Presented by

Klaus Schmoetzer
Airbus, Dept. BCECS4
Head of
Conveyance Systems
28183 Bremen / Germany
E-mail: klaus.schmoetzer@airbus.com

Enhanced Cargo Monitoring
- Container Communication Interface
Study Item

International Aircraft Systems Fire Protection Working Group
Meeting in Atlantic City on November, 1st-2nd, 2005
Cargo Compartment Fire Detection

• JAR/FAR 25.857 requires a smoke or fire detector system for cargo holds
  ‣ Such systems monitor
    – directly the compartment
    – indirectly the goods loaded in containers/palettes
  ‣ Corrective actions are initiated by the cockpit crew or automatically
Transport logistic

Air freight can be a weak point

There is an interest to know

- which cargo is on board (on which location)
- specific to type information like temperature, humidity, acceleration,....
Air Freight Aspects

• Air freight increases rapidly
• Just in time delivery is a real challenge
• Air freight containers/pallets (ULDs) are packed by third parties
• Inspection time is very limited
• Transport security risk is linked to volume

In specific cases monitoring of goods within containers may contribute to security
Monitoring needs

• Customers & insurances want to know what happened to the shipment (liability issues)
• Forwarders need to increase monitoring of goods
• Security authorities expand their focus on ..... 
• Improvements maybe feasible for
  ▶ temperature sensitive goods (Vaccines / Pharmaceuticals)
  ▶ hazardous materials (HazMat)
  ▶ high valuable cargo (electronics, pharmaceuticals)

Such a monitoring needs communication between container and aircraft
Enhanced Air Freight Logistic – automatic ULD identification

**Carrier**

- Delivery

**Airport**

- Load Instruction
- Identification

**Aircraft**

- Load Master Station
  - Status of the Cargo compartments
  - Variance comparison of the identified/traced cargo and the load instruction

- Cargo Identification- and Tracing-System

- Network
Container Communication Interface (CCI)

• The container com-interface shall
  ‣ enable data exchange between container & aircraft
  ‣ be based on industrial standards like
    ‒ RFID (868 to 915 MHz)
    ‒ WIFI (Wireless LAN 2,4 GHz)
  ‣ have hot plug ability (auto log in)
  ‣ provide an interface to a SENSOR PLATFORM
  ‣ be furnished with a battery pack
    ‒ maybe solar assisted
Use of RFID capabilities for cool chain aspects

• If readers are installed in aircraft they can be used to:
  ‣ interrogate cargo (within the container)
  ‣ acquire data from dedicated goods
  ‣ enhance the monitoring
  ‣ set off a warning
  ‣ ........

This could be an improvement for sensitive goods (not only for e.g. Vaccines/Pharmaceuticals)
Example:
- Sensor Platform for cool chain monitoring

**Characteristics of a Temperature Monitoring Transponder Platform**

- High reading range > 4 m
- Display for the indication of the active temperature and of further status information
- Low total volume
- Small battery design
- Energy saving passive interface
- Accuracy of the temperature measurement +/- 0.5 K
- Scalability of the data memory

**CoolChain RFID-S Technology Platform**
Example:
- Study on automated Container / Pallet Identification

Test Objectives:

- Technical feasibility for RFID based automated identification of airfreight ULDs at the cargo door area of aircrafts
- Definition of optimized position of RFID antennas and transponders

Technical concept:

RFID components (UHF - 868 MHZ):

Reader
Antenna
Transponder (passive)

Reader
Antenna
Transponder

Energy
Data (Ident.Nr.)
Example:
- Study on automated Container / Pallet Identification

Test conditions for trials:

Following parameters have been changed during the trials and tests:

- Antenna positions
- Antenna architectures (fields)
- Transponder positions
- Transponder architectures
- Transmitting power (antenna output, range: 0.6-3.0 Watt)
- ULD weight (an empty ULD suffers more vibrations than a fully loaded)
- Dry / wet transponder

Antenna positions at cargo door:
A1: Left / right side
A2: Floor of cargo door area
A3: Ceiling of cargo door area
Example:
- Study on automated Container Identification

Transponder positions on container:

TC1: Left / right side [document pocket]
TC2: Bottom side of container
TC3: Top side of container
TC4: Front / back side
Example:
- Study on automated Pallet Identification

Transponder positions on pallets

TP1: Top of pallet (fastening rail)
TP2: Bottom side of pallet
RFID location at ULD
-IATA recommended place is not always useable
Automated onboard identification of cargo can contribute to enhance of security
Benefits of RFID assisted air freight handling

- Automated tracing of goods
- Automated verification of aircraft load instruction
- Reduction of false loading
- Reduction of ground time
- Paperless data transfer
- Electronic Bill of Loading

- Wireless interface can be used to enable more services than simply RF-Identification e.g.:
  - change/update information on relevant item
  - self control / monitoring means
  - memorize what’s of interest
  - data exchange (e.g. actual temperature, history ..)
High valuable or important cargo

- High valuable Cargo needs specific attention:
  - we should know where it is
  - unexpected movements might be detected automatically

- GSM/GPS-Module
- RFID-Tag e.g. with temperature sensor
Which type of RFID maybe needed within air freight handling?
### Air Freight related RFID standardisation

<table>
<thead>
<tr>
<th>Subject</th>
<th>Added Value</th>
<th>RFID Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labeling</td>
<td>• EPC&lt;br&gt;• P/N &amp; S/N&lt;br&gt;• Life Cycle Data</td>
<td>Passive</td>
<td>0.5 – 1 €</td>
</tr>
<tr>
<td>Tracking</td>
<td>Localization of ULD</td>
<td>Semi-active</td>
<td>20 €</td>
</tr>
<tr>
<td>Quality assurance</td>
<td>• Trace ability&lt;br&gt;• Sensor based data gathering (temp. humidity)</td>
<td>Active</td>
<td>50 – 200 €</td>
</tr>
<tr>
<td>ULD / Cargo Monitoring</td>
<td>Monitoring &amp; interaction</td>
<td>Active</td>
<td>100 – 500 €</td>
</tr>
</tbody>
</table>
Outlook / Conclusion

• Introduction of a Container Communication Interface
  ‣ enables placement of sensors close to the cargo
  ‣ supports gathering of real time data
• Data exchange seems feasible in the range of
  ‣ 850 to 950 MHz (GSM Cell Phones) or
  ‣ 2,4 GHz (Wireless LAN)
• The associated Sensor Platform enables
  ‣ an enhanced cargo monitoring e.g.
    – Hazardous materials (overheat / fire)
    – Cool Chain aspects
    – Explosion prevention / protection
    – Specific to type security issues
Cargo Communication Interface

Your Turn

Questions?
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