Supporting
you on the ground
to keep you
in the air

1969·2009
EMBRAER

CNS / ATM

Agenda

Introduction

Roadmaps

PBN

LPV

ADSB

CPDLC

Next Steps

Agenda

Introduction

Roadmaps

PBN

LPV

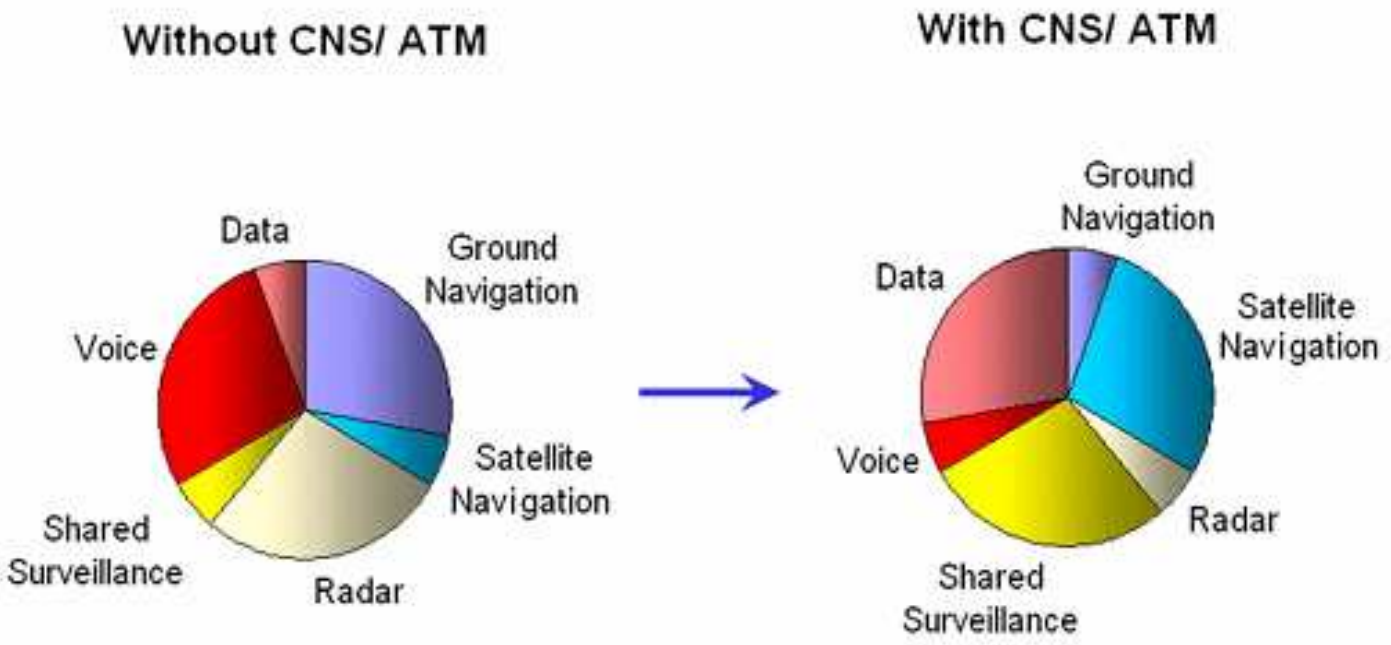
ADSB

CPDLC

Next Steps

Communication Navigation Surveillance / Air Traffic Management

- Focus on the optimal use of the airspace in terms of time, safety, airline and ATC operations



Introduction

Communication	Navigation	Surveillance
CPDLC	PBN { - RNAV, - RNP } LPV	ADS-B

CPDLC: Controller Pilots Data Link Communication
PBN: Performance Based navigation
RNAV: Area Navigation
RNP: Required Navigation Performance
LPV: Localizer Performance Vertical Guidance
ADS-B: Automatic Dependent Surveillance Broadcast

Agenda

- Introduction
- Roadmaps
- PBN
- LPV
- ADSB
- CPDLC
- Next Steps

Worldwide Roadmaps

Next Generation

USA

Single European Sky ATM Research

SESAR

EUROCONTROL

Europe

ICAO • OACI • ИКАО

国际民航组织 • ايكاو

ICAO Role is Harmonization

DECEA

Concepção Operacional ATM Nacional

Brazil

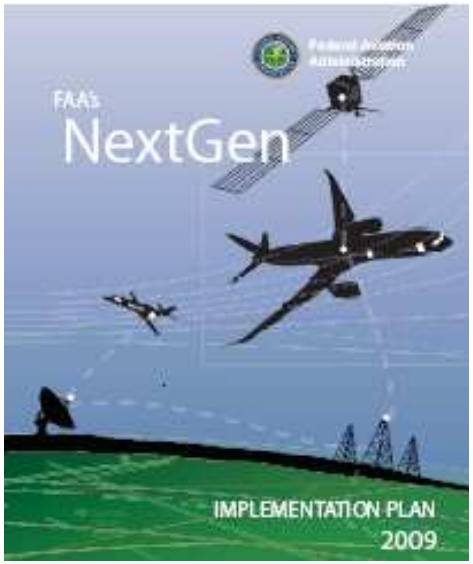
Australian Government
Civil Aviation Safety Authority

Australia

Worldwide Roadmaps

FAA NextGen (USA)

- It is shorthand for the Next Generation Air Transportation System, refers to a wide-ranging initiative to transform the air traffic control system to meet future demands and avoid gridlock in the United States sky and in the airports.
  - May 2008 - FAA assumed NextGen Implementation
  - June 2008 – FAA launched NextGen Implementation Plan
  - February 2009 – FAA launches 2009 version of Implementation Plan

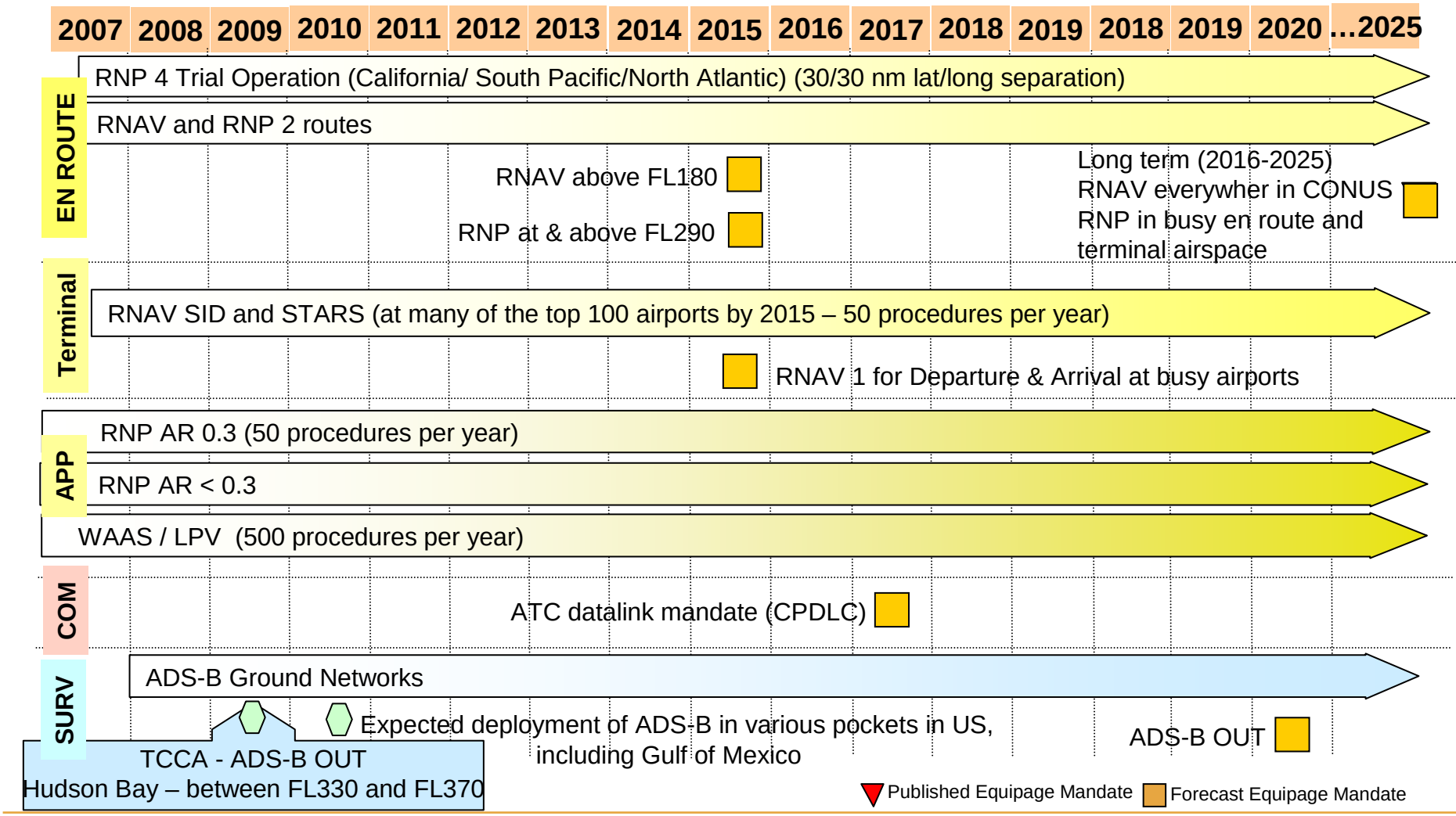


Near term Implementation
5 – 10 years

Long Term Planning

Worldwide Roadmaps

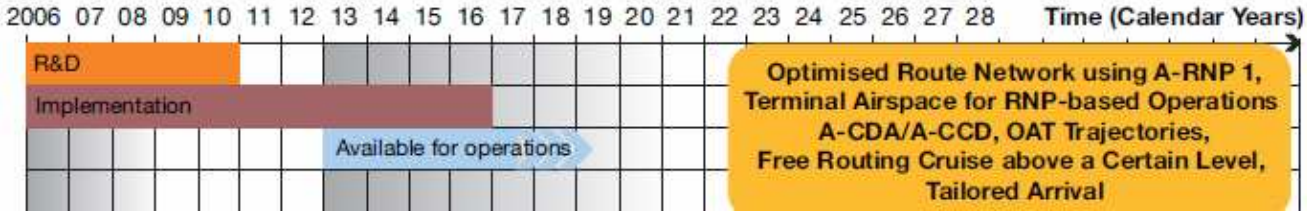
FAA NextGen (USA)



Worldwide Roadmaps

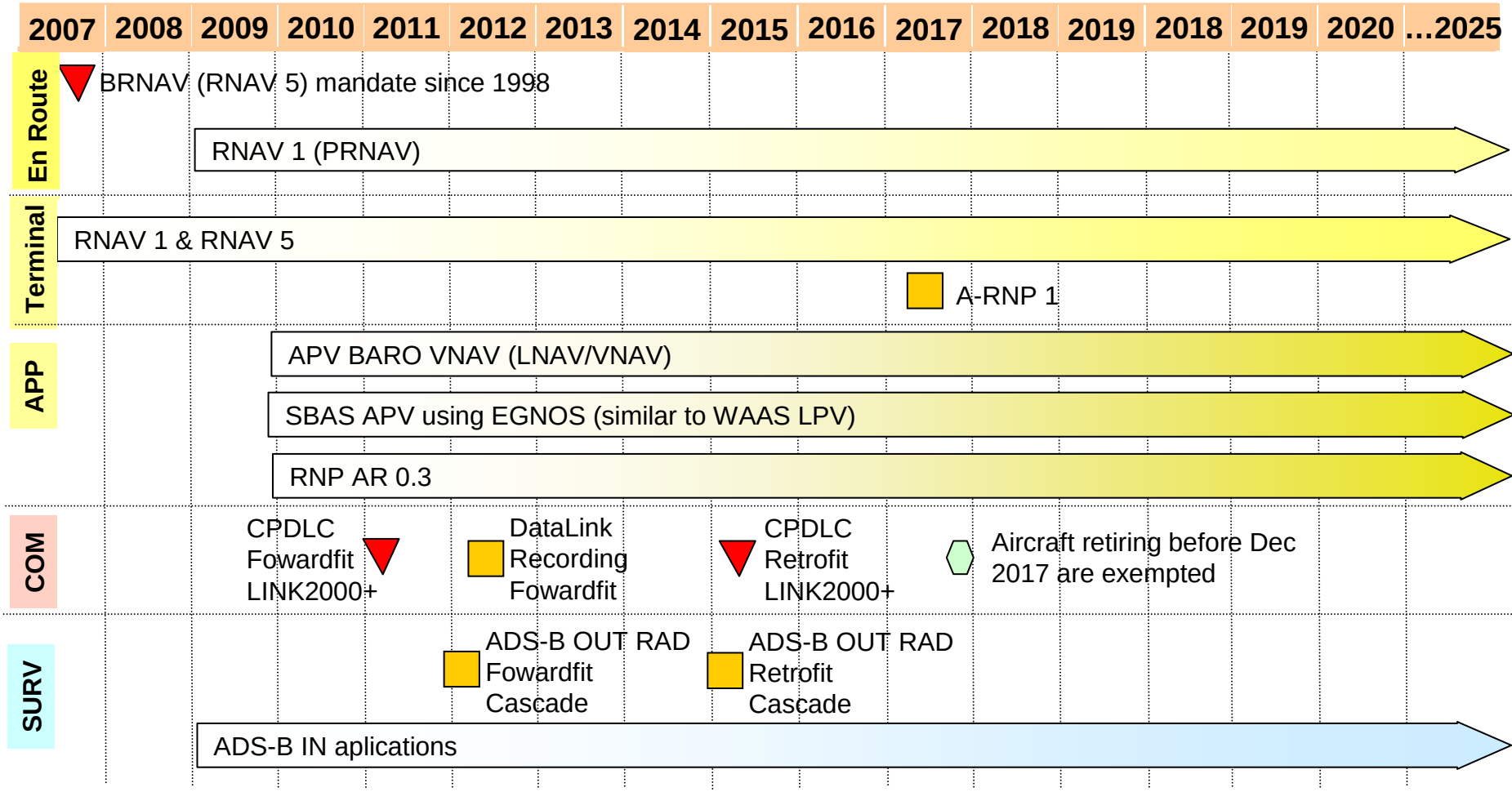
SESAR (Europe)

- **SESAR** – Single European Sky ATM (Air Traffic Management) Research: Program launched in 2004 by European Commission and Eurocontrol to develop and to implement the Single European Sky.
- SESAR aims at developing the new generation air traffic management system capable of ensuring the safety and fluidity of air transport worldwide over the next 30 years.



Worldwide Roadmaps

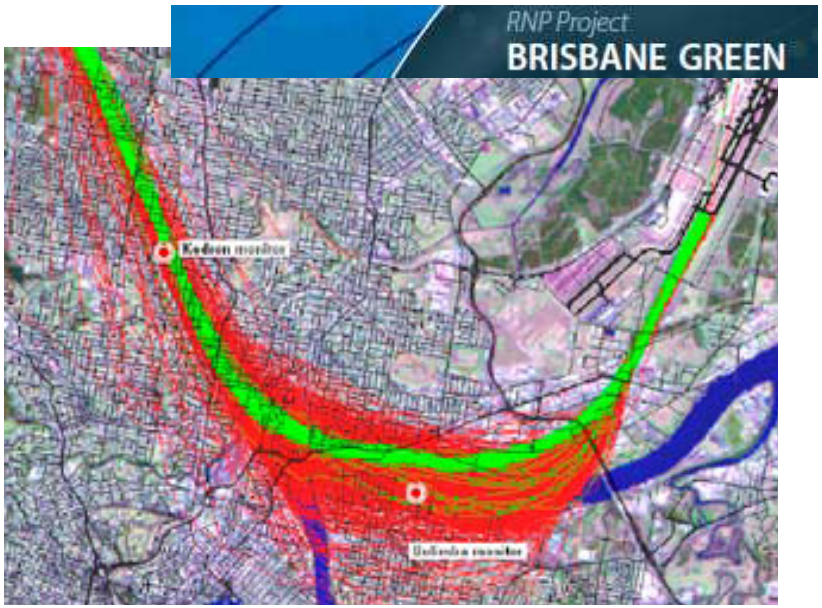
SESAR (Europe)

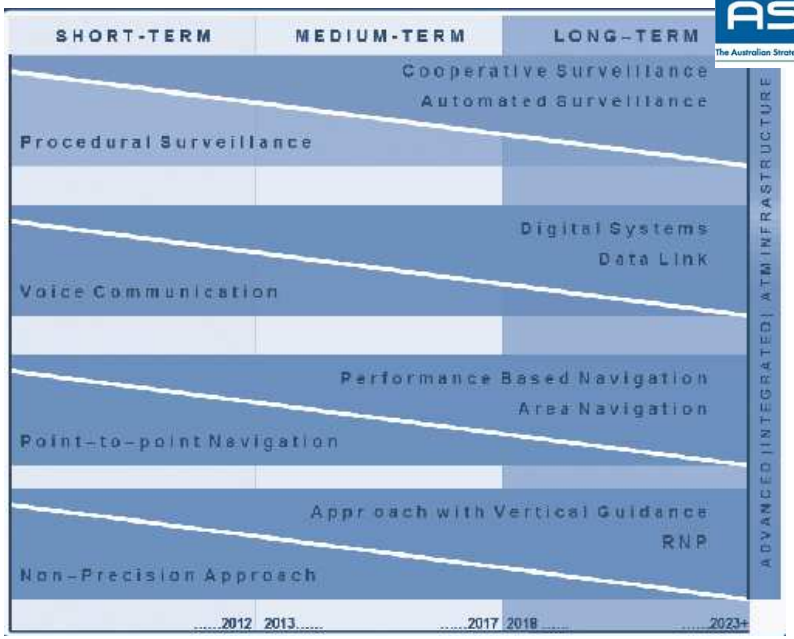


Worldwide Roadmaps

ASTRA (Australia)

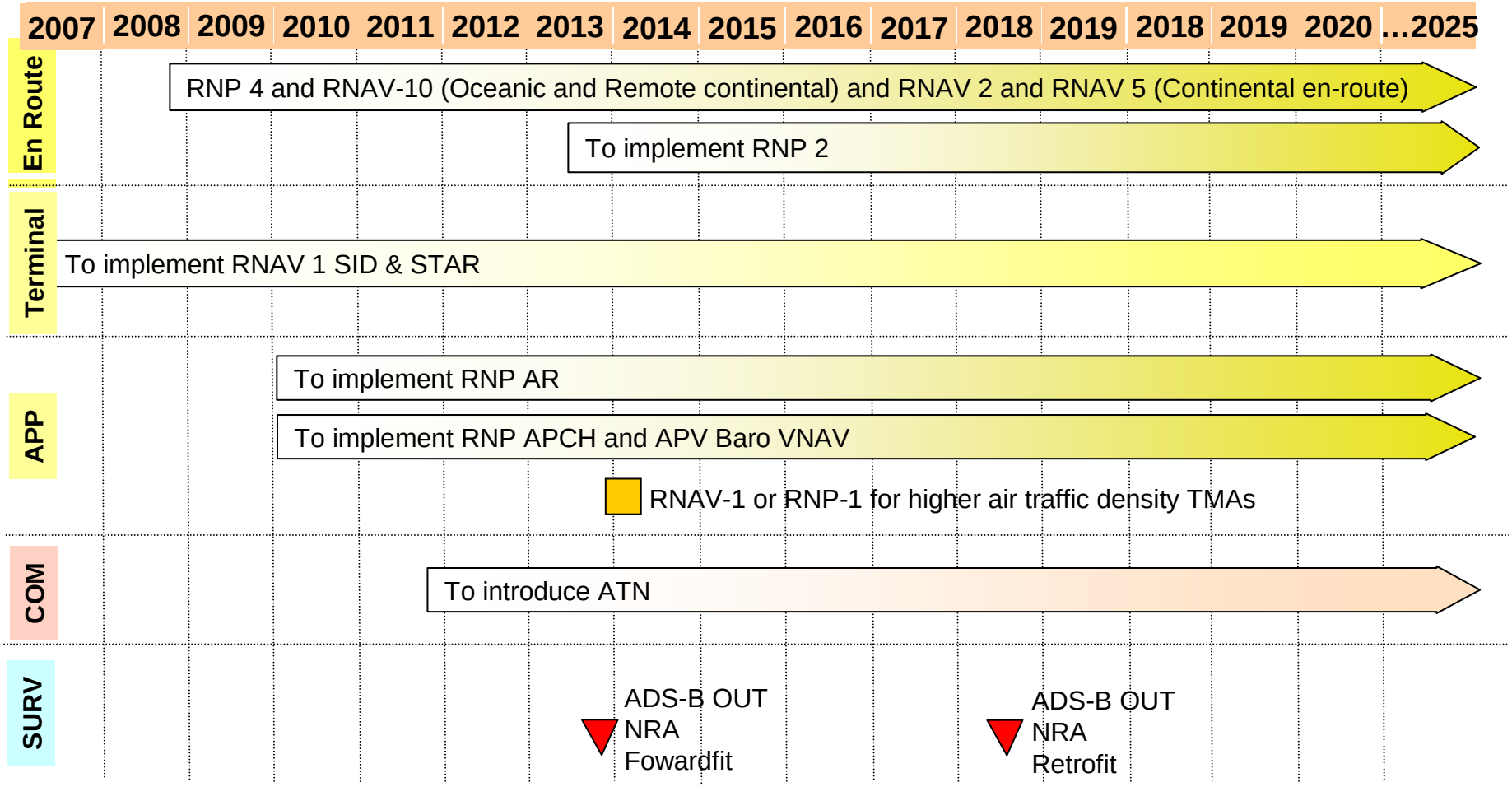
- ATM Strategic Plan: is the first of a suite of documents supporting the evolution to a future air traffic management [ATM] system in Australia that is performance-based, addresses ATM community expectations, is cost-efficient and is globally harmonized.





Worldwide Roadmaps

ASTRA (Australia)



CONOPS (Brazil)

- ***DECEA*** – PORTARIA No 299/GC3 (May 2008) published the "Concepção Operacional ATM Nacional" with the Brazilian Operational Concept (CONOPS) for CNS/ATM implementation. It is aligned with ICAO plans.


MINISTÉRIO DA DEFESA
COMANDO DA AERONÁUTICA

CONTROLE DO ESPAÇO AÉREO

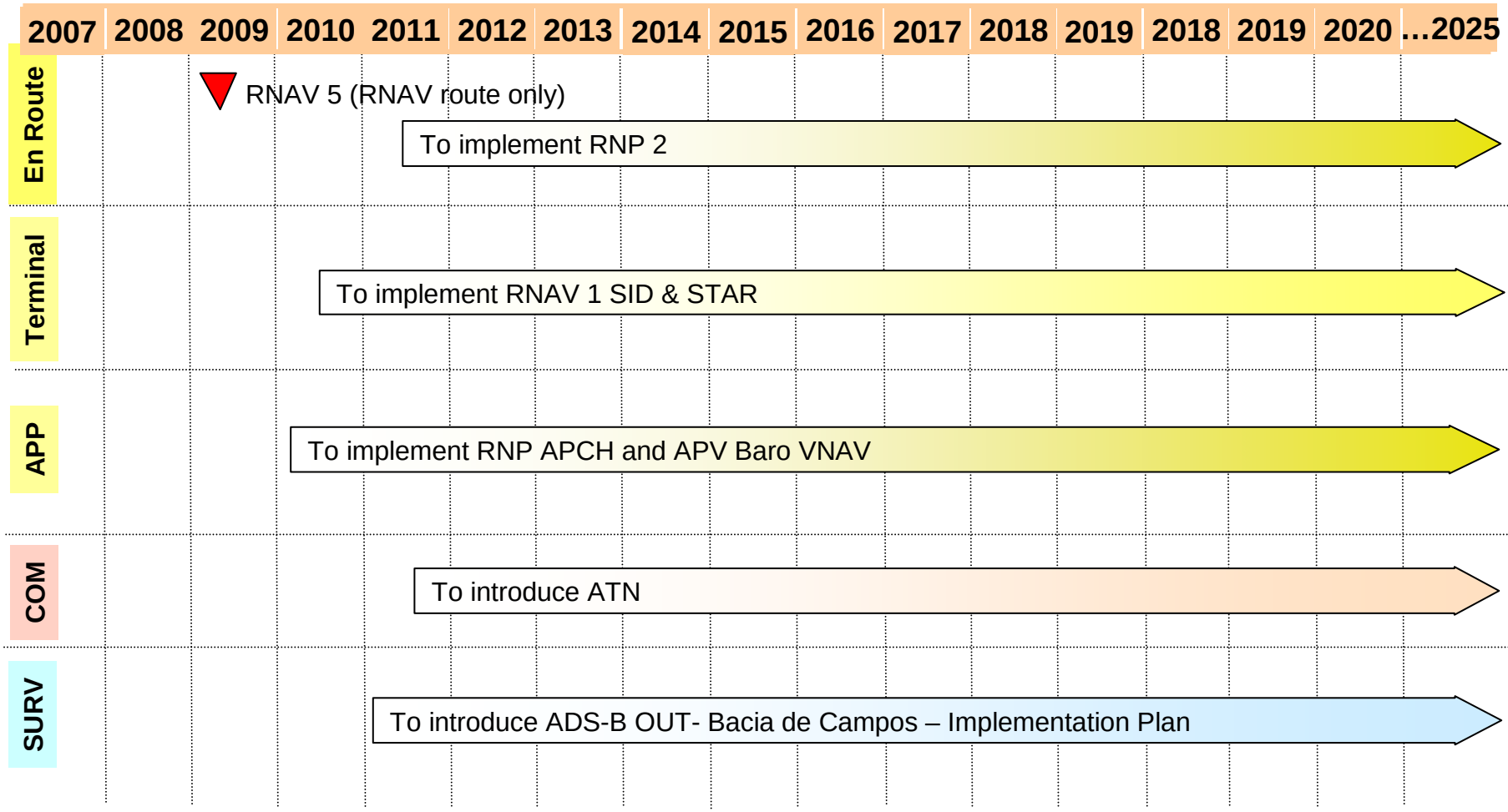
PCA 351-3

PROGRAMA DE IMPLEMENTAÇÃO ATM NACIONAL

2009

Worldwide Roadmaps

CONOPS (Brazil)



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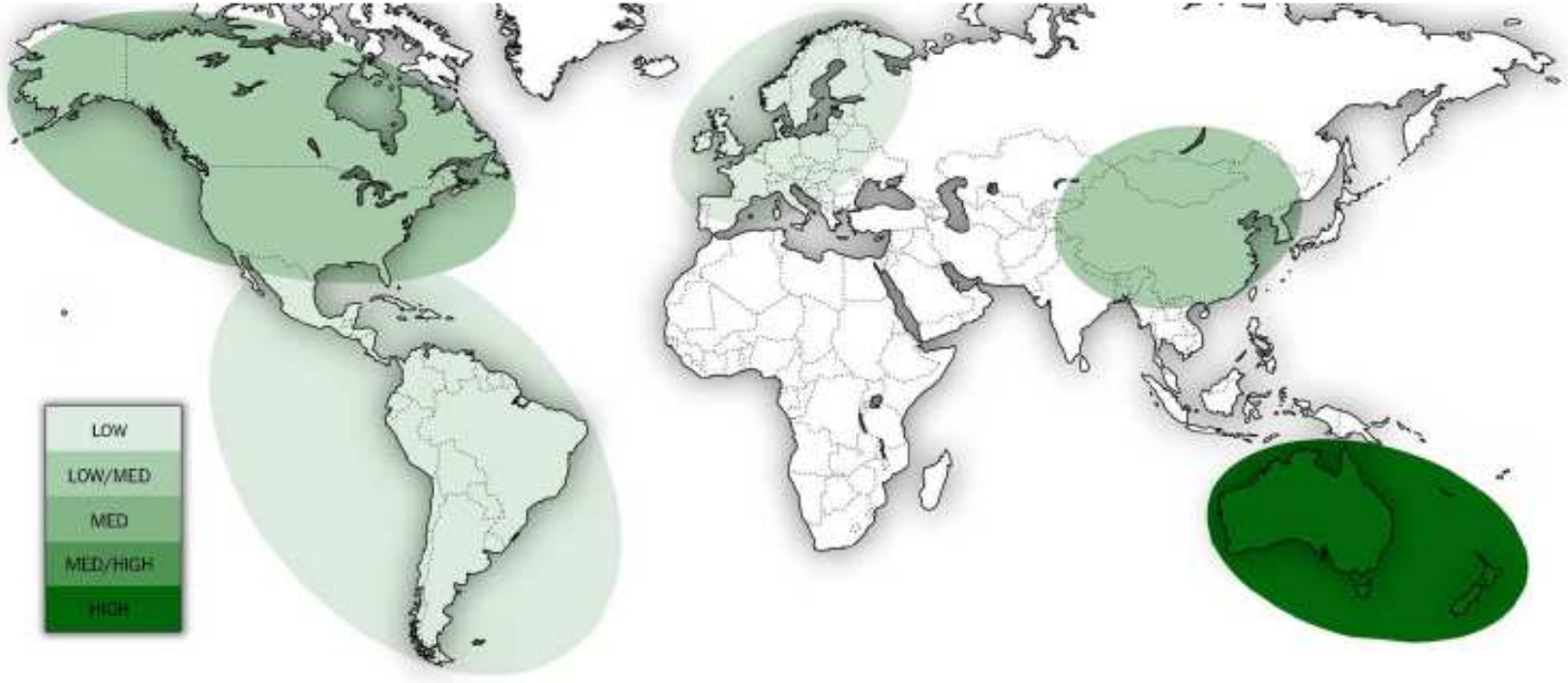
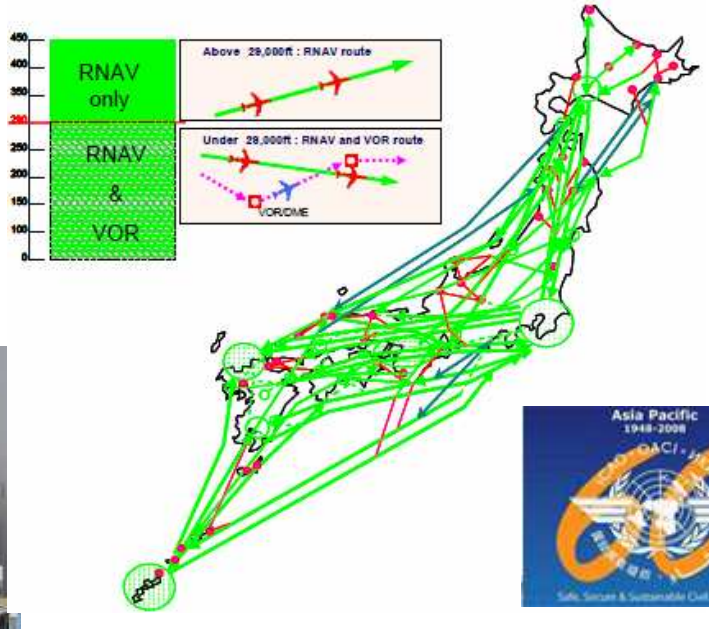
PBN Deployment Today……



Source: Naverus PBN Summit, 2008

PBN Basic Concepts

And forward movements are taking place……



Nomenclature

- Global efforts to embrace the ICAO PBN manual nomenclature

IATA

The New RNAV/RNP Values

Area of Application	Nav Accuracy (NM)	Nav Specification (current)	Nav Specification (new)
Oceanic/Remote	10	RNP 10	RNAV 10 (RNP 10 label)
	4	RNP 4	RNP 4
En route/ Continental	5	RNP 5 Basic RNAV	RNAV 5
En route /Continental and Terminal	2	US RNAV type A	RNAV 2
	2	N/A	RNP 2
Terminal	1	US RNAV type B P RNAV	RNAV 1
	1	N/A	RNP 1
Approach	0.3	RNP 0.3	RNP 0.3
	0.3-0.1	RNP/SAAAR	RNP 0.3-0.1 (RNP/AR)

ERJ 145 Status

- These are the achieved certifications for the ERJ 145 Family

The New RNAV/RNP Values

Area of Application	Nav Accuracy (NM)	Nav Specification (current)	Nav Specification (new)
Oceanic/Remote	10	RNP 10	RNAV 10 (RNP 10 label) ✓
	4	RNP 4	RNP 4 ✗
En route/ Continental	5	RNP 5 Basic RNAV	RNAV 5 ✓
En route /Continental and Terminal	2	US RNAV type A	RNAV 2 ✓
	2	N/A	RNP 2 ✗
Terminal	1	US RNAV type B P RNAV	RNAV 1 ✓
	1	N/A	RNP 1 ✗
Approach	0.3	RNP 0.3	RNP 0.3 ✗
	0.3-0.1	RNP/SAAAR	RNP 0.3-0.1 (RNP/AR) ✗

RNP– ERJ 145 Modification

RNP 0.3 AR (AC 90-101)

Honeywell

Display System
- IC
- Display

Navigation System
- DUAL FMS 5.2 OR DUAL FMS 4.8
- VNAV

Recording System
- FDR

Auto Flight System
- IC
- GC-550

Universal

Display System
- IC
- Display

Navigation System
- DUAL FMS
- GPS
- VNAV

Recording System
- FDR

Auto Flight System
- IC
- GC-550

RNP APCH (AC 90-105)

Honeywell

Universal

Baro VNAV is optional (LNAV or LNAV/VNAV lines of minima)

RFleg is optional (if not compliant, procedures with RF legs cannot be flown)

Dual FMS is not Mandatory

Legend:
- xxx SW upgrade
- xxx SW+HW upgrade

EJETS Status

- These are the achieved and also the intended certification for the EJETS

IATA

The New RNAV/RNP Values

Area of Application	Nav Accuracy (NM)	Nav Specification (current)	Nav Specification (new)
Oceanic/Remote	10	RNP 10	RNAV 10 (RNP 10 label)
	4	RNP 4	RNP 4
En route/ Continental	5	RNP 5 Basic RNAV	RNAV 5
En route /Continental and Terminal	2	US RNAV type A	RNAV 2
	2	N/A	RNP 2
Terminal	1	US RNAV type B P RNAV	RNAV 1
	1	N/A	RNP 1
Approach	0.3	RNP 0.3	RNP 0.3
	0.3-0.1	RNP/SAAAR	RNP 0.3-0.1 (RNP/AR)

TBD

ANAC/FAA

RNP AR 0.3

MAP 1.0

ANAC/FAA/EASA

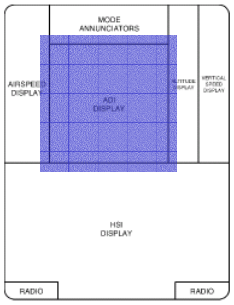
RNP AR < 0.3

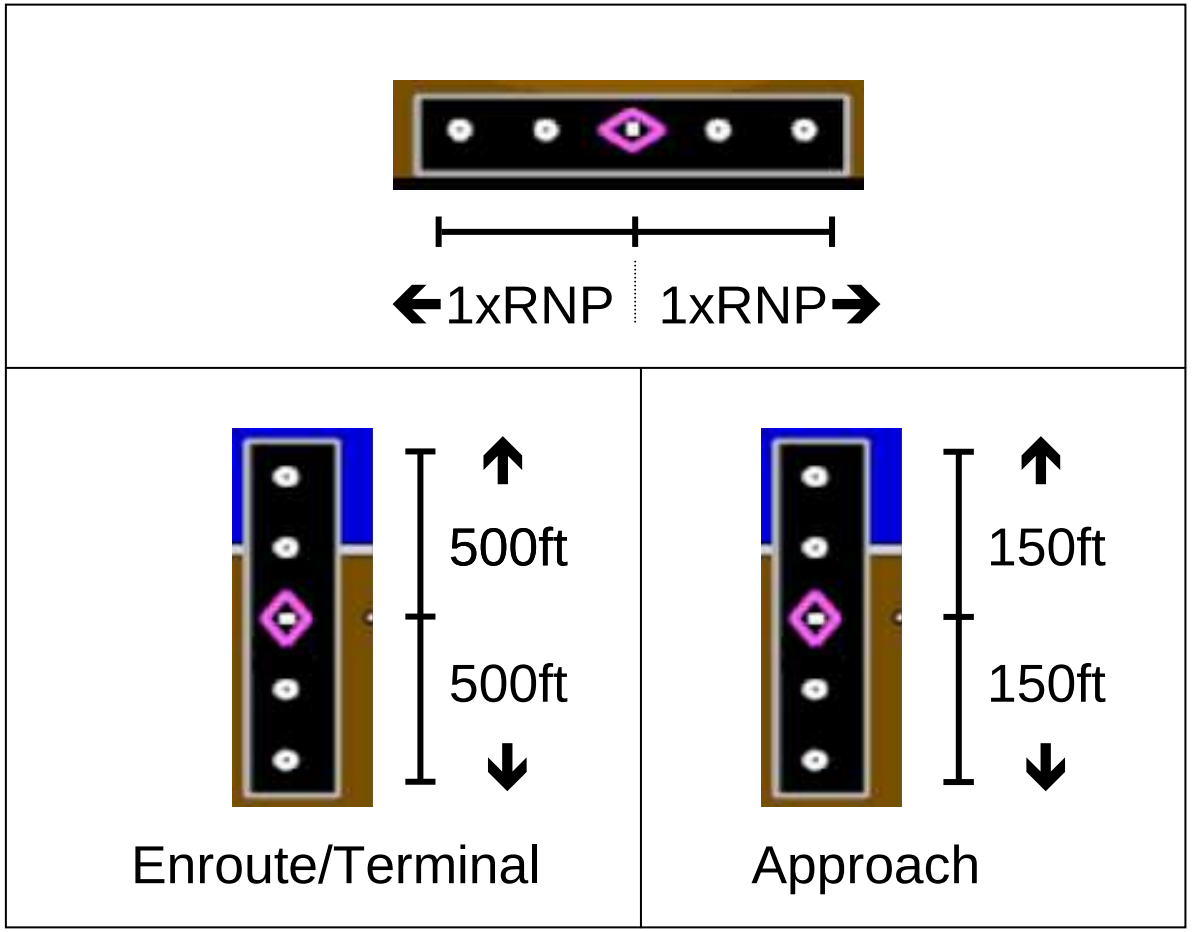
MAP < 1.0

LOAD 23

RNP AR 0.3 / Missed Approach 1.0

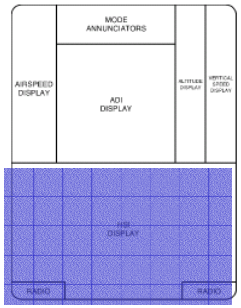
- PFD

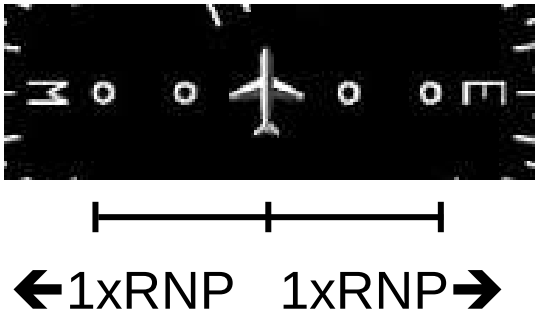




RNP AR 0.3 / Missed Approach 1.0 (cont.)

- PFD





RNP AR 0.3 / Missed Approach 1.0 (cont.)

- MFD

RNP AR 0.3 / Missed Approach 1.0 (cont.)

- MCDU

RNP AR 0.3 / Missed Approach 1.0 (cont.)

- MCDU

RNP AR 0.3 / Missed Approach 1.0 (cont.)

RNP AR System Design

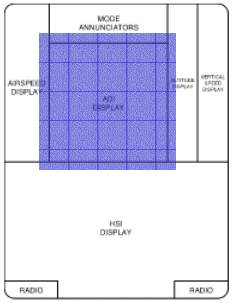
RNP AR < 0.3 / Missed Approach < 1.0

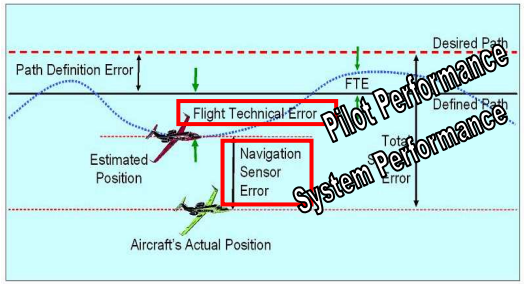
- It will be an optional feature
- To support this level of precision on RNP AR certification the following modifications are foreseen:
  - Changes in the FMS, EDS and AFCS to incorporate new features in the displays and auto LNAV arming in the Go Around.
  - Upgrade the current GPS to a WAAS sensor providing the condition Select Availability = off .
  - LPV under studies (software modifications)

RNP AR System Design

RNP AR < 0.3 / Missed Approach < 1.0 (cont.)

- PFD



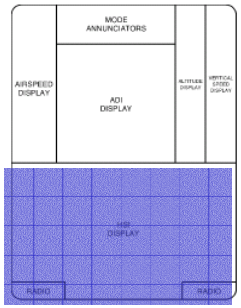


	EPU+FTE < 1xRNP
	EPU+FTE > 1xRNP
	FTE > 1xRNP
	DGRAD

In evaluation by airworthiness authorities

RNP AR < 0.3 / Missed Approach < 1.0 (cont.)

- PFD

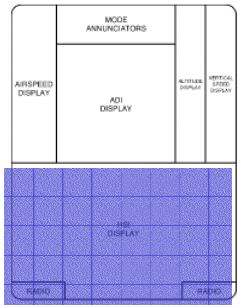


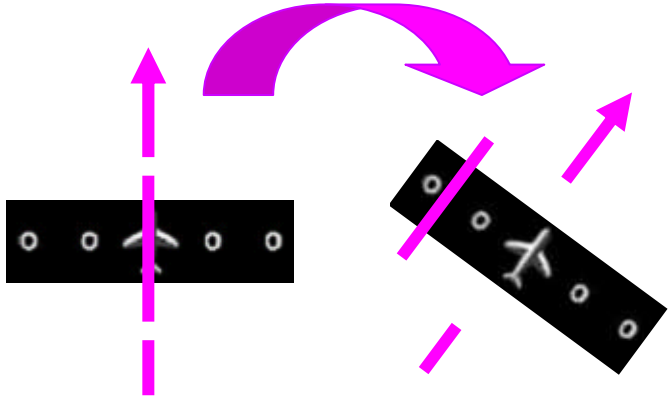
ACTIVE NAVIGATION SENSOR

RNP AR System Design

RNP AR < 0.3 / Missed Approach < 1.0 (cont.)

- PFD



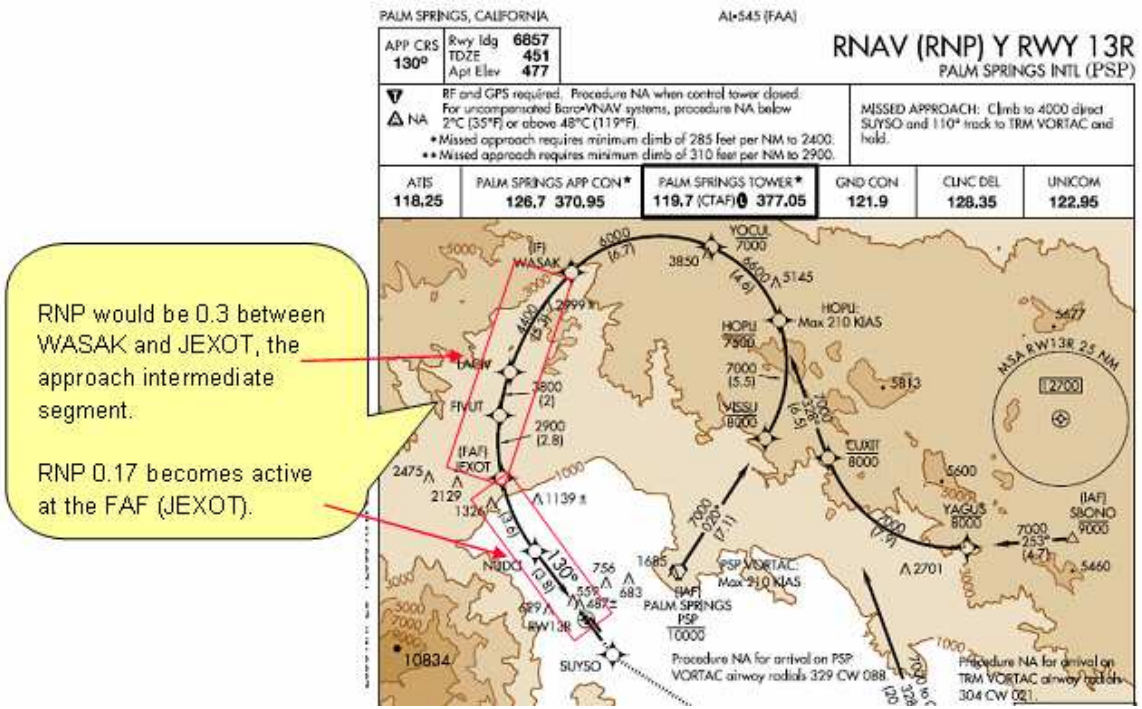


CURRENT FLY BY changed by…..

Enhanced FLY BY

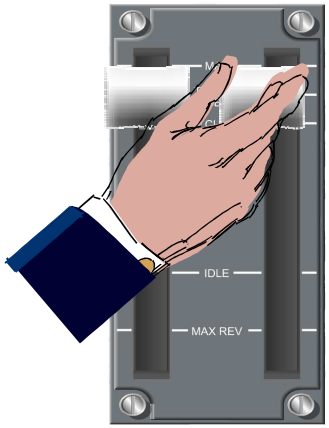
RNP AR < 0.3 / Missed Approach < 1.0 (cont.)

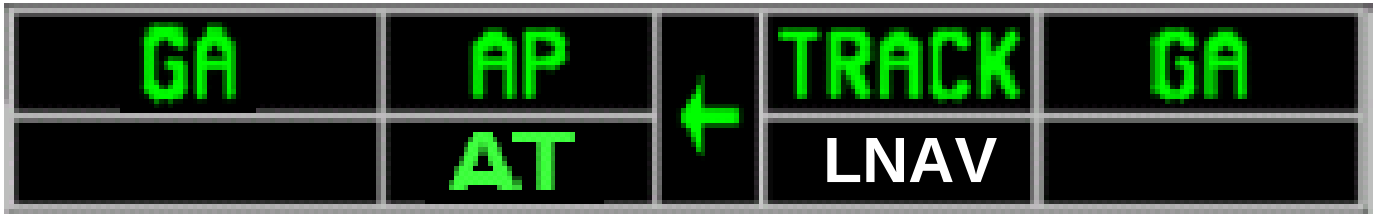
- RNP value for each approach will come from the Navigation Database and the pilot will be able to select the lower RNP value published for a specific approach

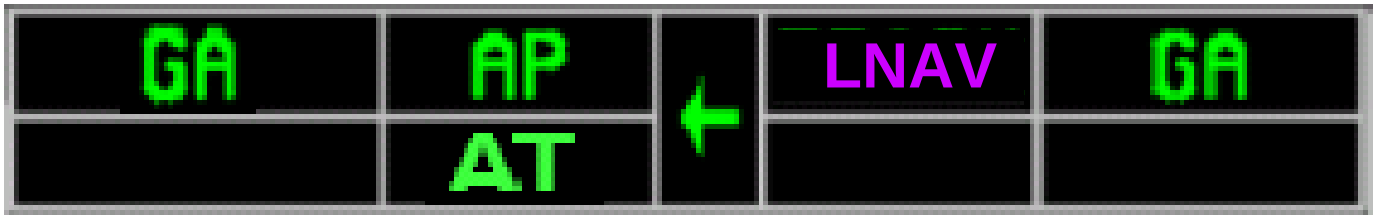


RNP AR < 0.3 / Missed Approach < 1.0 (cont.)

- Auto Arming of LNAV for all missed approaches procedures. Even if the airplane is performing a Non-FMS approach, upon hitting the TOGA button, the primary navigation source will automatically change to FMS and arm LNAV. It engages automatically above 200 ft.







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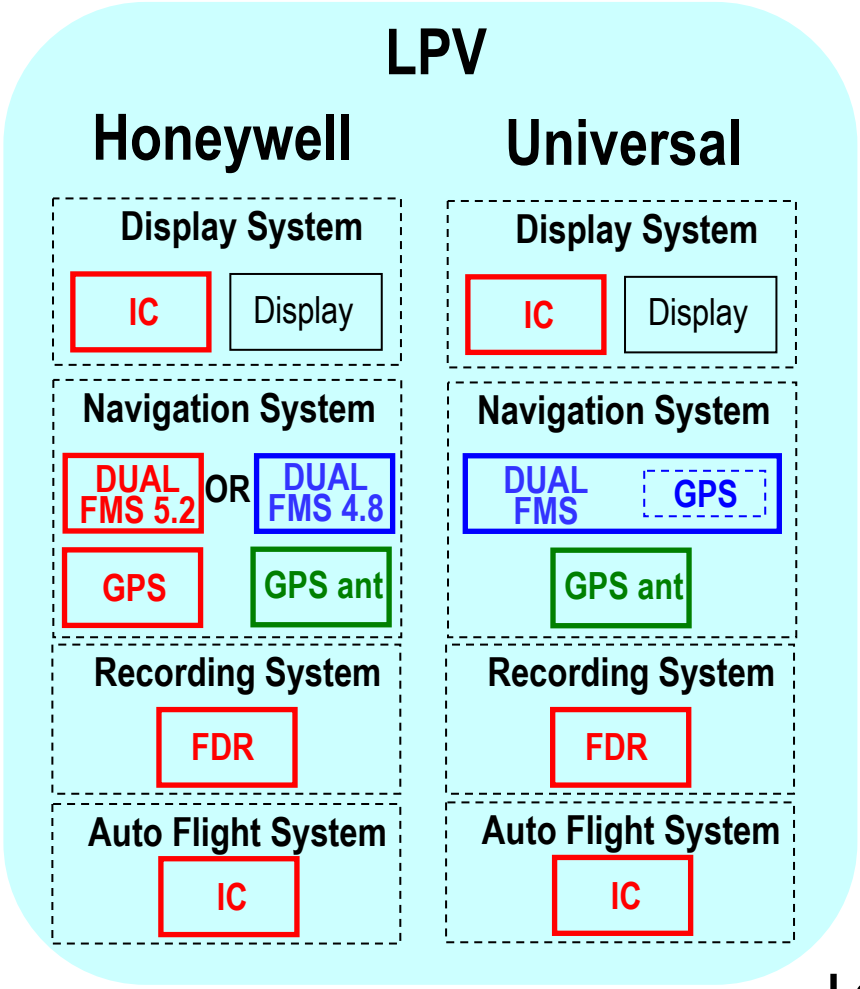
LPV– ERJ 145 Modification



Legend:

xxx SW upgrade

xxx SW+HW upgrade

xxx HW upgrade

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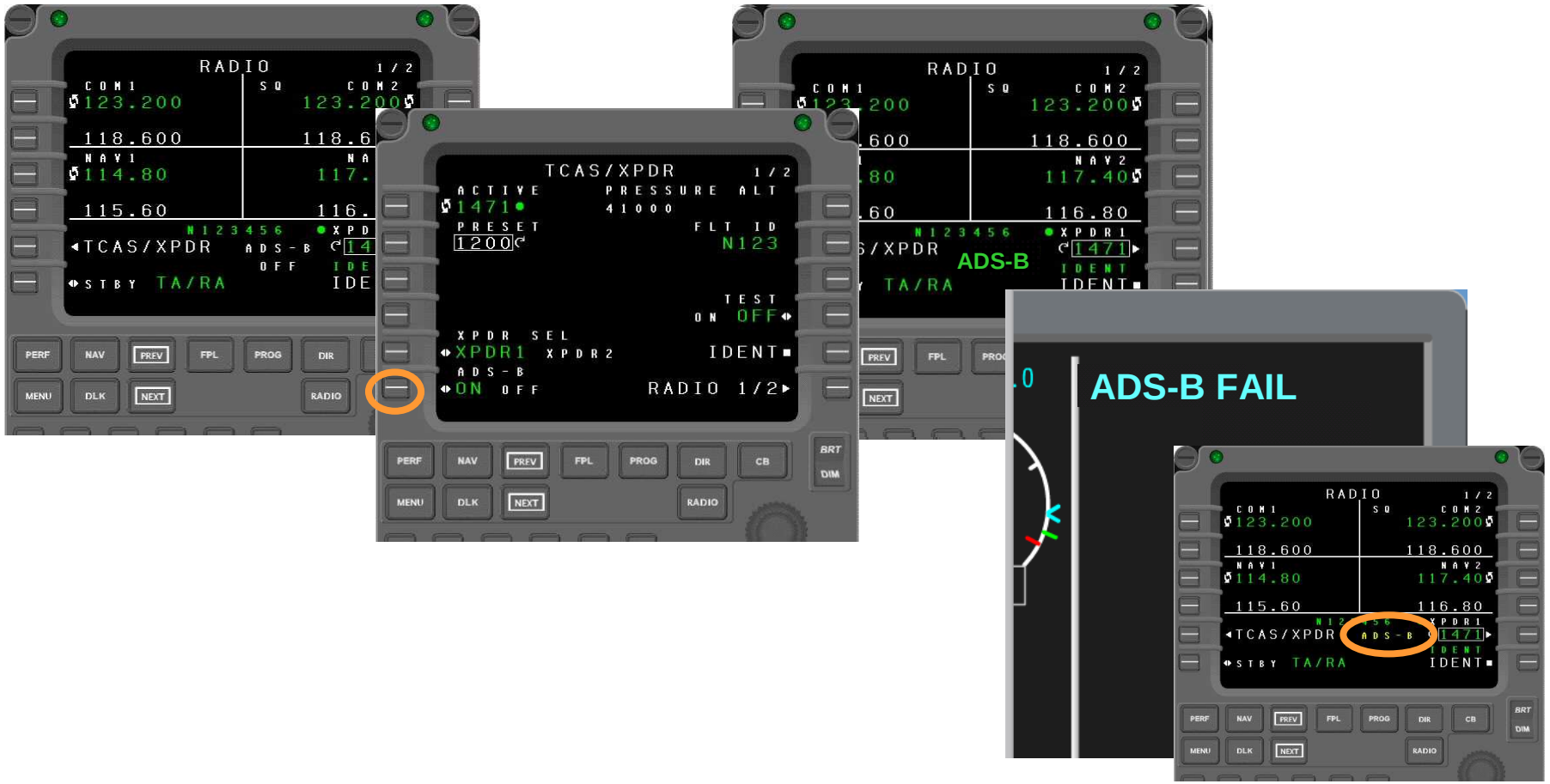
ADS-B OUT – E-JETS Implementation

Human Interface

- ADS-B Control and Status are done at MCDU RADIO Page



ADS-B OUT – E-JETS Implementation

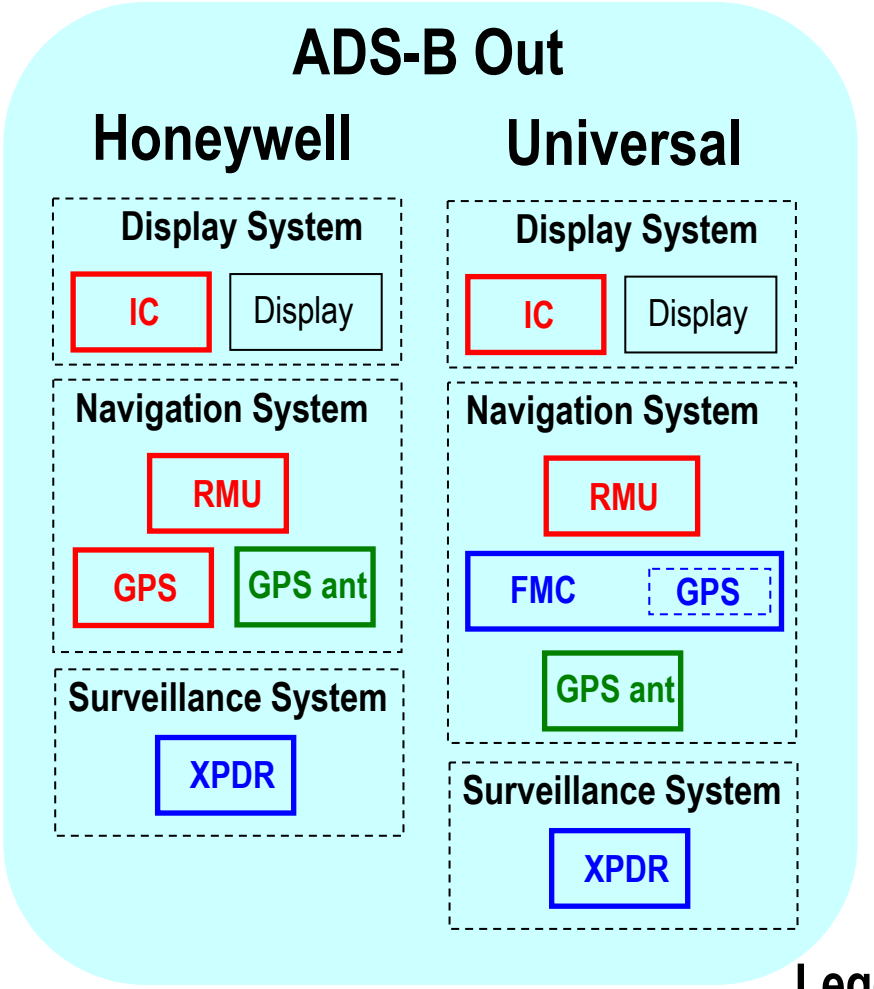
Solution

- ADS-B OUT requires:
  - Load modification
  - Transponder upgrade to Mode S “extended squitter” (1090 MHz)
  - GPS WAAS + GPS WAAS Antenna
  - ARINC 429 Wiring between XPDR and GPS

Schedule

- It will be an optional feature and is planned for Load 23
- ADS-B IN development under studies

ADS-B OUT – ERJ 145 Modification



Legend:

xxx SW upgrade

xxx HW upgrade

xxx SW+HW upgrade

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CPDLC – E-JETS Implementation

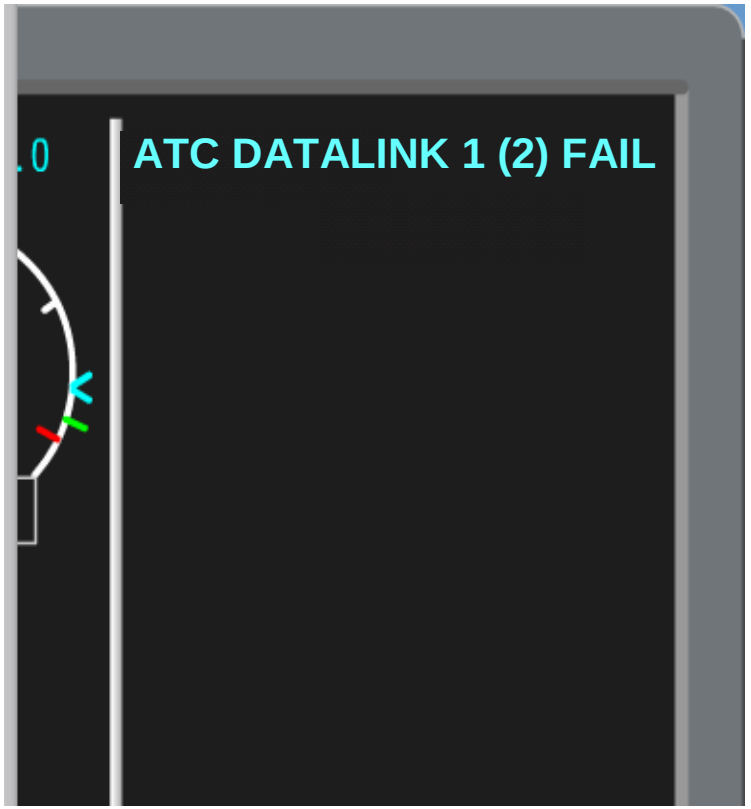
Human Interface

"ATC MESSAGE "

CPDLC – E-JETS Implementation

Human Interface

- Abnormal Operation
  - CAS message DATALINK 1 (2) FAIL (Advisory) will replace the current CAS message CMF 1 (2) FAIL
  - New CAS message ATC DATALINK 1 (2) FAIL (Advisory) to indicate fail of ATC partition.
  - All messages will be inhibited on Takeoff and Landing



CPDLC – E-JETS Implementation

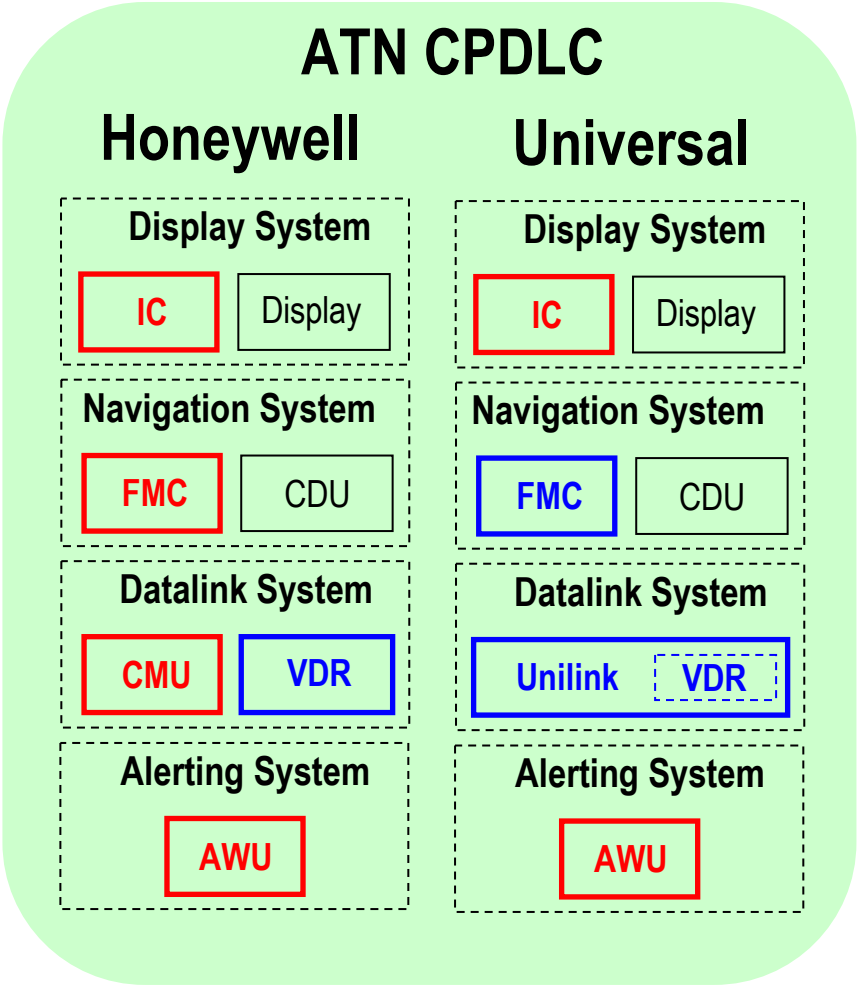
Impacts

- Datalink Communication Impacts
  - VDL Mode 2 Required
- Pentium M retrofit is necessary for CPDLC implementation

Status

- It will be an optional feature and supported by customer contract
- ATN CPDLC is planned to Load 25 (Oct/2010)

CPDLC – ERJ 145 Modification



Legend:

xxx SW upgrade

xxx SW+HW upgrade

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Next Steps – ERJ 145

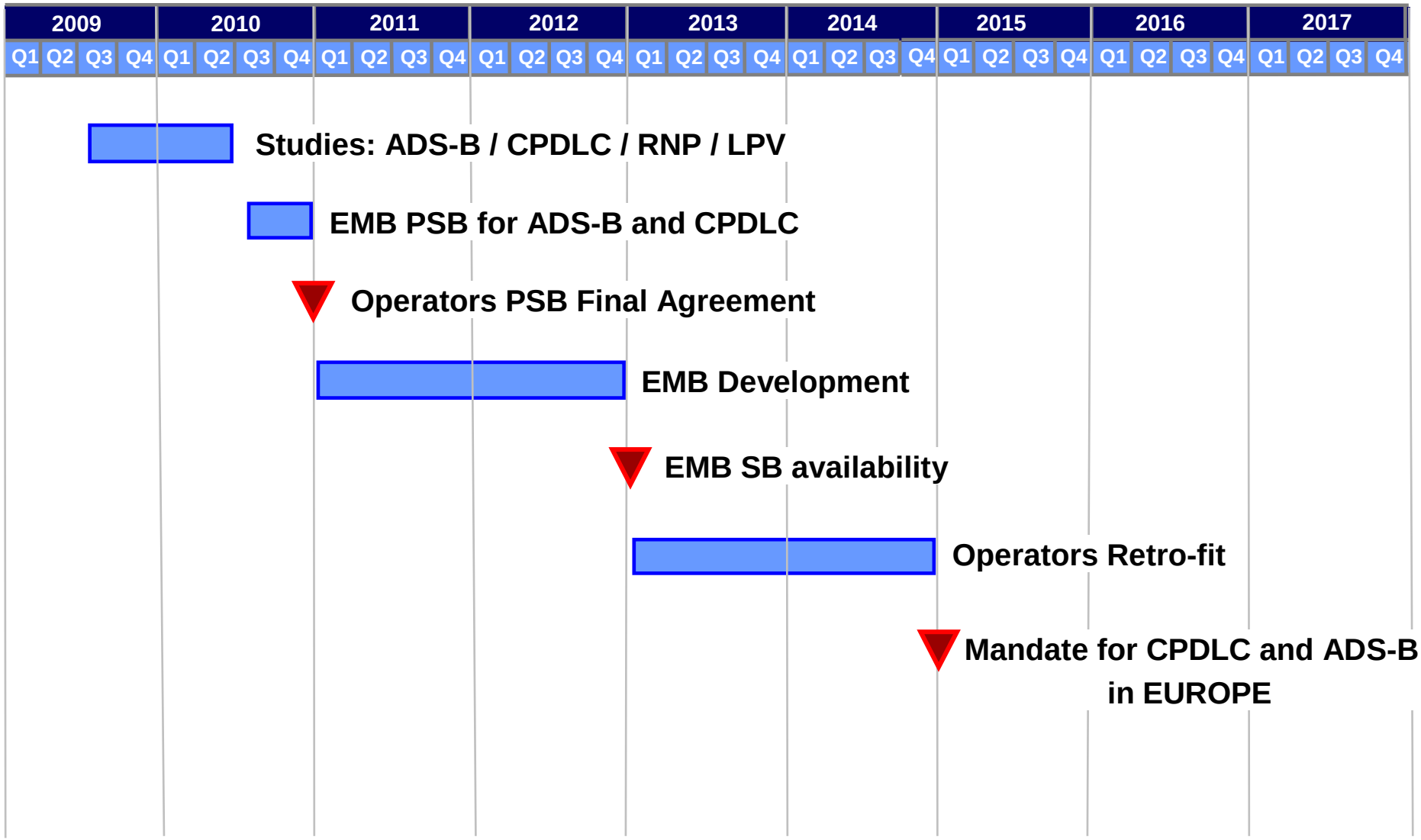
RNP and LPV developments

- Embraer is conducting a preliminary study to evaluate technical solutions for these functionalities – 2Q/10.
- Customers to inform the Account Managers of their interest in pursuing the development of these functionalities.

CPDLC and ADSB

- Embraer is conducting a study to evaluate technical solutions for these functionalities.
- PSBs to be provided – 3Q/10.

Next Steps – ERJ 145



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you on the ground
to keep you
in the air

1969·2009
EMBRAER

THANK YOU!