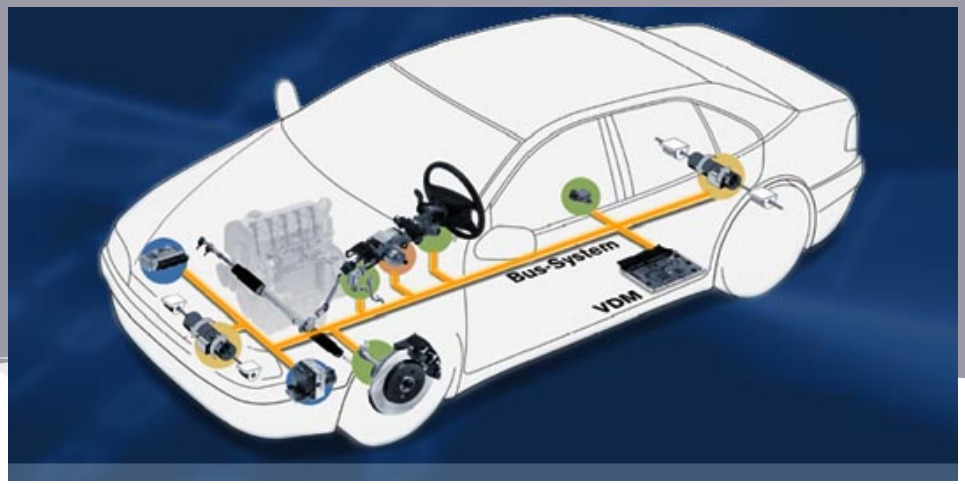
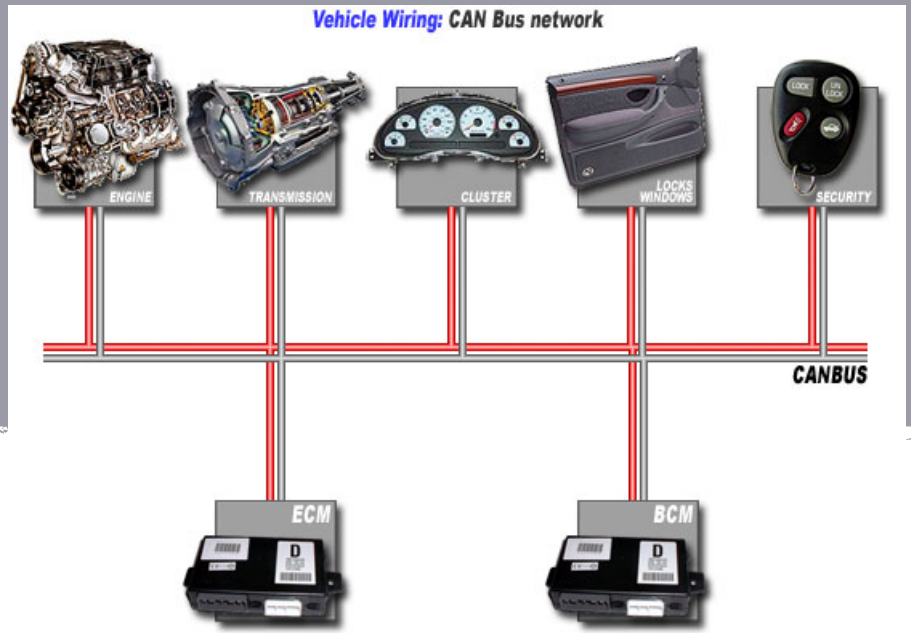
Control Area Network (CAN) Bus



By:
Andrew Curtin
Mike Denko
Andrew Viola

CAN Network

http://www.arm.com/community/partners/product_images/4668.jpg



http://www.canbuskit.com/what.php

History

- First introduced in February of 1986 by Robert Bosch GmbH
- Developed because existing serial buses in the early 1980s were not able to fulfill all the requirements to be used in passenger cars
- Intel released the first CAN controller chip in 1987
- In November 1993 the CAN ISO standard was published
- First applications included use by an elevator manufacturer and some textile machine manufacturers
- Multiple higher level protocols for CAN have been developed since 1994

BOSCH

Invented for life

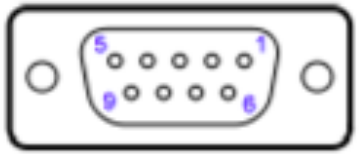
http://www.esdmagazine.com/bosch-to-present-new-filling-solutions/

Applications

- Most common use is in the automobile industry
  - Used to connect subsystems within an electronic control unit as well as connect electronic control units together
  - Typically the largest control unit in a vehicle is the engine control unit
  - Modern automobiles may have up to 70 electronic control units
  - Many devices in cars use CAN including the radio, transmission, airbags, ABS, cruise control, and power steering
- CAN is also used in both railway and aerospace applications
- Other applications include use in hospital equipment, elevators, and even coffee machines

http://gallery.novylen.net/d/24119-2/camaro02.jpg

Wires / Pinout



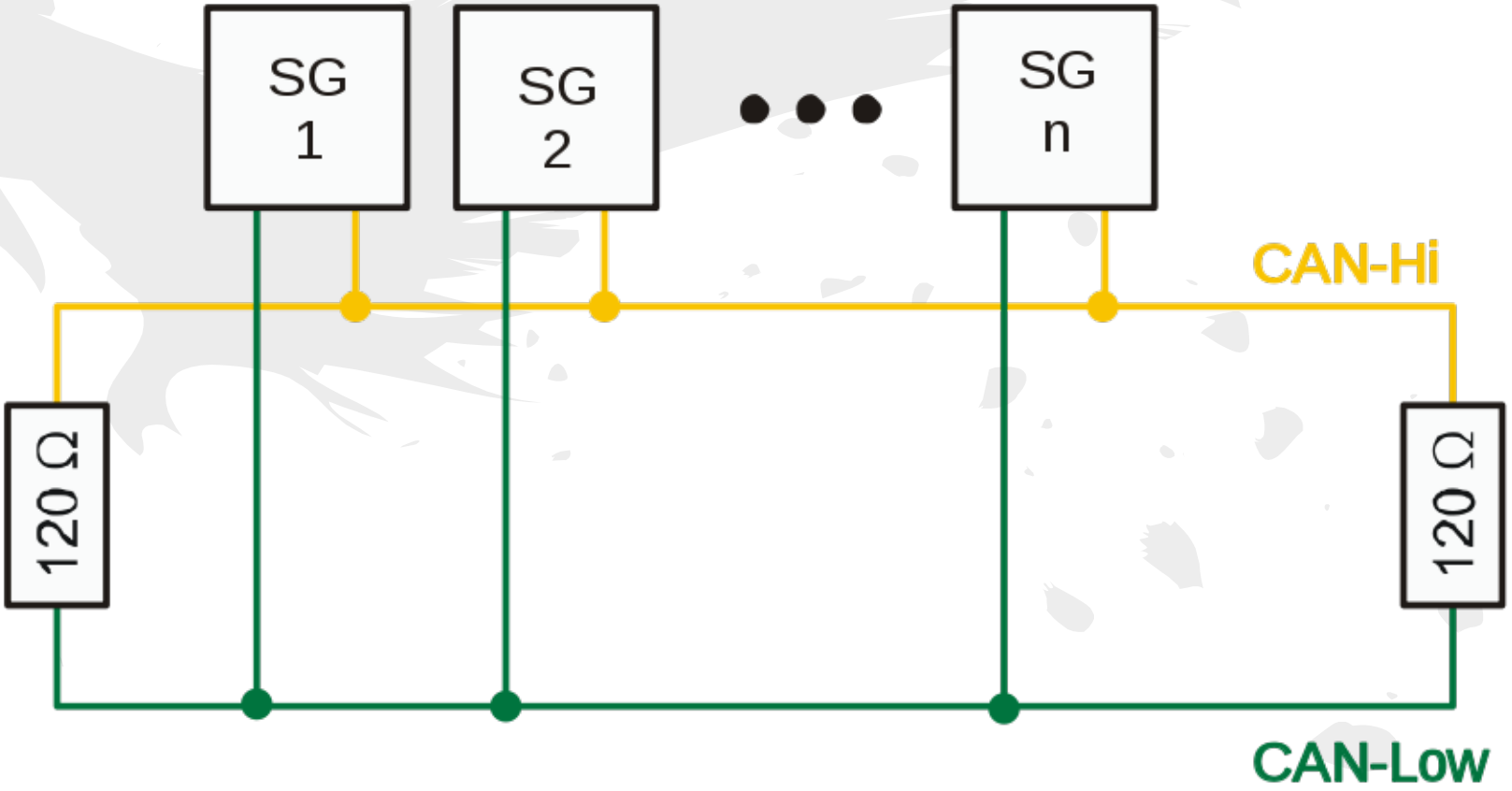
DE-9

9 Pin (male) D-Sub CAN Bus PinOut		
Pin #	**Signal Names**	**Signal Description**
1	Reserved	Upgrade Path
2	CAN_L	Dominant Low
3	CAN_GND	Ground
4	Reserved	Upgrade Path
5	CAN_SHLD	Shield, Optional
6	GND	Ground, Optional
7	CAN_H	Dominant High
8	Reserved	Upgrade Path
9	CAN_V+	Power, Optional

*required wires are highlighted

http://www.interfacebus.com/Can_Bus_Connector_Pinout.html

Topology



Wikipedia

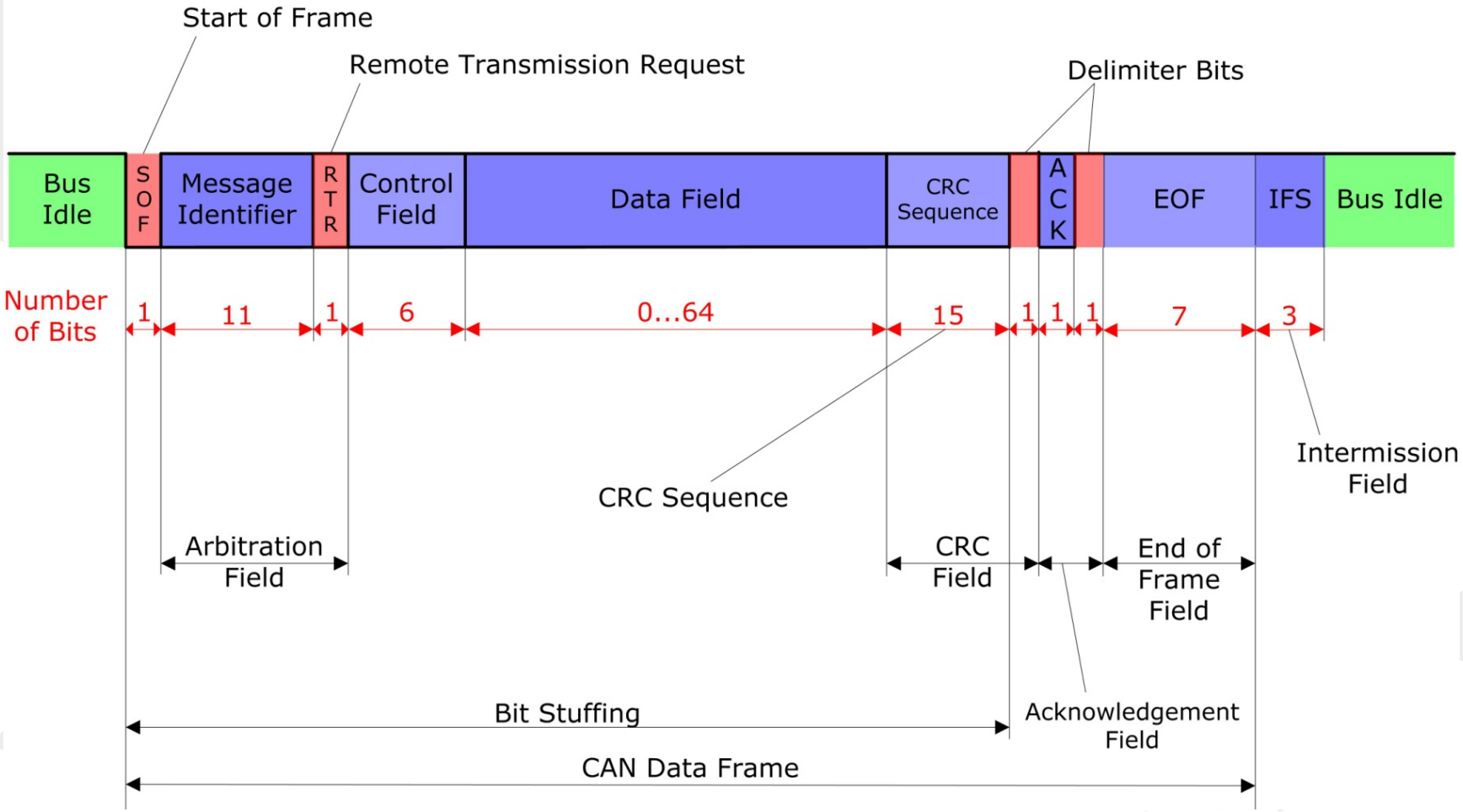
Data Transmission

- Serial communication
- Asynchronous
- Message frames
- Baud Rate (bits/s)
  - all nodes same rate
  - 1Mbit/s max

Frames

- ID
- Data
- Frame Types
  - Data
  - Error
  - Remote
  - Overload

Data Frame



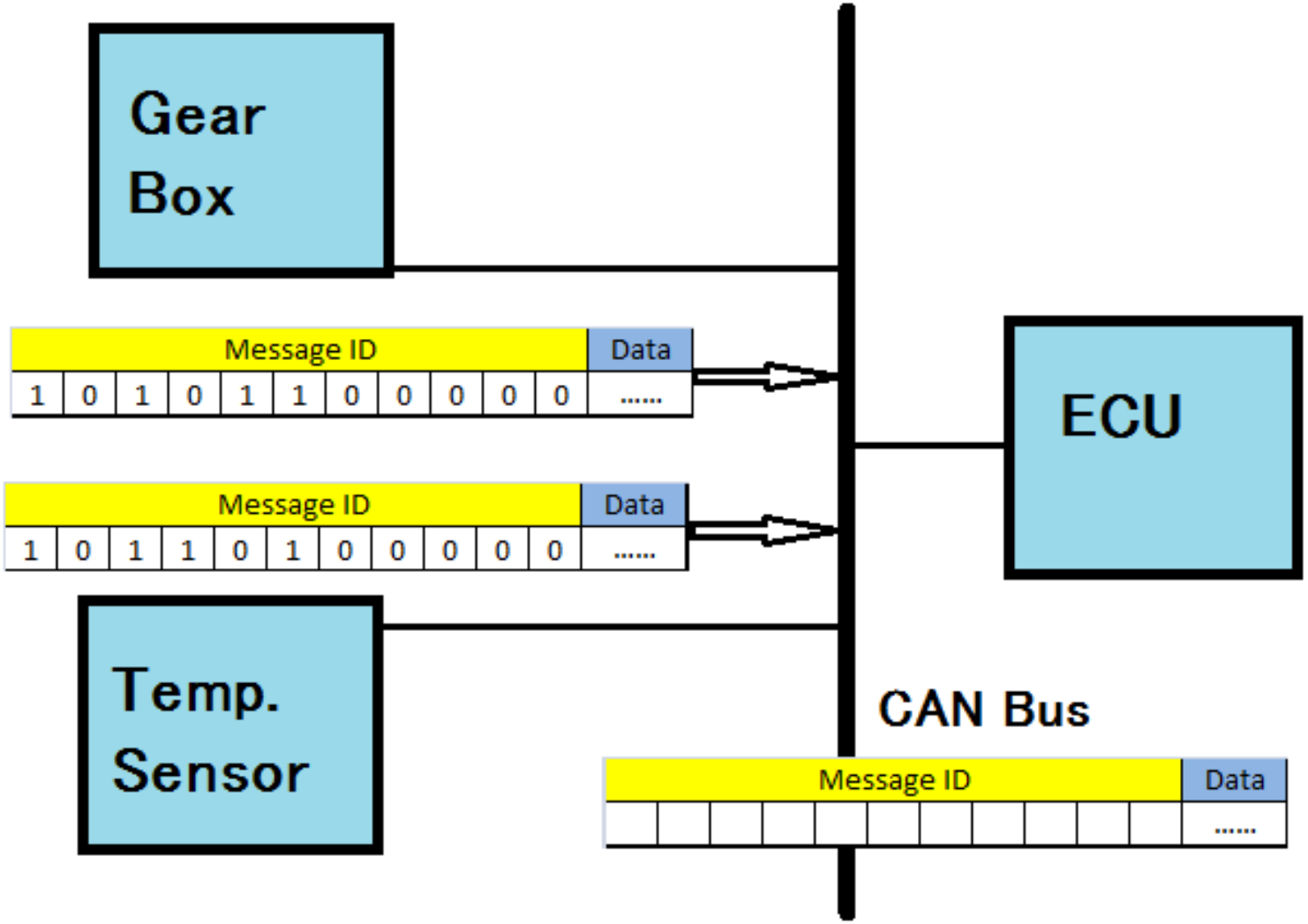
http://www.copperhillmedia.com/Downloads/CAN%20Seminar_files/slide0030_image072.jpg

Arbitration

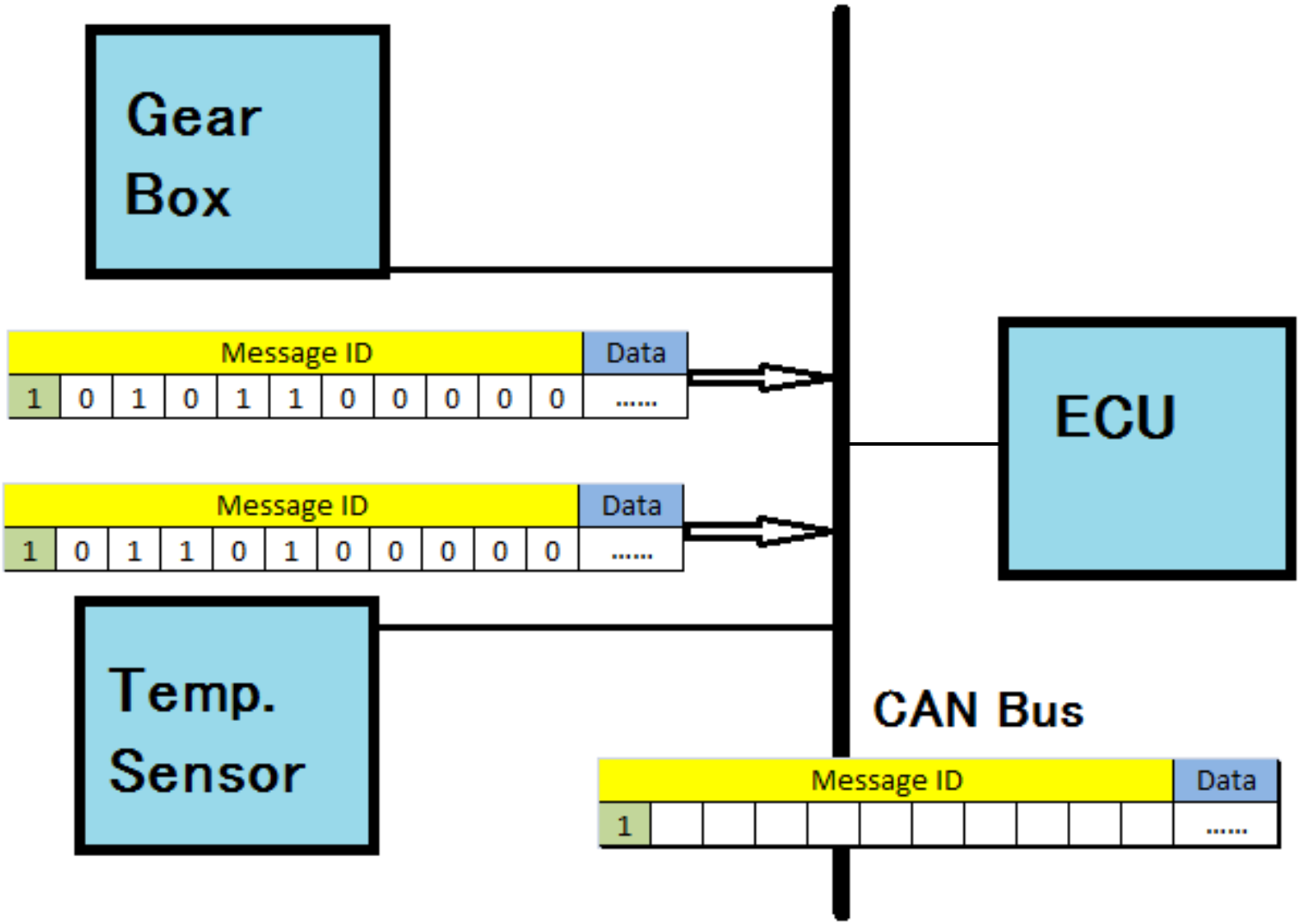
- Zero Dominant
- Similar to I2C

	Dominant 0	Recessive 1
Dominant 0	0	0
Recessive 1	0	1

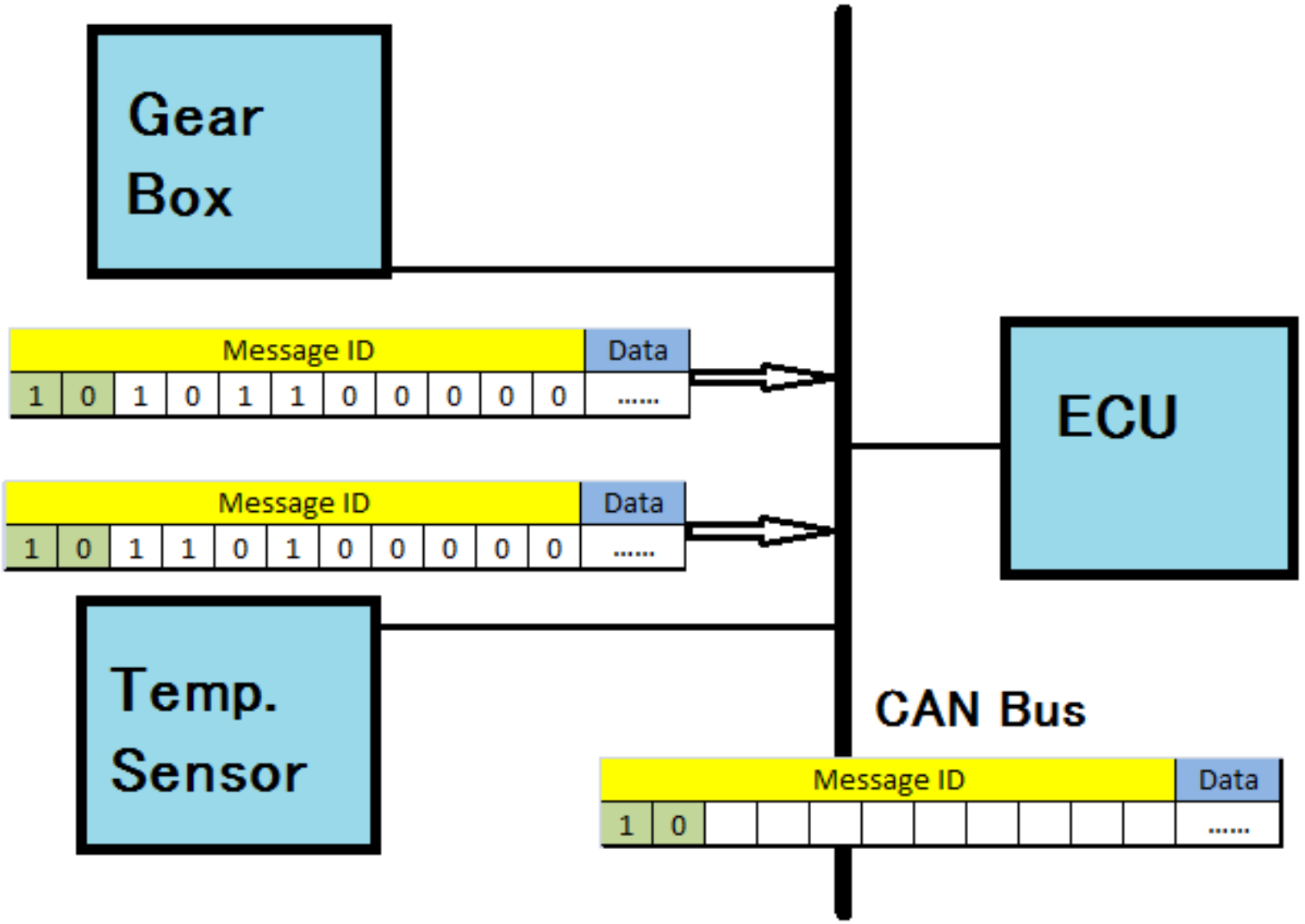
Data Transmission Example



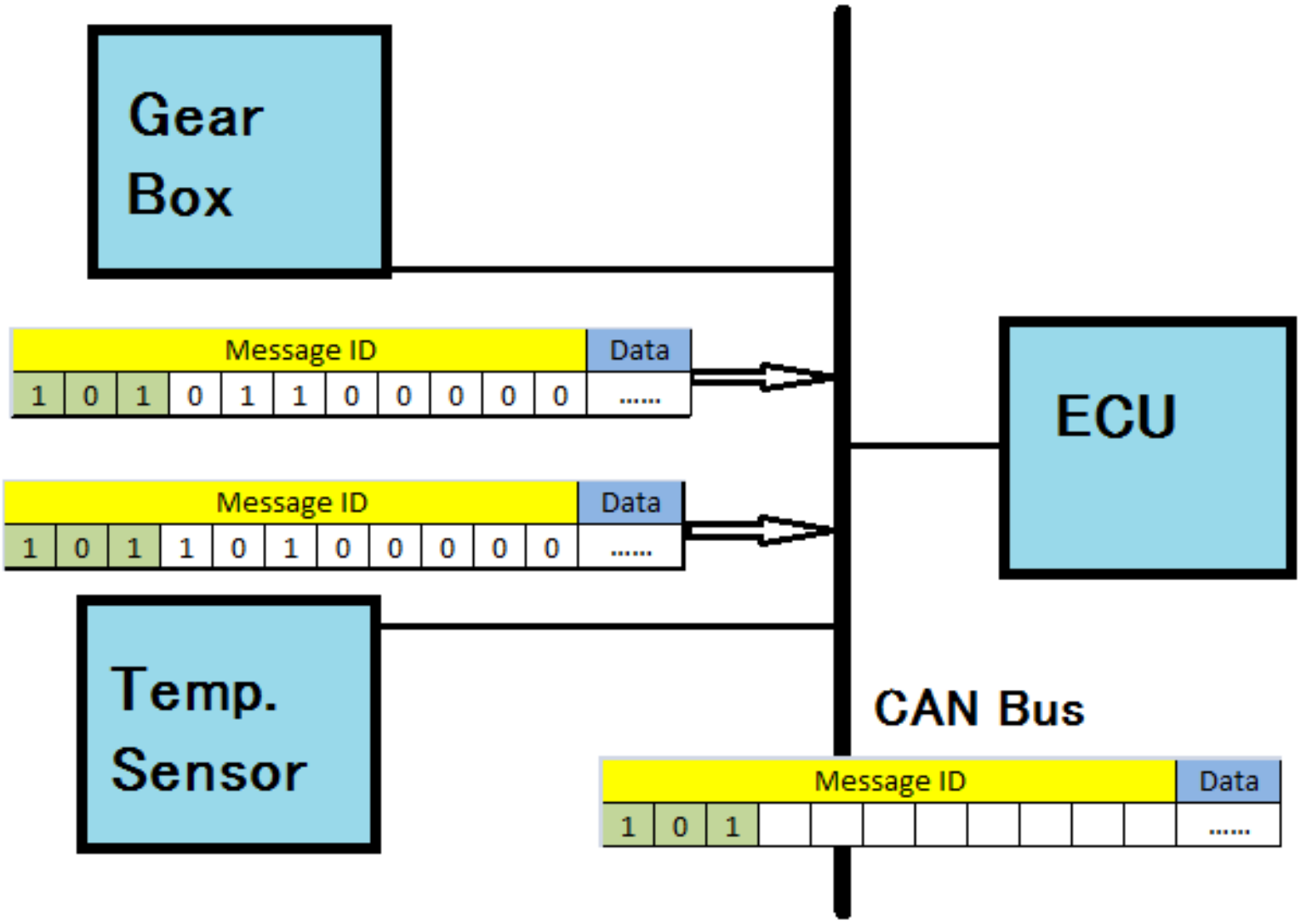
Data Transmission Example



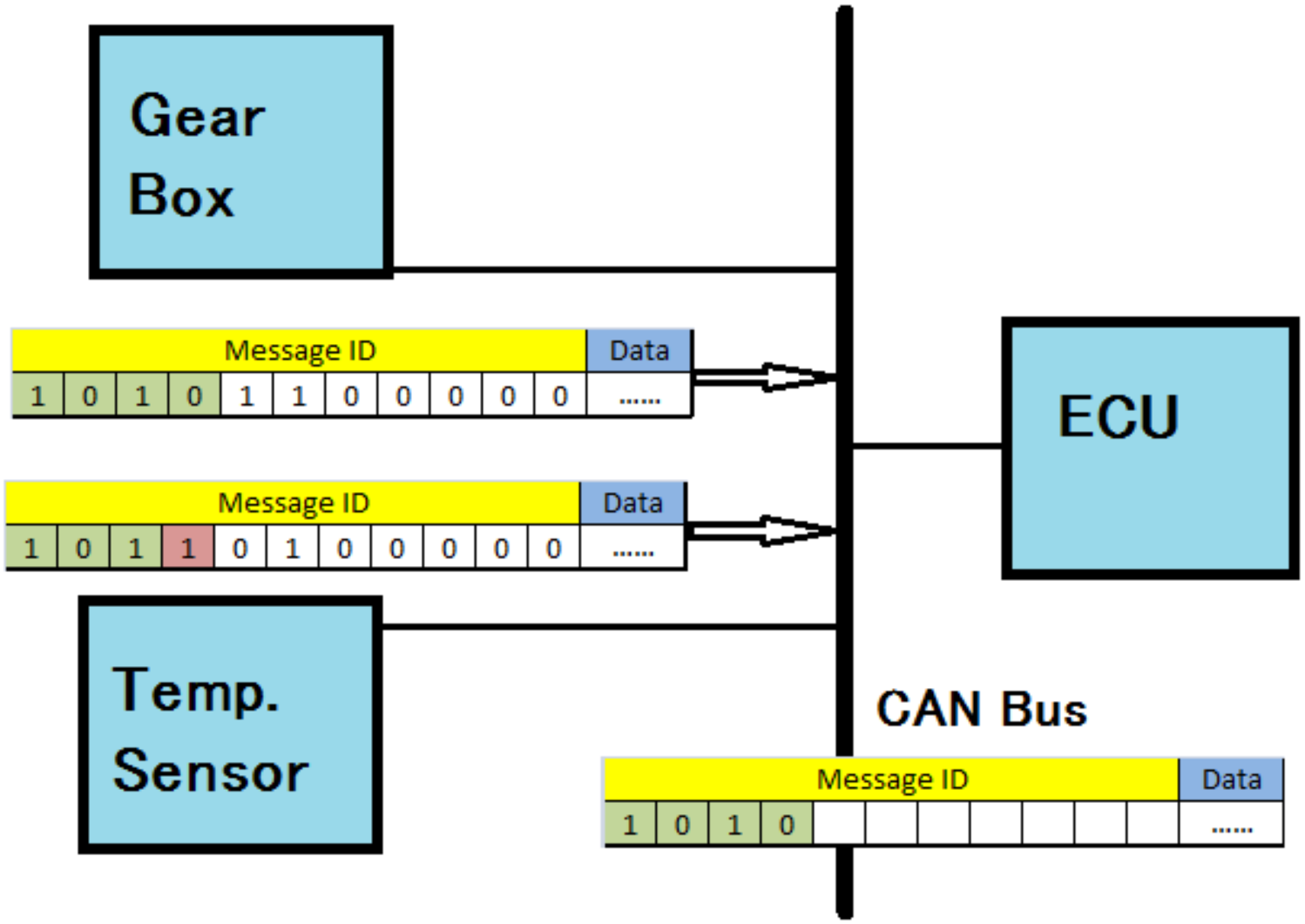
Data Transmission Example



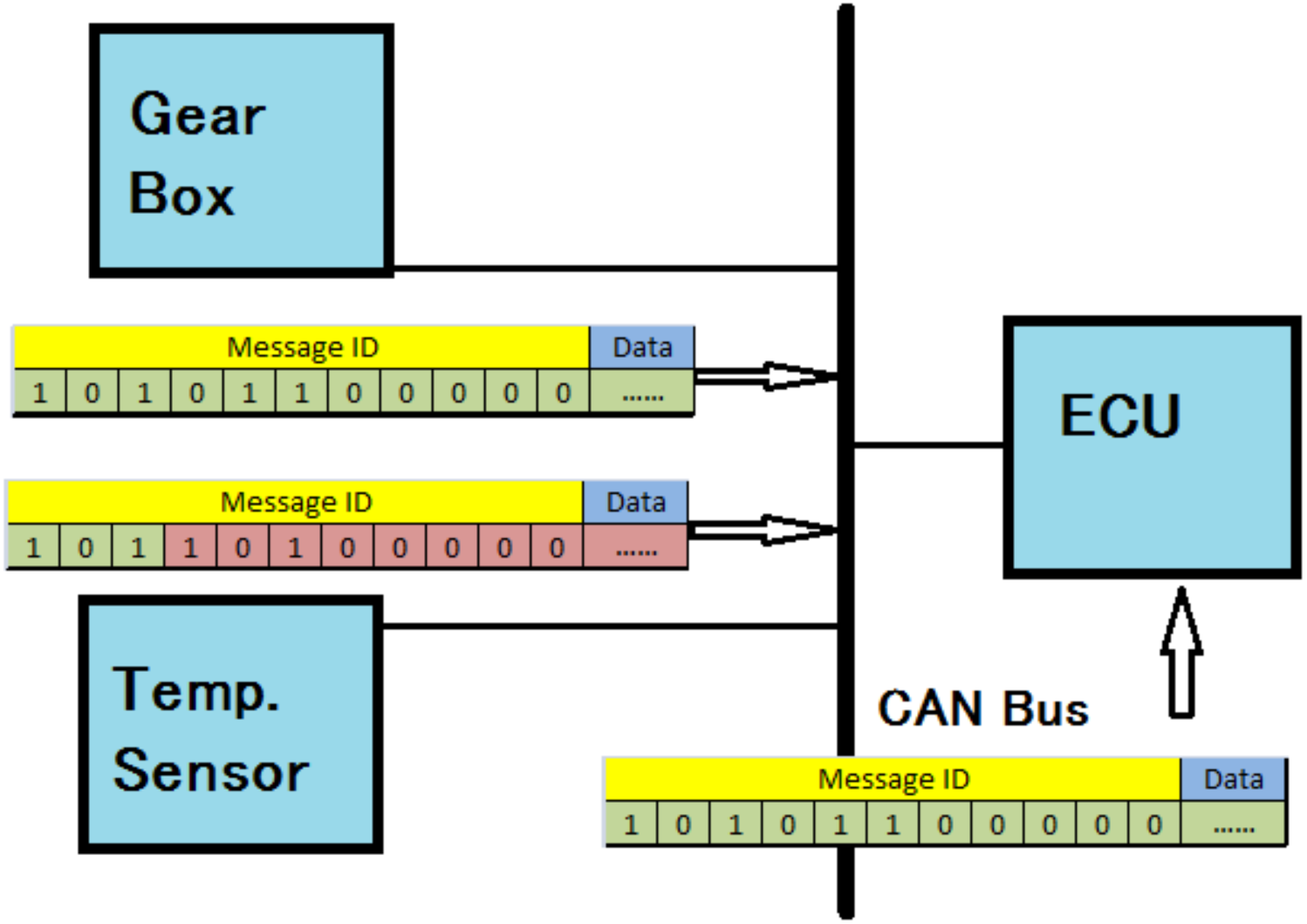
Data Transmission Example



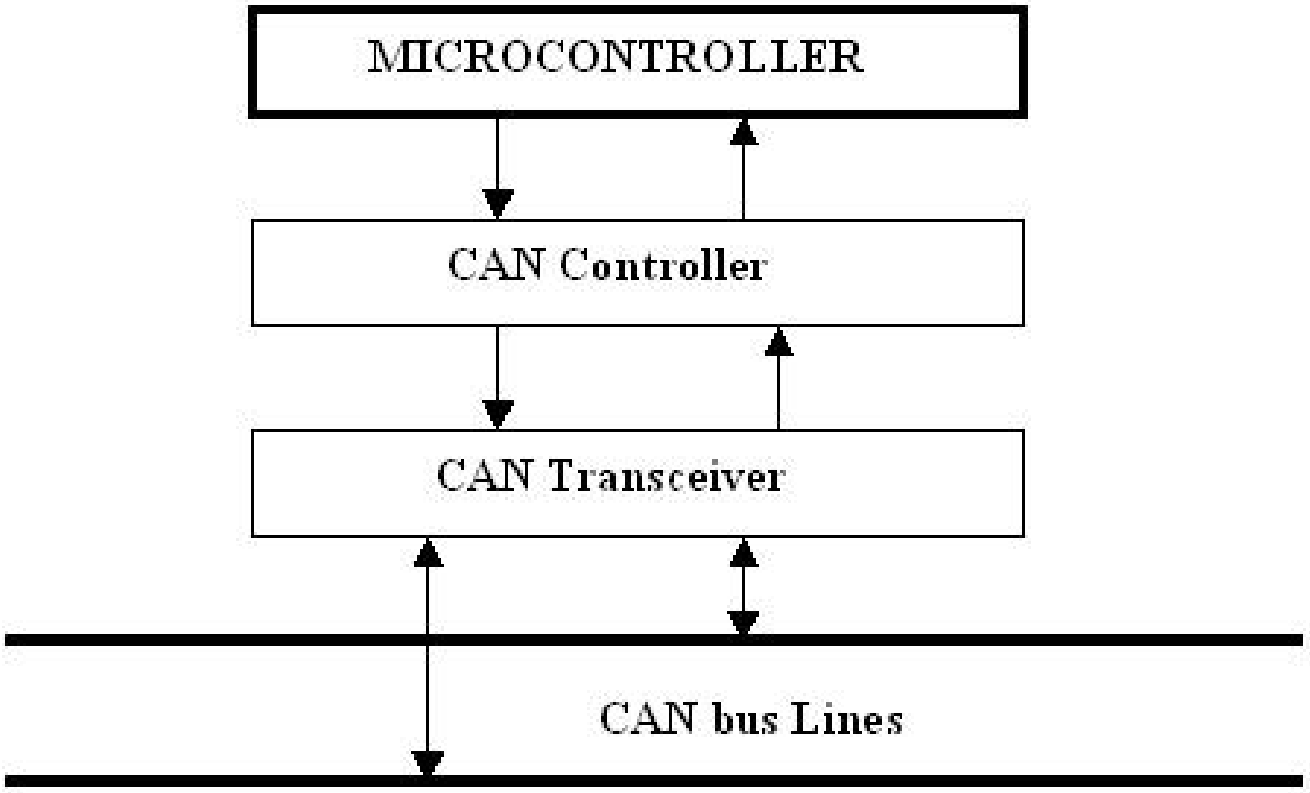
Data Transmission Example



Data Transmission Example



Physical Layers

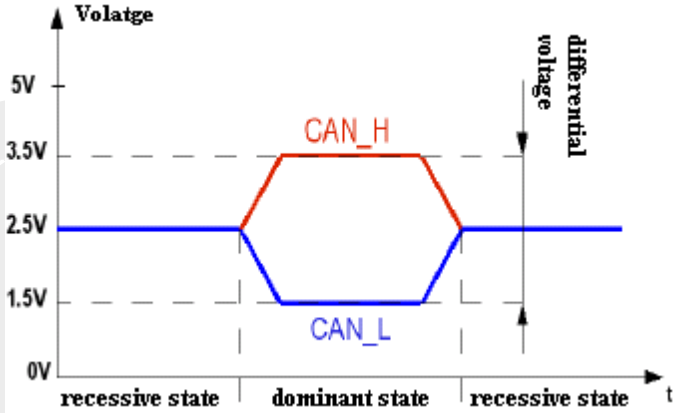


http://www.eeherald.com/section/design-guide/esmod9.html

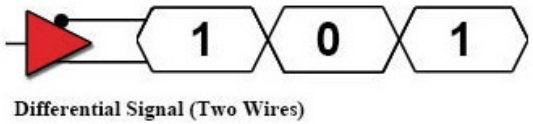
Special Features

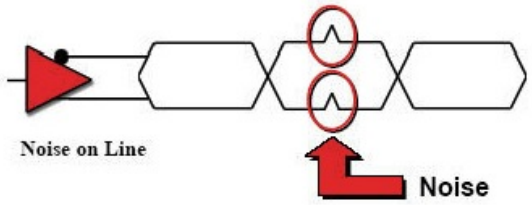
- CAN network
  - multi-master
  - nodes
    - each node can send/receive
    - differential signalling
      - noise cancelling

Differential Signalling



http://canbus.pl/images/iso11898-levels_en.png





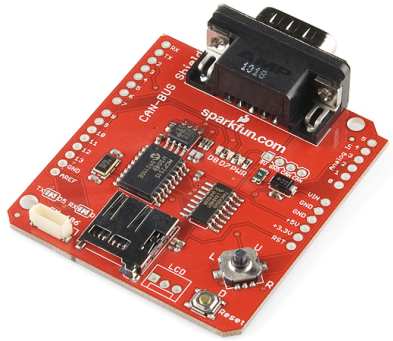
http://img.tomshardware.com/us/2004/11/29/the_tft_connection/differential-signal.jpg

CAN Physical Layers

- High Speed CAN
  - 2 wires and a transfer rate of up to 1 Mb/s (dependent upon wire length)
  - Most common physical layer
- Low-Speed/Fault-Tolerant CAN Hardware
  - 2 wires and a transfer rate of up to 125 kbit/s
  - Used in door wiring and in brake lights
- Single-Wire CAN Hardware
  - 1 wire and a transfer rate of up to 33 kbit/s
  - Used in comfort devices (mirrors, seats, etc.)
- Software-Selectable CAN Hardware
  - Can be configured to use any of the layers

Interfacing with the CAN bus

- Sparkfun Arduino Shield
  - Microchip MCP2515 CAN controller
  - MCP2551 CAN transceiver
  - interfaces with SPI to microcontroller
- Many other CAN interface chips
  - TI
  - Maxim
  - AMI semi



http://www.sparkfun.com/products/10039

Advantages

- reliability
  - differential signalling
- priority
  - easily prioritize messages
- low wire count
- node independence
  - can add / remove nodes
  - node breakdown doesn't bring down network

Disadvantages

- regulate wire length
  - particularly for high speeds
- requires termination
  - resistor

Questions?

References

http://en.wikipedia.org/wiki/CAN_bus
http://www.interfacebus.com/CAN-Bus-Description-Vendors-Canbus-Protocol.html
http://zone.ni.com/devzone/cda/tut/p/id/2732
http://www.canbuskit.com/what.php

End