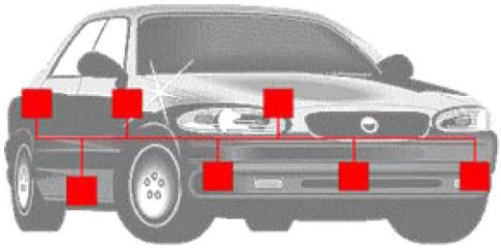
# Introduction to CANBUS



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## Presentation Goals

1. CANBUS Introduction
   - What is CANBUS?
   - Who uses CANBUS?
   - CANBUS history
   - CANBUS timeline
2. CANBUS Characteristics
   - OSI Model
   - Physical Layer
   - Transmission Characteristics
3. Message Oriented Communication
4. Message Format
5. Bus Arbitration

# What is CANBUS?

CANBUS or CAN bus – Controller Area Network bus

An automotive serial bus system developed to satisfy the following requirements:

- Network multiple microcontrollers with 1 pair of wires.
- Allow microcontrollers communicate with each other.
- High speed, real-time communication.
- Provide noise immunity in an electrically noisy environment.
- Low cost

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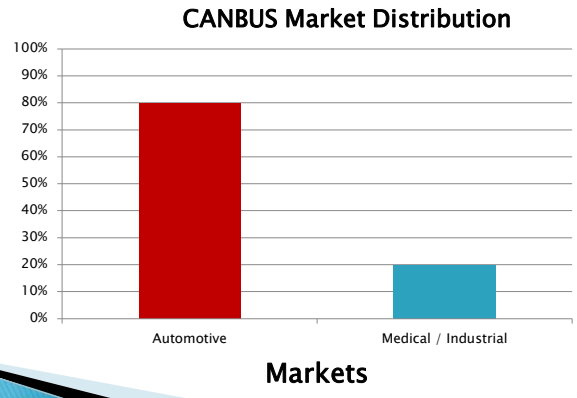
# Who uses CANBUS?

- Designed specifically for automotive applications
- Today – industrial automation / medical equipment

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# CANBUS History

- First idea – The idea of CAN was first conceived by engineers at Robert Bosch Gmbh in Germany in the early 1980s.
- Early focus – develop a communication system between a number of ECUs (electronic control units).
- New standard – none of the communication protocols at that time met the specific requirements for speed and reliability so the engineers developed their own standard.

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# CANBUS Timeline

- 1983 : First CANBUS project at Bosch
- 1986 : CAN protocol introduced
- 1987 : First CAN controller chips sold
- 1991 : CAN 2.0A specification published
- 1992 : Mercedes-Benz used CAN network
- 1993 : ISO 11898 standard
- 1995 : ISO 11898 amendment
- Present : The majority of vehicles use CAN bus.

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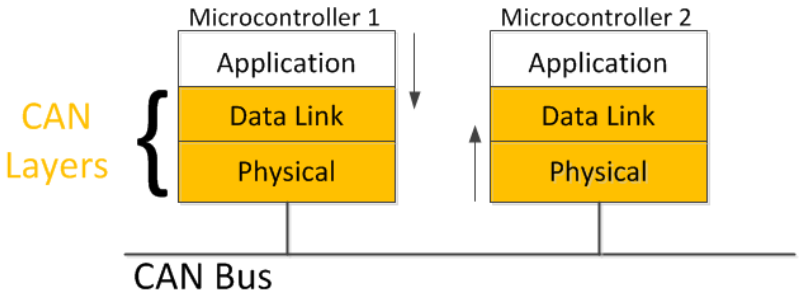
# CANBUS and the OSI Model

- CAN is a closed network
  - – no need for security, sessions or logins.
  - – no user interface requirements.
- Physical and Data Link layers in silicon.

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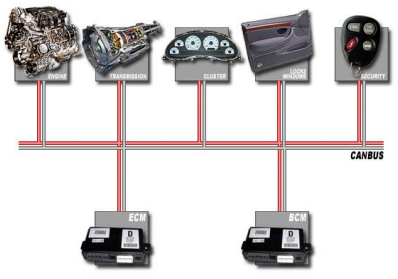
# CANBUS Physical Layer

- Physical medium – two wires terminated at both ends by resistors.
- Differential signal – better noise immunity.
- Benefits:
  - Reduced weight, Reduced cost
  - Fewer wires = Increased reliability

**Conventional multi-wire looms**


VS.

**CAN bus network**




http://canbuskit.com/what.php

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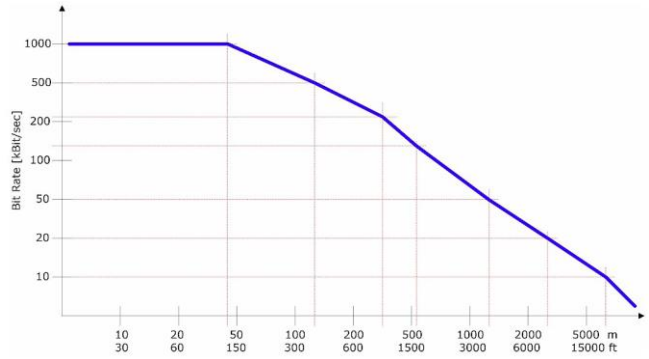
# Transmission Characteristics

- Up to 1 Mbit/sec.
- Common baud rates: 1 MHz, 500 KHz and 125 KHz
- All nodes – same baud rate
- Max length:120' to 15000' (rate dependent)



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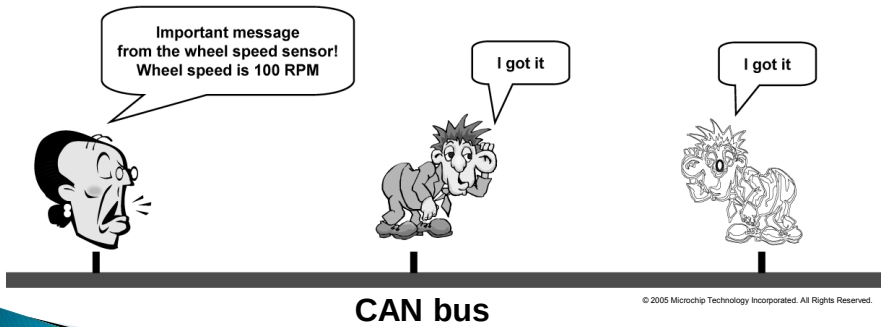
# Message Oriented Transmission Protocol

- Each node – receiver & transmitter
- A sender of information transmits to all devices on the bus
- All nodes read message, then decide if it is relevant to them
- All nodes verify reception was error-free
- All nodes acknowledge reception



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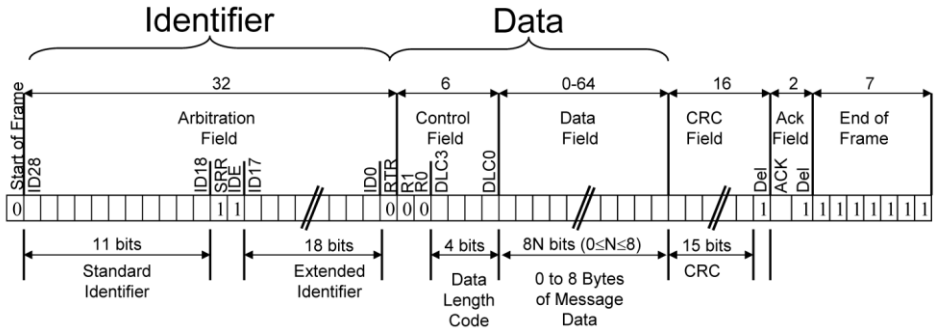
# Message Format

- Each message has an ID, Data and overhead.
- Data –8 bytes max
- Overhead – start, end, CRC, ACK

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# Example of Message Transaction

| | ID | Data |
|---|---|---|
| ▪ Instrument panel ECU says "can anyone tell me what the block temperature is? | 400 | |
| ▪ Block ECU sees this message and issues a message "block temperature is 76 Celsius" | 400 | 076 |
| ▪ Instrument panel ECU sees block temperature message and displays it on console | | |


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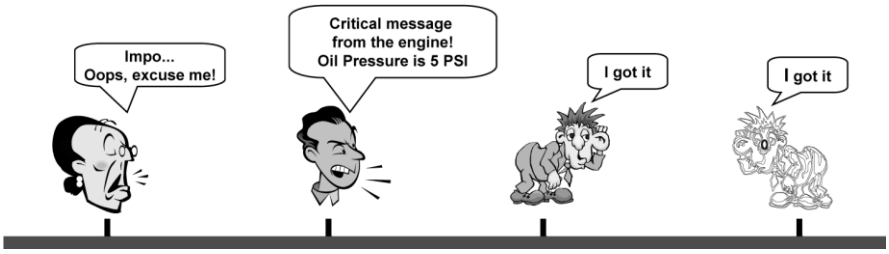
# Bus Arbitration

- Arbitration – needed when multiple nodes try to transmit at the same time
- Only one transmitter is allowed to transmit at a time.
- A node waits for bus to become idle
- Nodes with more important messages continue transmitting




**CAN bus**

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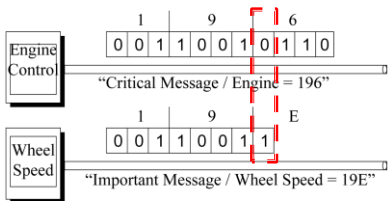
# Bus Arbitration

- Message importance is encoded in message ID.
  Lower value = More important
- As a node transmits each bit, it verifies that it sees the same bit value on the bus that it transmitted.
- A “0” on the bus wins over a “1” on the bus.
- Losing node stops transmitting, winner continues.

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## Summary

- CAN bus – Controller Area Network bus
- Primarily used for building ECU networks in automotive applications.
- Two wires
- OSI – Physical and Data link layers
- Differential signal – noise immunity
- 1Mbit/s, 120’
- Messages contain up to 8 bytes of data

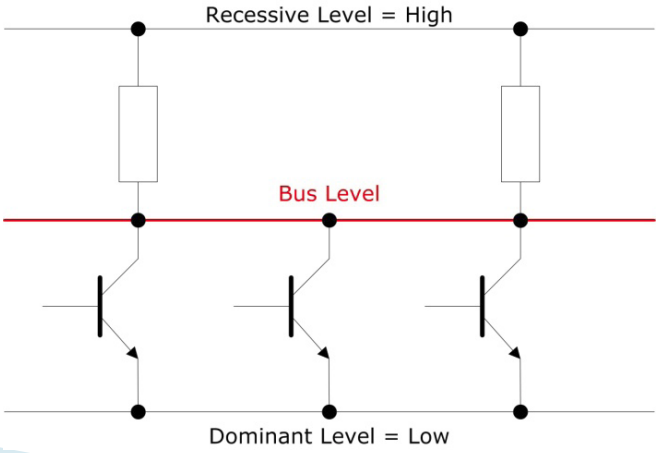


## End of Presentation

- Marek Hajek

# Bus arbitration

A “0” (low voltage) on the bus by 1 node wins over a “1” (high voltage) on the bus.

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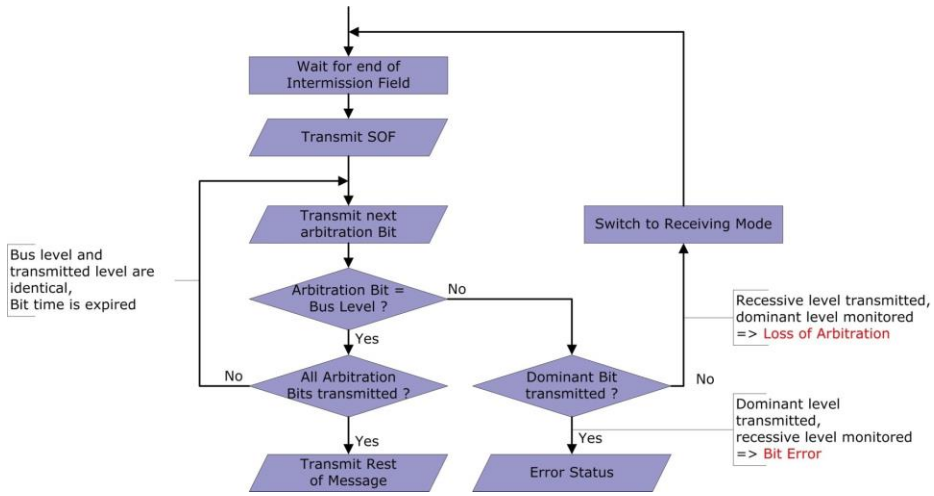
# Bus Arbitration Flowchart

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