CAN FD in Aviation

16th International CAN Conference, Nürnberg

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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

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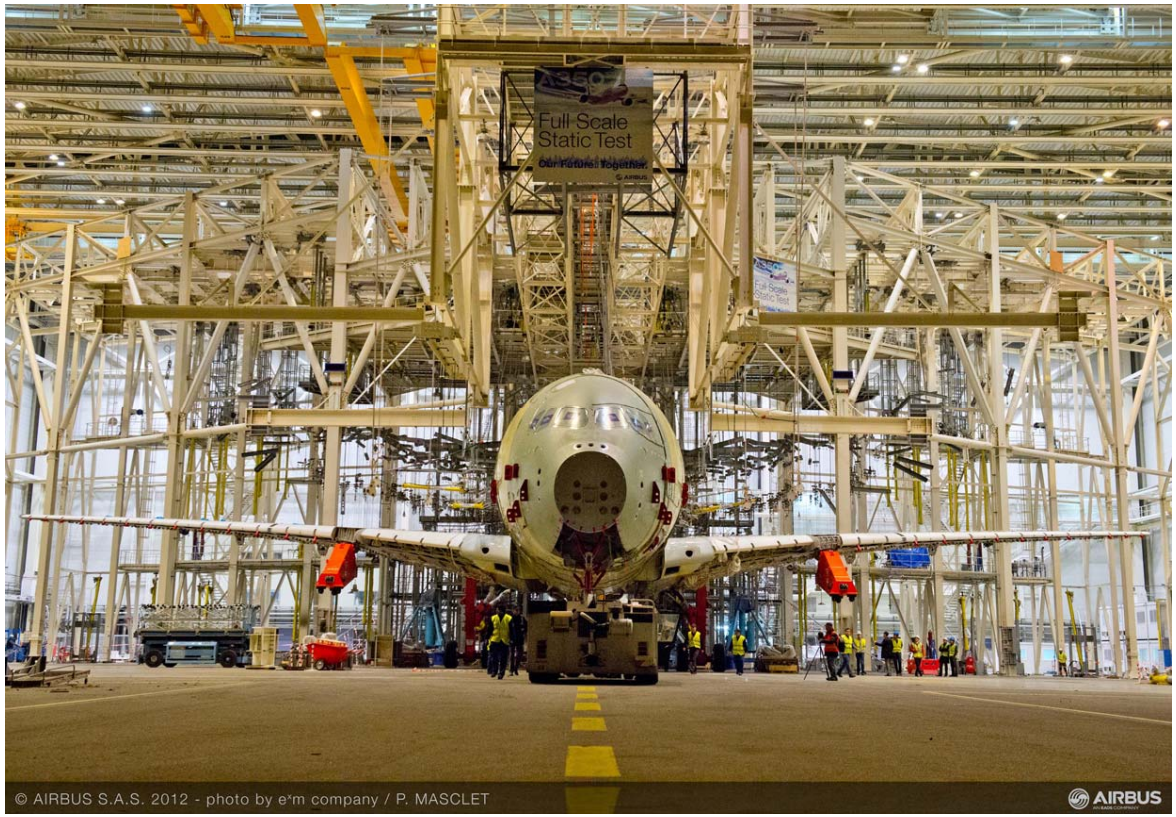
ARINC 825 Working Group

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
- Obsolesence of parts is a strong factor
- Update strategy for CAN nodes mostly means: re-design



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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

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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

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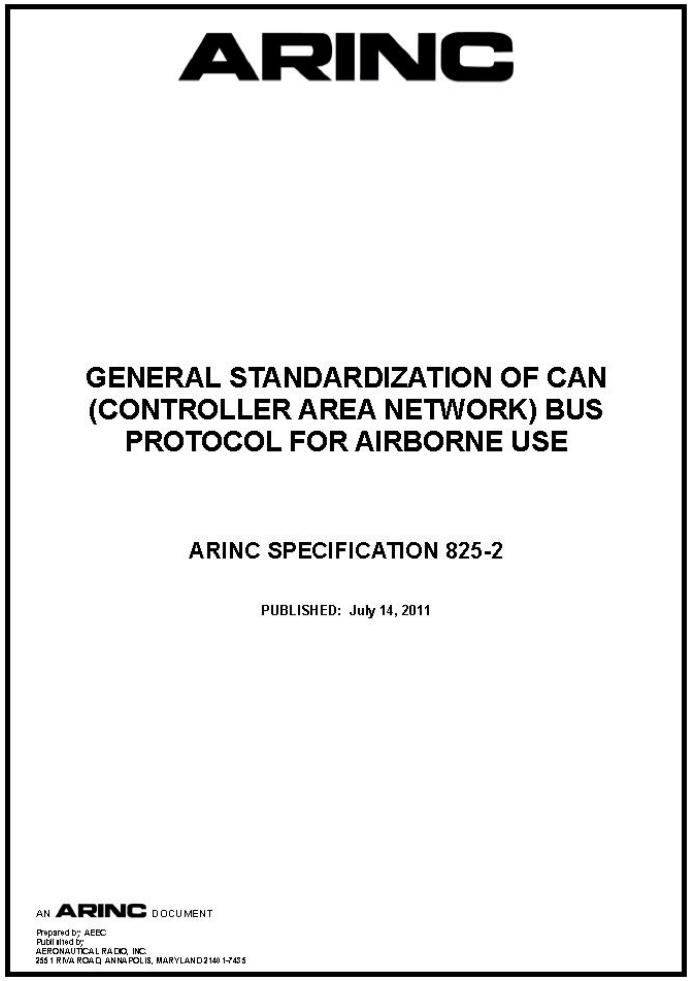
ARINC 825 Standard Supplement 4

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


ARINC

GENERAL STANDARDIZATION OF CAN (CONTROLLER AREA NETWORK) BUS PROTOCOL FOR AIRBORNE USE

ARINC SPECIFICATION 825-2

PUBLISHED: July 14, 2011

AN ARINC DOCUMENT

Prepared by: AEEC
Published by:
AERONAUTICAL RADIO, INC.
2551 RIVA ROAD, ANNAPOLIS, MARYLAND 21401-7435

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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

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Integration Test Rig

Purpose:

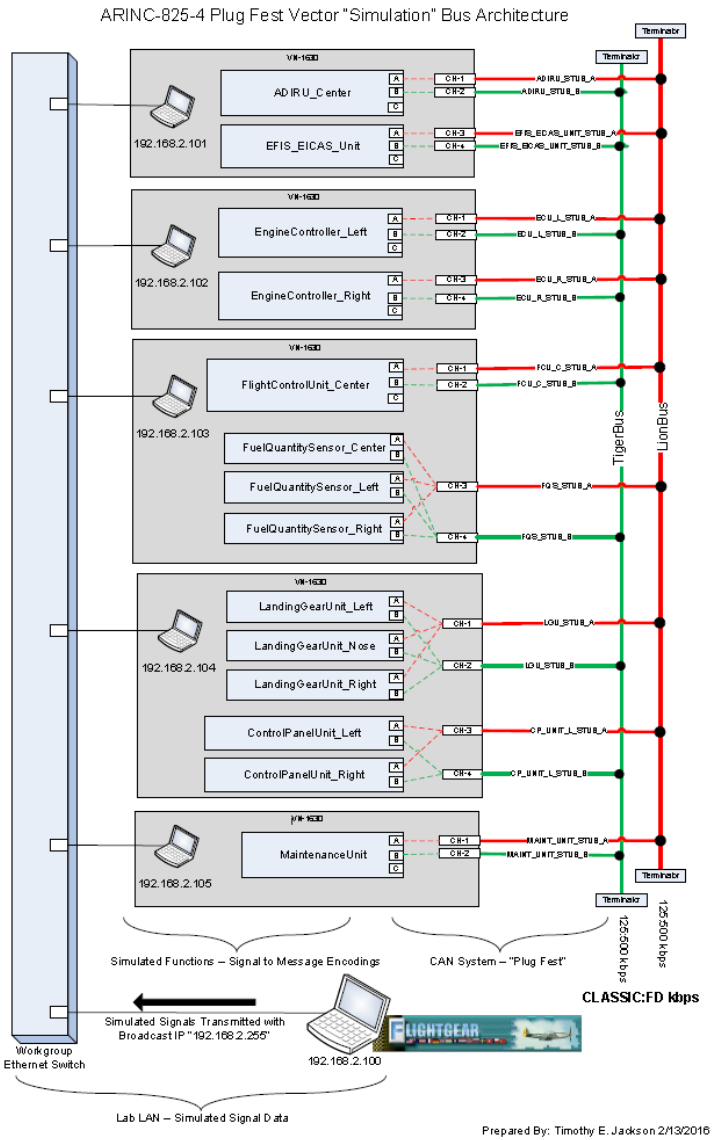
Integration of CAN FD nodes

- 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



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Plugfest

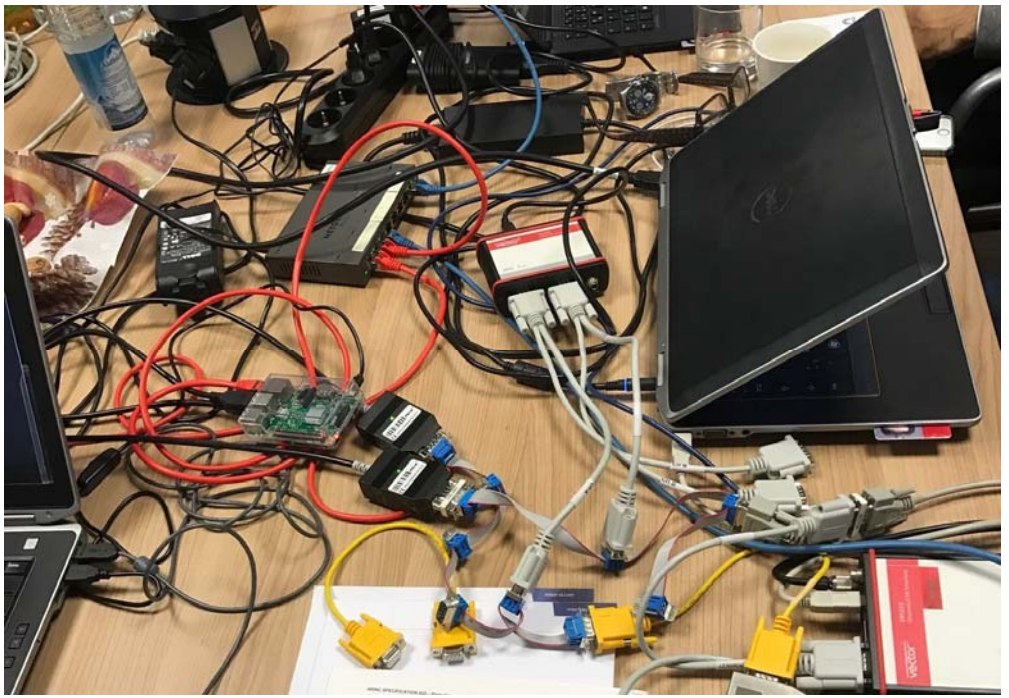
Plugfests are important for aviation to verify interoperability of CAN / CAN FD nodes

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



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Equipment for General Aviation

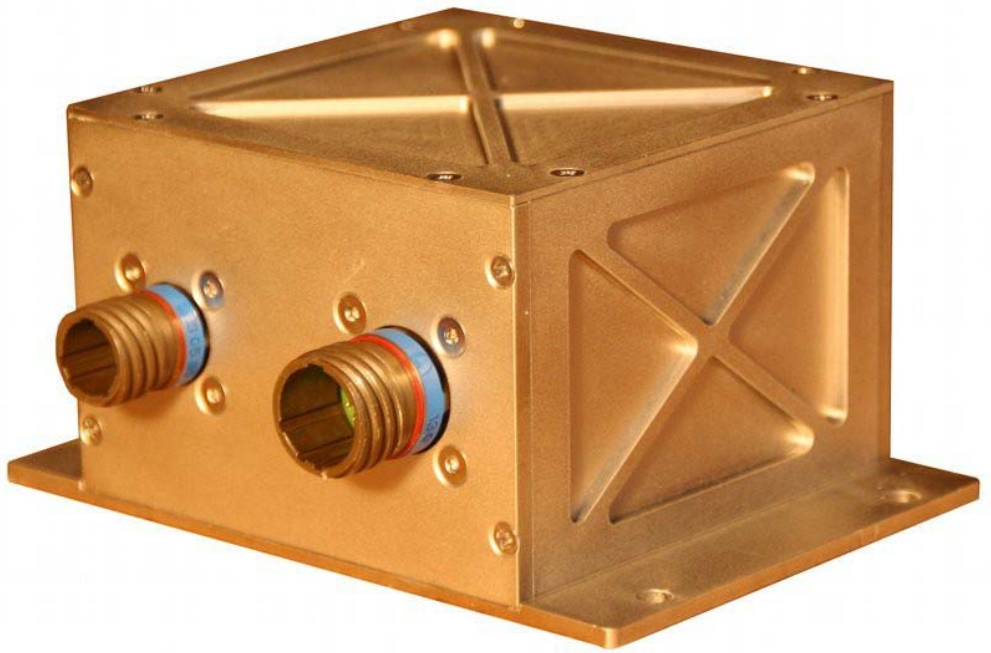
Integration Example: Micro Air Data Computer (MADC)

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



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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)

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Thank you

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