The OBD-2 Stack & CANbus

Introduction

What will be covered in this presentation:

1. What is OBD-2?
    - Protocols
    - Standards
2. What is CAN bus?
    - Architecture
    - Data Transmission

What is OBD-2?

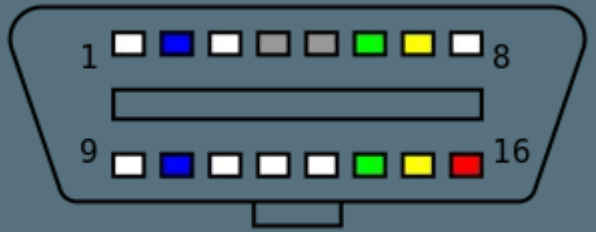
OBD-2 is the latest iteration of a standard for vehicle self-diagnostic and reporting.

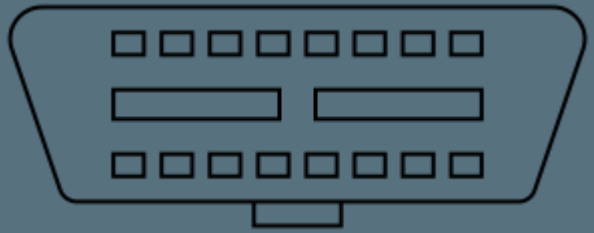
OBD-2 includes many standards (SAE, ISO) that specify the different technical components that make up a self-diagnostic & reporting system.

OBD-2: SAE J1962

The SAE J1962 standard specifies the physical connector used in OBD-2 applications:

- 2 types:
  - A(top) 12 volt
  - B(bottom) 24 volt
- Pins 4&5(grey)= chassis/signal ground
- Pin 16(red)=battery voltage
- Others are protocol and manufacturer specific

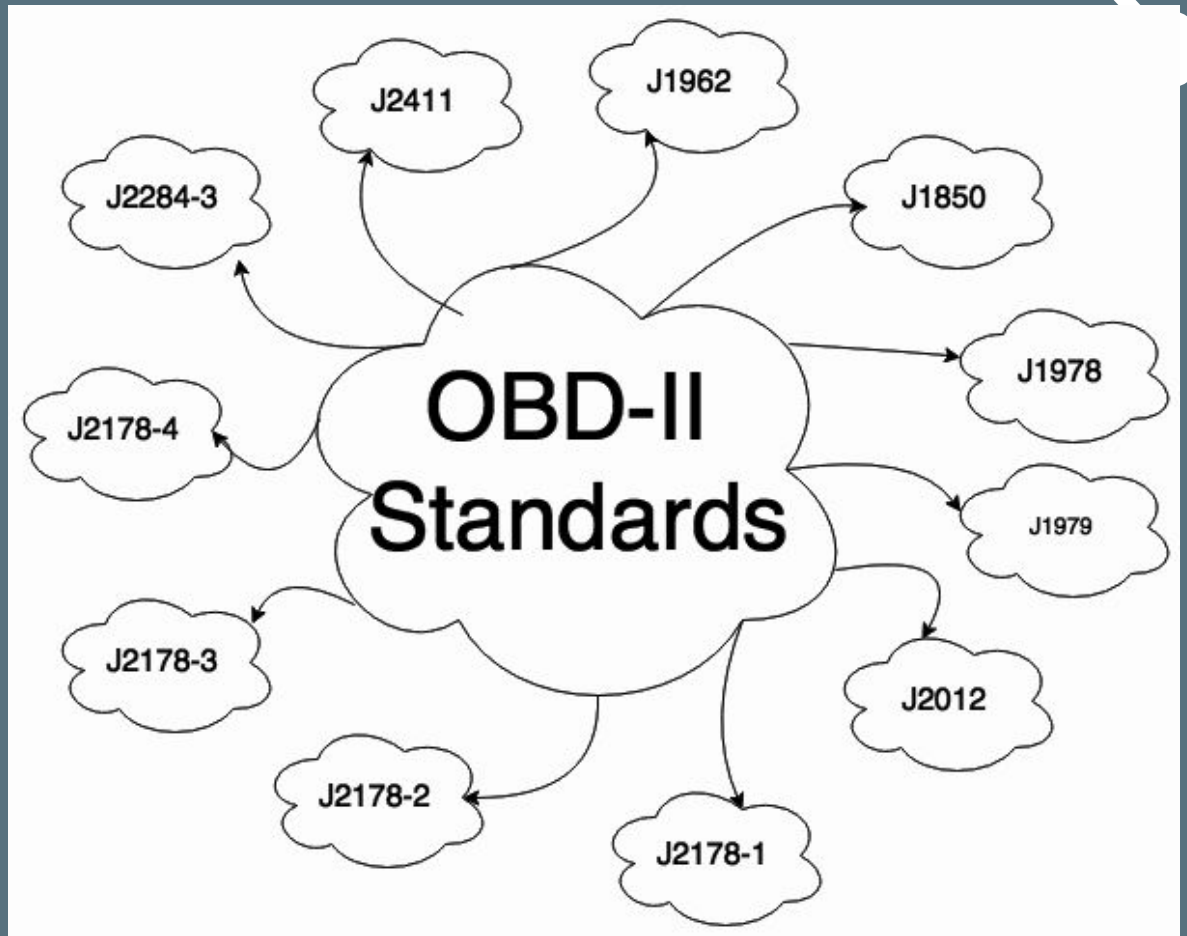




OBD-2 Modes of Operation

ISO 15031 specifies several modes of operation for OBD-2 to retrieve different pieces of data:

More Standards



Signaling Protocols

Big Five:

- SAE J1850 PWM (Ford)
- SAE J1850 VPW (GM)
- ISO 9141-2 (Chrysler, Euro+Asian Manufacturers)
- ISO 14230 KWP2000 (K-Line)
- **ISO 15765 CAN ← Vehicles sold in the U.S after 2008 must support CAN bus.**

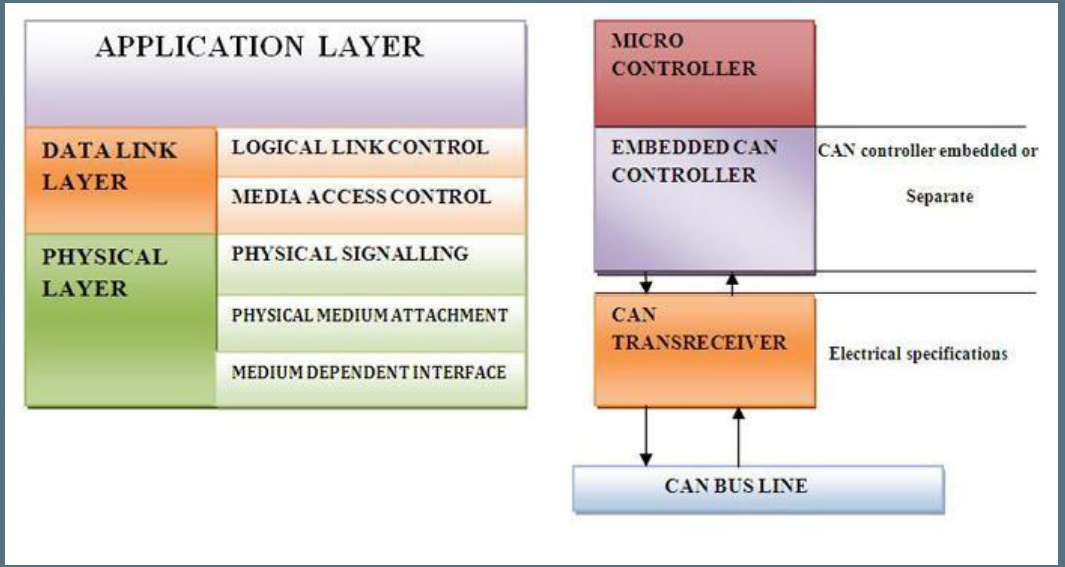
What is CANbus?

CAN = Controller Area Network

Specifies three layers from the OSI model:

- Application
- Data Link
- Physical

(Remaining 4 are Manufacturer specific)



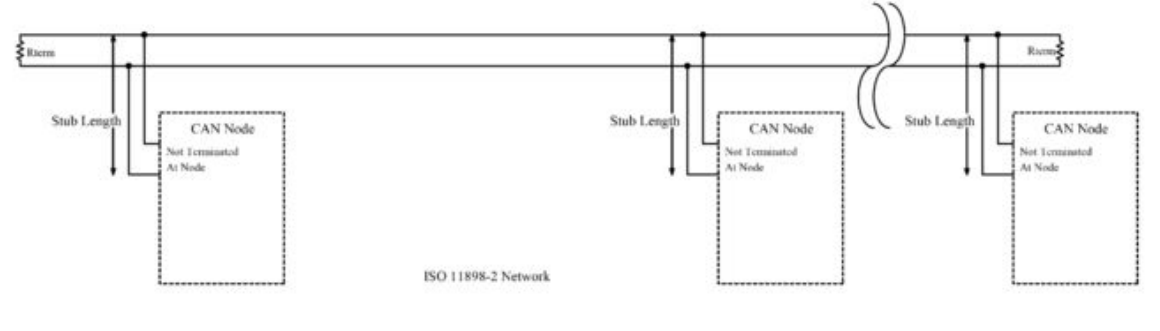
CANbus Architecture

CANbus is composed of nodes connected to a bus.

It is a multi-master serial bus, i.e. there is no single centralized processing unit.

Each Node (or ECU, Electronic Control Unit) consists of:

- A Processing Unit / CPU (e.g. a microcontroller)
- A CAN Controller
- A CAN Transceiver



CANBus: Data Transmission

CAN uses something called a lossless, bitwise arbitration system:

- The nodes are synchronized to read bits at the same time, but data transmission is not regulated by a clock.
- There are “Dominant” bits and “Recessive” bits
- If one node transmits a “Dominant” bit, and another one transmits “Recessive”, the dominant node wins.
- For example, Brake system always has “Dominant” bit
- Additionally, the lower a Node’s ID number, the higher

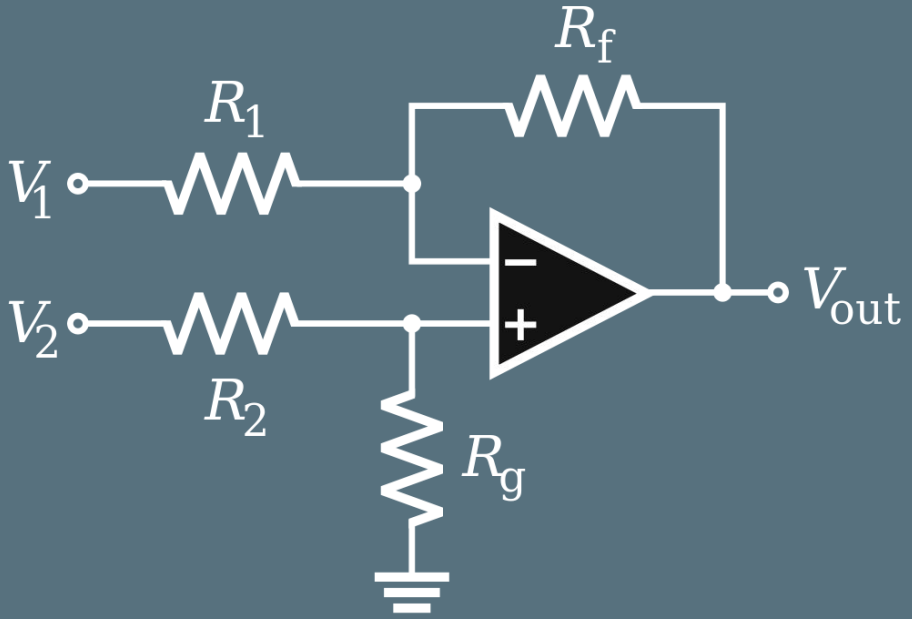
	Start Bit	ID Bits										The Rest of the Frame
		10	9	8	7	6	5	4	3	2	1	0
Node 15	0	0	0	0	0	0	0	0	1	1	1	1
Node 16	0	0	0	0	0	0	0	1	Stopped Transmitting			
CAN Data	0	0	0	0	0	0	0	0	1	1	1	1

CANBus: Receiving Data

Physically, the CANbus is a “twisted pair” bus: two wires carrying a **differential** voltage signal.

To read data requires taking the difference of voltages on the two lines: Data = CAN High - CAN Low.

In circuit design this is commonly done using a circuit like the one on the right, called a **differential** amplifier (V1 = CAN Low, V2 = CAN high, Vout = Data Signal).



Note: All of the resistors (squiggly lines) will be of equal value. This is to create a “unity gain”. If the values are not equal, the circuit will have an output gain, meaning the signal will be amplified by some value. This is undesirable because it could cause large voltages that may overload the controller.