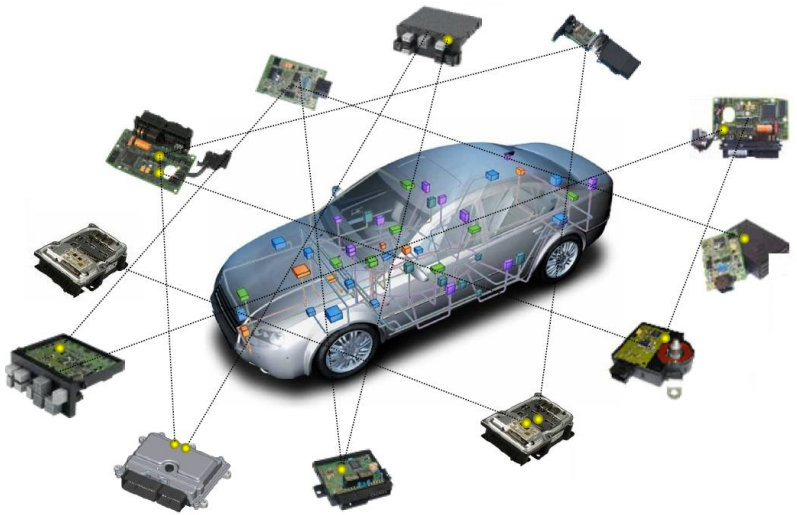
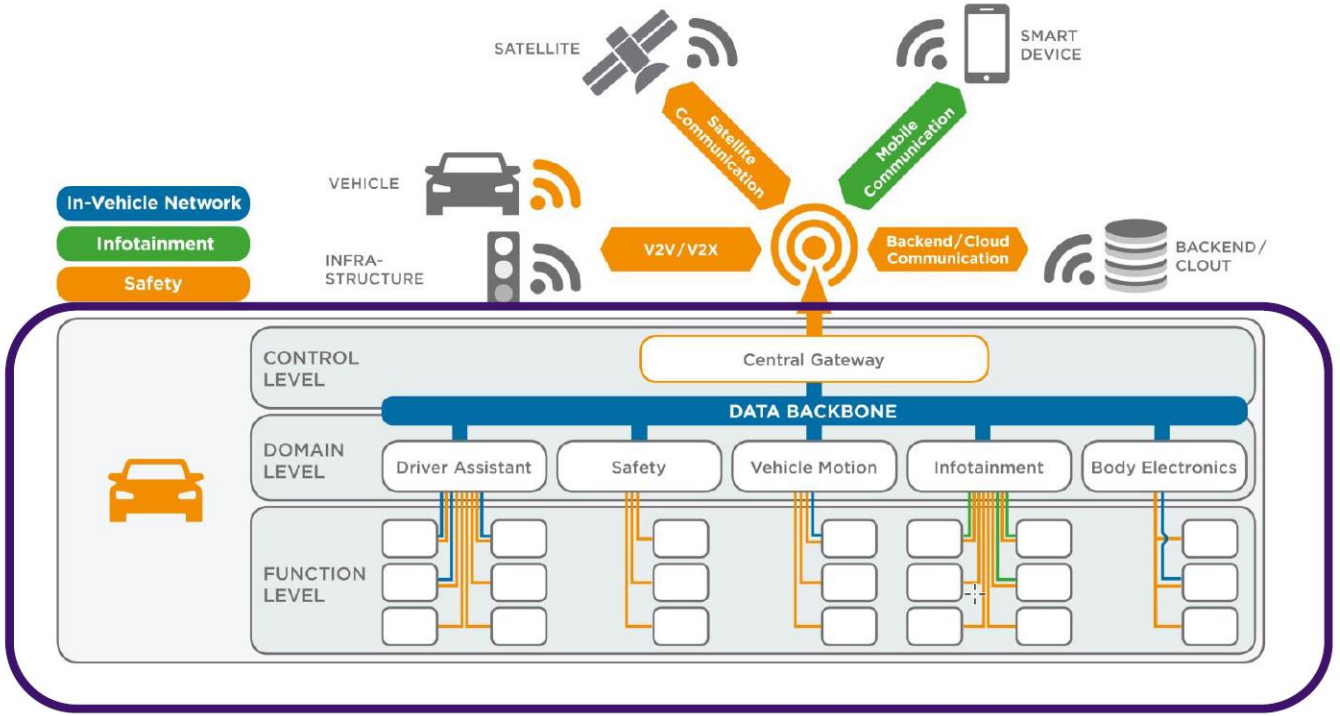
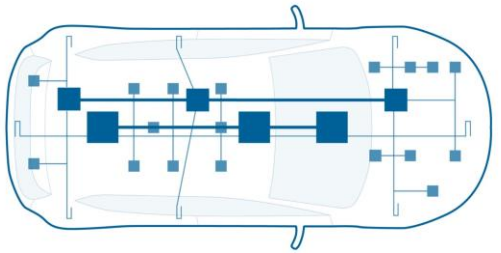
CAN PROTOCOL

BOSCH

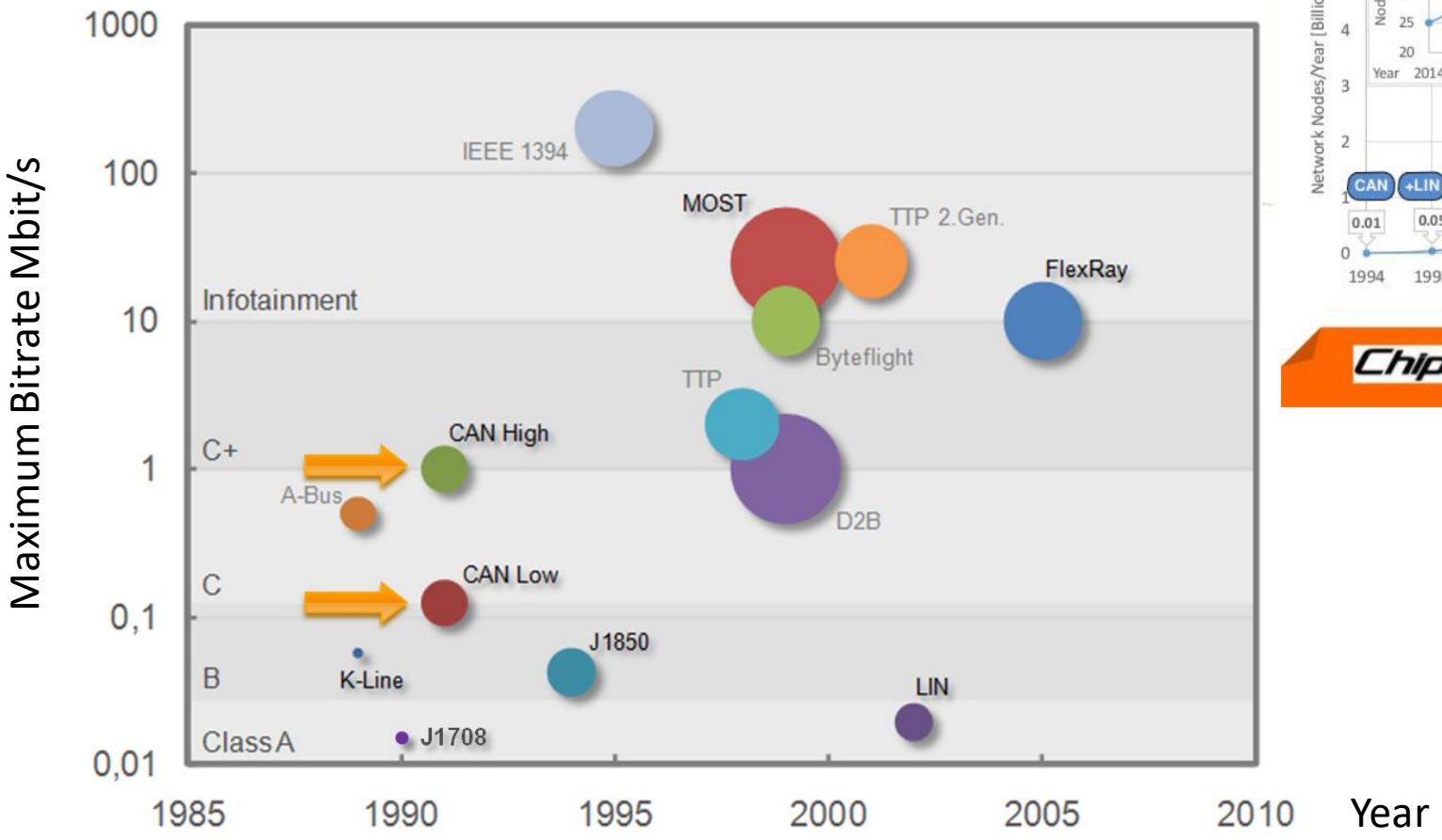
Introduction
Vehicle network

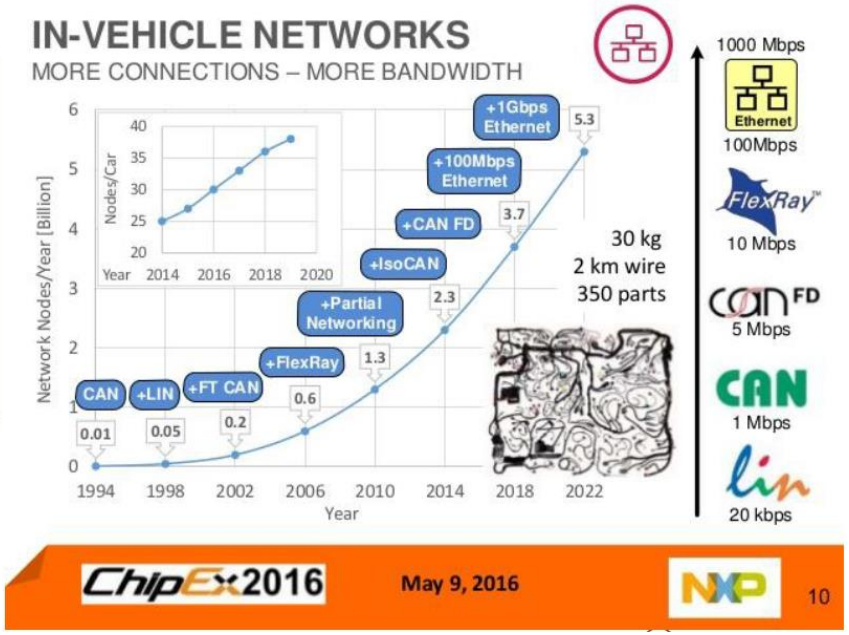






Introduction
History

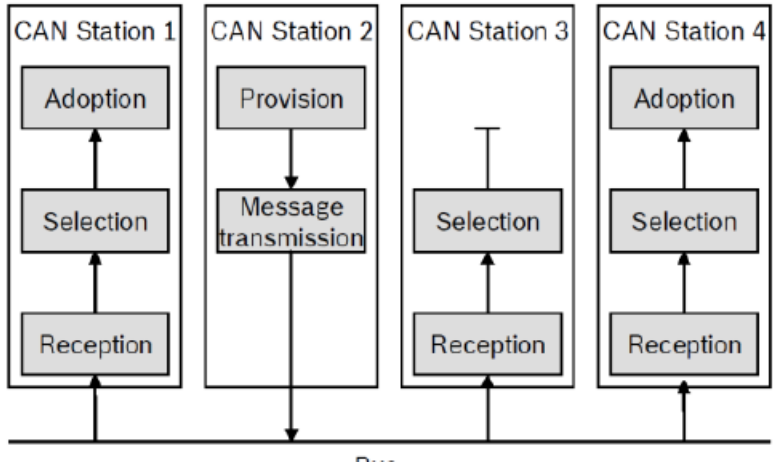


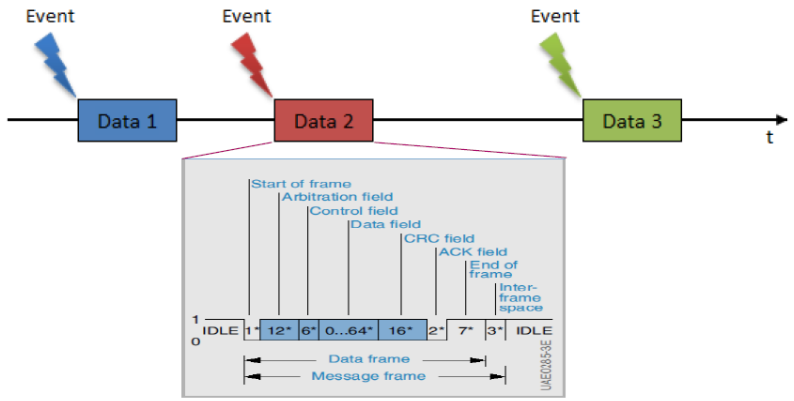


Introduction

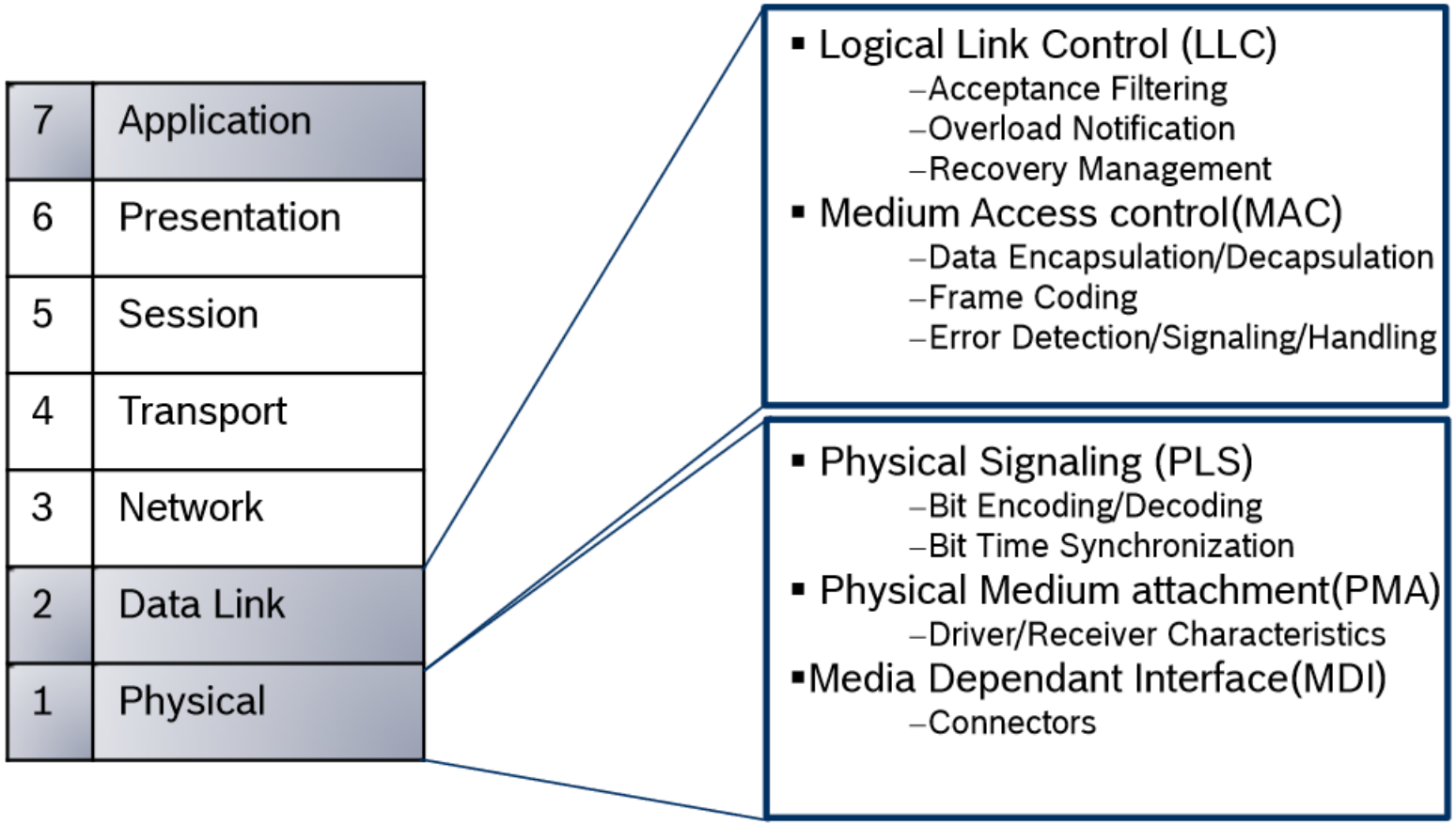
Characteristics of ‘CAN’

- CAN is a multi-master Bus
- Theoretically No limitation on the number of nodes
- Configuration flexibility - No node addressing
- Prioritization of messages through “Identifiers”
- Multicast reception with the time synchronization
- System wide data consistency
- Guarantee of latency times
- Error detection and error signaling
- Automatic retransmission of corrupted messages
- Temporary errors - permanent failures of nodes and auto switching off defect nodes



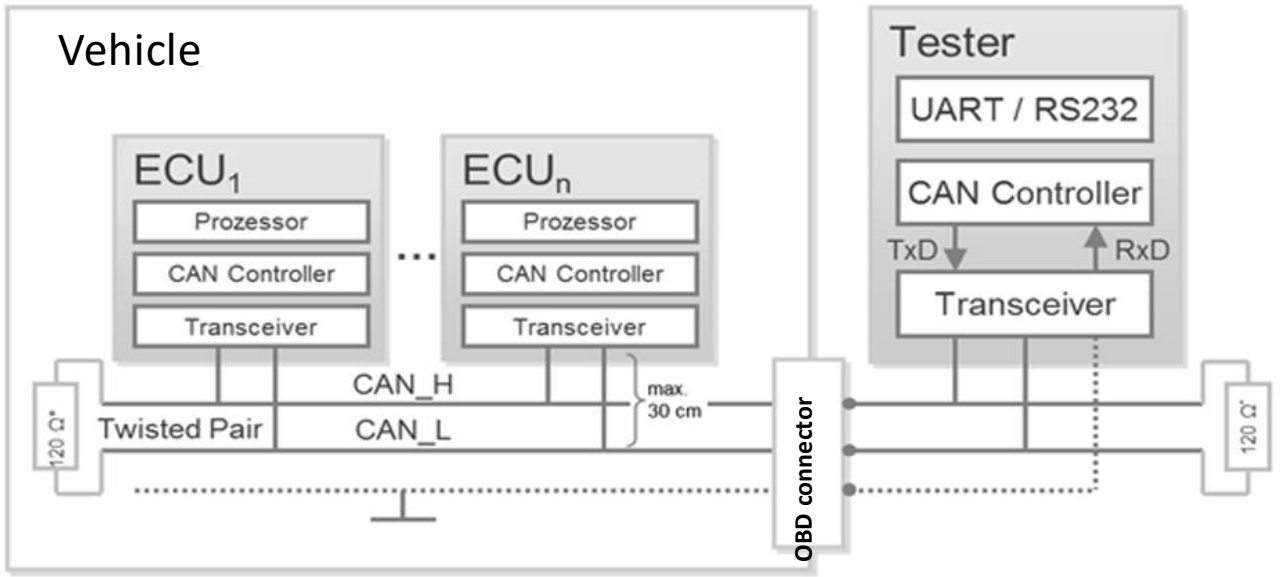


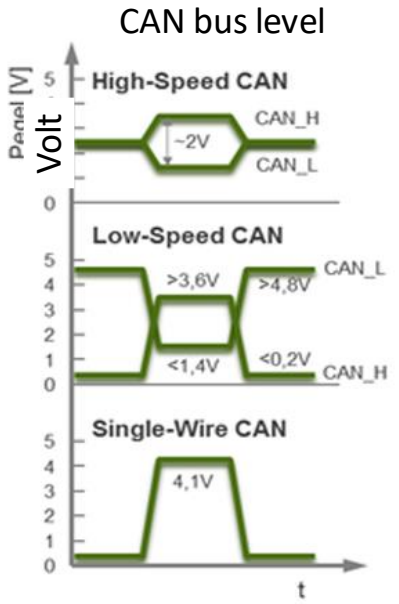
Introduction
CAN in the OSI model



CAN Protocol
Physical Layer

- Bit rate: up to 1Mbit/s
- Bidirectional Dual-wire bus with 40-50m maximum in length
- Multi-Master

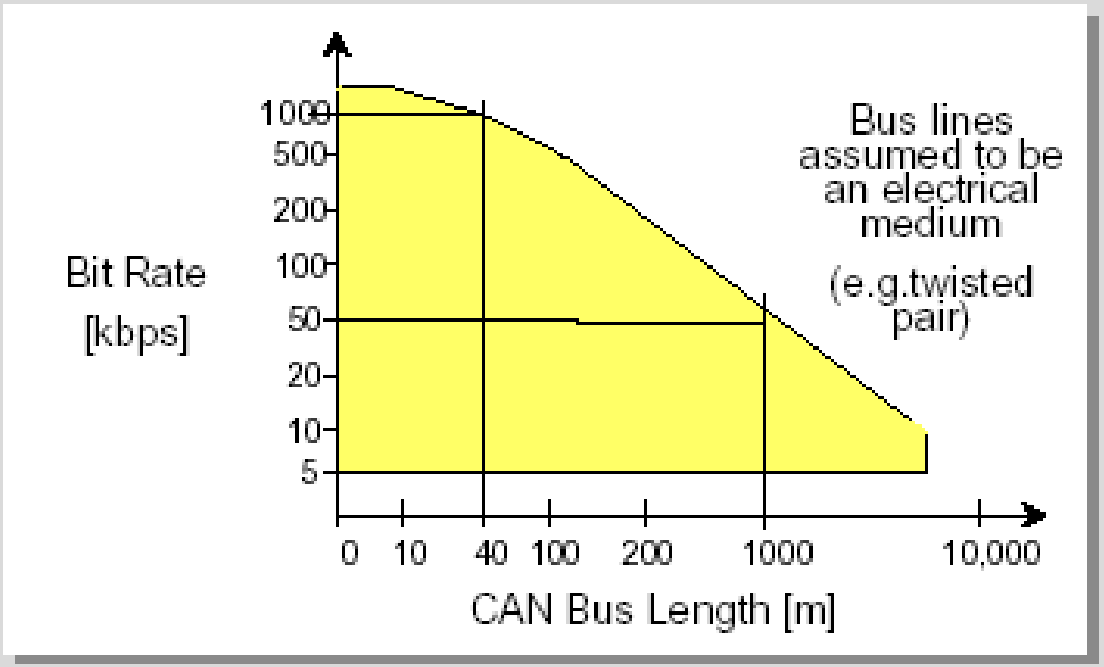




CAN Protocol

Relation between Baud Rate and Bus Length

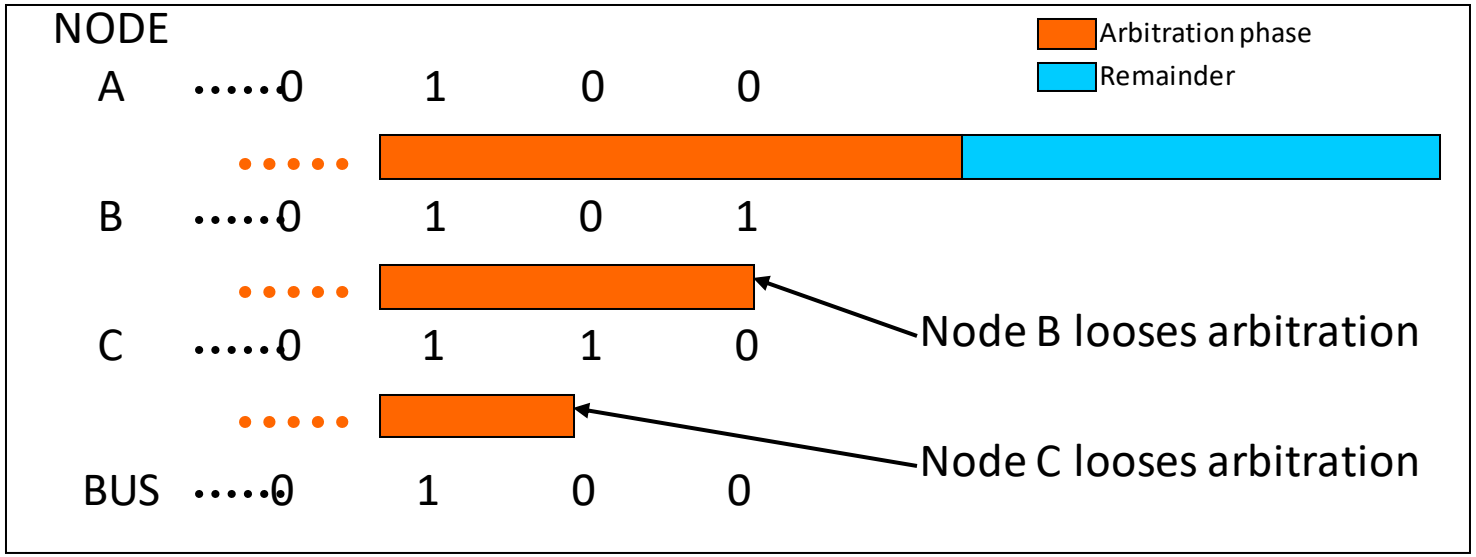
- Up to 1Mbit / sec @40m bus length (130 feet)



CAN Protocol

Bus Access and Arbitration

- Bus access through CSMA with AMP



- Advantages
  - No Collision
  - Transmission of highest priority message within the latency time

CAN Protocol
Message Transfer

Frame Formats

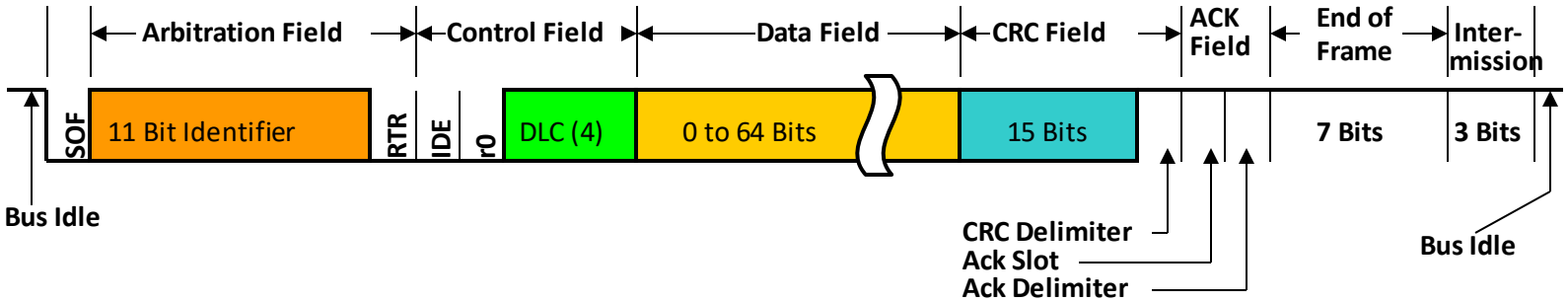
- Standard Frame - 11bit Identifier
- Extended Frame - 29 bit Identifier

Frame Types

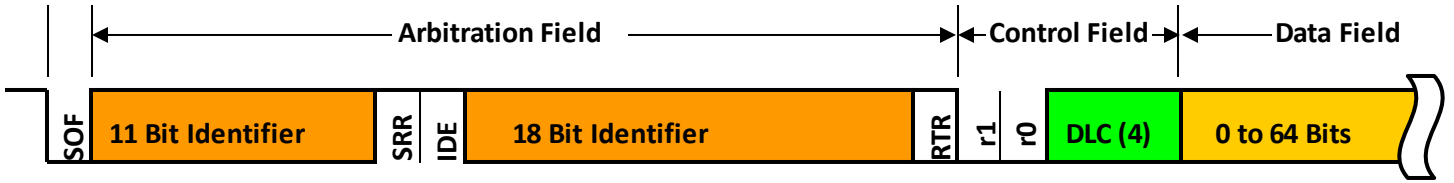
- Data Frame
- Remote Frame (not useful)
- Error Frame
- Overload Frame (not useful)
- Inter-frame Spacing

CAN Protocol
Data Frame

Standard Data Frame Format



Extended Data Frame Format

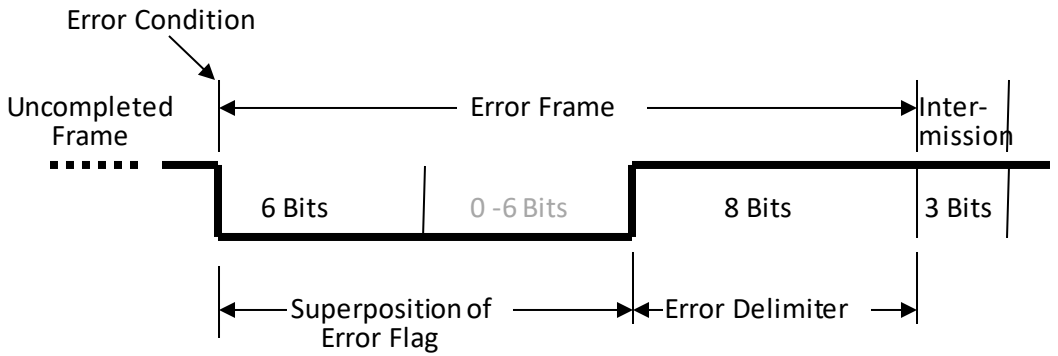


Difference between Standard Frame and Extended Frame

- Differs only in Arbitration field and Control field

CAN Protocol
Error Frame

Error Frame Format (Active Error Frame)

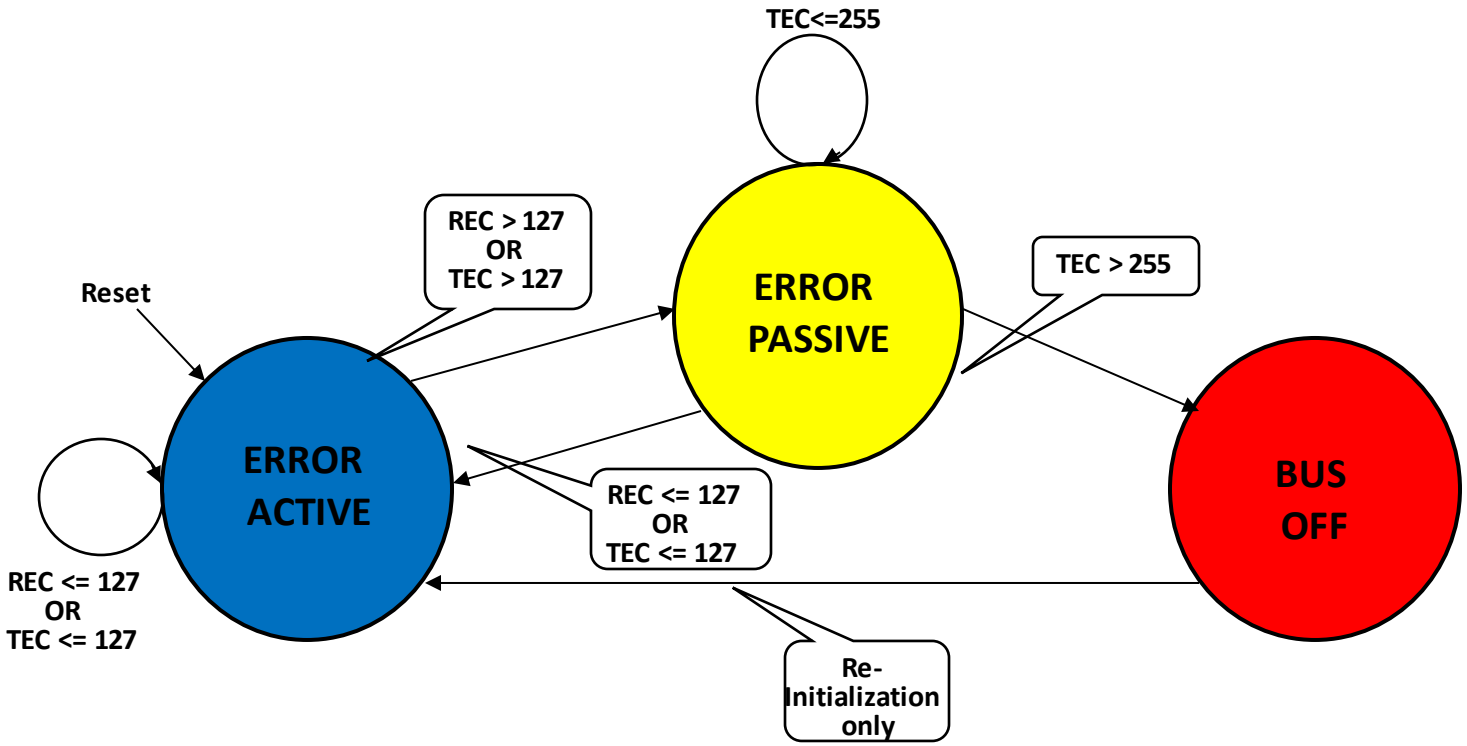


- Error flag can start within the frame that is currently being transmitted

Types of Error flags

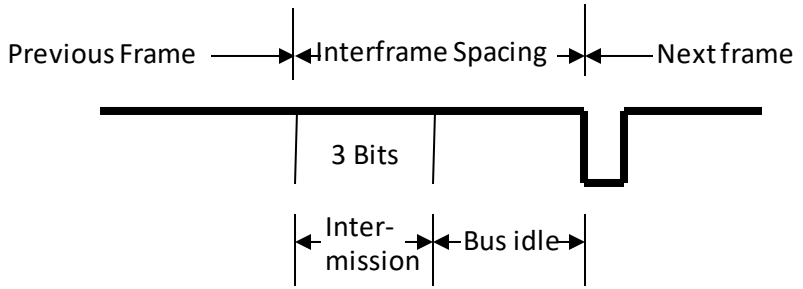
- Active Error flag - consists of 6 consecutive ‘dominant’ bit
- Passive Error flag - consists of 6 consecutive ‘recessive’ bit

CAN Protocol
Error Handling

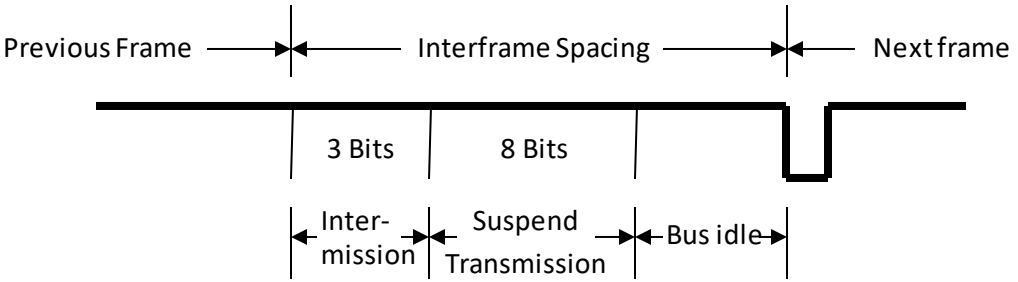


CAN Protocol
Interframe Spacing

After the transmission of a frame by an Error Active node



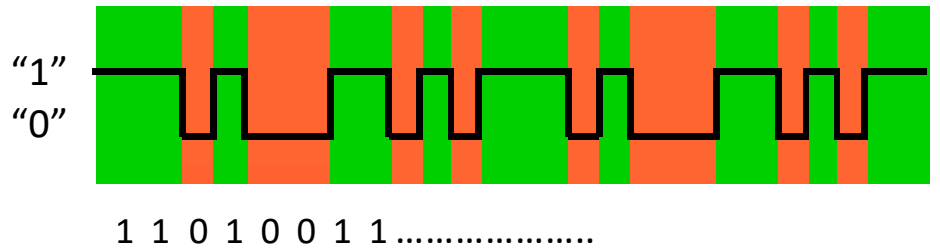
After the transmission of a frame by an Error Passive node



CAN Protocol
Message Coding

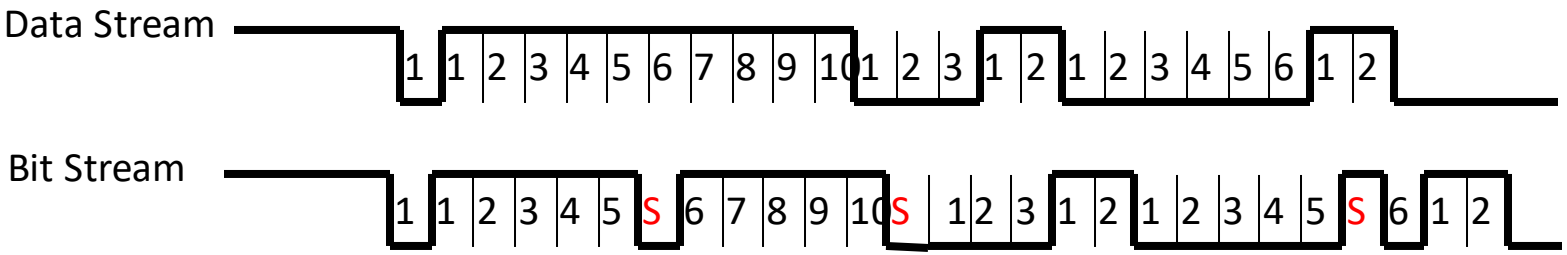
Non-Return-to-Zero coding

- Keeps the frequency of the signal on the bus to minimum.



Bit-Stuffing

- Ensures sufficient Recessive and Dominant edges for Re-Synchronization.



CAN Protocol

Types of Error Detected in CAN Bus

CRC Error:

- Every node receive the message, Calculate CRC and compare it with Received CRC.

Acknowledge Error:

- Transmitting node send a ACK slot bit as a recessive bit and check for dominant bit to verify reception.

Form Error:

- Generated when any of following bit is detected as a dominant bit where One should not be.

e.g. CRC delimiter, ACK delimiter, End of Frame, Inter Frame Space.

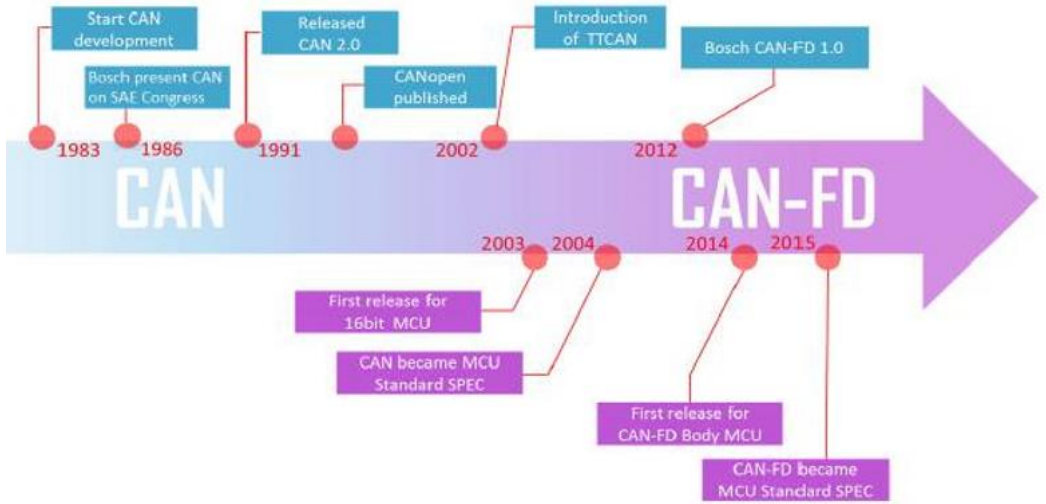
Bit Error:

- Node detect the signal that is opposite of what it send on Bus.

Stuff Error:

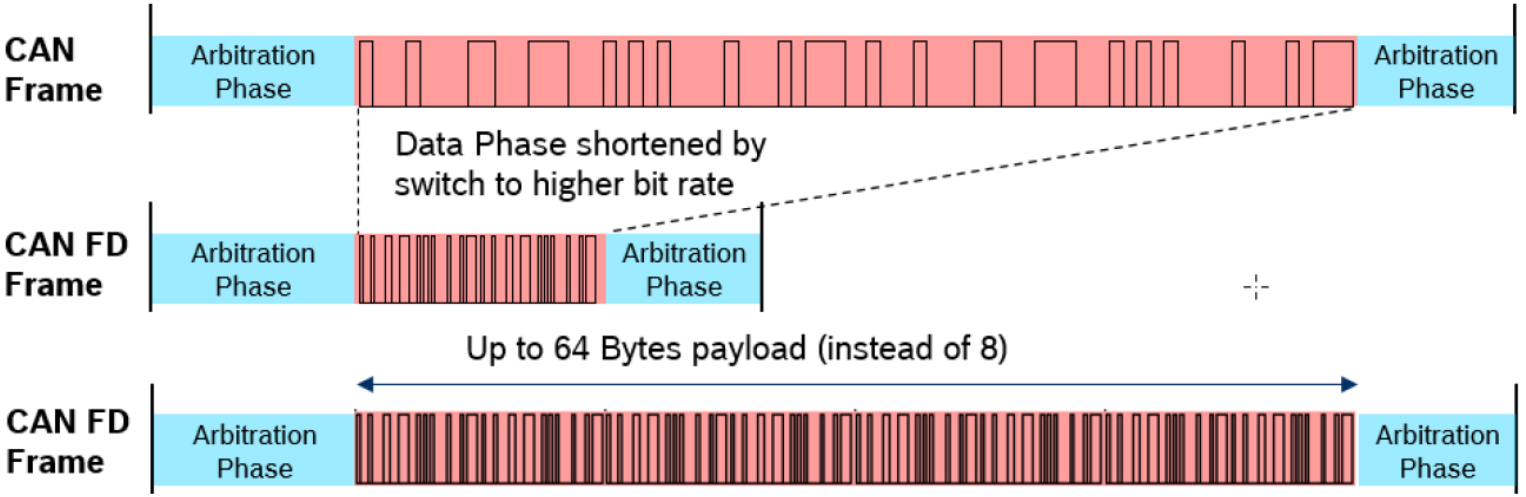
- Bit stuffing rule is violated when 6-consecutive bits with the same polarity are detected.

Introduction about CAN FD



Main improvement:

- Increase bit rate (2,4 … up to 8 Mbit/s)
- Increase payload up to 64 bytes



Reference

-CAN Specification 2.0 – Bosch

-ISO 11898-2 – High speed CAN

-ISO 11898-2 2015 – CAN FD

Q & A