Electronic Flight Bags (EFBs) in the Airline Industry

“A Sales Manager’s Perspective”

Matthias Gondeck
Dipl.-Ing. / BEng (Hons) / MRAeS

Business Development - Goodrich Corporation
Munich
Content

Goodrich Company Overview

What is an Electronic Flight Bag (EFB)

Airline’s Business Case & Basic Sales Process

Goodrich EFB Solutions Class 2/3 – Current Programmes

The Future of EFB & Implementation of new Technologies / ADS-B in/out

SmartDisplay® EFB Architectures & ADS-B Applications

Questions & Answers
Goodrich Corporation – A Company Overview

- 2009 sales - $6.7 billion
- **Broad product portfolio**
- One of the largest global aerospace and defense suppliers
- **New technology** on modern fleets drives growth
- Strong focus on **operational excellence**
- Operating history of 140 years
- 24,000 employees
- More than **80 locations worldwide across 17 countries**
Navigation charts…. needs to be up-dated every **28 days** in accordance to the AIRAC cycle (Aeronautical Information Regulation And Control Cycle)

Up to 50-60 kg per a/c manuals
Airline Transformation

Paper Charts and Documents

Digital Information Solutions

EFB display unit – for fight deck

EFB computing unit – avionics bay

Transformation
The definition of an Electronic Flight Bag (EFB), according to the FAA's Advisory Circular (AC-120-76A), is an electronic display system intended primarily for cockpit / flight deck or cabin use.

EFB devices can display a variety of aviation data or perform basic calculations (e.g. performance data, fuel calculations etc.).

One of the major motivators for using an EFB is to reduce or eliminate the need for paper and “clutter” in the cockpit.

In short, an EFB is an electronic information management device that helps flight crews perform flight management tasks more easily and efficiently, in a less-paper environment.

Many routine processes are historically evolved, still paper based, inefficient & expensive
EFB Classifications - Hardware

Hardware is based on its level of sophistication & integration with the aircraft systems

- **Class 1** EFBs are Portable Electronic Devices (PEDs) such as Laptops, handheld electronic devices or iPads (COTS – Commercial-Off-The-Shelf). Must be stowed during critical flight phases, (taxi, take-off and landing operations).

- **Class 2** EFBs are also referred to as Portable Electronic Devices (PEDs), which range from modified COTS equipment to purpose-built devices. Typically mounted in the aircraft with the display being viewable to the pilot during all phases of flight! Display mounts and computing mounting require design approval (STC*). Class 2 EFB can be connected to the aircraft power & data sources via ARINC429 (read only) or the ARINC717 interface.

- **Class 3** EFBs are fixed, installed equipment and, therefore, require installation design approval (STC). The hardware often designed in accordance with RTCA/DO-160E** requirements. There may be DO-178B requirements for software.

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STC* - Supplemental Type Certificate
RTCA/DO-160E** - Environmental Conditions & Test Procedures for Airborne Equipment
EFB Classifications - Software

Operational Approval “only” – do not require AIR* design approval

A
- Pure Paper Replacement
- Non-critical Flight Phases
- 6 months EFB + paper backup
- Principal Inspector (PI) Approval

Applications include: Aircraft Flight Manual (AFM), Flight Operations Manual (FOM), Minimum Equipment List (MEL), Aircraft Flight Log, Pilot Flight Log, etc. (files in pdf, XML, HTML-format)

B
- Interactive data
- Critical Flight Phases, taxi, T/O & LDG
- 6 months EFB + paper backup
- (PI) Approval & Aircraft Evaluation Group AEG

Applications include: Take-off, en route, approach & landing, missed approach, go-around etc. performance calculations, Weight & Balance Calculations, powers settings for reduced thrust, runway limitation, Cost Index modeling, Weather Data, Video Surveillance (CDSS) etc.

C
- Interactive functions
- ARINC 429 read & write
- Certified O/S per RTCA/DO-178B
- ADS-B in/out CPDLC

Applications include: CPDLC (Controller Pilot Data Link Communication), ADS-B solutions for in Cockpit Display of Traffic Information (CDTI) such as EnRoute traffic (ITP), M&S, & AMM.

Full airworthiness and operational approval process, requires AIR design approval / AEG evaluation / PI

Operate on Certified O/S per RTCA/DO-178B such as Deos™ e.g.

Deos™ is a proven, full featured DO-178B Level A certifiable real-time operating system (RTOS)

ADS-B** applications on Class 3 EFB

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**Personalized EFB vs Aircraft related EFB concept**

**Personalized EFB**
- Each Pilot with a Laptop – Class1, stand alone solution
- Each Pilot with a Laptop – Class2, with laptop docking station (LDS) on flight deck

**Major advantage:** the updating process is for free!

**Aircraft related EFB**
- Each Laptop remains on aircraft – Class2
- EFB computing- and display device remains on the aircraft Class2/Class3

**Major advantage:** less maintenance
Turnkey end-to-end EFB solutions

Aircraft / on-board Hardware
- Aircraft Installation Kit – EASA STC Engineering Order (EO)
- Display Mounting Arm Solutions
- FAA- or EASA STC European DOA
- EFB Hardware Class 2 / Class 3
- 3G Connectivity

EFB – Applications / Software
- EFB firmware
- GUI / CDM
- CDSS
- ADS-B
- ETL
- AIRBUS LPCNG
- Performance
- Document
- Chart Viewer
- EFB Forms

Communications
- Satellite SATCOM
- Memory Key - USB
- Portable Data Loader
- ADS-B in/out
- 3G/4G Cellular
- ACARS
- WIFI 802.11x

Ground Applications
- EFB Ground Manager
- Data aggregation & distribution
- EFB Data status tracking
- Library Manager
- EFF
- Chart Manager
- Forms Designer

Web-based Products
- Flight Ops Portal
- Metc & Eng. IT infrastructure
- Manual Manager
- CBT
- Pilot Briefing Module

Key:
- Performance* - T/O - & LDG Perf, In-flight Perf, Loadsheet
- Documents** - FCOM (Flight Crew Operating Manual), MEL, Ops Library
- ACARS*** - Airborne Communications Addressing & Reporting System
Content

- Goodrich Company Overview
- What is an Electronic Flight Bag (EFB)
- Airline’s Business Case & Basic Sales Process
- Goodrich EFB Solutions Class 2/3 – Current Programmes
- The Future of EFB & Implementation of new Technologies / ADS-B in/out
- SmartDisplay® EFB Architectures & ADS-B Applications
- Questions & Answers
Airline’s Business Case – Electronic Flight Bag (EFB)

- **Reduce paper** in the cockpit, which decreases weight and cuts down “clutter”
- **Reduce cost and workload** required to update documents
- **Keep information up-to-date**, enabling easy document updates
- **Send flight reports quickly and effectively**, allowing issues to be addressed more rapidly
- **Reduce fuel and maintenance costs** by using accurate take-off and landing calculations and using ITP – In Trail Procedures
- **Improve safety** with onboard performance calculations, Airborne Traffic Situational Awareness (ATSAW) & Runway incursion
- **Increase payload** with real-time performance calculations
- **Improve routing decisions** by accessing real-time weather information

18 month return on investment (pay back)
First Step
- Entry level EFB, e.g. Laptop, iPad, Class1 with type A & B software available for Flight Operations.

Second Step
- Upgrade to a Class2 with Type A & B, a/c connectivity & communication. etechlog (ETL) system in line maintenance. Cost Index (CI) module for tactical decision making and fuel consumption reduction.

Third Step
- Upgrade to installing ADS-B and CPDLC* equipment for future use in flight operations and on the airport, Class3 & Type A, B & C software.

Fourth Step
- Providing cabin signals to generate ancillary revenues via mobile phones, advertising & other devices & services.

CPDL* Controller Pilot Data Link (CPDL) - method by which air traffic controllers can communicate with pilots over a datalink system.

CPDLC* Controller Pilot Data Link Communications - method by which air traffic controllers can communicate with pilots over a datalink system.
The basic Sales Process (retrofit) – what are the Airline’s requirements?

- Software? a/c related or personalized? Scalable & growth potential?
- Class 1 or Class 2?
- Per aircraft
- Class 2 or Class 3?
- Software? Class2 - STC
- FAA/EASA STC? a/c fleet type?
- FAA/EASA STC**?
- Class 1 Laptop or iPad
- <10,000 feet Back-up paper
- All phases of flight Fully paperless
- FAA - EASA validation or ground - up EASA STC with European DOA**
- C-Check & mtce schedule
- Cost of NRE**
- GPS/FMC/AMM/CDSS via EFB
- Weight on wheels, door open
- All aircraft
- FAA/EASA STC*?
- a/c fleet type?
- Minor or Major Modification?
- FAA/EASA STC**?
- a/c fleet type?
- Minor or Major Modification?
- FAA - EASA validation or ground - up EASA STC with European DOA
- C-Check & mtce schedule
- Cost of NRE
- Scalable & growth possibilities?
## Applications & Benefits

<table>
<thead>
<tr>
<th>Applications</th>
<th>Benefits</th>
<th>Class1 EFB</th>
<th>Class2 EFB</th>
<th>Class3 EFB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic charts</td>
<td>◬ eliminate paper ◬ efficient distribution</td>
<td></td>
<td></td>
<td>(X)</td>
</tr>
<tr>
<td>CBT (Computer Based Pilot Training)</td>
<td>◬ eliminate paper ◬ efficient distribution ◬ flexible usage</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>eFF (electronic Flight Folder)</td>
<td>◬ eliminate paper ◬ efficient distribution ◬ flexible usage</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Documentation</td>
<td>◬ eliminate paper ◬ efficient distribution ◬ flexible usage</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Performance Calculation</td>
<td>◬ Flexible &amp; cost efficient adoption of operational needs</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>eTechlog EFL (electronic technical log Book)</td>
<td>◬ eliminate paper ◬ efficient distribution ◬ flexible usage</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cost Index (CI) mainly CRJ</td>
<td>◬ save time &amp; fuel ◬ lowering fuel burn and emissions</td>
<td>(X) ✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>AMM (Airport Moving Map) – ADS-B in/out</td>
<td>◬ Improve situational awareness</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Merging &amp; Spacing (M&amp;S) – ADS-B in/out</td>
<td>◬ safe time &amp; fuel ◬ increasing capacity &amp; efficiency within the terminal airspace</td>
<td>X</td>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td>ITP (In Trail Procedures) Oceanic – ADS-B in/out</td>
<td>◬ flexible procedure ◬ desired flight level (turbulences/winds) ◬ lowering fuel burn &amp; emissions</td>
<td>X</td>
<td>X</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Source:** Andreas Ritter, Lufthansa German Airlines, ADS-B & CI included Gondeck

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*Dipl.-Ing. Matthias Gondeck - MRAeS, HAW Hamburg, 15th September 2011*
Goodrich EFB evolution - hardware

- **EFB Video Server**
  - VIU or CIU

- **Traditional EFB – Class 2**
  - tuifly.com, Sukhoi SSJ100, Bombardier Global Express/XRS/5000 platforms
  - Avionics Hardware: full RTCA DO-160 qualification
  - Part 25 Certified
  - ARINC 429
  - Video Surveillance
  - 115VAC and 28VDC
  - Integrated Communication

- **Laptop Docking Station EFB – Class 2**
  - Lufthansa, Emirates, Embraer 190/195, Augsburg Airways, Eurowings (CRJ700/900)
  - Avionics Hardware: RTCA/DO-160 qualification
  - Part 25 Certified LDS and Display
  - ARINC 429

- **SmartDisplay® Class 2 or Class 3**
  - US Airways A320, A330
  - United Airlines B744
  - Sun Country B737NG
  - Computer & Display one unit
  - EFB Interface Unit (ARINC 429, Ethernet Switch, Memory, additional I/O)
  - Part 25 Certified
  - Fast/Simple Installation
  - Modular & upgradable

- Boeing Class III EFB accessory
- 450+ Units Flying Since 2003
- ARINC 429
- Ethernet Switch
- Air Berlin VIU selected for B737NG
- SCIU on B787

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LDS EFB – Class2 architecture for A320, A330, A340 aircraft
Lufthansa A340-600 LDS-EFB installation
European Aviation Safety Agency

SUPPLEMENTAL TYPE CERTIFICATE
10016410, REV. 2

This Supplemental Type Certificate is issued by EASA, acting in accordance with Regulation (EC) No. 216/2008 on behalf of the European Community, its Member States and of the European third countries that participate in the activities of EASA under Article 90 of that Regulation and in accordance with Commission Regulation (EC) No. 1702/2003 to

ROSEMOUNT AEROSPACE, INC.
14500 JUDICIAL ROAD
BURNsville 55306-4898
USA

and certifies that the change in the type design for the product listed below with the limitations and conditions specified meets the applicable type certification basis and environmental protection requirements when operated within the conditions and limitations specified below:

Original Product TC Number: EASA-A.064

TC Holder: AIRBUS
Model: A318-111/112/113/114/115
Model: A318-111/112/113
Model: A320-211/212/213/214
Model: A320-231/232/233
Model: A321-111/112/113/131
Model: A321-211/212/213/311/312

Original STC Number: FAA STC ST00364CH

EASA Certification Basis:
Certification basis in accordance with EASA Type Certificate Data Sheets A.064.
The Certification bases for the original product and the following additional or alternative airworthiness requirements are applicable to this certification:
1. CRI F.01 "Installed Resources for EFIS Class 2 Provisions"
2. CRI H.01 "Enhanced Airworthiness Programme for Aeroplane Systems - ICA on EIS".
The certified noise and/or emissions levels of the original product are uncharged and remain applicable to this certification.

Description of Design Changes:
Installation of Rosemount Aerospace 8700C2.4 Laptop Docking Station
- Electronic Flight Bag (EFB) System Provisions.
See Continuation Sheet(s).

For the European Aviation Safety Agency,

Date of Issue: 21.06.2010

MARIO HERNI
Project Certification Manager
Large Aeroplanes

Photo: A320 - Lufthansa

A320 family EASA STC - LDS

Copyright: Lufthansa
A319CJ – German Ministry of Defense (MOD) – LDS EFB

- 2x AIRBUS A319CJ for German Ministry of Defense (MOD)
- Goodrich delivered LDS-EFB LRUs
- Goodrich delivered Engineering Data Package (EO)
- Goodrich provided permission letter, for the purpose of utilizing existing EASA STC engineering data package
- Lufthansa Technik (LHT) integrated Goodrich Laptop Docking Station EFB
Boeing B777 - LDS-EFB installation – Class2

Laptops remains on board - aircraft related concept

Copyright: Emirates
CRJ700 & CRJ900 - LDS-EFB installation – Class2

- CRJ700/900 (Lufthansa Cityline)
- CRJ900 (Eurowings)
- Lufthansa Flight Training Berlin
- Global 5000 and Global Express via BJAC in Canada - traditional EFB
- CRJ700 (myair) – traditional EFB
Tuifly.com B737NG – Class2 installation

Graphic: courtesy tuifly.com
Tuifly.com B737NG – EFB Class2/3 installation

Mr. Sebastian Franz – Pilot & EFB - Programme Manager

EFB ON/OFF location in overhead panel

Photo: courtesy tuifly.com
Thales is responsible for the Superjet100 avionics suite, including displays, communication, navigation and surveillance systems. Goodrich supplies the Maintenance Access Terminal – MAT (SFE) for e-techlog (ETL) and the Electronic Flight Bag – EFB (BFE), both computer modules (CMs) and touch screen display modules (DMs).

**CDSS**
Goodrich’s computer module (CM) does have CDSS capabilities available, which can be utilized via the EFB.

**FLIGHT DECK**
Superjet100 is fitted with Messier-Dowty retractable twin-wheeled tricycle-type landing gear with a Sukhoi braking system and Goodrich wheels and brakes. Four-wheel bogies are offered as an option for the main landing gear units.

**Notes:**
SFE = Seller Furnished Equipment  
BFE = Buyer Furnished Equipment (OEM optional list often dual options!)
Embraer 190/195 – Goodrich BFE selectable & ARINC 828 compliant

Laptop Docking Station (LDS)
Electronic Flight Bags – BFE (optional)
ARINC 828 compliant
Embraer 190/195 – Goodrich BFE selectable & ARINC 828 compliant

- Embraer ERJ 190/195 BFE optional & OEM installed
- ERJ 195 (Lufthansa Cityline)
- ERJ 195 (Augsburg Airways)
- ERJ 195 (Air Dolomiti)
- ERJ 195 (Swiss Aviation Training)
- Goodrich Engineers part of the AEEC - EFB Task Force
- Active Development of ARINC 828 & ARINC 840 standards
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Automatic Dependent Surveillance Broadcast (ADS-B) in/out

- **Automatic**
  - Periodically transmits information with no pilot or operator input required

- **Dependent**
  - Position and velocity vector are derived from Global Positioning System (GPS/GNSS)

- **Surveillance**
  - A method of determining position of aircraft, vehicles, or other assets

- **Broadcast**
  - Transmitting information available to anyone with the appropriate receiving equipment

Video ADSB_1.0_2.5MB.wmv EUROCONTROL
FAA Capstone - Programme

The Capstone Program is an FAA funded safety program located in Alaska, primarily focusing on rural areas of the state. The program concentrates on increasing safety in aviation through technology and making the process of integrating that technology more efficient. Some of the systems currently being developed in Capstone includes GPS Receivers, Data Link Transceivers, ADS-B, Multi-Function Displays, Flight Information Services, Moving Maps, and Terrain Databases.

EUROCONTROL CASCADE - Programme

The CASCADE programme co-ordinates the European implementation of ADS-B (Automatic Dependent Surveillance Broadcast), a surveillance technique that relies on aircraft broadcasting their identity, position and other aircraft information. This signal can be captured on the ground for surveillance purposes (ADS-B-out) or on board other aircraft for air traffic situational awareness (ADS-B-in) and airborne separation assistance. ADS-B-out has reached initial operational capability status in 2008, ADS-B-in for air traffic situational awareness in 2011.

Standards development take place in the Requirement Focus Group, a joint venture between EUROCONTROL, the FAA, EUROCAE and RTCA* with participation of Airservices Australia, NAV CANADA, the Japanese Civil Aviation Board and many industrial partners.

RTCA* - Radio Technical Commission for Aeronautics – Washington D.C. USA

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The main Benefits for ADS-B in/out

- **low cost** when compared to other surveillance alternatives (up to 1/10 of a radar system with system coverage),
- its **high accuracy**, and
- the support of **airborne surveillance** applications which will enable many future **safety** and **capacity benefits**.

- **ADS-B-out** has safety and capacity benefits in areas where there is **no surveillance today** or where the separation minima applied is large due to surveillance deficiencies.

- **ADS-B-out** has also significant **economic benefits** when used to replace part of a radar infrastructure.

- **ADS-B-in** has primarily **safety benefits** by increasing the situational awareness of pilots, but it also enables to provide **capacity benefits** when spacing and separation applications will be introduced.
SafeRoute™ - Merging & Spacing and SAMM

Surface Area Movement Management (SAMM)

- Eliminates up to 99% of Runway Incursions
- Provides moving map display of the airport surface and position of participating nearby traffic (aircraft and ground vehicles), relative to own ship
- Provides display of Intruder information, i.e. Flight ID, Ground Speed & Intent.
- Utilizes ADS-B technology which is basic building block of Next Generation Air Transportation System

“GIVE IMMEDIATE WARNINGS OF PROBABLE COLLISIONS/INCURSIONS DIRECTLY TO FLIGHT CREWS IN THE COCKPIT”

Representation of Indicating & Alerting sample, respectively Runway Status Indication or RSI (Blue), Caution (Yellow), and Warning (Red)

The CDTI Images displaying ACSS SafeRoute™ are provided courtesy of ACSS & Astronautics Corporation of America.

Source: www.acss.com
The Merging & Spacing function makes use of onboard aircraft surveillance to provide flight deck spacing commands that allow aircraft to follow one another at the safest, most efficient interval possible from cruise altitude to the runway. These applications ensure more consistent aircraft spacing while increasing capacity and efficiency within the terminal airspace.

The CDTI Images displaying ACSS SafeRoute™ are provided courtesy of ACSS & Astronautics Corporation of America.

Source: www.acss.com

The CDTI Images displaying ACSS SafeRoute™ are provided courtesy of ACSS & Astronautics Corporation of America.

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Note the **aircraft** on the far left. It was given instructions to vector off course because it did not have the proper spacing from the **lead aircraft** for approach. This procedure wastes time and fuel. With the **Merging & Spacing** functions, aircraft will be spaced far from the destination aircraft so when they come to the merge point, they will have the proper spacing.
Integrated display system (Navigational Display) – OEM installed

Retrofit EFB Class3 of some 10,000 aircraft

Source: www.eurocontrol.int
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CDM – Cockpit Data Management Solutions™
Turn-key solutions for a paperless cockpit with integrated EFB hardware, software, and support services

SmartDisplay® with Lufthansa Systems LIDO Enroute Chart

OSYS etechlog

EFB computing unit – avionics bay
SmartDisplay® EFB – “Entry Level ” Class 2

**SmartDisplay™ Unit (SDU):**
- Processor: Intel Core Duo 1.6 Ghz processor
- OS: Windows XP Pro embedded
- RAM: 2 GB
- Storage: 32 GB compact flash
- Communications: 10/100 BaseT Ethernet
- RS-422
- Discretes (DI): 4 inputs
  - 1 DI for USB Power Inhibit (Wireless Comm)
  - 1 DI for Install Location (Capt/FO)
- Mounting Provision for USB Comm Device (3G & Wifi)
- Power: 28 VDC Power inputs
- Dimensions: 10.6 in X 7.8 in X 1.2 in*

![Diagram of SmartDisplay® EFB system](image-url)

- Wireless inhibit aircraft discrete input
- 10/100 Ethernet
- Circuit Breakers
- FO system power switch
- Capt system power switch
- Aircraft power
Upgrade to SmartDisplay® “plus” EFB - Class3

SmartDisplay™ Unit (SDU):
- Processor: Intel Core Duo 1.6 GHz processor
- OS: Windows XP Pro embedded
- RAM: 2 GB
- Storage: 32 GB compact flash
- Communications: 10/100 BaseT Ethernet
- RS-422
  - Discrete (DI): 4 inputs
  - 1 DI for USB Power Inhibit (Wireless Comm)
  - 1 DI for Install Location (Capt/FD)
- Mounting Provision: for USB Comm Device (3G & Wi-Fi)
- Power: 28 VDC Power Inputs
- Dimensions: 10.6 in X 7.6 in X 1.2 in

Electronic Flight Bag - Interface Unit (EFB-IU)
- ARINC 828 Aircraft Interface Device (AID)
- Processor: Power PC
- OS: Linux
- Communications: Six 10/100 BaseT Ethernet Switch
- ARINC 429: 10 Receive (RX) channels, 4 Transmit (TX) channels
- ARINC 634: Supports ARINC 429 data over Ethernet
- ARINC 717: 1 Receive channel (provisions)
- RS-422 (examples: Legacy GPS, WX, or Indium)
- RS-232 (examples: Engineering, Legacy GPS)
- Discrete: (DI): 8 inputs
- Power: 28 VDC
- Dimensions: 1.0 in X 9.6 in X 7.6 in

Digital Flight Data Acquisition Unit (DFDAU)

Cockpit Aislestand - Ethernet Connectivity (optional)
- ARINC 744A Printer

Air Data Inertial Reference Unit (ADIRU)

Air Data Inertial Reference Unit (ADIRU)
SmartDisplay® CDM – Cockpit Data Management Solutions™

**Business Drivers**
- IT - Back Office integr.
- Business process integr.
  - Flight Ops
  - Eng. & mtce.
  - Commercial
  - IT-Dep.

**New Technology**
- ADS-B in/out
- CPDLC
- 3G/4G com.
- AIRBUS LPONG
- FAA NextGen

**Airline Benefits**
- Business process integration / Back Office
- Versatility & flexibility to host self-developed, OEM & 3rd party applications
- Hardware maintained & upgraded
- Communication capabilities
- Multiple redundancies within architecture
- Growth path for ADS-B and CPDLC
- Usage during all phases of flight

**Airline Benefits plus**
- Truly integrated solution
- Business process improvement
- Improved operational efficiencies
- Improved turnaround times
- Safety benefits due to superior integration
- Fuel cost savings & time
- Emission reduction
- Noise footprint reduction
- Lower maintenance costs
- HUMS integration with ADS-B out
- Obsolescence management
- Technology refresh cycle

**FAA / Eurocontrol Objectives**
- Increase airspace & airport capacity
- Greater precision & reliability
- Emission & Noise
- Safety, capacity, efficiency

**Cass3, Type A, B & C**
- Goodrich SmartDisplay® Class 3 EFB displaying the ACSS SafeRoute™ Merger & Spacing (M&S) CDTI

**Cass2, Type A & B**
- Goodrich SmartDisplay® Class 2 EFB displaying SmartRoute™ Merger & Spacing (M&S) CDTI
Thank you very much, questions are welcome!