History of CAN in Aviation

First applications on Airbus and Boeing commercial aircraft
• based on ISO-11898
• application specific solutions / no layered protocols
• many incompatibilities identified during integration of BFE
• call for standard protocols / start of ARINC 825

ARINC 825 Standard 2008
• standard for aviation CAN-bus systems
• based on ISO-11898
• basis for interoperability
• adapted to specifics in aviation

2010 ARINC 825 Supplement 1 (layered protocols)
2012 ARINC 825 Supplement 2 (layered protocols)
2013 ARINC 825 Sup. 3 (address based communication)
2015 ARINC 825 Sup. 4 deferred due to concerns
2016 ARINC 825 Sup. 4 CAN FD re-started
Industry Background

Aircraft systems use CAN extensively
~80 systems per a/c
~3 bus segments per system
~25 nodes per segment

ARINC 825
• standard for CAN-bus systems in aviation
• adapted to specifics in aviation
  – EMI / Lightning Protection
  – cable / connectors / cable length
  – layered protocol
  – guidance for the designer

A/C lifecycle
• A/C is in operation for 30 years
• Obsolescence of parts is a strong factor
• Update strategy for CAN nodes mostly means: re-design
Industry Interaction

Chip industry
• Provides definition of the bus
• Provides essential bus parameters

Automotive industry
• Provides forecast for implementation
• Provides lessons learned on topology
• Provides layered protocol experience

Aviation industry
• Provides layered protocol experience
• Provides experience with regulatory requirements
• Provides experience with address based communication
CAN FD Roadmap

- ISO 11898-1 CAN FD specification updated
- Chip manufacturers plan to move to CAN FD
- CAN FD FPGA’s available for development and verification
- CAN FD Transceivers >1 MBit/s available
- CAN FD implementation in cars supported by: Volkswagen, Porsche, Mercedes, GM, Toyota and Hyundai
- CAN FD implementation in aircraft supported by: Airbus, Boeing, GE Aviation, CMC, Panasonic, Stock Flightsystems
- Plugfest for CAN FD performed in Berg/Munich, Dec. 2016
- Plugfest planned for April 2017 in Santa Rosa, CA (discussed later in this presentation)
- ARINC 825 Standard Supplement 4 for 2018
ARINC 825 Standard Supplement 4

Planned content / updates:

• CAN with Flexible Data-Rate (FD)
• Timing and Bandwidth Management for CAN FD
• Common Latency methodology
• Physical layer protocols and parameters
• Safety, reliability and failure analysis
• Protocol and service implementation conformance matrix
• CRC security aspects
• System and Network Interoperability (ARINC 429, ARINC 664 Part 7: conversions and gateways)
• Include Interface Control requirements
Activities of the ARINC Working Group

**Algebraic Sample Point** calculation proposal
- discussion of proposal with Dr. Mutter (Bosch)
  → proposal to be updated

**XML-Schema definition** proposal
- definition of node / network setup
  → evaluation of proposal

**MIB Management Information Base** proposal
- to evaluate network quality
  → evaluation of proposal

**Integration Test Rig**
- Plugfest performed
  → integrate more nodes

**CRC Security Test Rig**
- In preparation

Looking forward to feedback from CiA iCC participants

07 March 2017
Integration Test Rig

Purpose:

Integration of CAN FD nodes
• Verify interoperability of CAN FD nodes from different suppliers
• Verify communication within a system
• Verify layered protocols
• Verify interoperability with and through Ethernet as Ethernet is the backbone network of the aircraft

→ Acceptance criteria: to be defined

Plugfests
Good verification means for first integration of CAN FD nodes
Plugfest

Plugfests are important for aviation to verify interoperability of CAN / CAN FD nodes

1. Plugfest in Berg/Munich/Germany, December 6th, 2016

Several implementations were interconnected → Worked

2. Plugfest in Santa Rosa, CA/USA, April 18th, 2017

During Plugfests various equipments will be verified, i.e.
- Peak USB Pro CAN Bus dongle
- aircraft equipment with CAN / CAN FD
Equipment for General Aviation

Integration Example: Micro Air Data Computer (MADC)

by Stock Flightsystems

- ARINC 825-2 Protocol
- Flightworthy

General Aviation vs. Commercial Aviation
- communication principles are the same
- need for communication services is different
- commercial equipment usually concentrates more function
CRC Security Test Rig

Dr. Koopman paper: CRC issue of legacy CAN

• Issue identified: for some input vectors, CAN does not fulfill the Hamming-Distance of 6
• CRC was corrected in CAN FD specification
• Will be evaluated through vulnerability checks

Way Forward: Vulnerability Checks
• Test scenarios are currently defined
• Acceptance criteria to be defined

Investigation by Esterline and McGill University, Montreal

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Conclusion

ARINC 825 standard Supplement 4 supports CAN / CAN FD

- aviation systems will use CAN / CAN FD
- Plugfests help integrate CAN / CAN FD nodes
- Using CAN FD will avoid obsolescence problems with CAN
- ARINC 825 guides suppliers’ designers + make right decisions
- aviation is a growing market for CAN FD

(General Aviation and Commercial Aviation)
Thank you