Controller Area Network

Team 5
Introduction

- Controller Area Network
- Originally developed by Robert Bosch for automobile in-vehicle network
- Multi-drop, multi-master serial bus provides communications between controllers, sensors and actuators
- Very reliable, robust
- Inexpensive
There are 2 versions:
- CAN 2.0 A (standard)
- CAN 2.0 B (extended)

International Standard ISO 11898
- ISO 11898 2 High Speed applications
- ISO 11898 3 Low Speed applications
CAN Characteristics

- All messages are broadcast messages
- All nodes are allowed to broadcast
- All messages contain an ID that identifies the source or content
- Each receiver decides to process or ignore the message
Physical Medium
Signal Level
Seven layers in OSI model

- Application
- Presentation
- Session
- Transport
- Network
- Data Link
- Physical

Logical Link Control (LLC)
- Acceptance filtering
- Overload notification
- Recovery management

Medium Access Control (MAC)
- Data encapsulation/decapsulation
- Frame coding (stuffing/de-stuffing)
- Error detection/signaling
- Serialization/deserialization

Physical Signaling
- Bit encoding/decoding
- Bit timing/synchronization

Physical Medium Attachment
- Driver/receiver characteristics

Medium Dependent Interface
- Connectors/wires

Defined by
ISO11898

CAN Controller
Transceiver MCP2551
Physical Layer

No Specifications
- driver/receiver
- transport medium
  - wires
  - connectors
Data Link Layer

Defined by the CAN specification

- Filtering
- Error detection
- Signaling
- Coding
Data Transmission

Serial Bus
CAN High and CAN Low
CAN 2.0 C 250 kbps
CAN 2.0 B 500 kbps
Data Transmission

Synchronous
### Data Transmission

#### Priority System

Truth tables for dominant/recessive, logical or, and logical and (for comparison)

<table>
<thead>
<tr>
<th>Bus state with two nodes transmitting</th>
<th>Logical or</th>
<th>Logical and</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominant</td>
<td>0 1</td>
<td>0 1</td>
</tr>
<tr>
<td>Recessive</td>
<td>0 1</td>
<td>0 0</td>
</tr>
<tr>
<td>Dominant</td>
<td>0 1</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Recessive</td>
<td>1 1 1</td>
<td>1 0 1</td>
</tr>
</tbody>
</table>
Data Transmission

Priority System

Module 1 ID: 000111111  31
Module 2 ID: 001000000  32
Frames

- Four types of frame
  1. data frame
  2. remote frame
  3. error frame
  4. overload frame
In data frame, there are two message format.
1. base frame format
2. extended frame format
Remote Frame

- What is remote frame
- What is the difference between data frame and remote frame
  1. RTR difference
  2. no data field
Error Frame

- There are two different fields:
  1. Error Flag (two types)
     a. active
     b. passive
  2. Error Delimiter (8 recessive bit)
Overload Frame

- Two bit fields
  1. Overload Flag
  2. Overload Delimiter
- two conditions
  1. require delay of next data or remote frame
  2. detection of dominant bit
Modern Application

- Up to 70 ECUs per vehicle
- Supports over 100
- Allows for full communication without host computer
- Communication between main Engine Control Module and other ECUs
- In first application, reduced wiring by over 1 mile, reduced weight by over 100 lbs
Vehicle Wiring: conventional multi-wire looms

Vehicle Wiring: CAN Bus network

CANBUS
Application: Others

- Industrial Machinery
- Medical Systems
- Agricultural Machinery
- Elevator Control Systems