Flight Operations Safety Awareness Seminar (FOSAS)

Technical solutions and design enhancements

Airbus Flight Operations Support and Training Standards
Nairobi, 19-21 Sep. 2017

AIRBUS

Technical solutions and design enhancements

Soft Go-Around

ROPS / RAA

Harmonized PFD

AED (A350)

EFB Weather

On Board

Future Aircraft Projects

AIRBUS

Technical solutions and design enhancements

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Soft Go-Around Function

Why a SOFT Go-Around?

Developed to reduce during go-around:

+ High vertical Speed
+ High Pitch angle
+ High Longitudinal acceleration

› **To Reduce Flight Crew Workload**

› **To Reduce Flight Crew Spatial Disorientation**

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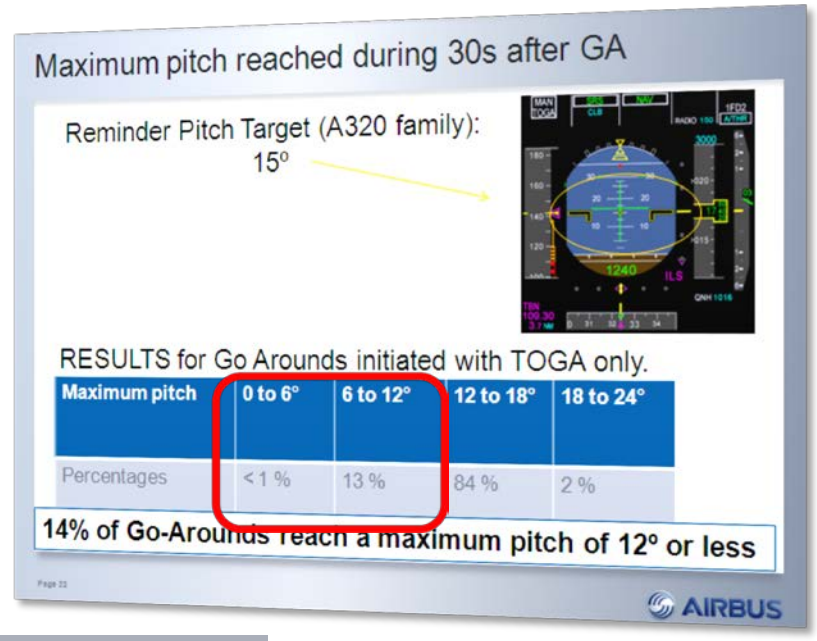
Soft Go-Around Function

Why a SOFT Go-Around?

ROTATION .....PERFORM

According to Go-Around survey

+ **More than 13%** of the Go-Arounds **with TOGA** selection are performed with an initial **Pitch below 12°**



Error → **› Incorrect Pitch Management**

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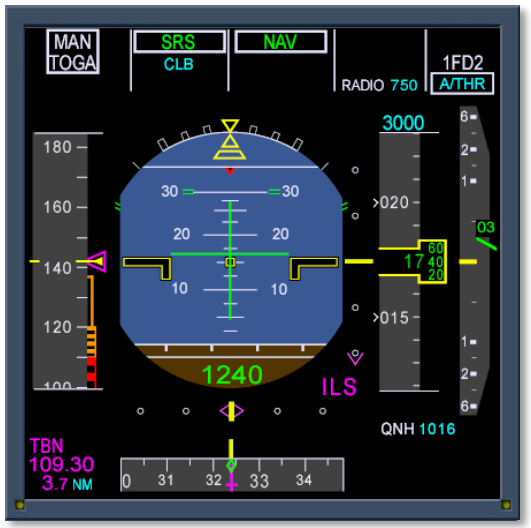
Soft Go-Around Function

Why a SOFT Go-Around?

ROTATION .....PERFORM

+When flying manually, rotate towards the Go-Around pitch target:



A320
A330
A340-500/600
15 º

A380/A350
A340-200/300
12.5 º

SOP

› Know your Go-Around Initial Pitch Target

A300/A310
18 º

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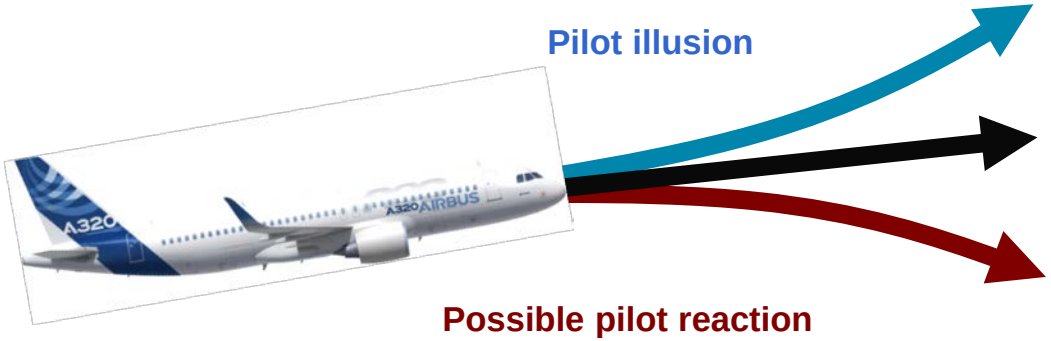
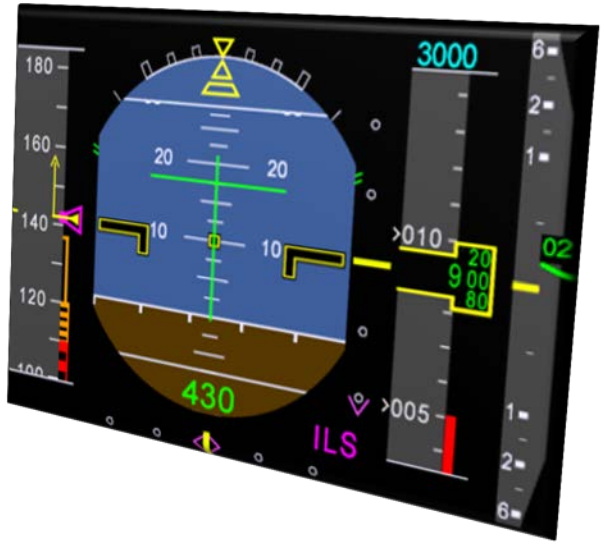
Soft Go-Around Function

Why a SOFT Go-Around?

ROTATION .....PERFORM

+ If during a manual go-around the required pitch is not reached or maintained:
  + Linear acceleration will result,
  + This could induce, “false climb illusion”





SOP › **Fly the correct pitch**

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Soft Go-Around Function

› All Engines Operative (AEO) only

Principle : Thrust Mode

Manual thrust mode	• Same thrust management
Available during go-around	• Same engagement conditions
Pre-computed engine thrust	• Rate of Climb: Approx. 2000ft/min • Cockpit Indications
If 2000 ft/min cannot be reached (e.g. overweight)	• GA soft thrust = TOGA thrust

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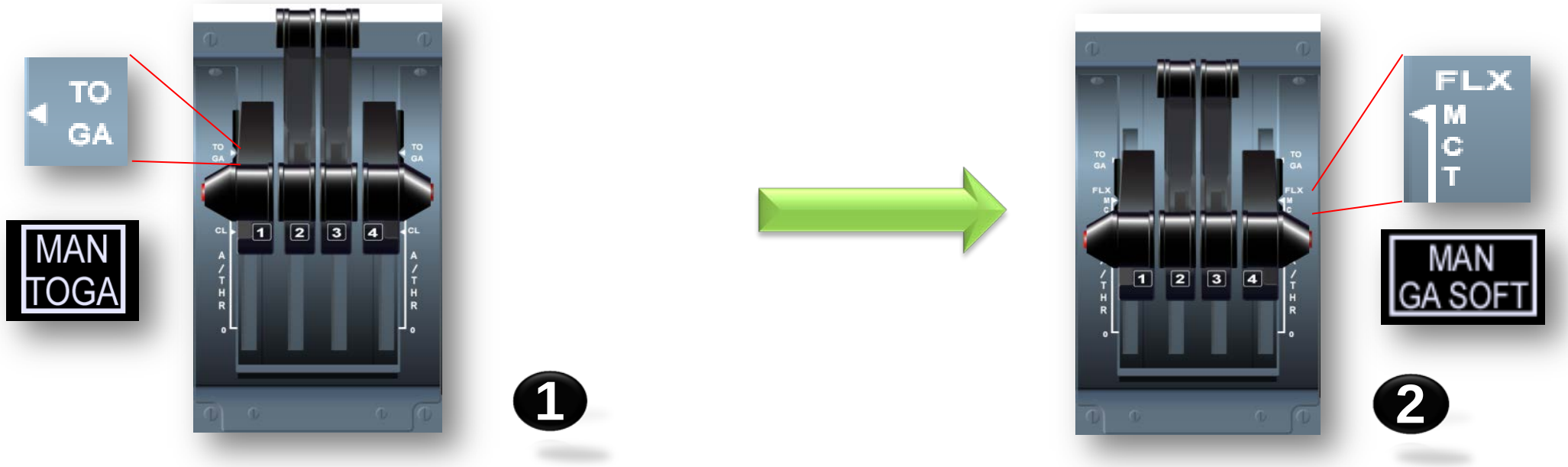
Soft Go-Around Function

How to activate?

+TOGA detent then FLEX/MCT detent



›GA initiation: TOGA (no change)

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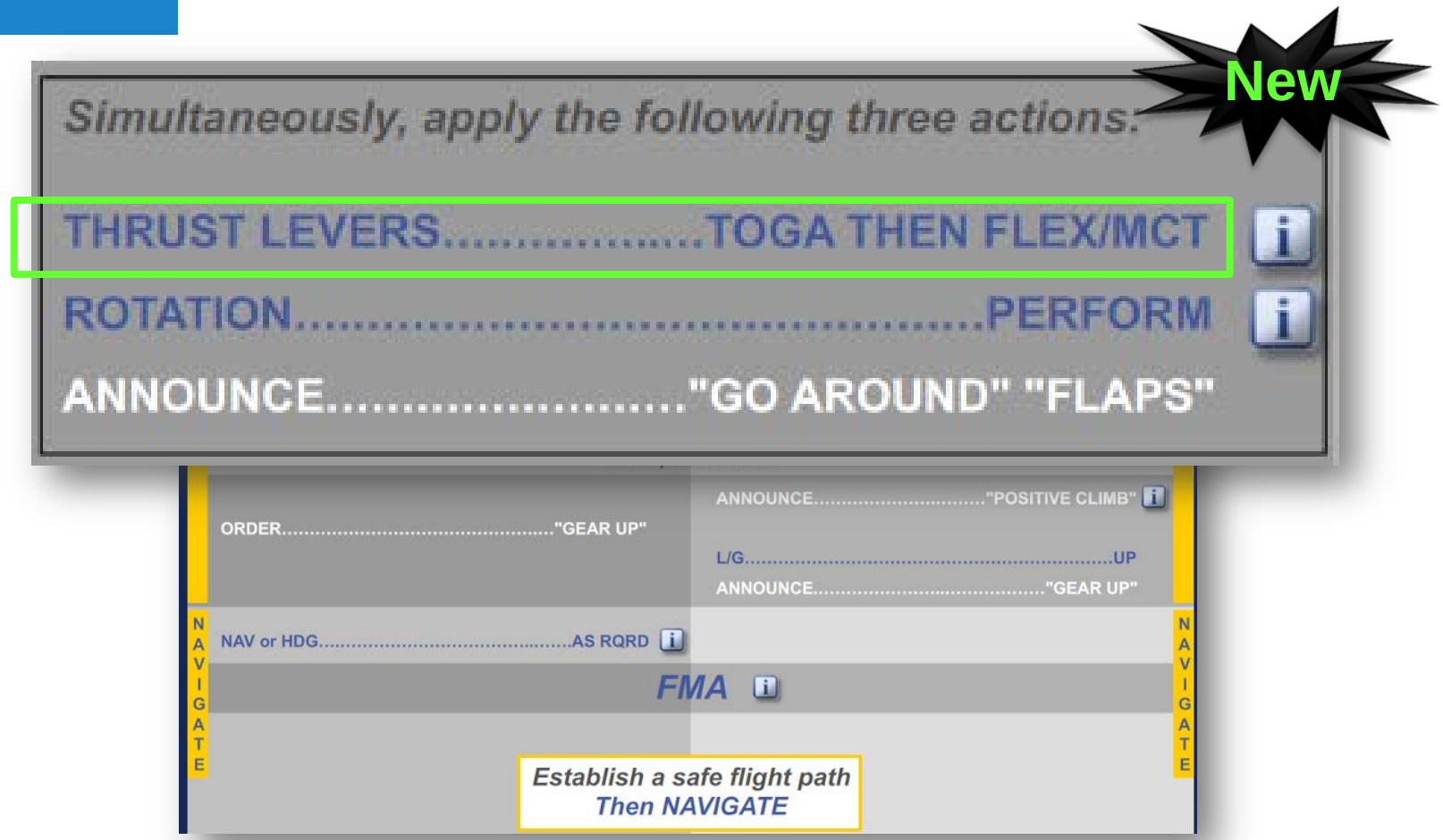
Soft Go-Around Function

Procedure



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Soft Go-Around Function

Availability

A300/A310 family A340	• Not planned
A320 family	• Optional on the A320neo (2015), not planned on the A320ceo
A330	• Optional for A330 aircraft delivery (2015)
A380	• Optional
A350 XWB	• Basic

Technical solutions and design enhancements

Soft Go-Around

ROPS / RAA

Harmonized PFD

AED (A350)

EFB Weather On Board

Future Aircraft Projects

AIRBUS

Preventing Runway Overruns and Incursions: The Airbus Solutions

Preventing Runway Overruns and Incursions:
First Line of Safety = SOPs

Remaining In-Service Events

Continuous Innovations developed by Airbus
Available on most of the Airbus Fleet
To Enhance Safety

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Preventing Runway Overruns and Incursions: The Airbus Solutions

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Preventing Runway Overruns and Incursions: A Global Offer

Preventing Runway Overruns: Runway Overrun Prevention System

Preventing Runway Overruns: ROPS Objectives

OBJECTIVES

Improve flight crew awareness during the landing phase about the risk of runway overrun:

- ✓ During approach: It helps the flight crew with the decision of performing a go-around
- ✓ After touchdown: It warns the flight crew about the risk of overrun and requests relevant braking actions

Preventing Runway Overruns: ROPS Principles

Aircraft localization
- Runway data
- Aircraft position

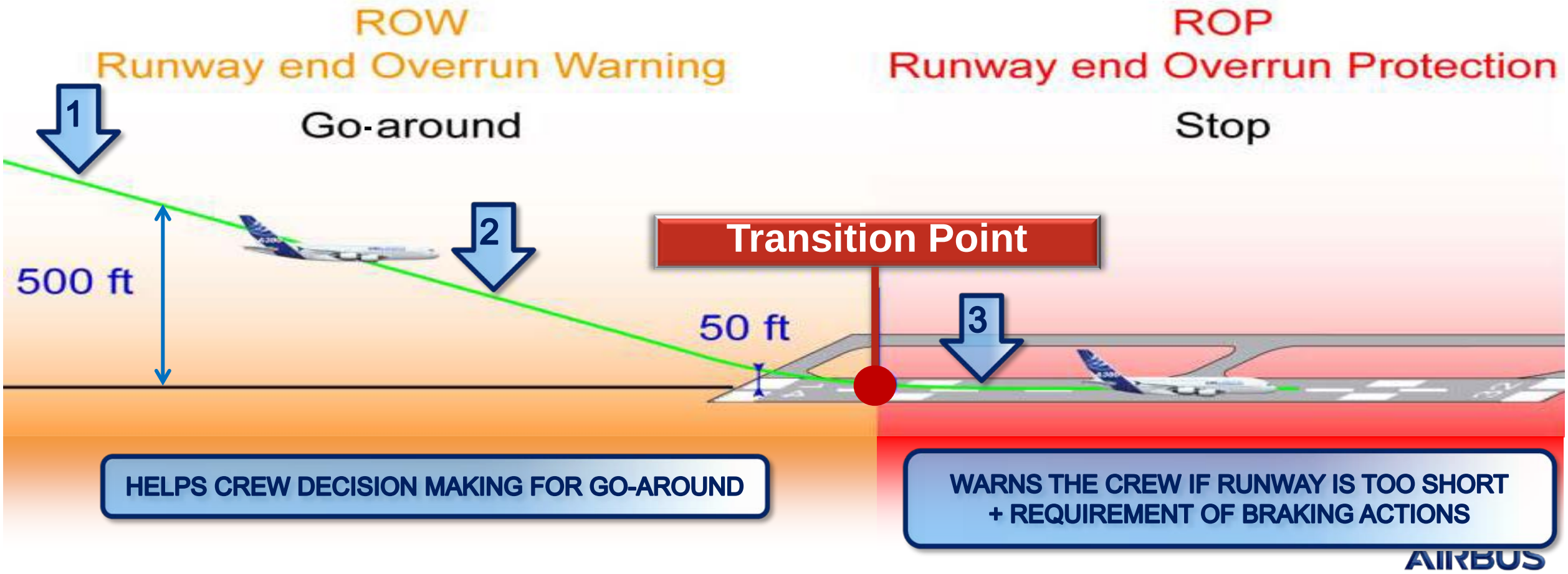
Flight parameters
- Ground speed
- Vertical speed
- Landing configuration
- Wind

- Landing Distance computation on dry & wet runways
- Real-time comparison with the current runway length

Preventing Runway Overruns: ROPS Principles

ROPS Runway Overrun Prevention System = ROW + ROP =

The Airbus solution to prevent runway overrun during landing phases



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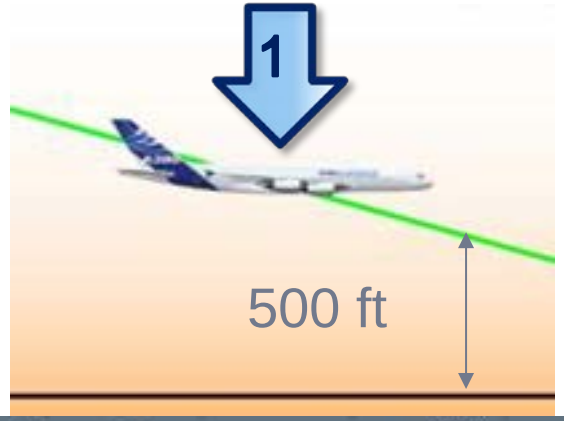
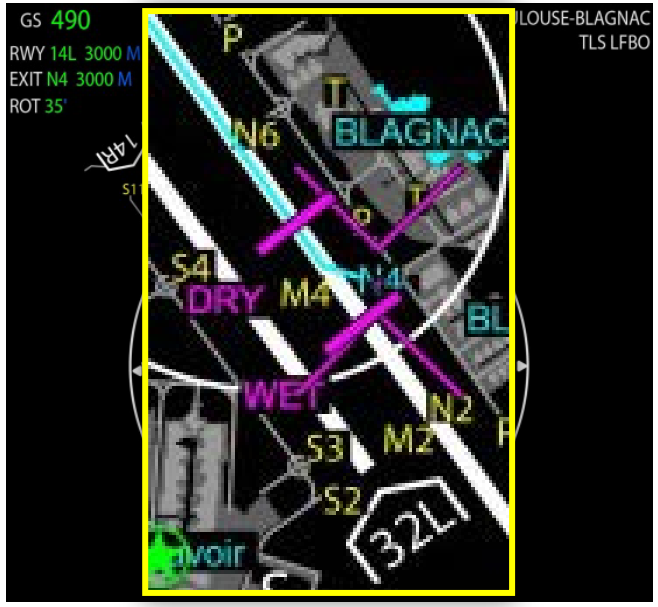
Preventing Runway Overruns: ROW Principle (A380 & A350 only _ Above 500 ft)



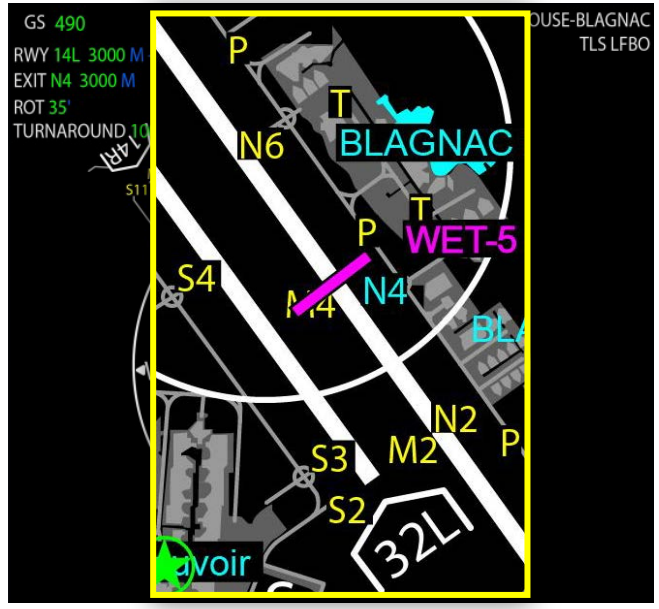


ND

- ND: Mode PLAN Zoom 2 NM
- SOP: DES preparation (Runway selected)
- <u>Assumptions</u>: Normal landing, Max. Braking, Idle Rev. on dry runway / Max Rev on wet runway

➢ <u>Predictive</u> ROW (Above 500 ft) available on ND

= Minimum achievable landing distance (+ 15%)



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Preventing Runway Overruns: ROW Principle (A320, A330, A340, A380)

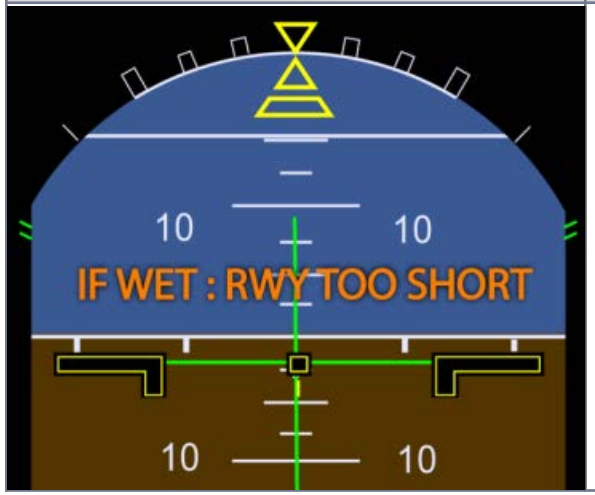
1st case

Risk of Runway Excursion on Wet Runway only

Preventing Runway Overruns: ROW Principle (A320, A330, A340, A380)

PFD (Below 500 ft)	Aural	Pilot Action (Below 500 ft)
	None	Go-around decision if runway condition is not DRY

Preventing Runway Overruns: ROW Principle (A380)

PFD (Below 500 ft)	Aural	Pilot Action (Below 500 ft)
	None	Go-around decision if runway condition is not DRY

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Preventing Runway Overruns: ROW Principle (A380)

PFD (Below 500 ft)	**Aural**	**Pilot Action** (Below 500 ft)	ND (A380)
	None	Go-around decision if runway condition is not DRY	

Preventing Runway Overruns: ROW Principle (A320, A330, A340, A380)

2nd case

Risk of Runway Excursion on both Wet and Dry Runway

Preventing Runway Overruns: ROW Principle (A320, A330, A340, A380)

PFD (Below 500 ft)	Aural (Below 200 ft)	Pilot Action (Below 500 ft)
	**"RWY TOO SHORT !"**	Go-around decision regardless of runway condition

Preventing Runway Overruns: ROW Principle (A380)

PFD (Below 500 ft)	Aural (Below 200 ft)	Pilot Action (Below 500 ft)
	**"RWY TOO SHORT !"**	Go-around decision regardless of runway condition

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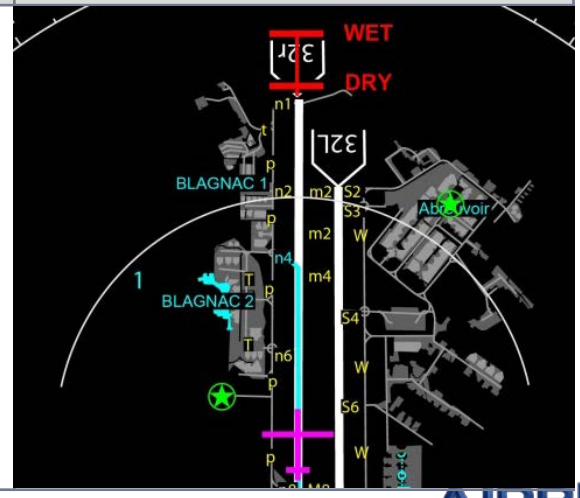
Preventing Runway Overruns: ROW Principle (A380)

PFD (Below 500 ft)	**Aural** (Below 200 ft)	**Pilot Action** (Below 500 ft)	ND (A380)
	**"RWY TOO SHORT !"**	Go-around decision if runway condition is not DRY	

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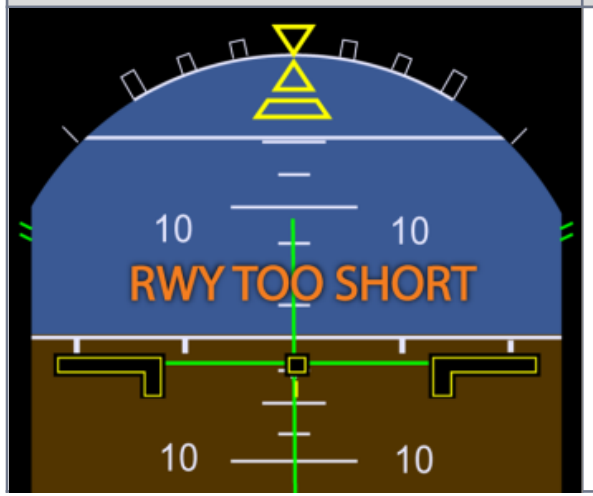
Preventing Runway Overruns: ROW Principle (A350 only)

PFD (Below 500 ft/above 200 ft)	**Aural**	**Pilot Action** (Below 500 ft/above 200 ft)	ND (A350)
	None	No pilot action. Be ready to initiate a Go-around.	

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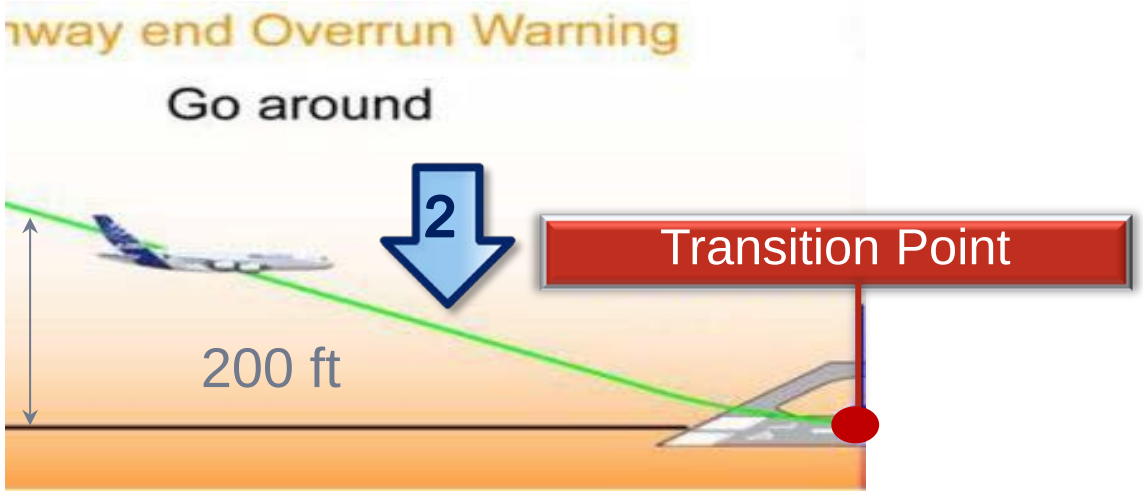
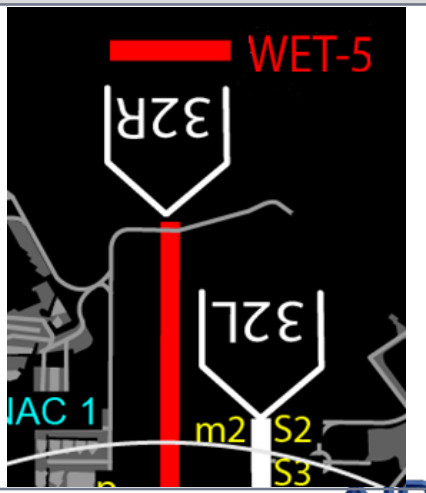
Preventing Runway Overruns: ROW Principle (A350 only)



PFD (Below 200 ft)	**Aural** (Below 200 ft)	**Pilot Action** (Below 200 ft)	ND (A350)
	**"RWY TOO SHORT !"** 	Go-around	

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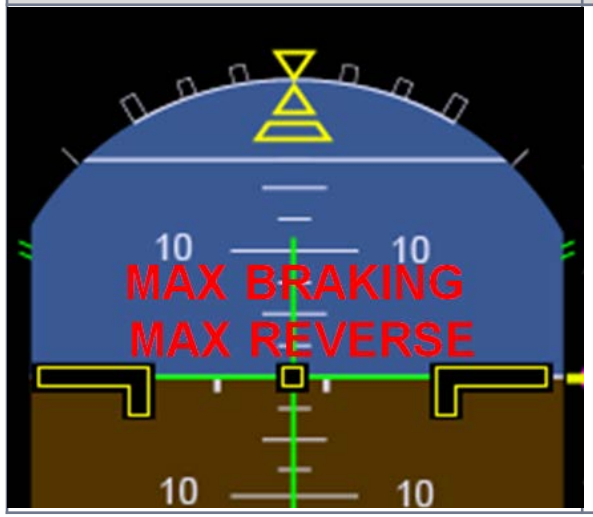
ROP Principle (A320, A330, A340, A380, A350)

PFD (On ground)	Aural (On ground)	Pilot Action (On ground)
	**"BRAKE…MAX BRAKING …MAX BRAKING"**  - If Max Braking applied and Max Reverse not selected, **"MAX REVERSE"**  - If there is still a risk of runway excursion at 80 kt **"KEEP MAX REVERSE"** 	Max Braking Max Reverse

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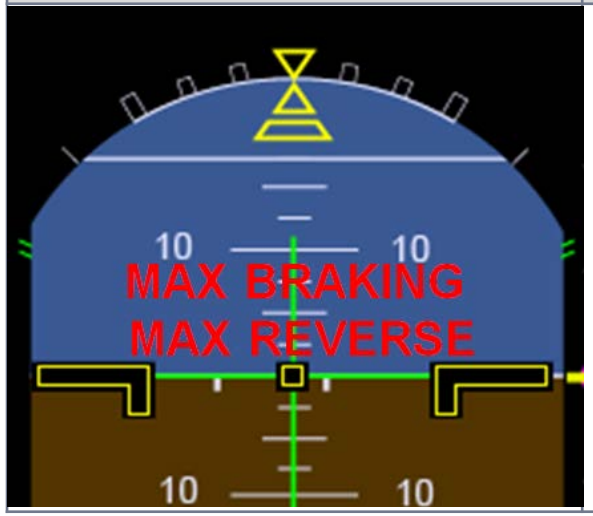
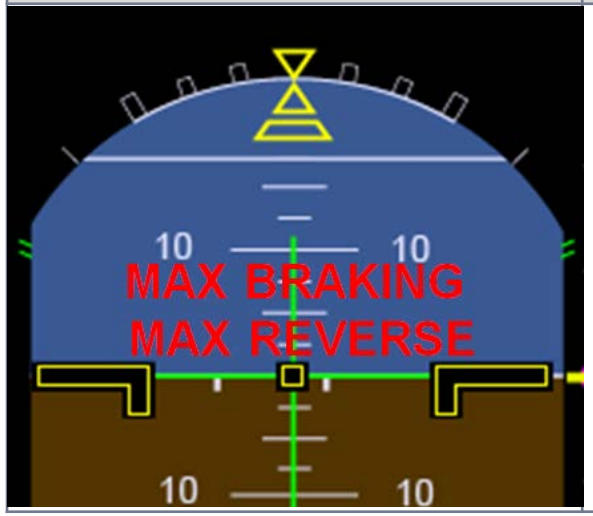
ROP Principle (A380, A350)

PFD (On ground)	Aural (On ground)	Pilot Action (On ground)
	**"BRAKE…MAX BRAKING …MAX BRAKING"** - If Max Braking applied and Max Reverse not selected, **"MAX REVERSE"** - If there is still a risk of runway excursion at 80 kt **"KEEP MAX REVERSE"**	Max Braking Max Reverse

ROP Principle (A380, A350)

PFD (On ground)	**Aural** (On ground)	**Pilot Action** (On ground)	ND (A350, A380) Autobrake modes
	**"BRAKE…MAX BRAKING …MAX BRAKING"** - If Max Braking applied and Max Reverse not selected, **"MAX REVERSE"** - If there is still a risk of runway excursion at 80 kt **"KEEP MAX REVERSE"**	Max Braking Max Reverse	

Preventing Runway Overrun: Illustration

ROPS
Runway Overrun Prevention System

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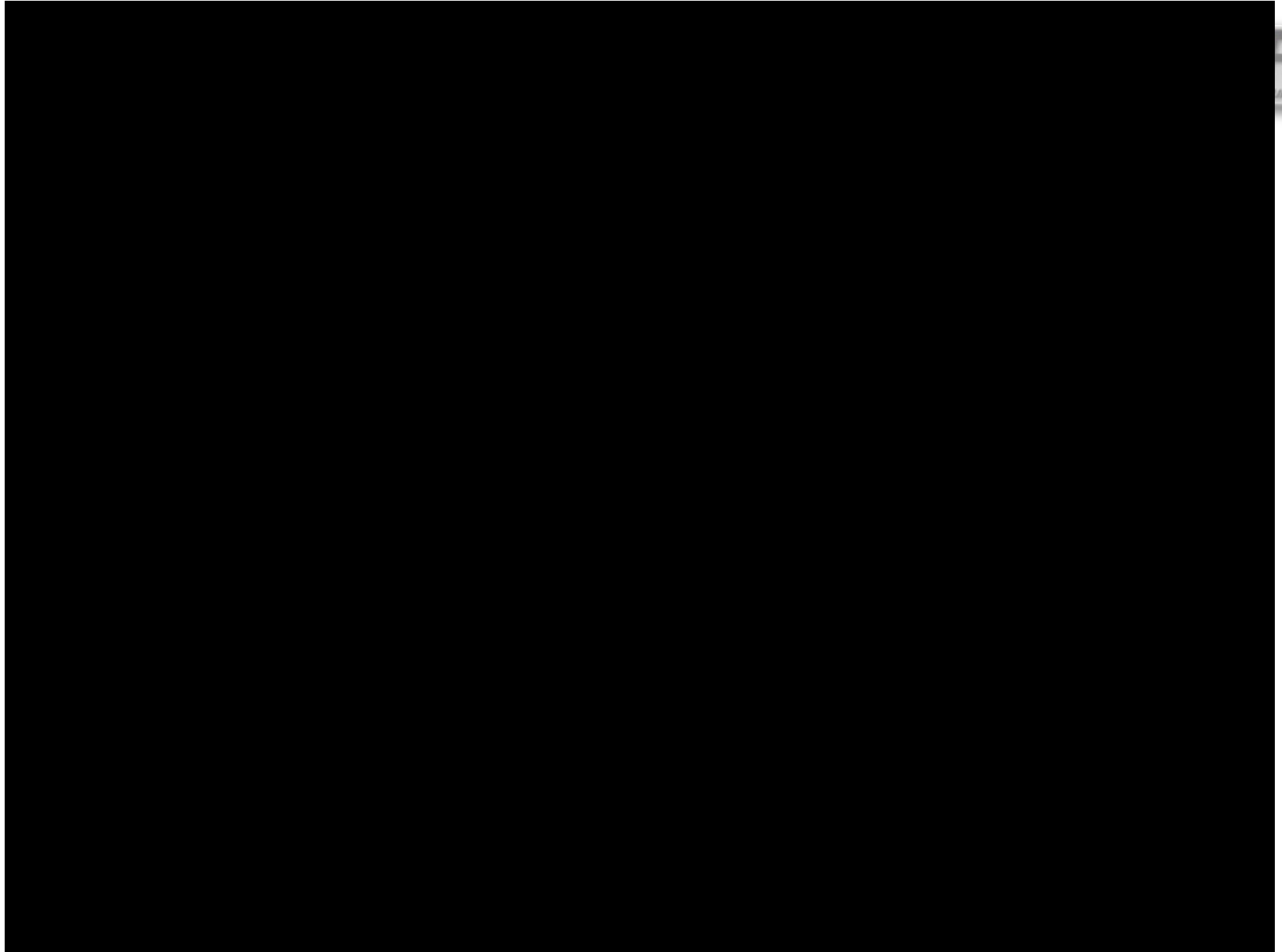
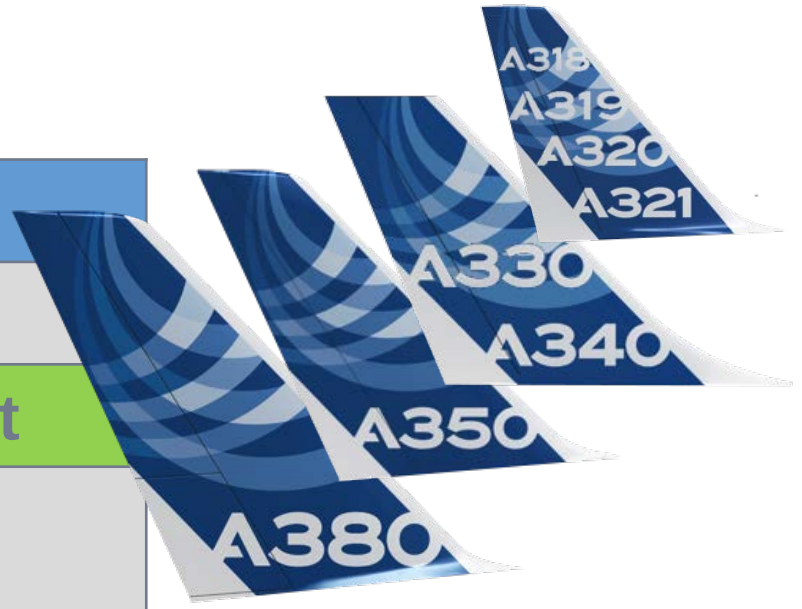
ROPS



Preventing Runway Overrun: Availability on the Airbus Fleet

ROPS
Runway Overrun Prevention System

Aircraft Family	Status
A300/A310	Not applicable
A320/A320neo	Available as an Option/**Retrofit**
A330/A340	Option/Retrofit A330: 2015 A340: 2016
A380	Option associated with BTV/**Retrofit**
A350 XWB	Basic associated with BTV



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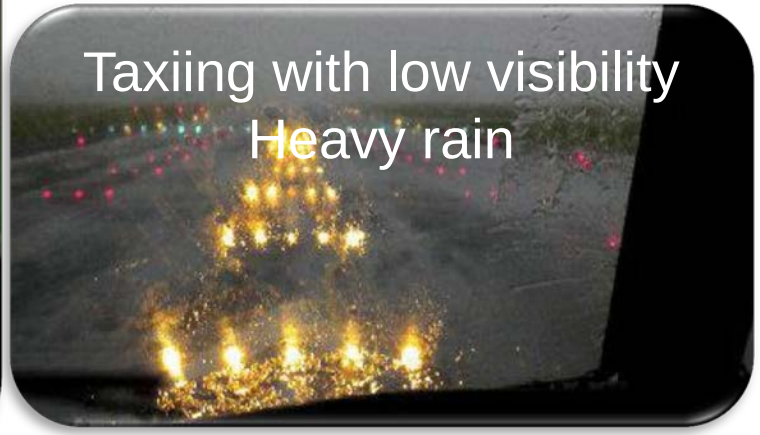
Preventing Runway Incursion: RAA

Preventing Runway Incursion: Challenging Airport Situations



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Preventing Runway Incursion: Runway Approaching Advisory

OBJECTIVES

Improve the flight crew awareness when the aircraft approaches:

- ✓ a runway when taxiing on a taxiway
- ✓ a runway intersection, when taxiing on a runway

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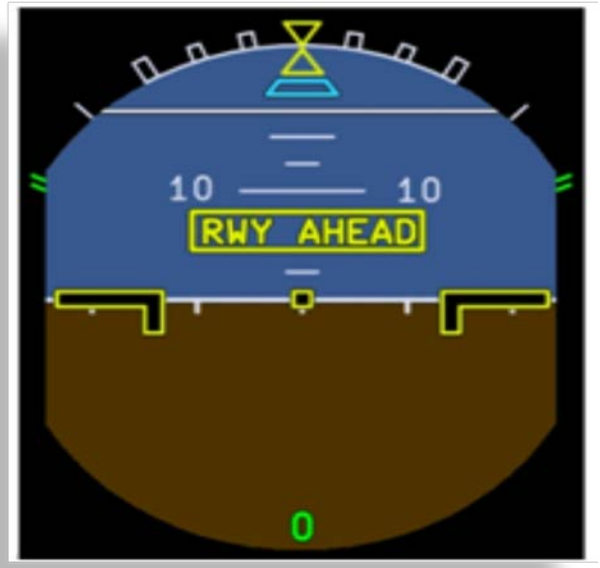
Preventing Runway Incursion: RAA Principle

Aircraft localization
- Runway data
- Aircraft position

Aircraft speed

Elapsed time before entering into the following runway/runway intersection

Preventing Runway Incursion: RAA Principle



PFD

ACTIVATION

- ✓ Taxi in/out phases (aircraft speed < 40 kt)
- ✓ Warnings displayed 7 s before the aircraft nose enters the protected area
- ✓ PFD: "RWY AHEAD" flashing
- ✓ ND: Various attention getters flashing
- ✓ Only visual alert to give priority to ATC clearance

ND

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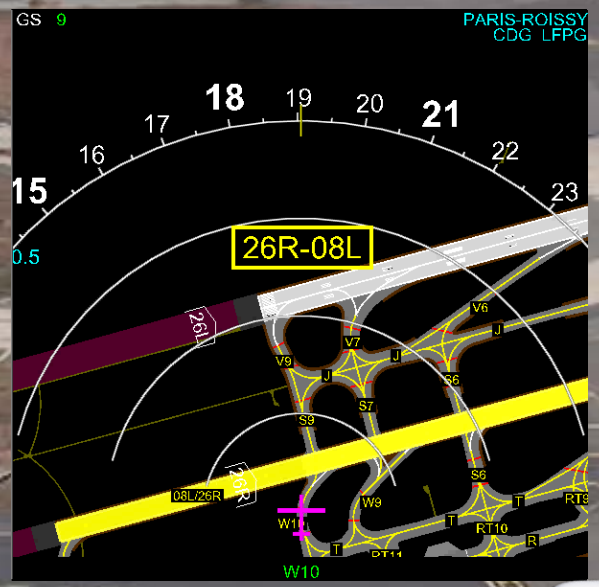
Preventing Runway Incursion: RAA Illustration (1/2)

Preventing Runway Incursion: RAA Illustration (2/2)

ARC or ROSE NAV mode + ZOOM

PFD



ND

ND

Preventing Runway Incursion: Availability on the Airbus Fleet

Aircraft family	Status
A300/A310	Not applicable
A320/A320neo	Available as an Option/Retrofit
A330/A340	
A380	
A350 XWB	Basic

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Preventing Runway Overruns and Incursions: Conclusion

Preventing Runway Overrun and Incursion:
A various set of innovations in aircraft design for safety enhancement:

- ✓ Progressive availability on most of the Airbus fleet
- ✓ Minor training impact

First Line of Safety = SOPs

Technical solutions and design enhancements

Soft Go-Around

ROPS / RAA

Harmonized PFD

AED (A350)

EFB Weather

On Board

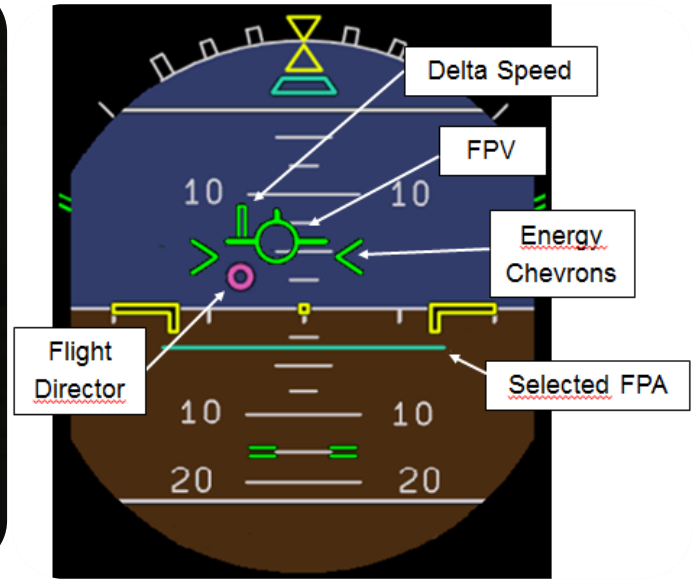
Future Aircraft Projects

AIRBUS

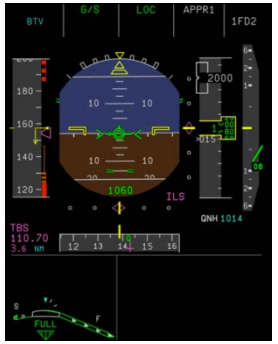
Harmonized PFD (hPFD)

Operational Advantage

- **Flight references on PFD** appear **similar to HUD when TRK/FPA mode** is selected
- **Help** the **transition** from **Head up** to **Head down**
- **Symbology consistent with future Enhanced/Synthetic Vision Systems**



TRK-FPA mode



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Harmonized PFD (hPFD)

Interface

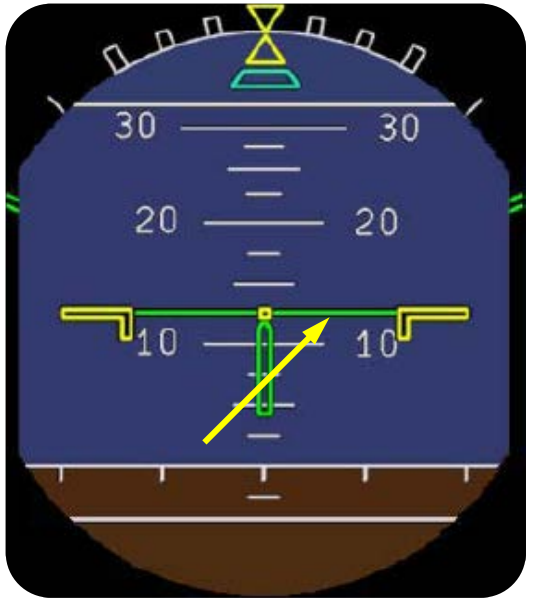
+Flight Director pitch bar at takeoff

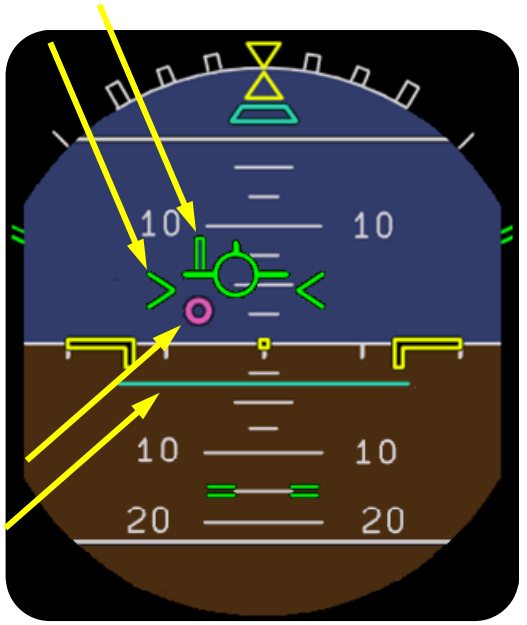
+Flight Path Director (or Donut FD)

+Energy Chevrons

+Speed Delta (on left FPV wing)

+Display of the selected FPA





Harmonized PFD (hPFD)

Availability

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Technical solutions and design enhancements

Soft Go-Around

ROPS / RAA

Harmonized PFD

AED (A350)

EFB Weather

On Board

Future Aircraft Projects

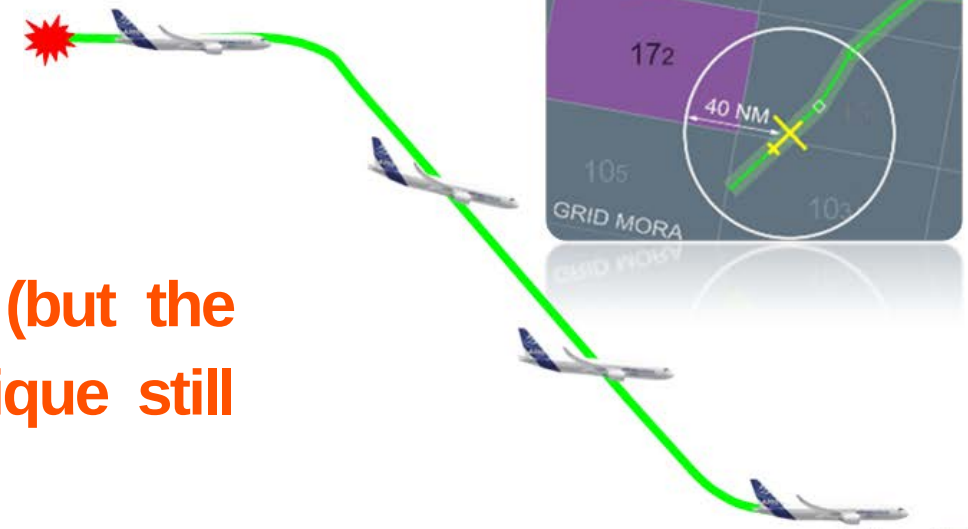
AIRBUS

Automatic Emergency Descent (AED)

Operational Benefit

- **Flight Crew Workload Reduction (but the conventional EMER DES technique still possible)**

- **If flight crew incapacitated (hypoxia): The aircraft automatically descends**



Max(FL100, 40 NM Grid MORA)

Availability
A350-900: Q1 2018
A350-1000: Baseline

Level B Training

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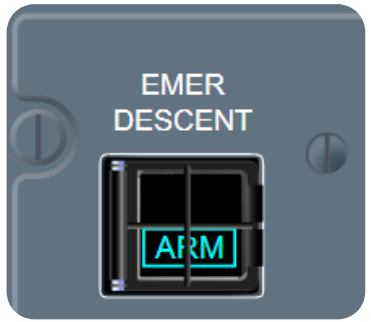
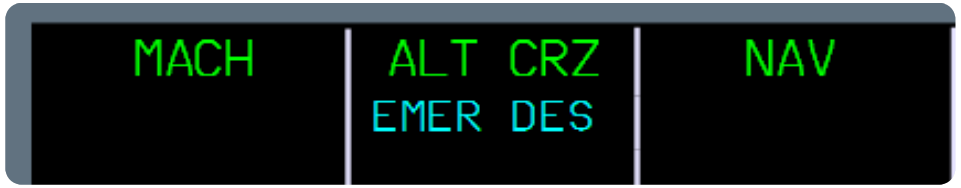
Automatic Emergency Descent (AED)

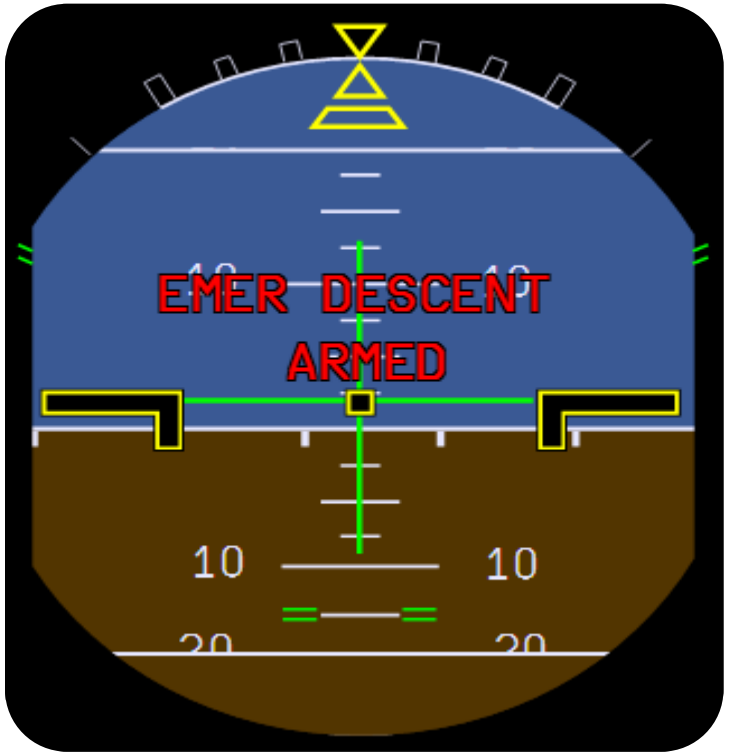
Interface



+ New EMER DESCENT pushbutton on center pedestal

+ New AP/FD EMER DES mode and PFD messages





+ Flight crew can interact at any time
+ *In case of RA during AED, AP/FD TCAS mode automatically engages until RA resolutions.*

  AED resumes if EMER DES conditions are still present

Automatic Emergency Descent (AED)

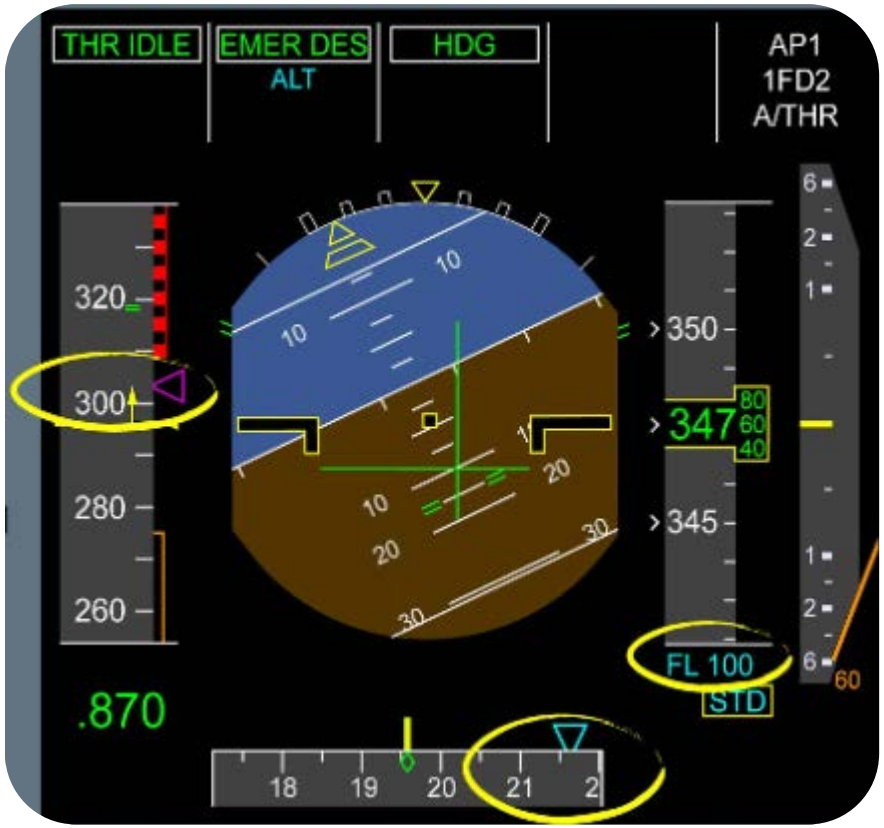
Manual Operation

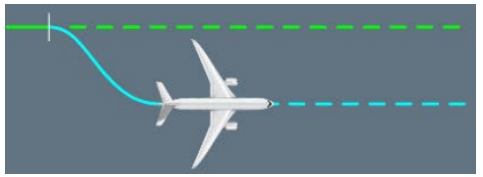
+ The flight crew presses the EMER DESCENT pb

Automatic Emergency Descent (AED)

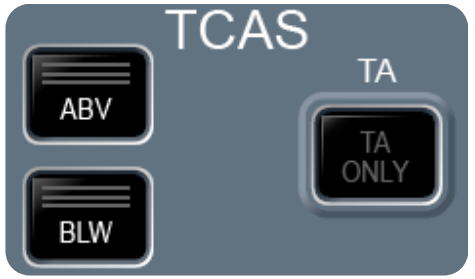
Manual Operation

+ The flight crew extends the speed brakes





3 NM side step



TCAS BLW mode

+

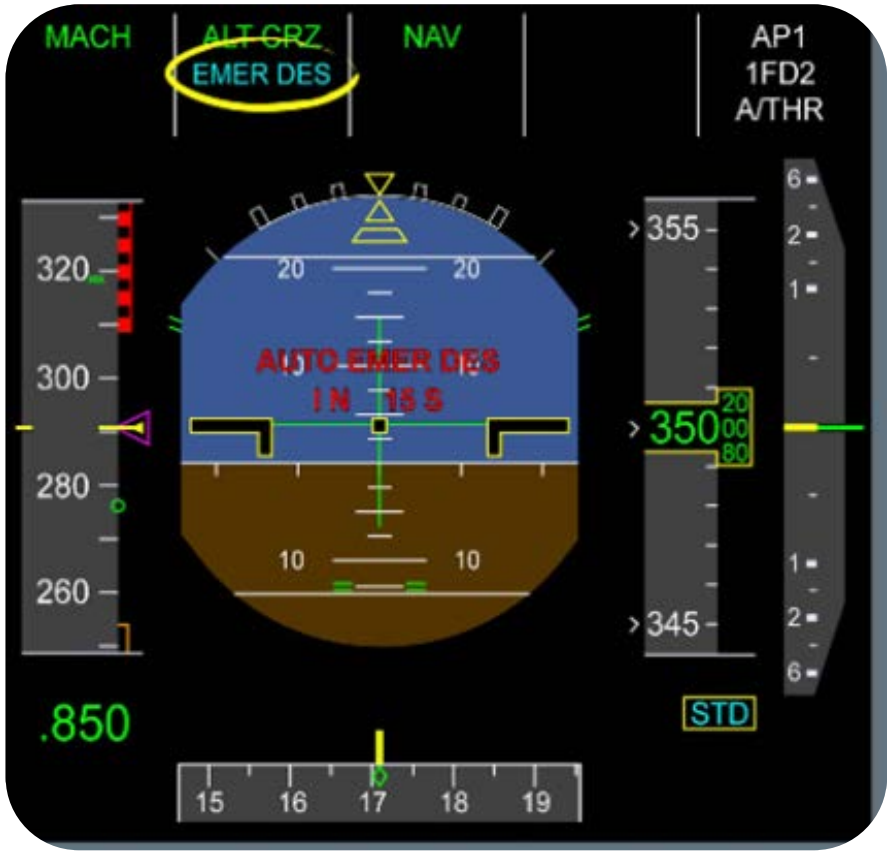
Automatic squawk 7700

Automatic Emergency Descent (AED)

Automatic Operation

+ Countdown if CAB ALT >14 000 ft within15 s

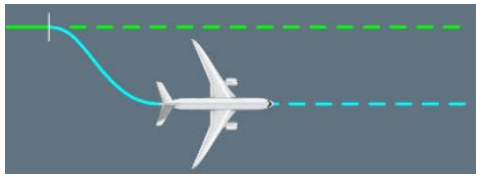
The ARM indication flashes.



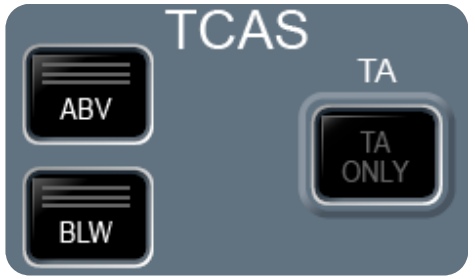
Automatic Emergency Descent (AED)

Automatic Operation

+ Without crew action: Automatic engagement of AP/FD EMER DES & HDG modes



3 NM side step



TCAS BLW mode

+

Automatic squawk 7700

Automatic Emergency Descent (AED)

Memory Items

+ No change.

+ But 2 techniques now available to initiate EMER DESCENT

[MEM] EMER DESCENT

If the pressure altitude is above 10 000 ft:

- CREW OXY MASKS ..... USE

- SIGNS ..... ON
- EMER DESCENT ..... INITIATE

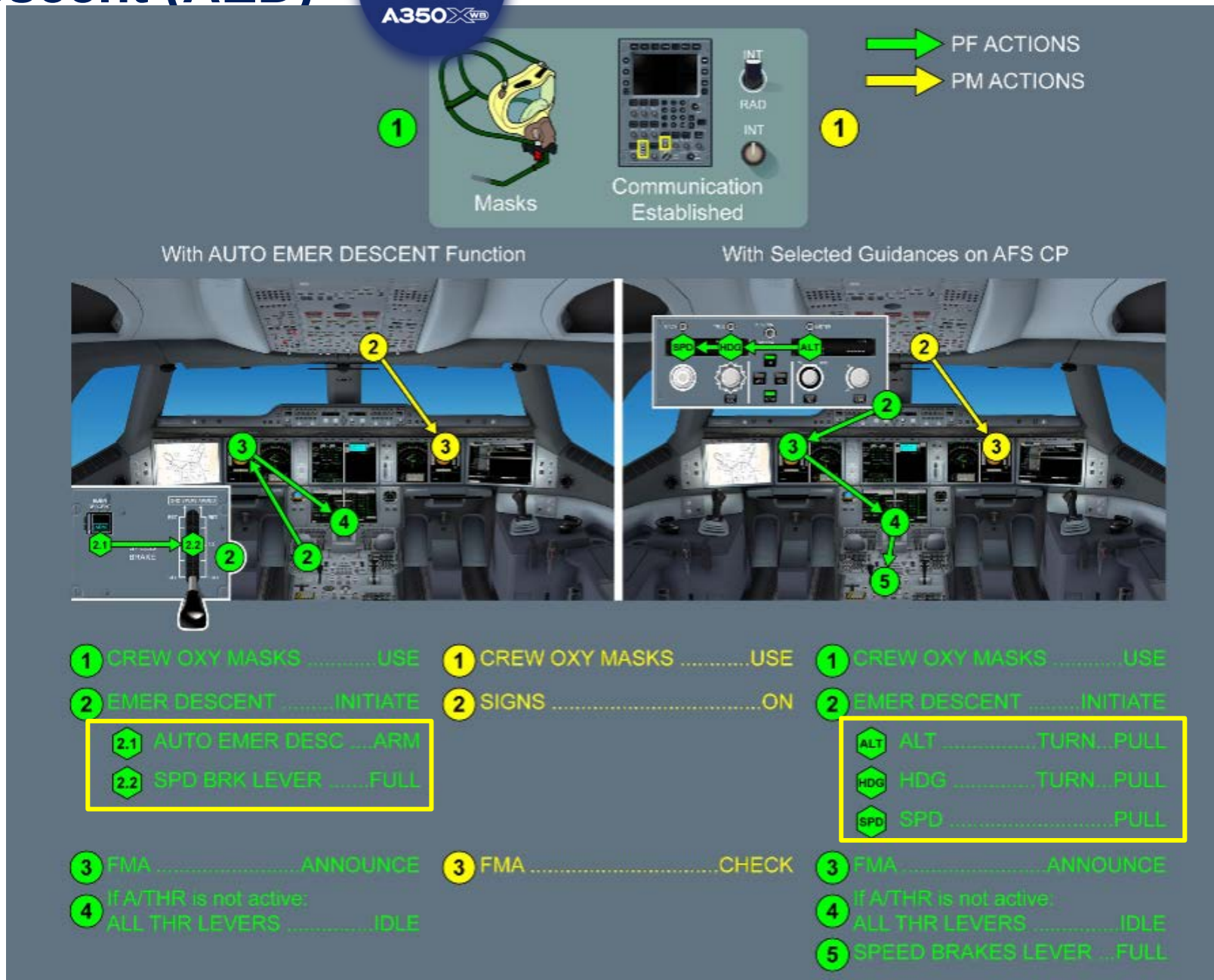
Initiate the emergency descent with one of the following techniques:

- *Use of the AUTO EMER DESCENT function*
- *Use of selected guidance via the AFS CP.*

If A/THR is not active:

- ALL THR LEVERS ..... IDLE

- SPEED BRAKES LEVER ..... FULL



Technical solutions and design enhancements

Soft Go-Around

ROPS / RAA

Harmonized PFD

AED (A350)

EFB Weather

On Board

Future Aircraft Projects

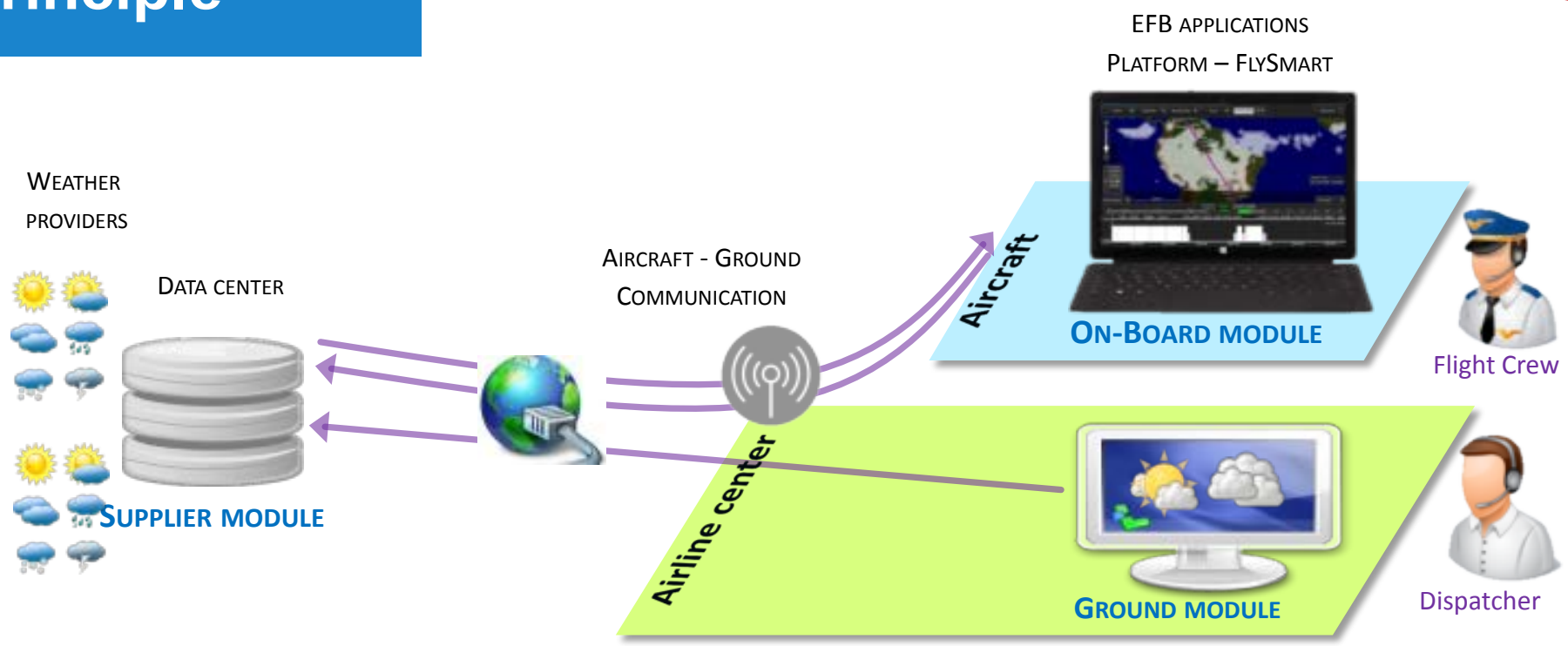
AIRBUS

EFB - Weather On Board

A320 A330 A340 A350XWB A380

Deployment in Progress

Principle



Very useful strategic tool, to anticipate before the weather radar's range

AIRBUS

EFB - Weather On Board

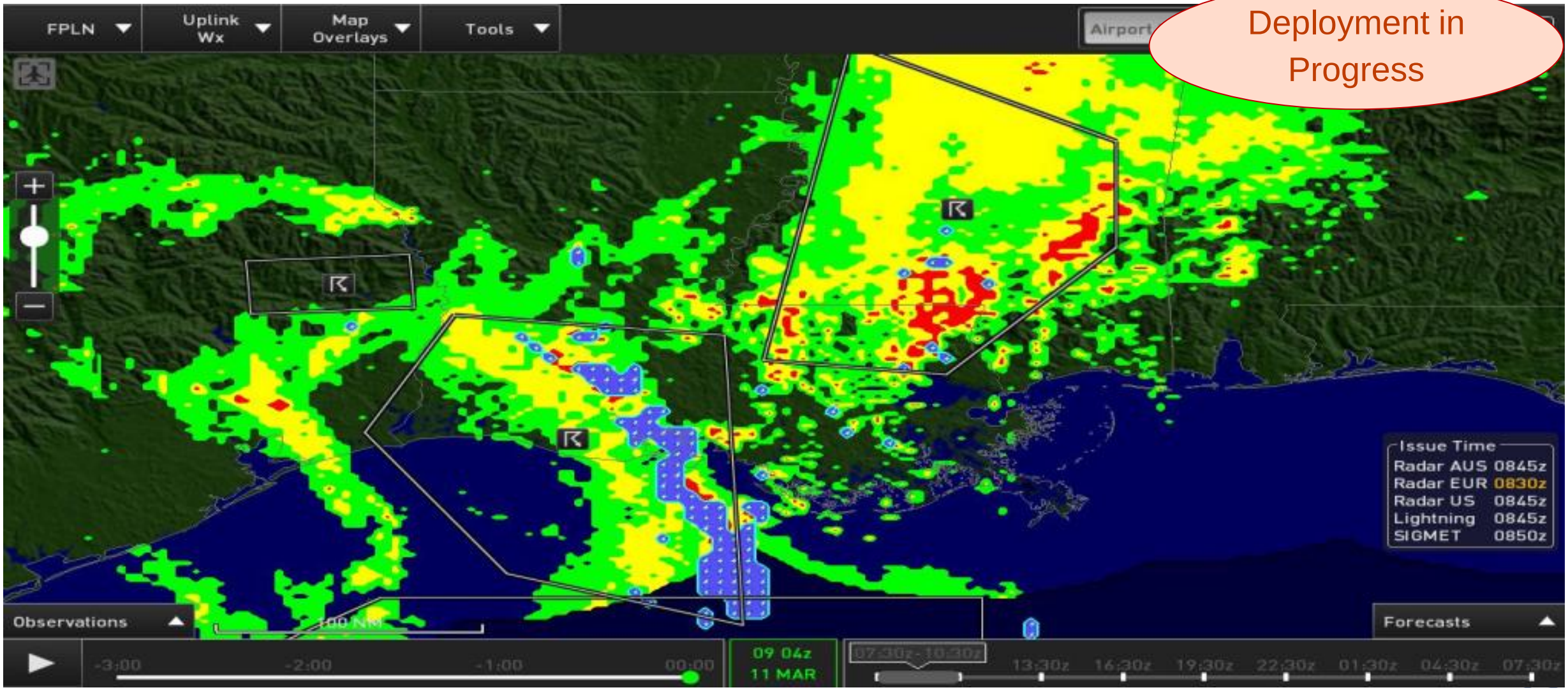
Key Features

	Essential	Premium **Includes Essential**
Observations	Airport METAR/SPECI	Satellite IR, Ground Radar, Lightning, PIREP
Forecasts	Airport TAF, CB Tops, Icing, SIGMET Clear Air Turbulence (CAT)	Wind
Display	Interactive **Map Background, Time scale** Display of Navaids, Waypoints, Airports, Airport search	**Vertical Section** CB Tops, CAT, Icing **Flight Plan display** **Map centering** (Class 2 only) D-ATIS @major airports Ground: Dispatcher application

AIRBUS

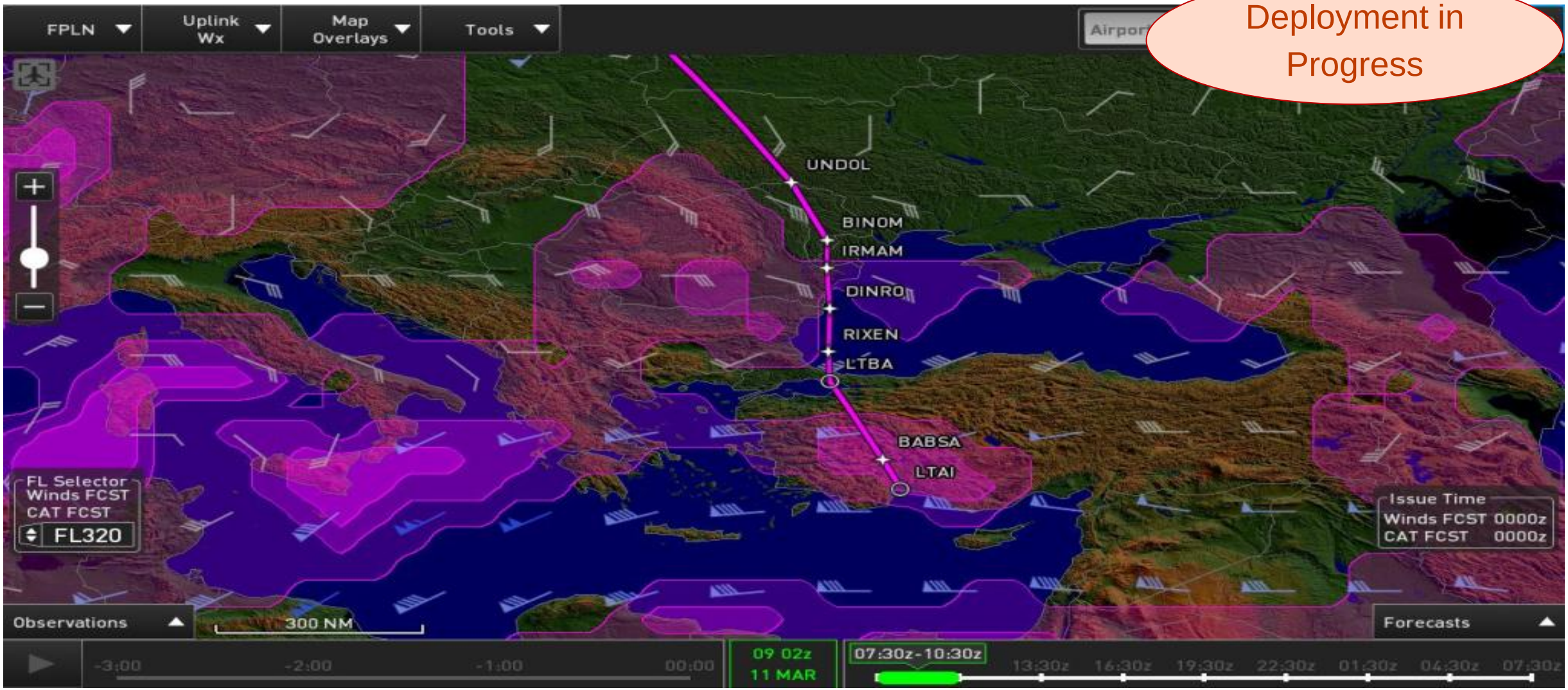
EFB - Weather On Board

Weather on Board – Lightning Observations & SIGMET Forecasts



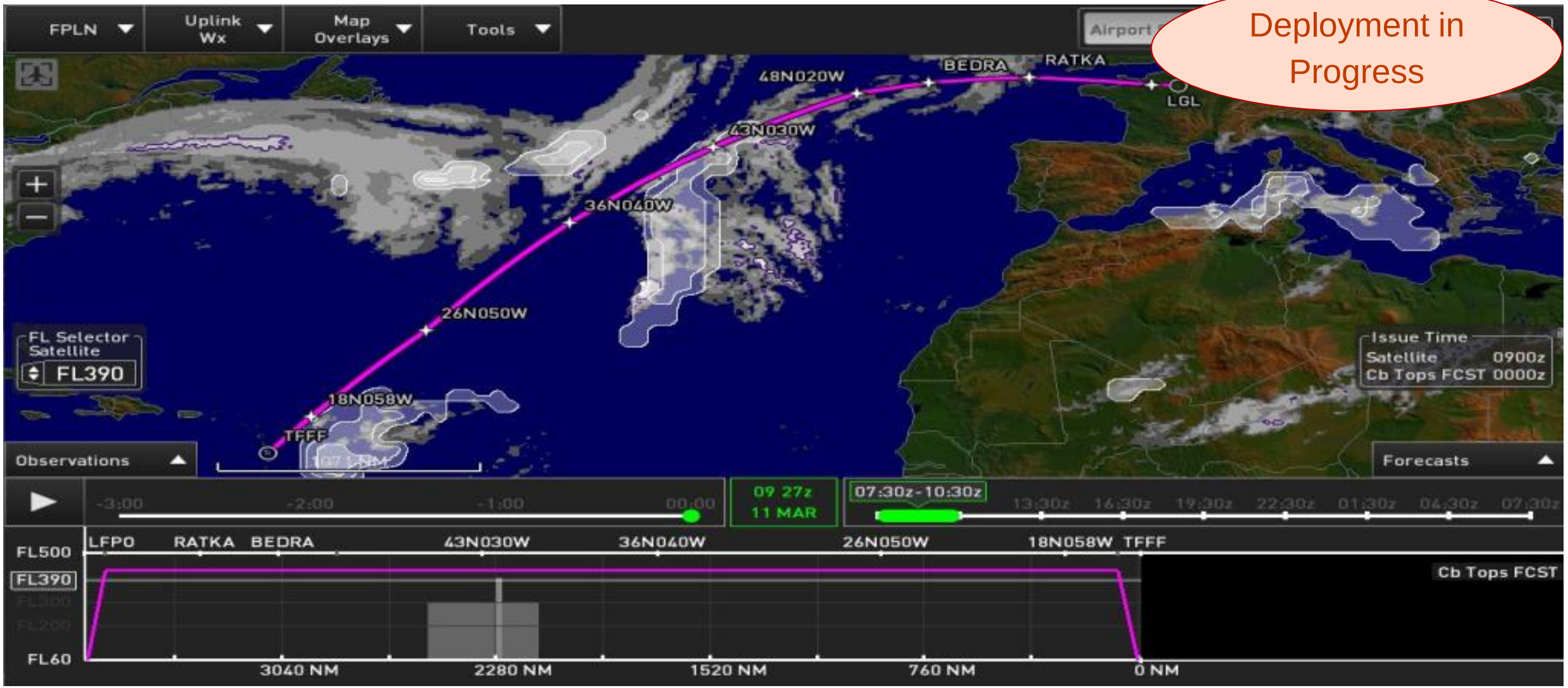
EFB - Weather On Board

Weather on Board – Clear Air Turbulence & Winds Forecasts



EFB - Weather On Board

Weather on Board – CB Tops Forecasts & Satellite Observations



EFB - Weather On Board

Principle

	ESSENTIAL	PREMIUM	
EFFECTIVITY			
FLYSMART INTEGRATION	"CLASS 1" EFBS	"CLASS 1" EFBS	"CLASS 2" EFBS
OPERATING SYSTEM	WINDOWS & IOS	WINDOWS & IOS	WINDOWS
MARKET AVAILABILITY	AVAILABLE	AVAILABLE	Q3 2017

Technical solutions and design enhancements

Soft Go-Around

ROPS / RAA

Harmonized PFD

AED (A350)

EFB Weather

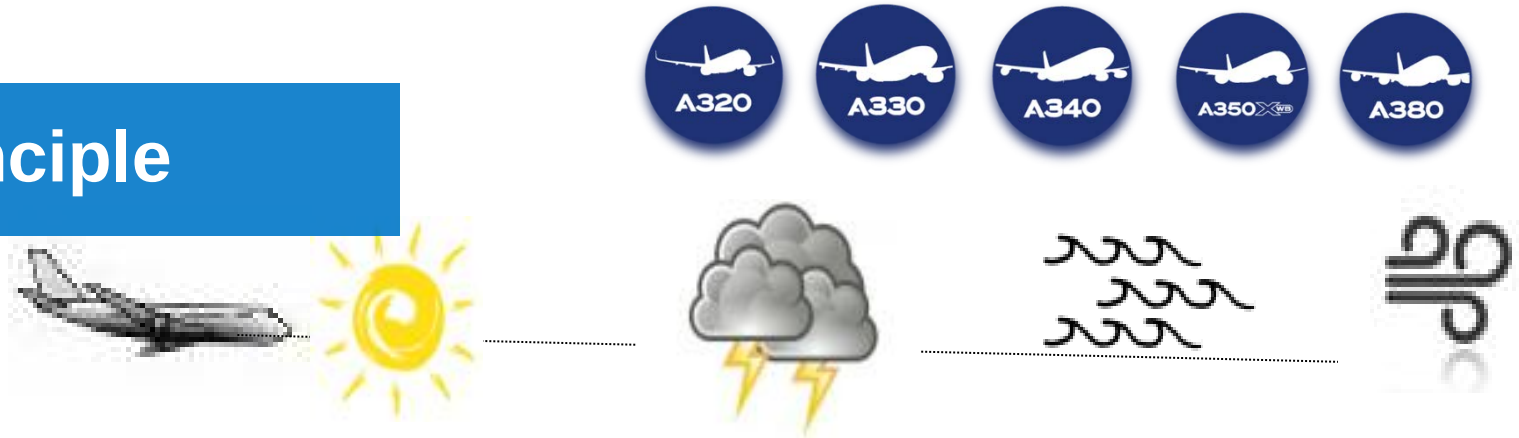
On Board

Future Aircraft Projects

AIRBUS

Aircraft as a Weather Sensor

Principle



Mid-Term

+ Destination 10X project launched by Airbus Safety Department
(Ref. to 2017 Flight Safety Conference in Santiago)

- Turbulences
- Temperatures
- Volcanic Ash
- Lightening strikes
- Ice Crystals
- …
- Humidity
- Winds

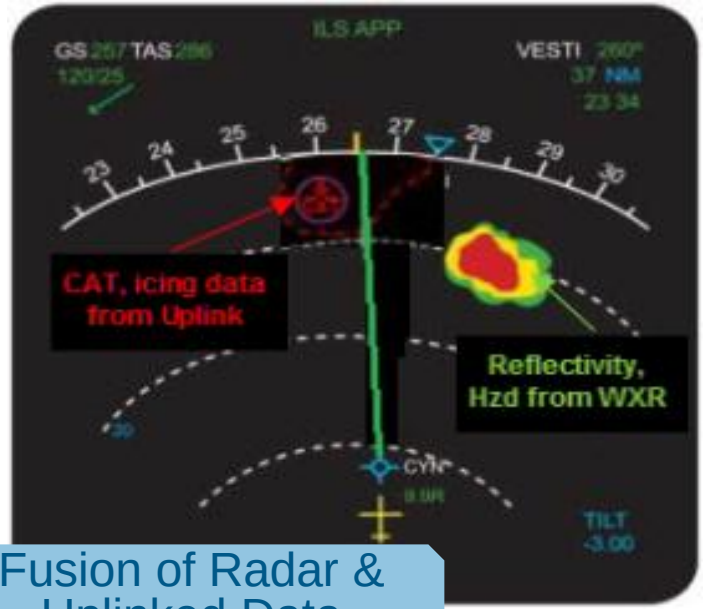
AIRBUS

Aircraft as a Weather Sensor

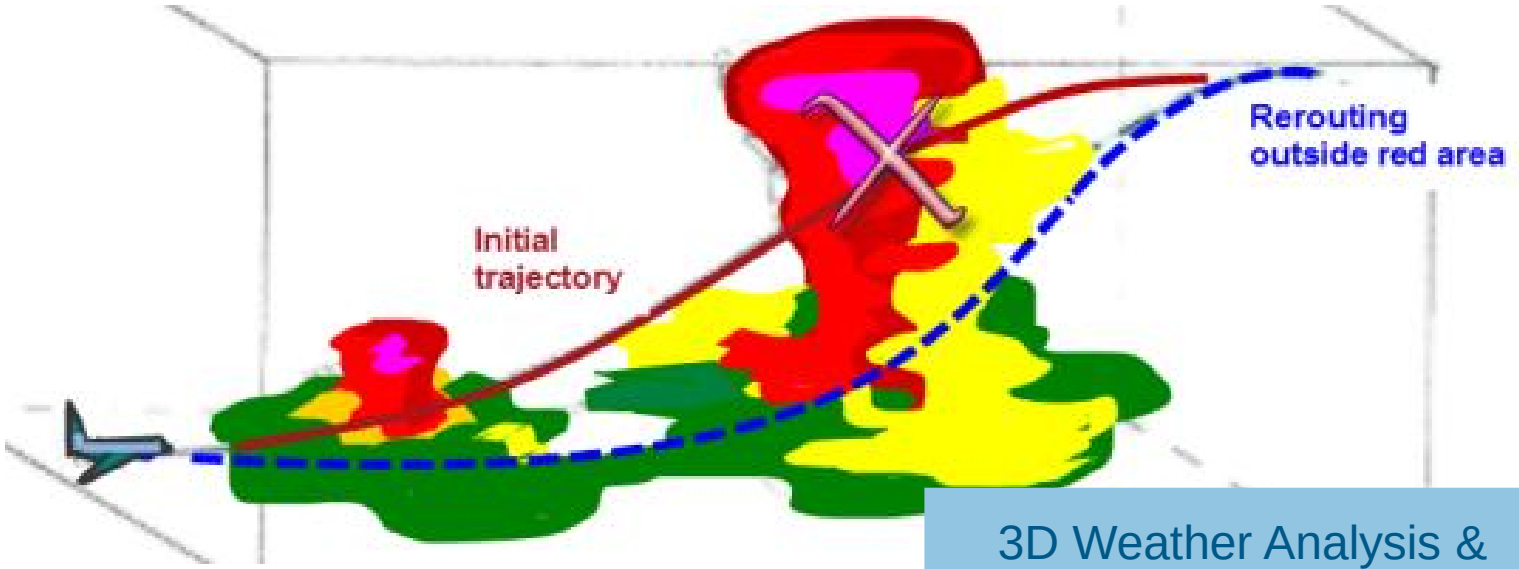
Areas of Research

A320 A330 A340 A350XWB A380

Long -Term



Fusion of Radar & Uplinked Data



3D Weather Analysis & Automatic Re-routing

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Ice Crystals Detection

Spot on Ice Crystals

Today's Status Ice Crystals Icing (ICI)

+ No possible detection with existing radars (too low reflectivity)
+ Creation of a new FCTM chapter to explain the phenomenon
  - ICI **always above or downwind of convective clouds**: Classical radar operational recommendations are useful (prefer lateral, upwind deviation)
  - Clues to identify ICI: **Appearance of rain at very low T°**, Surprizing **TAT around 0**°C, etc.
  - Recall of good practices in the case of an event because of ICI: Follow Airbus sensed and not-sensed procedures

New in 2017 FCTM

AIRBUS

Spot on Ice Crystals

Ice Crystals Detection

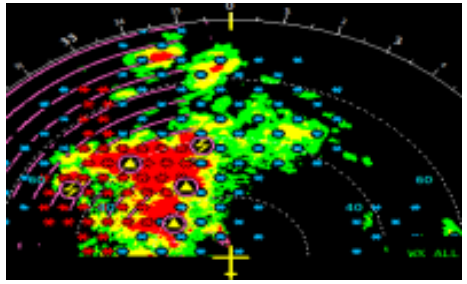
A320 A330 A340 A350XWB A380

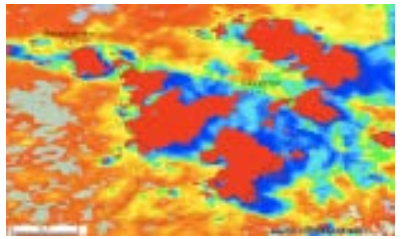
Mid-Term project

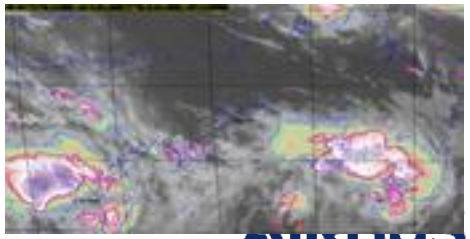
+ International Collaboration since 2004

+ Icing wind tunnels, flight tests
  + 3 campaigns of 26 flights in deep convective clouds
  + Specific instrumentation developed

+ Outcomes:
  + Ice Crystals Detectors
  + Enhanced Weather Radars
  + Spaceborne Retrieval







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Preventing Runway Incursion: Retrofit

See Appendix for details

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Preventing Runway Incursion: Training

A/C Family	Minimum Training Requirement
A320	System Knowledge Module **MINOR TRAINING IMPACT**
A330/A340	
A380	
A350 XWB	