Embedded and Real-Time Systems

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Hamed Farbeh

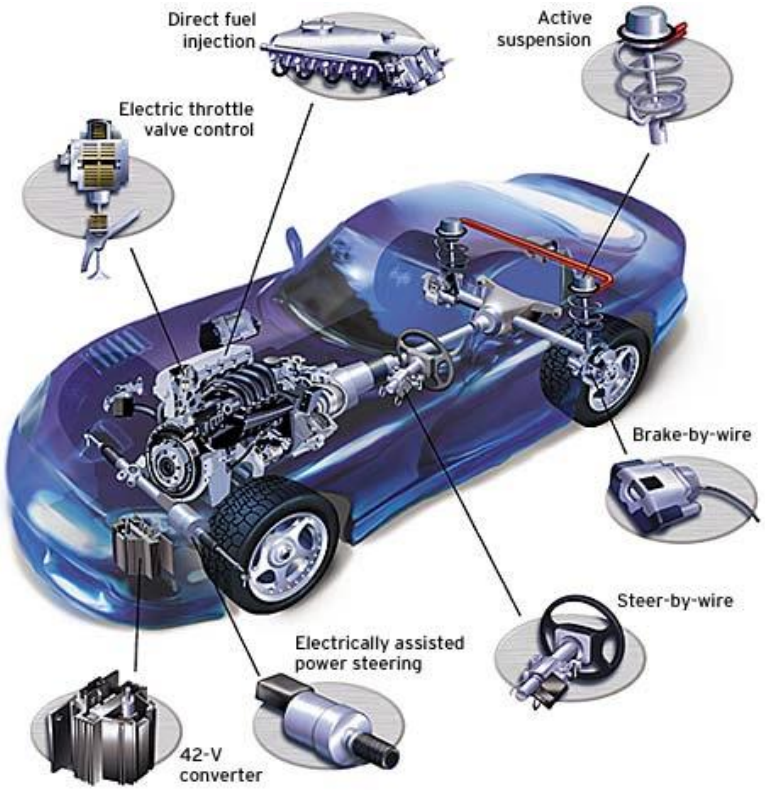
farbeh@aut.ac.ir

Department of Computer Engineering

Amirkabir University of Technology

Lecture 13

Automotive Communication Protocols

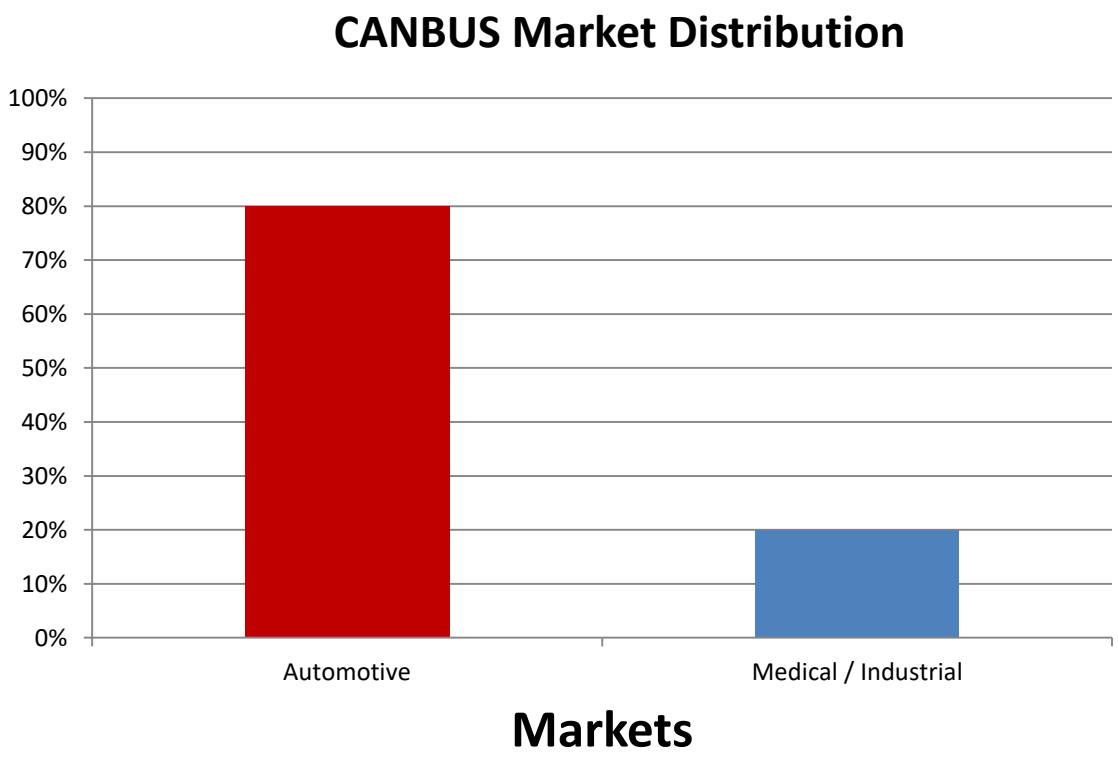


CAN Bus

- CANBUS or CAN bus – **C**ontroller **A**rea **N**etwork **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

Who uses CANBUS?

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



CANBUS History

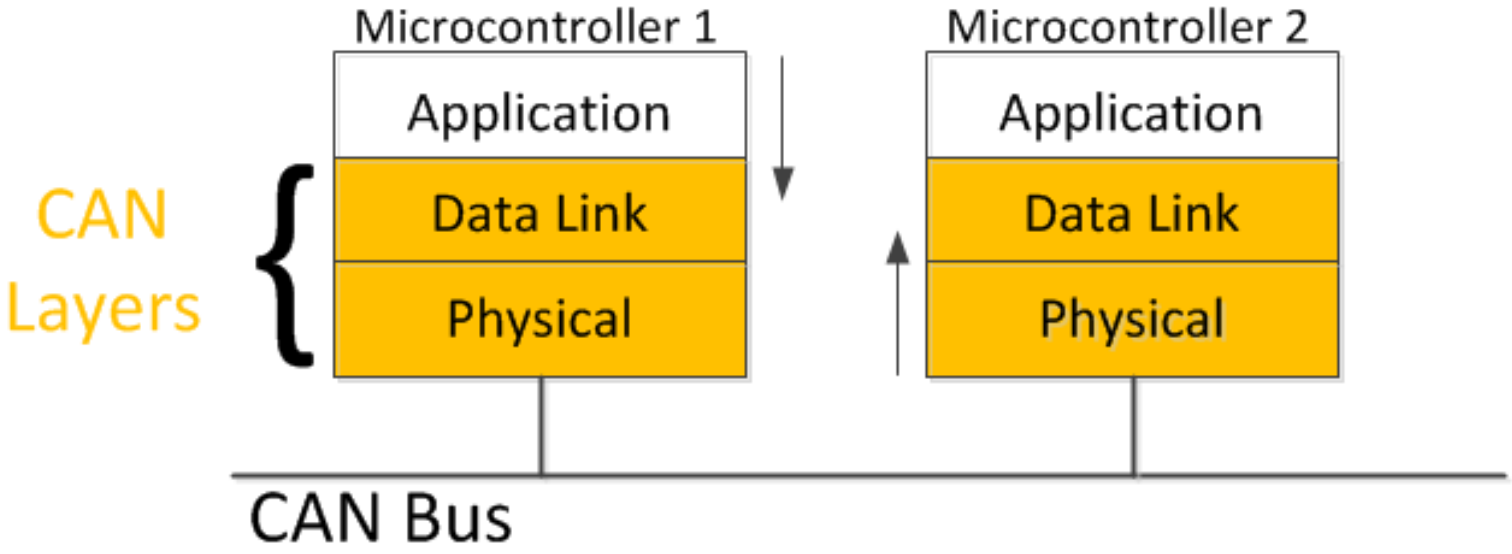
- First idea
  - The idea of CAN was first conceived by engineers at Robert Bosch Gmbh in Germany in the early 1980s
- Early focus
  - Develop a communication system between a number of ECUs (electronic control units)
- New standard
  - None of the communication protocols at that time met the specific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

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

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



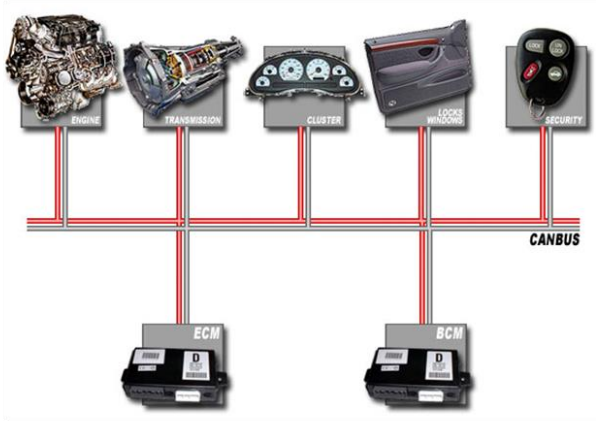
CANBUS Physical Layer

- 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.

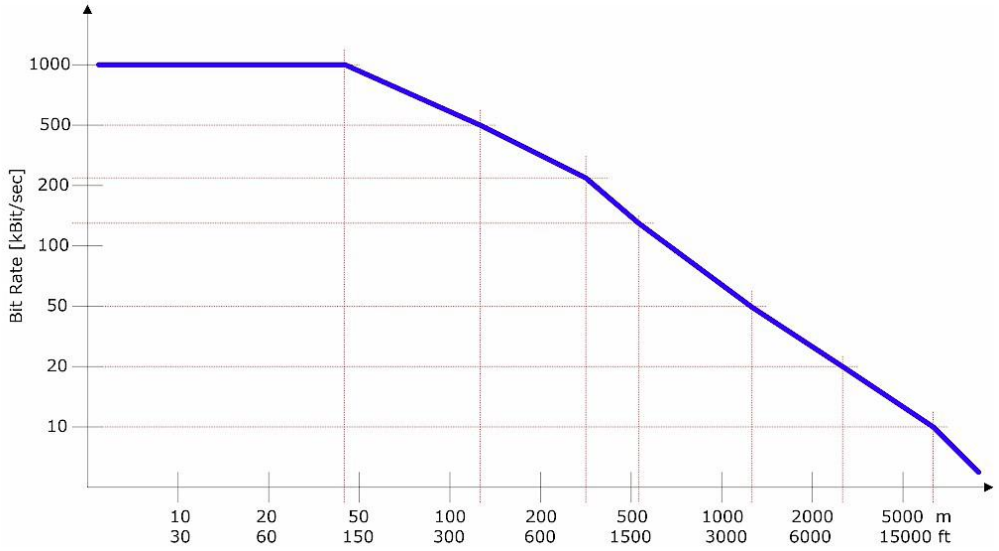
CAN bus network



http://canbuskit.com/what.php

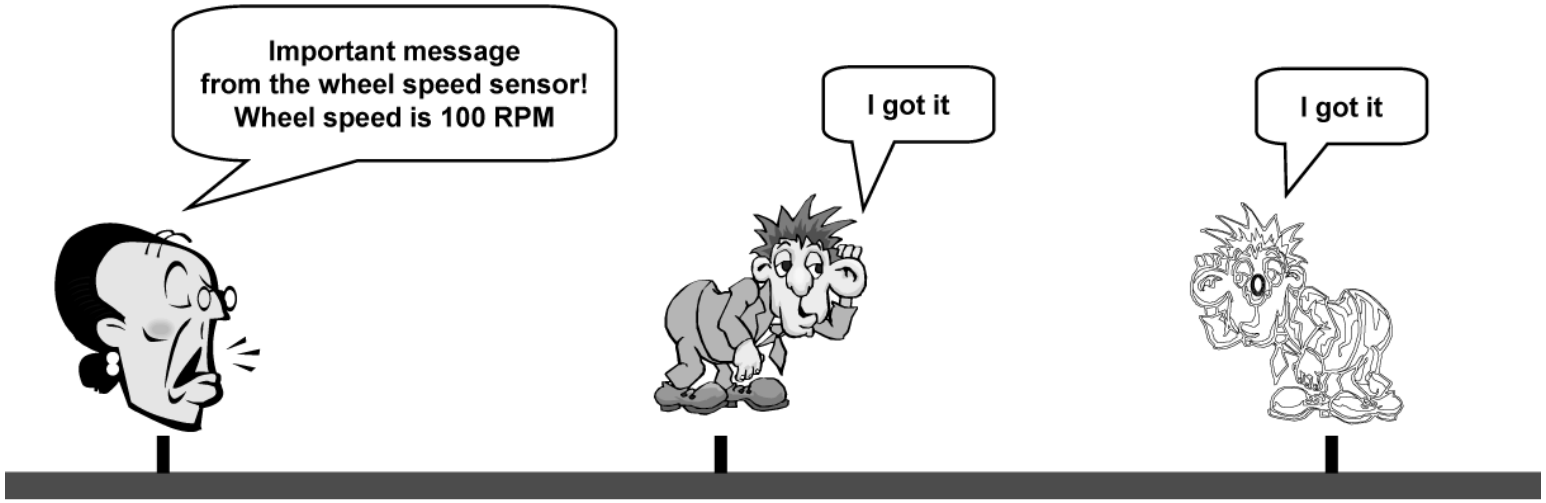
Transmission Characteristics

- 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)



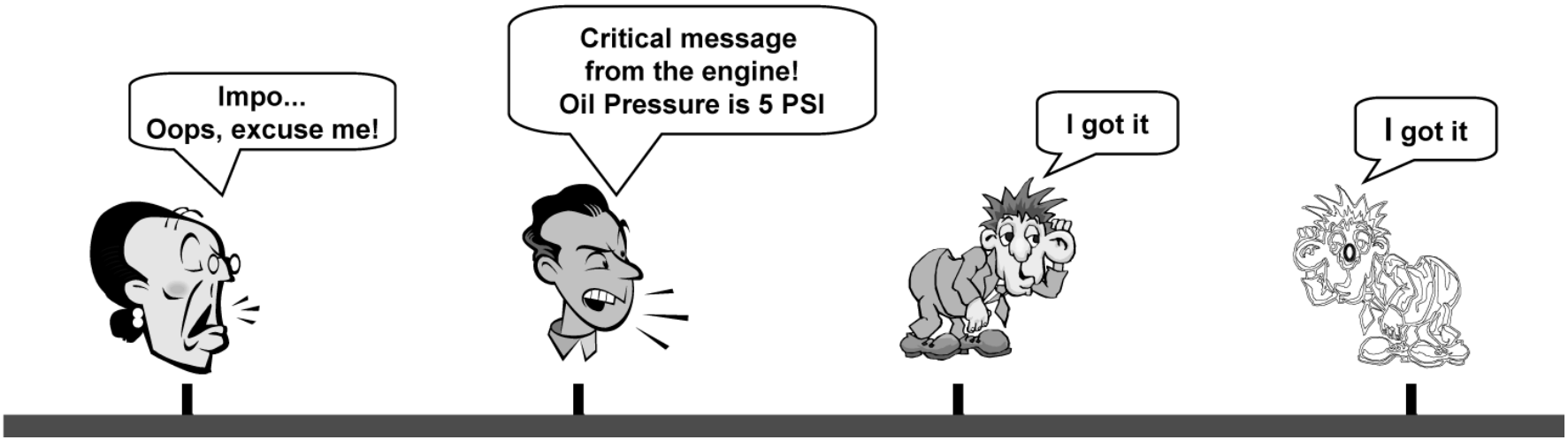
Message Oriented Transmission Protocol

- 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



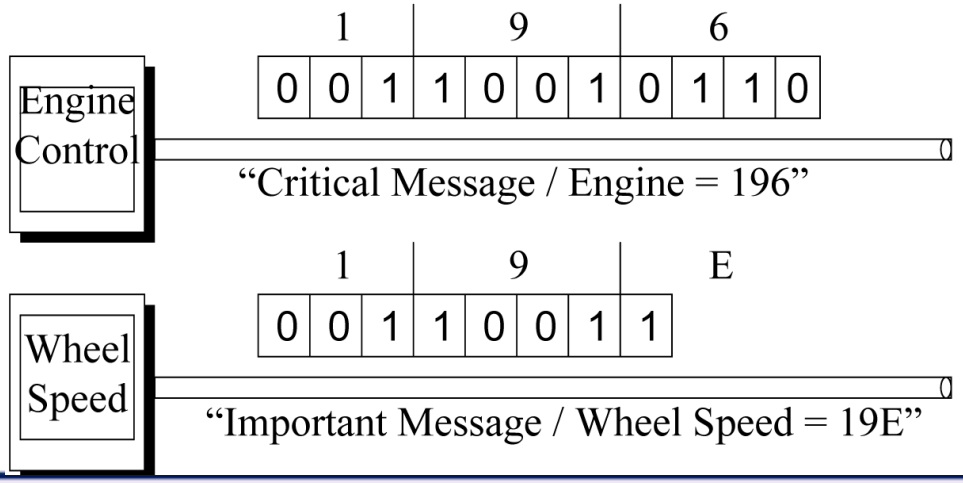
Bus Arbitration

- 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



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



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