Agenda

Embraer Civil Aircraft
- Commercial Aircraft
- Executive Aircraft

Data Link Applications
- EJets Data Link Applications
  - ACARS AOC/ATS
  - ATN B1
  - FANS 2

E2 Overview
ERJ Family

ERJ 135
MODEL YOUR BUSINESS. YOUR WAY.
37
1,750 nm
Mach 0.78

Rolls-Royce AE3007

ERJ 140
CUSTOMIZED CAPACITY
44
1,650 nm
Mach 0.78

Rolls-Royce AE3007

ERJ 145
MISSION VERSATILITY WITH 50 SEATS
50
1,550 nm
Mach 0.78

Rolls-Royce AE3007

ERJ 145 XR
THE XR GOES THE DISTANCE
50
2,000 nm
Mach 0.78

Rolls-Royce AE3007

Honeywell Primus 1000
Available FMS Systems:
• Universal 1K
• Honeywell NZ-2000
E2 Family

E175-E2
BEHOLD THE POWER OF 2
GTF PW1700G engines
1,930 nm

E190-E2
BEHOLD THE POWER OF 2
GTF PW1900G engines
2,800 nm

E195-E2
BEHOLD THE POWER OF 2
GTF PW1900C engines
118 - 132
2,000 nm

Honeywell Primus Epic
COMMERCIAL AVIATION

AIRCRAFT IN OPERATION
1.6 THOUSAND +

AIRLINES
90 +

COUNTRIES
61

* E-Jets families and ERJ only; scheduled and non-scheduled airlines.
EXECUTIVE AIRCRAFT

PHENOM 100E
PHENOM 300
LEGACY 450
LEGACY 500
LEGACY 600
LEGACY 650
LINEAGE 1000E
Phenom 100/300

PHENOM® 100E
ENTRY LEVEL
5 - 7 passengers
1 - 2 crew
1,178 nm

PHENOM® 300
LIGHT
1 - 2 passengers
7 - 10 crew
1,971 nm

Garmin G1000/3000
Prodigy Flight Deck 100/300
Legacy 450/500

LEGACY® 450
MIDLIGHT
2 7-9
2,500 nm

LEGACY® 500
MIDSIZE
8-12 2
3,125 nm

Rockwell Collins
Pro Line Fusion
Legacy 600/650

**LEGACY® 600**

Super Midsize

- 13 - 14 passengers
- 2 crew members
- 3,400 nm range

**LEGACY® 650**

Large

- 13 - 14 passengers
- 2 crew members
- 3,900 nm range

Honeywell

Primus Elite
Lineage 1000

**LINEAGE® 1000E**

**Honeywell Primus Epic**
EXECUTIVE AVIATION

900 JETS DELIVERED

60 COUNTRIES
Data Link Applications

Aircraft with multiple types of data link systems

- ACARS AOC (CMF/CMU)
- FANS 1/A (Generic)
- FANS 1/A
- FANS 1/A+
- ATN B1

ATSU - Any airspace
ATU - Oceanic and remote airspace
ATSU - Continental airspace

Source: FAA AC 20-140B
# Data Link Applications Status

<table>
<thead>
<tr>
<th>Data Link Application - Sub-network</th>
<th>Phenom 100/300 Garmim G1000/3000</th>
<th>Legacy 450/500 Rockwell Collins Pro Line Fusion</th>
<th>Legacy 600/650 Honeywell Primus Elite</th>
<th>Lineage 600/650 Honeywell Primus Elite</th>
<th>ERJ 145 Honeywell Primus Epic</th>
<th>E2 Jets Honeywell Primus Epic</th>
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<td><strong>ACARS</strong> AOC / ATS</td>
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<td><strong>FANS 1/A (w/ ADS-C)</strong></td>
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<td><strong>ATN B-1</strong></td>
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- Available
- Obsolete
- Under Certification
- Under Development
- Under Customer Request
- Not available

*1 Permanent Exemption
EJETS DATA LINK APPLICATIONS
CMF

Airborne router that supports datalink service access between aircraft datalink applications and ground service providers
EJets – ACARS AOC / ATS Applications

AOC Services:
- Reports: OOOIs, delay, ETA, diversion, post flight
- Free text messages
- Vox Contact messages
- Flight Initialization
- Weather
- Flight plan / Winds
- Meteorological Reports
- Maintenance Messages (AHEAD)

ATC Services (A623):
- ATIS
- Clearances: departure, expected taxi, oceanic, pushback
- TWIP
Specifications / Guidelines for implementation:

- ANAC FCAR HSI 52 CPDLC Means of Compliance
- EASA CRI F-40 Data Link Services for Single European Sky
- FAA AC 20-140A (Guidelines for Design Approval of Aircraft Data Link Communication Systems Supporting Air Traffic Services (ATS))
- EUROCONTROL-SPEC-0116
- DO-280B / ED-110B Interoperability Requirements Standard for Aeronautical Telecommunication Network Baseline1 (ATN B1 INTEROP Standard)
- DO-290 / ED-120 Safety and Performance Requirements Standard for Air Traffic Data Link Services in Continental Airspace (Continental SPR Standard) including change 1 and change 2
- DO-200A / ED-76 Preparation, Verification and Distribution of User-Selectable Navigation Databases
ATN B1 (CMF) – Human Machine Interface

- Visual Alert: “ATC” flag on the PFDs
- Aural Alert: “Message ATC”
- CAS message to indicate fail of CMF ATC Partition
- MCDU Pages: ATC MENU prompt (LSK 5R) on ACARS MAIN MENU page

ATC 1(2) DATALINK FAIL
Display of Uplink Messages: one button push required

- DLK pressed
  - Is there any pending CPDLC message?
    - NO
      - Is there any pending AOC/ATS message?
        - NO: ACARS MAIN MENU Page
        - YES: CMU NEW Page or the AOC/ATS Message if only 1 exists
  - YES: ATC MSG LOG Page or the CPDLC Uplink Message if only 1 exists
Two main technical issues observed in the ATN B1 deployment in Europe:

- **Provider Abort (PA):** it corresponds to a sustained loss of ATN connectivity greater than 6 minutes leading to the loss of CPDLC connection between the a/c and the ATC
  - Industry Requirement: below 1%
  - Best observed rate: 5% (some a/c that are in the White List)
  - EPIC observed rate: 20% (not only EJets)

- **Transmission Delays:** it corresponds to transmission delays in the CPDLC messages between the a/c and the ATC; it does not cause PA but leads to operational impact

Since Nov 2013 some ANSPs introduced a White List with aircraft authorized to log on the ATN network. The EJets are not currently included.

The European Commission requested EASA and SESAR Joint Undertaking to conduct technical investigations.
PAs cannot be attributed to a single cause

PAs happen in a “random” way, at different locations, with different avionics, ANSPs, ACSPs (SITA/ARINC), and at different times of the day

PAs occurrences could be attributed to a combination of the following factors:

- Use of a single frequency (CSC – 136.975 MHz) for network management and data
- Concurrency of AOC and ATN traffics over this single frequency channel, leading to an excessive channel usage level compared to the ATN protocol needs
- The VGS networks are mainly driven by AOC needs, leading to a saturated and non-optimized VGS network for en-route (over FL 285) purposes
- The resulting RF complex environment (where there are many VGSs in view) introduces some unexpected demands on the VGS handover logic at airborne level
- Increase of the Radio Frequency congestion leading to delays in data transmissions or disconnections
Honeywell / Embraer Investigation (Mar/Nov 2014)

Flight Test Campaigns in Europe airspace flying an Embraer 170:

- Data from these tests highlighted the high level of PAs and TRTDs
- Graphical presentation of traffic from various layers of ATN stack received
- Google Earth map to show ground station coverage, handoff, provider aborts, stale messages
- Ground issues were observed and discussed with Eurocontrol, Data Link Service Providers and other stakeholders
- Root causes were identified and are being implemented in the Primus EPIC loads

*The Flight Test Campaign pointed out a high channel utilization as the main contributor of PAs and Transmission Delays*
Forward and retrofit mandate for aircraft: 5 February 2020

The improvements in Primus Epic (CMF) will be available before that:

- The flight test campaign of Nov/14 performed with these improvements demonstrated satisfactory results (CMF 3.X)
- The inclusion of EJets in the White List is expected
SJU Investigation (Nov 2015)

- VDL M2 over one single frequency (SSC) would already reach its capacity limits in 2015. Therefore, Multi-frequency deployment in Europe is a “MUST” as of today (2015)

- A 4 frequencies implementation is a minimum requirement to support VDL M2 deployment until 2025 in high density area

- Further optimization options under investigation by ELSA (VDL Mode 2 Measurement, Analysis, Testing and Simulation Campaign) may extend the viability of VDL M2 over 4 frequencies beyond 2025 in high density area

- It is highly recommended to anticipate the evolution of the European datalink infrastructure in the ATM masterplan and to prioritize the development of the next generation datalink technology within SESAR
EJets – FANS 2 (CPDLC integrated w/ NG FMS)

FANS 2 = FANS 1/A+ and ATN B1 data link applications

FANS 1/A+ network: ACARS. Viable sub-networks:
- VDL Mode A
- VDL Mode 2
- SATCOM Iridium (under certification)

ATN B1 network: ATN. Viable sub-network:
- VDL Mode 2 with multi-frequency

Automatic ATC Transfers:
- FANS 1/A ↔ FANS 1/A
- ATN B1 ↔ ATN B1
- FANS 1/A ↔ ATN B1

FANS 1/A and ATN B1 messages harmonization:
- Same display / same alerts
EJets – FANS 2 (CPDLC integrated w/ NG FMS)

Specifications / Guidelines for implementation:

- EASA CRI F-40B Data Link Services (equivalent with CS-ACNS)
- FAA AC 20-140B Guidelines for Design Approval of Aircraft Data Communication Systems Supporting Air Traffic Services (ATS)
- DO-280B / ED-110B Interoperability Requirements Standard for Aeronautical Telecommunication Network Baseline1 (ATN B1 INTEROP Standard)
- DO-258A / ED-100A Interoperability Requirements for ATS Applications Using ARINC 622 Data Communications (FANS 1/A Interop Standard)
- DO-290 / ED-120 Safety and Performance Requirements Standard for Air Traffic Data Link Services in Continental Airspace (Continental SPR Standard) including change 1 and change 2
- DO-200A / ED-76 Preparation, Verification and Distribution of User-Selectable Navigation Databases
- ARINC 622-4 ATS Data Link Applications over ACARS Air-Ground Network
FANS 2 (NG FMS) – Human Machine Interface

Aural Alert: “MESSAGE ATC”

PFD: ATC Flag

Aural Alert: “ATC ATC ATC...”
The aural will stop only when the message changes from NEW to OPEN

PFD: ATC Flag for FANS 1/A A/D Messages
FANS 2 (NG FMS) – Human Machine Interface

MCDU
FANS 2 (NG FMS) – Human Machine Interface
E2 CPDLC IN BOX
E2 – CPDLC In Box (PFD)
Thank You

Fernanda C. R. Vilarinho
fernanda.vilarinho@embraer.com.br
+ 55 12 3927 3647