

ONE PROTOCOL TO RULE THE IN-CAR NETWORK?

High-Level Comparison of two new automotive networking protocols: Ethernet vs. CAN-FD

The automotive industry has seen massive growth of electronic control units (ECUs) in cars. These ECUs evolved from stand-alone units to intelligent nodes in networks using both proprietary protocols and industry-wide standards.

Network architectures have brought down cost and increased reliability and performance. In the past the industry saw the development of data buses as in-car network standards. In the future the industry will need to expand the existing vehicle network protocols and adapt the standard networking architecture into cars.

CHARACTERISTICS OF CAN AND CAN-FD

HIGH-LEVEL CHARACTERISTICS OF CAN

- SHARED BUS - NODES** are connected directly to one another via a dual wire line, suitable for medium bandwidth use cases.
- COST-EFFICIENT TECHNOLOGY** with established set of standards and large ecosystem
- Bus arbitration controlled by **FRAME HEADERS**
- DATA CONSISTENCY SUPPORT**
Instant syntax check with subnet-wide notifications

CAN FD FORMAT

- UP TO 64** data bytes per frame (8 bytes for Classical CAN)
- Bit rate during data phase **CAN BE CONFIGURED** to be greater than bit rate during arbitration phase
- Bit length in data phase **CAN BE SHORTER** than physical layer loop delay
- ENABLES KNOWLEDGE** of message transmitter's error status

HIGH LEVEL CHARACTERISTICS OF AUTOMOTIVE ETHERNET

- 100 MBIT/S** / **1 GBIT/S**
100 MBIT/S or 1 GBIT/S point-to-point full-duplex communication
Not a bus system
- UNICAST or MULTICAST**
Broadcast possible, but frames are generally forwarded only on ports needed to reach the set of receiving end stations
- Up to 1500 BYTES** per frame including transport protocol overhead
- LARGE ECO-SYSTEM**
Has been used for decades , large eco-system of tools , parts , software, hardware, and knowledge
- AVB ETHERNET** is a profile for switched Ethernet
Time synchronization, bandwidth reservation, traffic shaping and defined latency
2nd generation is called Time Sensitive Networking (TSN) and is under standardization in IEEE 802.1
- Ethernet is an **ADVANCED (NEW) TECHNOLOGY** for automotive OEMs and Tier-1 suppliers

HIGH-LEVEL COMPARISON CAN VS ETHERNET

CAN (FD)

AUTOMOTIVE ETHERNET

CLASSICAL CAN : 500 kbit/s
CAN FD : 2 Mbit/s data phase



Bit rate

100 Mbit/s (Full-duplex) or
1 Gbit/s (Full-duplex)

CLASSICAL CAN : 0 to 8
CAN FD : 0 to 64 (improved data cohesion)

Frame payload
[bytes]

42 TO 1500

DEPENDS ON:

- Length of longest frame
- Frame header (message priority)
- Bus utilization

Communication
Latency

Maximum **2 MS OVER 7 HOPS** (AVB Ethernet). Microsecond level, predictable latencies with Scheduled Traffic in TSN and Frame Preemption

AUTOSAR 4.2.1 has common notion of time (global time sync)

CAN FD has **MESSAGE TIME STAMPING**

Temporal
Accuracy

AUTOSAR 4.2.1 has common notion of time (global time sync)

AVB Ethernet has **TIME SYNCHRONIZATION**

Instant frame syntax checking (subnet level)

CAN FD format enables knowledge of transmitter's error status

Functional
Safety

Seamless Redundancy in progress (802.1 CB)

Under preparation : Ingress Policing

DATA-DEPENDENT WAKEUP SUPPORTED when selective wakeup transceivers used

Node activation
by bus activity

NODES CAN BE ACTIVATED through a control line or through presence of any traffic

AVB = Audio Video Bridging, TSN= Time Sensitive Networking

All data used based on:

Ethernet and CAN FD: Two protocols for next generation vehicles. November, 2014. General Motors.

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