Electronic Flight Bag
Enabling a Safe and Efficient Global Air Transportation System
Boeing Crew Information Services
Jeppesen

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Kevin Gosling
Project Manager - EFB Development
Boeing Commercial Airplanes
EFB is a system comprising hardware and software that provides:

- Flight Crew access to emerging electronic flight operations data, general purpose computing and communications
- Replacement of many of today’s paper documents
- A range of implementations spanning portable electronic devices up to installed certified integrated systems
Why Implement EFB?

- *Today*, virtually all documents are authored electronically, yet distributed with paper. Aircraft operations are documented and supported extensively using paper.

**Goal:** Eliminate paper and associated revisions required to operate an airplane

**Today**

Airplane Manuals* - 77 lbs/ 35 kg

* Typical 777 manual set. Does not include maintenance logs.

**With EFB**

QRH
Airline Requirements for EFB?

Based on Airline Inputs

System Requirements
• Open Architecture
• Simple, intuitive operation
• Data accessible - all phases of flight
• Range of implementations (portable through installed)
• Replace existing paper products
• Provide rapid updating
• Improved Communications - AOC to CPDLC
• Common implementation across Airline fleets
• Minimize training footprint
• Growth and flexibility to expand with Airline needs
• Low Cost
EFB Implementation

Specifying Systems that are:

• Modular and Scaleable - Multiple entry levels
• Operate with Windows and Linux
• Provide Connectivity with ACAR’s, SATCOM, Connexion etc
• Integration with existing Avionics and Systems
• ARINC 763 Compatible
• Include Video Surveillance in baseline
• DO-160D and RTCA DO-178B Level C
• Data distribution via secure internet (MyBoeingFleet.com)
• Pilot User Interface - Human Factors compatible
Boeing/Jeppesen scaleable EFB solutions provide multiple entry points and migration paths between portable and/or installed options.

Early adopter - 2002

• Non-Essential Applications Only
• Restricted number of Applications
• Restricted phases of flight

High End Adopter – 2003/4

• Essential & Non-Essential Level Applications
• Unlimited number of Applications
• All phases of flight
• Supports: laptops, Keyboards, printers, CCD

Transition

AND/OR
Boeing/Jeppesen scaleable EFB solutions provide multiple entry points and migration paths between portable and/or installed options.

Early adopter - 2002

High End Adopter – 2003/4

Support addition of ARINC 763 Network Server System

NSS – 2004/5

- Datalink Comms
  - SATCOM
- Gatelink
- CPDLC
- NOTAMS
- Weather
- Video Recording
- Data Recording
- Intranet
  - Crew Scheduling
  - E-Mail
- Security
- Expandable
- Supports Maintenance
  - Fault Reporting
Boeing & Jeppesen will provide applications that support Portrait or Landscape systems.
Today, once the airplane is airborne, communications with dispatch or Airplane Ops Center (AOC) is limited (e.g. ACARS/VHF)

Future CNS/ATM functionality may not be supported

Passengers often have better access to modern communications than the crew

Goals:

Short term: provide airlines with effective tools to communicate efficiently to flight and cabin crew when airborne, e.g. Company intranet, scheduling, fault reporting, etc.

Long Term: Facilitate CPDLC (Controller / Pilot Datalink Communications)
Surface Ops/Ground Navigation

• Today, some cars have better access to ground navigation than airplanes
• Airplane design has traditionally focused on Airborne Navigation

Goals:
Short Term: Provide Taxi Map Displays for Situational Awareness
Long Term: Incorporate NOTAM updates and route information
Weather Information

- *Today*, flight crews have limited access to real-time weather

**Proof of Concept Operational Program**

*AWIN Trials – Charts, Weather*

**Goals:**
- Provide flight crews access to weather information currently available only on the ground
- Facilitates better decision making and potentially reduced fuel burn
Application Manager - overview

- Provides the following system functions:
  - Pilot Access
    - Primary Pilot Interface control and top level application navigation management
    - Dedicated one touch bezel function key
    - View Transfer (DU to DU)
  - Maintenance Access
    - Software loading interface
    - System Utilities
    - Software configuration control
    - BIT/BITE
    - Maintenance diagnostics

Application & System specification subject to change
Video Surveillance - overview

Initial deployment*

- Allows pilots to view flight deck door area from seated position
  - Identify person at the door
  - Ensure nobody else within 8ft radius
- Displays located in forward field of view
- Split screen images for multiple camera viewing
- Airline selects number and location of cabin cameras

Future Options*

- Potential to record images during flight for later retrieval
- Datalink images off-board

* Contingent upon additional hardware options

Application & System specification subject to change
Onboard performance tool - overview

• Compute takeoff and landing performance
  • Calculates limit weights, V speeds, and engine power settings based on user input of airport conditions, and airplane configuration
  • Calculates assumed temperature thrust reduction for operations below limit weights
  • Accounts for MEL & CDL items and affecting aircraft performance
  • Accepts input of NOTAMS which alter airport definition (e.g. runway shortening, temporary obstacles)

• Facilitate Weight and Balance calculations
  • Verifies CG within limits based on user input of passenger, cargo and fuel load
  • Calculates stabilizer trim settings

Application & System specification subject to change
Electronic documents - overview

• Display PDF, HTML, XML documents
  • allow for integration between manufacturer supplied and airline authored documents
  • “smarter” formats (XML) provide best document display control
• Provides links between documents and document navigation using hypertext
• Text search engine
• Typical documents
  • Flight Crew Operations Manual
  • Flight Crew Training Manual
  • Minimum Equipment List
  • Airplane Flight Manual
  • Flight Planning & Performance Manual
  • Airline Policy Manuals
  • etc.

Application & System specification subject to change
Electronic logbook - overview

- Record basic flight information (crew members, flight times, weight and balance, fuel uplift, etc.)
- Record fault reports using pilot friendly graphical interface (electronic FRM)
- Provide flight crews with airplane status
  - deferred maintenance items
  - information on recurring faults (fault history)
- Record completion of non-routine (fault resolution) and routine maintenance action (servicing, scheduled checks)
- Work management tool for line mechanics
- Record airworthiness release
- Feed enterprise resource planning (ERP) databases
- Provide compliance with regulatory record-keeping requirements

Application & System specification subject to change
Taxi Moving Map - overview

- Improved Situational Awareness
- Own airplane position only
- New dedicated airport databases
- Consistent accuracy over entire airport surface
  - 3-5 meter accuracy maps
- Pilot selectable North-Up or Heading-Up modes
- Individual zoom and Pan functions
- Text remains readable during map rotations
- Each taxi segment individually labeled

Application & System specification subject to change
Navigation Charts - overview

- Electronic Terminal Area Charts
  - Content:
    - Jeppesen standard
    - Jeppesen tailored
    - Terminal charts (SIDs, STARs, Approach, Airport, noise & airspace)
  - Enhanced interface
    - Quicker access to charts
    - Pre-loading from FMS flight plan (where possible)
  - Format
    - Vector-based

- Airport Familiarization Charts
  - Familiarization prior to arrival
  - Individual Pilot selectable views
  - CBT

Application & System specification subject to change
Data Distribution using Secure Internet

Crew Information Systems Data Distribution

**Applications**
- Taxi Maps
- Jeppesen Charts
- eLogbook – fault reporting
- Performance Tool
- E-Documents
- Etc…
- Training

**Firewall**

- My Boeing Fleet
- Airline Firewall

**EFB**
- Laptop

**Ops Center**

- Ramp
- Hanger Maintenance

**Cockpit**

- Flight Deck Services

**Cabin**

- Flight Attendant Ops
- Passenger Service
- Fault Reporting

**Maintenance**

- Crew Information Systems Data Distribution using Secure Internet
How Do We Implement EFB?

Rules and Regulations

• FAA has recently released an EFB Advisory Circular
• AC 120-76 defines EFB’s in 3 separate classes
• Certification is divided into:
  – Parts 23 and 25 Airplane Airworthiness
  – Unique requirements for each class
• Operational Approval
  – Parts 91, 135 and 121 Operations
  – Same operational approval applies to all classes of EFB
• Human Factors Considerations
How Do We Implement EFB?

**Rules and Regulations (continued)**

**EFB Airplane Certification Criteria**
- Structural mountings, environmental, egress, safety
- Non-interference
- Equivalent level of safety must be shown
- Functional hazard assessments required for some applications
  - Data accuracy, integrity, availability
  - Loss of data and Misleading data
How Do We Implement EFB?

Rules and Regulations (continued)

EFB human factors considerations

• Should be considered for all EFB systems

• Part of the TC/SB process for all installed EFB’s

• Includes many aspects
  – Human/machine interface
  – Physical components (structural cradle, articulating arms, cabling, connectors, etc.)
  – Responsiveness of application
  – Lighting and readability issues
  – Input mechanisms
  – Managing multiple open documents
  – Critical phases of flight, etc.

• Supporting documents (e.g. Volpe Human Factors guide)
EFB Implementation

- Crew Laptop’s updated from server for offboard access
- Optional
- External antenna
- Terminal wireless transceiver
- Computer trays in EE-bay
- Cabin wireless access point

Airplane system interfaces
(ACARS, SATCOM, Connexion, FOQA, flight plan information, Weather etc.)

ARINC 763 Network Server System Architecture
Potential EFB Display Locations

757/767

737 NG

747-400

777
The Challenges

• Consistent with Flight Deck Philosophy
• Physical constraints for Retro-fit and Production
• Environmental Qualification considerations
• Crew Interfaces
• Lighting considerations
• Crew Workload
• Distractions and Fatigue
Electronic Flight Bags

Summary

• Eliminate paper
• Open architecture
• Basic and tailored applications to meet airline needs
• “Plug and Play” options for efficiency
• Certification - safety, workload and approval
• Integration to avionics and other on board systems
• Flexible, phased implementation to accommodate growth
HAVE A NICE FLIGHT. REMEMBER TO TURN ON YOUR LAPTOP COMPUTER DURING TAKEOFF.

I THOUGHT THEY TELL YOU TO TURN IT OFF. HOW WOULD THEY TRANSFER CONTROL TO YOU IF THEY HAD TROUBLE?

TURN OFF THAT $#% LAPTOP!!

NO WAY! I HAVE TO LAND THIS BABY! ...CAN I DO THAT IN 'EXCEL'?