

# 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

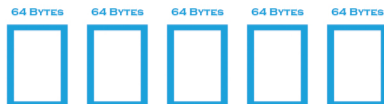


● Bus arbitration controlled by **FRAME HEADERS**



● **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

010100111001010101

● Bit length in data phase **CAN BE SHORTER** than physical layer loop delay



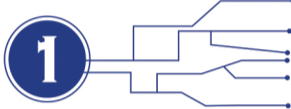
● **ENABLES KNOWLEDGE** of message transmitter's error status

### HIGH LEVEL CHARACTERISTICS OF AUTOMOTIVE ETHERNET

100 MBIT/S

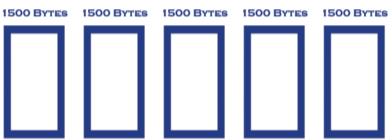
1 GBIT/S

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**

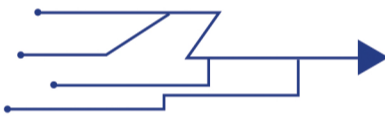
Has been used for decades , large eco-system of tools , parts , software, hardware, and knowledge



● **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 )



Temporal Accuracy

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

CAN FD has **MESSAGE TIME STAMPING**

AVB Ethernet has **TIME SYNCHRONIZATION**

Instant frame syntax checking ( subnet level )



Functional Safety

Seamless Redundancy in progress (802.1 CB)

CAN FD format enables knowledge of transmitter's error status

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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**Automotive BUS Systems Ethernet**