Can Bus

Controller Area Network

What is CAN bus?

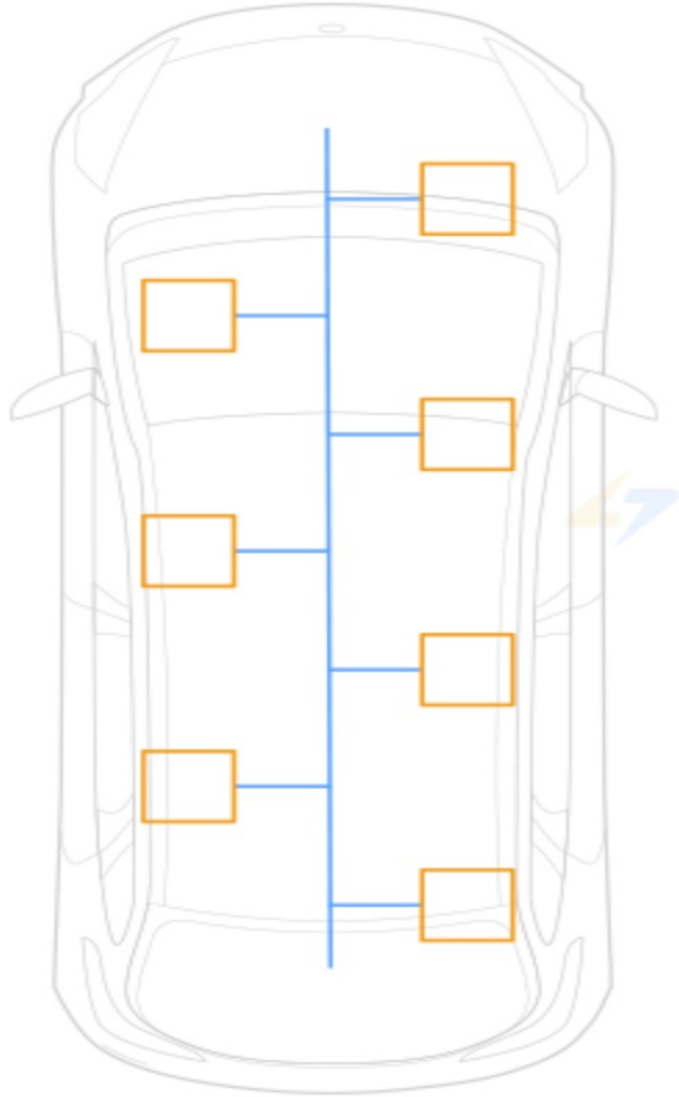
CAN bus (Controller Area Network) is a communication system used in vehicles/machines to enable ECUs (Electronic Control Units) to communicate with each other - without a host computer. For example, the CAN bus enables quick and reliable sharing of information between components e.g. your car's brakes and engine.

How it Works

- **Message-Based:** ECUs broadcast messages (data frames) onto the bus, and all other units receive them, deciding if the message is relevant to their function.
- **Priority: Messages** have priorities, so critical data (like braking commands) takes precedence over less important data, preventing network overload.
- **Decentralized:** No single ECU acts as a master; communication is peer-to-peer, making the system resilient.
- **Two Wires:** It uses a twisted pair of wires (CAN High and CAN Low) for differential signaling, which provides noise immunity.

Key Benefits

- Reduced Wiring: Replaces complex point-to-point wiring with a simple two-wire network, saving weight, cost, and space.
- Reliability: Ensures data integrity and efficient message delivery, crucial for safety systems.
- Scalability: Easy to add new ECUs (nodes) to the network.



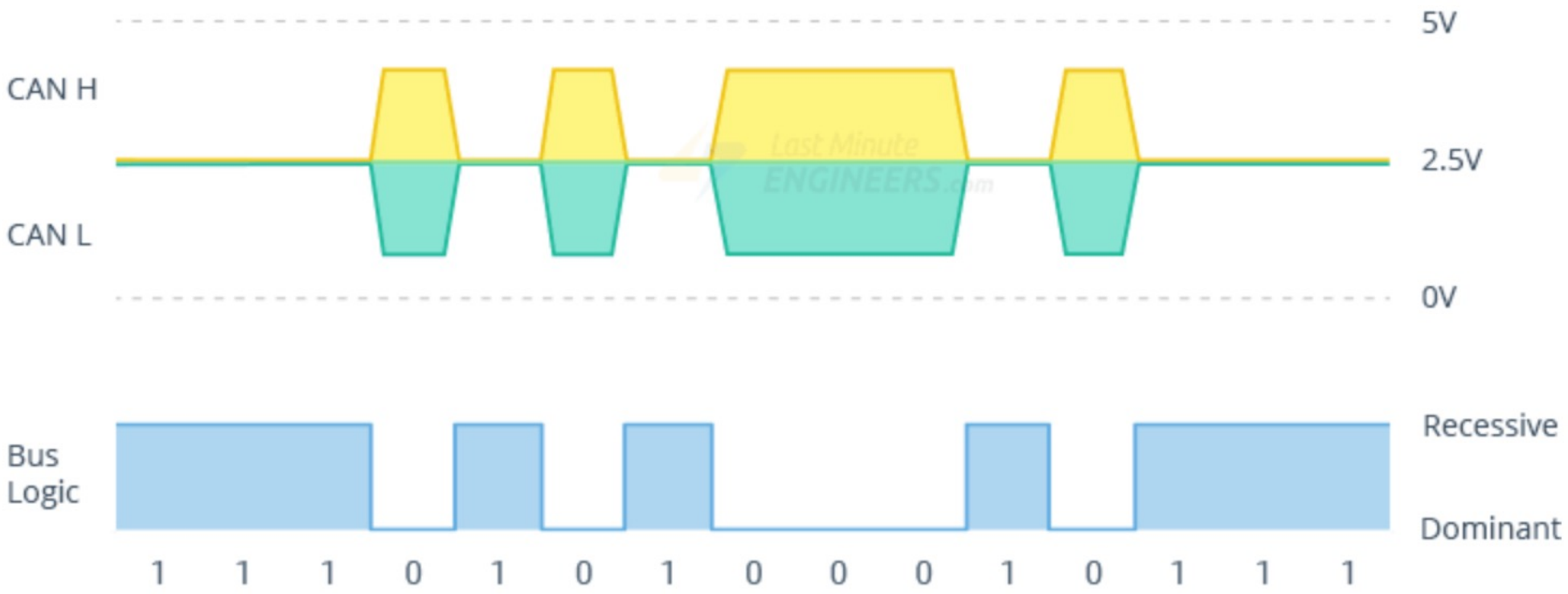
Where it's Used

- Automotive: Standard in virtually all modern cars, trucks, and motorcycles.
- Industrial: Machinery, robotics, and automation.
- Maritime & Aerospace: Ships, aircraft, and other complex systems.
- Other: Elevators, medical equipment, and even 3D printers.

The Cables

- Cab Bus uses a twisted pair of cables, known as CAN High and CAN Low
- Typically, they are twisted at the rate of one twist per 2.5cm which gives a characteristic impedance of 120 ohms
- They operate as a differential pair

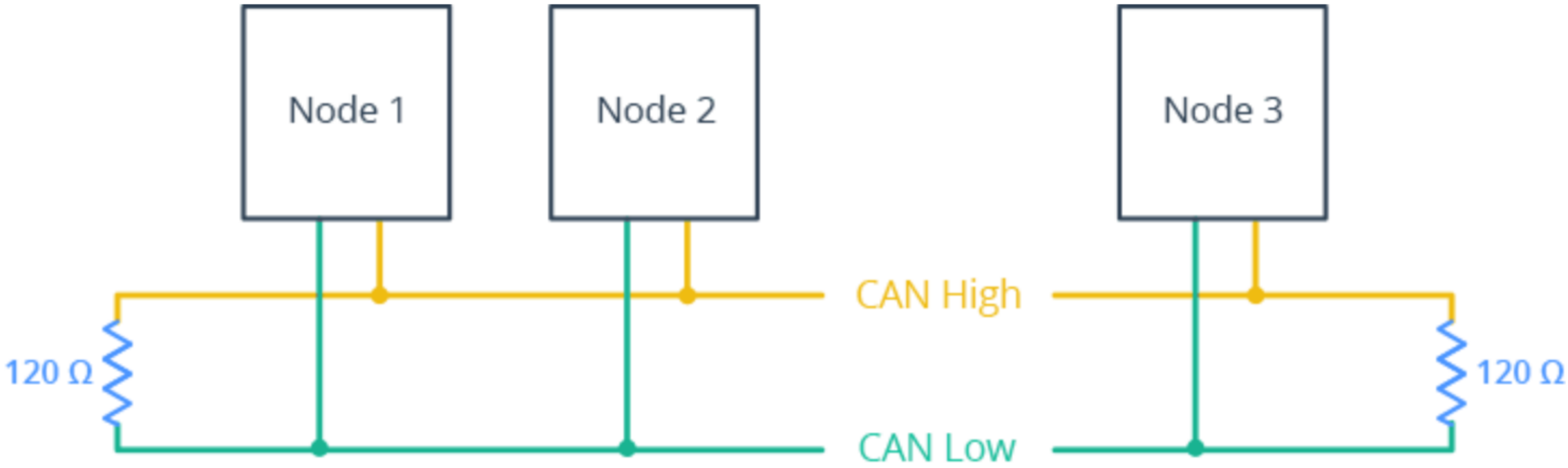
Differential Pair



Data Frames

SOF	Start of Frame
CAN ID	ID of the Message
RTR	Remote transmission request
Control	Defines the type of Can Bus
Data	Data to be sent
CRC	Cyclic redundancy check (error Correction)
ACK	Acknowledgement
EOF	End of Frame

The Bus



Each Node is connected to the bus using open collector devices

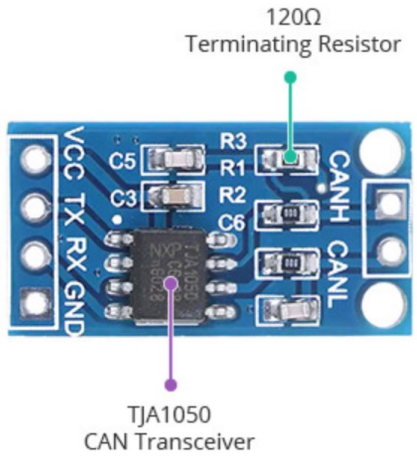
Data Collisions

- Sometimes, more than one node will try to send data at the same time.
- The Message ID gives each message a priority
- Messages with a lower priority yield to any message with a higher priority and shut down to allow the other message to be sent

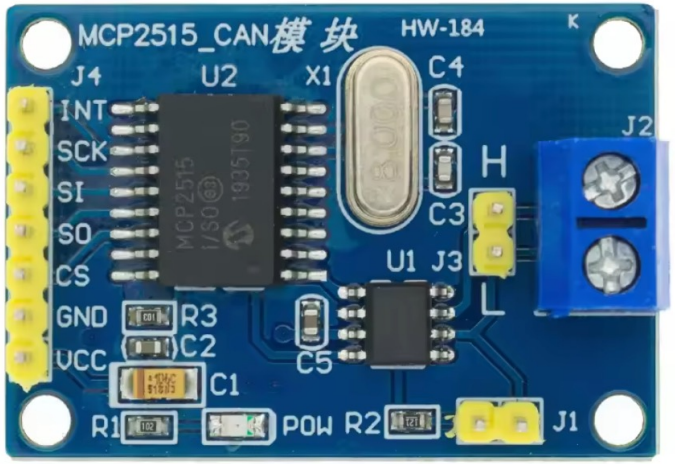
Controllers and Drivers

The ESP32 has a built in Can Bus Controller

However, it needs an external bus driver



The Arduino does not have a built-in controller and needs an external controller and driver



ESP32 Network

Note that Espressif Systems refer to Can Bus as Two-Wire Automotive Interface (TWAI). This is slightly odd as Can Bus is used in many other applications apart from the automotive industry.