
## SBAS & GBAS equipage



- A220 is currently **SBAS capable**, supporting LPV type of approaches.
  - baseline on all aircraft.
- A220 is **NOT GBAS capable** yet.
  - Some of existing customers interested in getting GBAS landing capability - *Under study*

# ATR Fleet Readiness Review

## Reminder of ATR fleet



- Important Note:** presentation is made on behalf of ATR
- ATR Point of contact: Michaël JOBARD – Avionics Specialist



# ATR Fleet Readiness Review for GBAS/GBAS

## ATR PBN CAPABILITIES SUM UP



		ATR 500	ATR 600
		HT1000-060	Since NAS STD2
RNAV 1, RNAV 2, RNAV 5		Yes	Yes
Oceanic & remote	RNAV 10 ; RNP 4	Yes (if 2 <sup>nd</sup> GPS installed)	Yes (if 2 <sup>nd</sup> GPS installed)
	RNP 2	Eligible (if 2 <sup>nd</sup> GPS installed)	Eligible (if 2 <sup>nd</sup> GPS installed)
Continental en-route	RNP 1	Yes	Yes
	RNP 2	Yes	Yes
Approach	LNAV	Yes	Yes
	LNAV/VNAV	NO	Yes
	LPV	NO	Yes (option)
RNP AR (Dep. / Appr. / M-A.)		NO	Yes (option)
RF leg		NO	Yes

- GBAS is **NOT AVAILABLE** on ATR
- No plan to develop GBAS capability, considering PBN implementation & Regional Aircraft specificities

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Thank you