Agenda

Introduction
Roadmaps
PBN
LPV
ADSB
CPDLC
Next Steps
Agenda

Introduction

Roadmaps

PBN

LPV

ADSB

CPDLC

Next Steps
Introduction

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**
- CPDLC

**NAVIGATION**
- PBN
  - RNAV
  - RNP
- LPV

**SURVEILLANCE**
- 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
CNS / ATM

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Next Steps
Next Generation

Single European Sky ATM Research

ICAQ Role is Harmonization

USA

Europe

Brazil

Australia
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
FAA NextGen (USA)


EN ROUTE
- RNP 4 Trial Operation (California/ South Pacific/North Atlantic) (30/30 nm lat/long separation)
- RNAV and RNP 2 routes
  - RNAV above FL180
  - RNP at & above FL290
- Long term (2016-2025) RNAV everywhere in CONUS
  - RNP in busy en route and terminal airspace

Terminal
- RNAV SID and STARS (at many of the top 100 airports by 2015 – 50 procedures per year)
  - RNAV 1 for Departure & Arrival at busy airports
- RNP AR 0.3 (50 procedures per year)
- RNP AR < 0.3
- WAAS / LPV (500 procedures per year)
- ATC datalink mandate (CPDLC)

COM
- ADS-B Ground Networks

SURV
- TCCA - ADS-B OUT
  - Hudson Bay – between FL330 and FL370
- Expected deployment of ADS-B in various pockets in US, including Gulf of Mexico
- ADS-B OUT

Published Equipage Mandate
Forecast Equipage Mandate
SESAR (Europe)


- 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.
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.
## ASTRA (Australia)

<table>
<thead>
<tr>
<th>Year</th>
<th>En Route</th>
<th>Terminal</th>
<th>APP</th>
<th>COM</th>
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- RNP-1 or RNP-2 for higher air traffic density TMAs

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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.
CONOPS (Brazil)

- **En Route**: RNAV 5 (RNAV route only)
  - To implement RNP 2

- **Terminal**: To implement RNAV 1 SID & STAR

- **APP**: To implement RNP APCH and APV Baro VNAV

- **COM**: To introduce ATN

- **SURV**: To introduce ADS-B OUT - Bacia de Campos – Implementation Plan

Published Equipage Mandate  | Forecast Equipage Mandate
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PBN Deployment Today……

Source: Naverus PBN Summit, 2008
And forward movements are taking place……
Nomenclature

- Global efforts to embrace the ICAO PBN manual nomenclature

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### The New RNAV/RNP Values

<table>
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<tr>
<th>Area of Application</th>
<th>Nav Accuracy (NM)</th>
<th>Nav Specification (current)</th>
<th>Nav Specification (new)</th>
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<td>RNP/SAAAR</td>
<td>RNP 0.3-0.1 (RNP/AR)</td>
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ERJ 145 Status

- These are the achieved certifications for the ERJ 145 Family

### The New RNAV/RNP Values

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</table>
RNP– ERJ 145 Modification

RNP 0.3 AR (AC 90-101)

- Honeywell
  - Display System: IC, Display
  - Navigation System: DUAL FMS 5.2, VNAV
  - Recording System: FDR
  - Auto Flight System: IC, GC-550

- Universal
  - Display System: IC, Display
  - Navigation System: DUAL FMS 4.8, VNAV
  - Recording System: FDR
  - Auto Flight System: IC, GC-550

RNP APCH (AC 90-105)

- Honeywell
  - Display System: IC, Display
  - Navigation System: DUAL FMS, GPS, 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

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:
- SW upgrade
- SW+HW upgrade
EJETS Status

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

The New RNAV/RNP Values

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ANAC/FAA
RNP AR 0.3
MAP 1.0

ANAC/FAA/EASA
RNP AR < 0.3
MAP < 1.0
RNP AR 0.3 / Missed Approach 1.0

- PFD

RNP AR System Design
RNP AR 0.3 / Missed Approach 1.0 (cont.)

- PFD

![PFD Image](image-url)
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.)

UNABLE RNP
PILOT RNP CANCELLED
UNABLE RNP
PILOT RNP CANCEL NEXT WP
UNABLE RNP NEXT WP
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

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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

Honeywell

- Display System
  - IC
  - Display
- Navigation System
  - DUAL FMS 5.2
  - GPS
  - OR
  - DUAL FMS 4.8
  - GPS ant
- Recording System
  - FDR
- Auto Flight System
  - IC

Universal

- Display System
  - IC
  - Display
- Navigation System
  - DUAL FMS
  - GPS
  - GPS ant
- Recording System
  - FDR
- Auto Flight System
  - IC
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Human Interface

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

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Human Interface

"ATC MESSAGE "
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
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

ATN CPDLC

Honeywell
- Display System
  - IC
  - Display
- Navigation System
  - FMC
  - CDU
- Datalink System
  - CMU
  - VDR
- Alerting System
  - AWU

Universal
- Display System
  - IC
  - Display
- Navigation System
  - FMC
  - CDU
- Datalink System
  - Unilink
  - VDR
- Alerting System
  - AWU

Legend:
- xxx SW upgrade
- SW+HW upgrade

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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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- **Studies: ADS-B / CPDLC / RNP / LPV**
- EMB PSB for ADS-B and CPDLC
- Operators PSB Final Agreement
- EMB Development
- EMB SB availability
- Operators Retro-fit
- Mandate for CPDLC and ADS-B in EUROPE
THANK YOU!