Challenges of future Cabin Networks EMC requirements

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Cabin Networks - Overview

Aircraft Control Domain (ACD)




Communication	Indication/Signalling	Control	Miscellaneous
• Passenger Address • Cabin Interhone • Service Interphone • Pre-recorded Announcements • Boarding & Theme Music • ...	• Doors & Slides Status • Evacuation Signalling • Passenger Lighted Signs • Passenger Call • Decompression Signalling • Cabin Ready • Emergency Crew Alerting • Cabin Smoke Detection • Lavatory Occupied • Electrical Load Management • Ventilation Control System Annunciation • ...	• Cabin Illumination • Reading & Attendant Work Lights • Galley Cooling • Galley Network • Airconditioning, Heater and Humidifier • Electrical Window Shades • ...	• Built-In Test Equipment (BITE) • Test and Diagnostic • Light Programming • Loadspeaker Level Adjustment • Layout Selection • Cabin Zones Programming • Data Loading • ...

Passenger owned devices domain (PODD)



Airline Information Services Domain (AISD)

Passenger Information and Entertainment Services Domain (PIESD)

Not shown: power network, cabin&cargo video surveillance, field bus systems

Needs&Trends: Multi- and Cross-Domain Communication

<u>Multi-Domain Communication Network:</u>
- One network, one server, integrated operation
→ take benefit from bandwidth and processing
performance growth
- especially interesting for wireless systems (e.g. frequency sharing)
→ less weight, cost, integration & operational effort, …

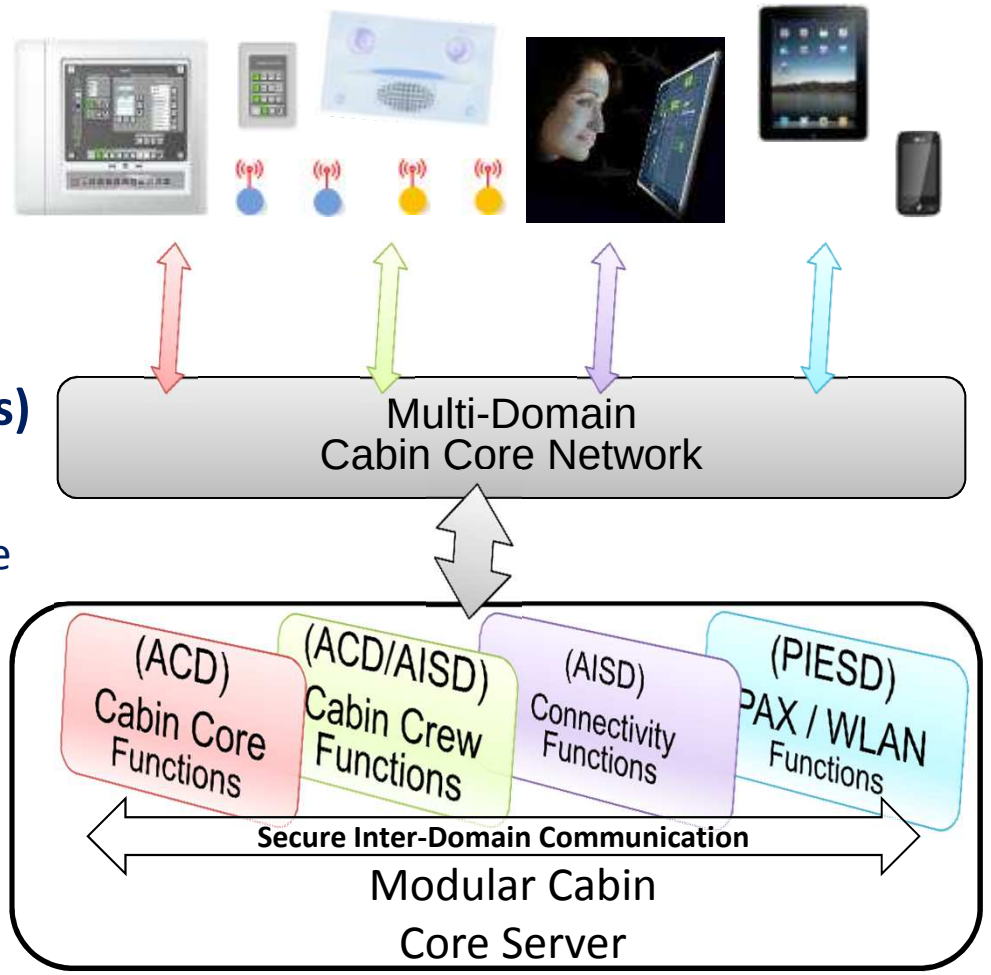
<u>Cross-Domain Communication:</u>
- to allow for transparent and integrated operation of all domains, e.g. via FAP

The Airbus Flight Attendant Panel (FAP) is a multi-domain device.

Multi/Cross Domain enables higher integration and eased operation.

Approach for a future Cabin Core System

- Modular Cabin Core System
  - → for all A/C domains
  - → secure inter-domain communication
  - → scalable, standardized HW
  - → open, standardized interfaces
- **High speed, multi-domain cabin core network (min. 1Gbit/s)**
- Wireless interfaces for sensors, cabin crew and cargo/ground service
- Simplified & unified HMI for Cabin Crew
- Cross program solution
- Integrated power network



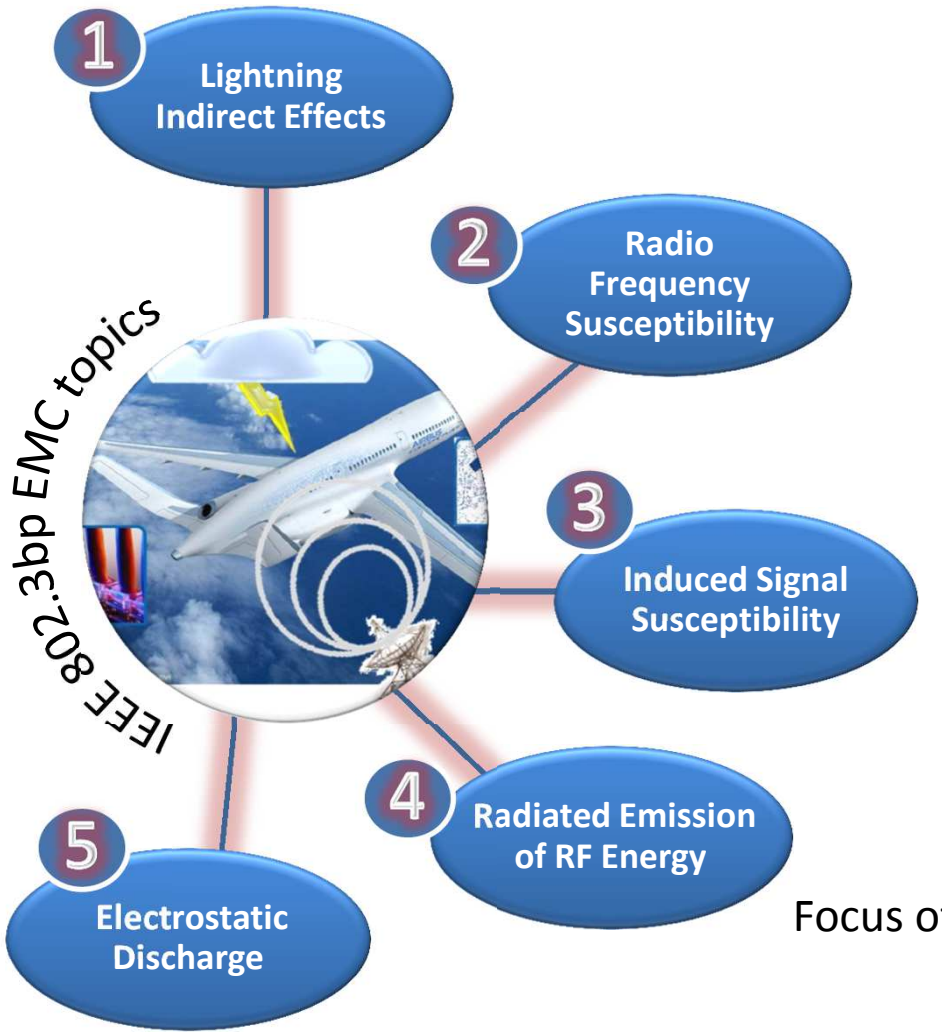
Use of IEEE 802.3bp in an aircraft

Any aircraft system using the IEEE 802.3bp Reduced Twisted Pair Gigabit communication standard needs to consider the following potential electromagnetic interference sources:

- Lightning Strikes on an aircraft creating lightning indirect effects.
- High Intensive Radiated Fields (HIRF) coming from e.g. radar stations.
- The onboard system electromagnetic environment composed of magnetic fields, electric fields and voltage spikes produced by all kind of electronic equipment on board of an aircraft such as personal electronic devices (PED), mobile phones, WLAN devices, aircraft systems, power supplies, crosstalk from cables, etc..
- Electrostatic Discharge (ESD) from passengers or maintenance personnel

- Moreover, an aircraft system using IEEE 802.3bp shall not disturb any other system on board of an aircraft – especially the communication and navigation system is concerned. This leads to a limitation of the emission of radio frequency energy from the equipment and the communication bus itself.

IEEE 802.3bp EMC topics for use in A/C



Typical aeronautical standards:

EUROCAE ED14
RTCA DO-160 G
ABD0100 (Airbus internal)

We apply category H:

Equipment in direct view of a radio receiver's antenna

Focus of this presentation

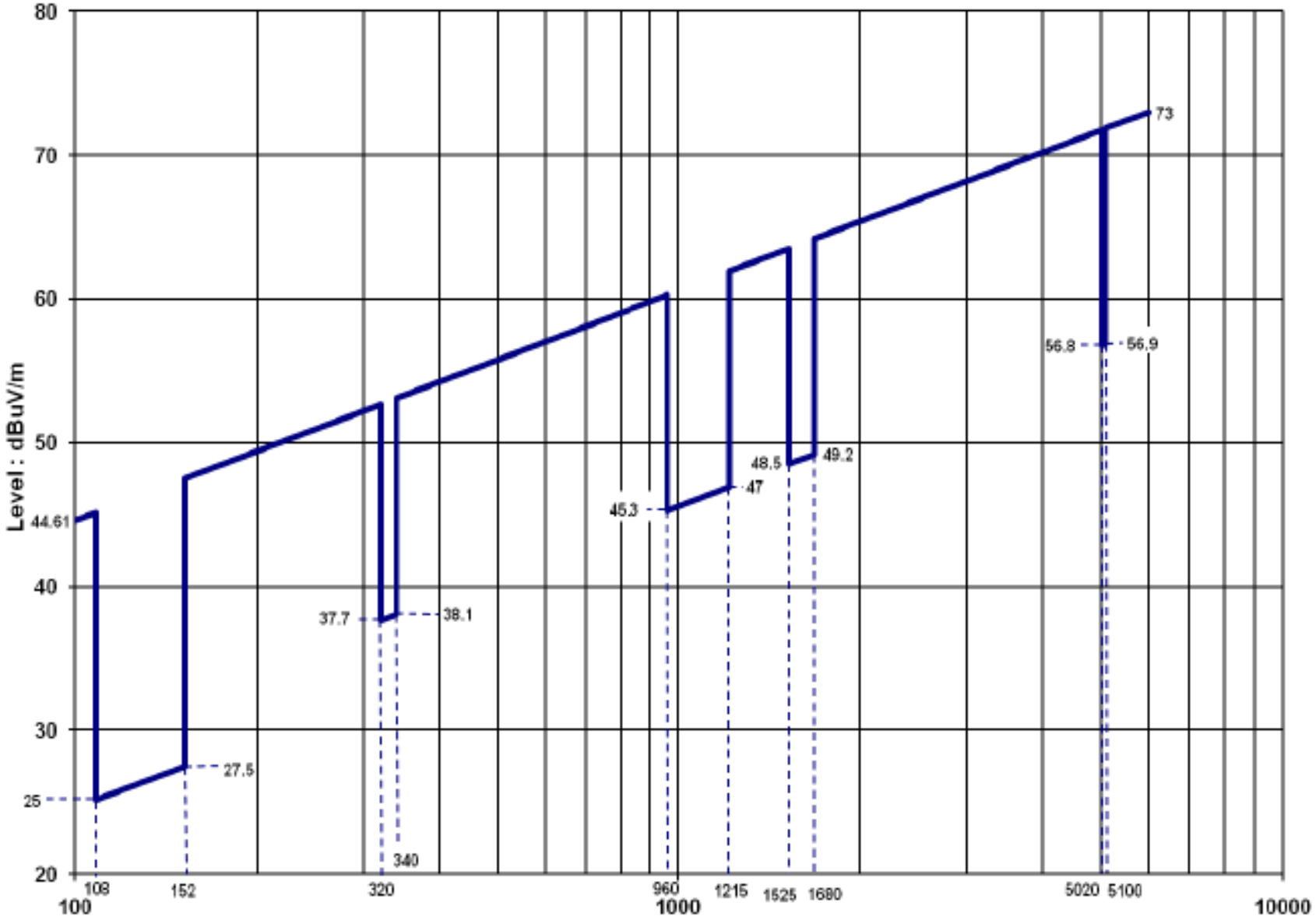
Emission of Radio Frequency Energy

High level requirement:

- The radiated emission of any equipment of the system shall be within specified limit levels in order to prevent system disturbances.

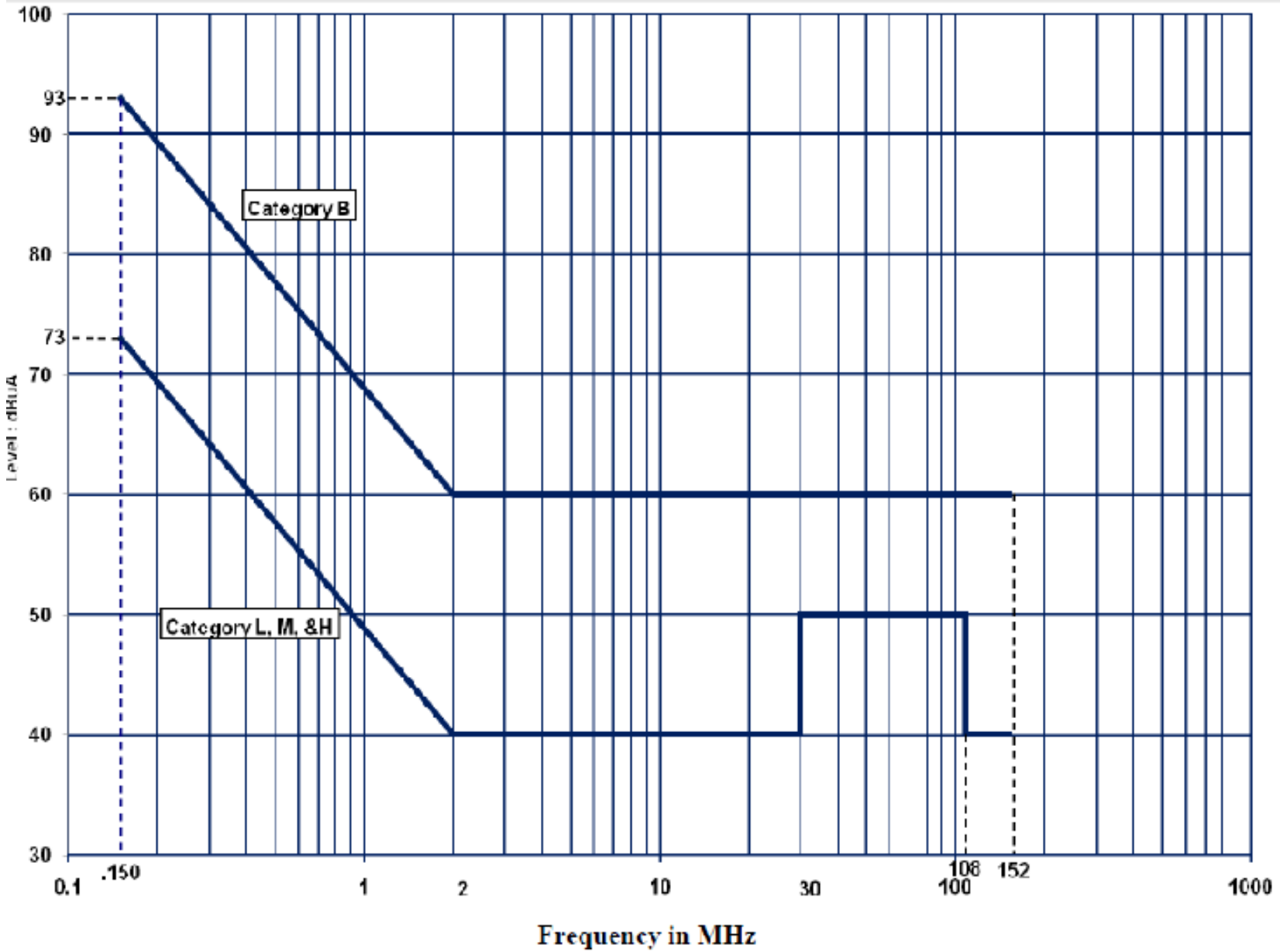
- Applicable requirements are stated in Airbus internal guidelines with reference to RTCA DO-160 sect. 21 but with an extended frequency range 2 MHz up to 6 GHz.

- The carrier frequency or multiples of the carrier frequency should not coincide with the notches of the radio frequency emission curve.



RTCA DO-160 G:

Figure 21-9 Maximum Level of Radiated RF Interference – category H



RTCA DO-160 G

Figure 21-2 Maximum Level of Conducted RF Interference – interconnecting bundles

Typical aeronautical cables and connectors

MLB24 Kabel 15m

EN2714 (MLB24)

- Shielded twisted pair
- AWG24
  - Characteristic Impedance: 75,2 Ohm
  - Propagation Delay: 6,5 ns/m
  - DC Resistance: 99 mOhm/m
  - Skin-Effect Resistance: 150 µOhm/m Hz
  - Dielectric Losses: 60pS/m*Hz

Baseline for connectors: D-SUB

Up to 4 connectors in one connection

Certification of industrial (e.g. automotive) grade components

- Procedures are in place to apply (complex) commercial out-of-the-shelf (COTS) components on aircrafts
- Many examples of successful application
  - Industrial Ethernet Phys for AFDX (DAL A)
  - Industrial CAN Bus Phys (DAL A, > 100m)
  - FlexRay Phy (>90m)
- Challenge: cable lengths, aforementioned environmental conditions, obsolensence

Possible roadmap for Airbus internal technology selection

- Package definition: Q3 2014
- First samples for prototypes: Q1 2015
- For serial production: Q1 2016

- Thank you!