

DEVICES AND COMMUNICATION BUSES FOR DEVICES NETWORK

Lesson-15: SERIAL BUS COMMUNICATION PROTOCOL— CAN

Serial Communication Distributed Control Area Network (CAN) Bus

Distributed Control Area Network
example - a network of embedded
systems in automobile

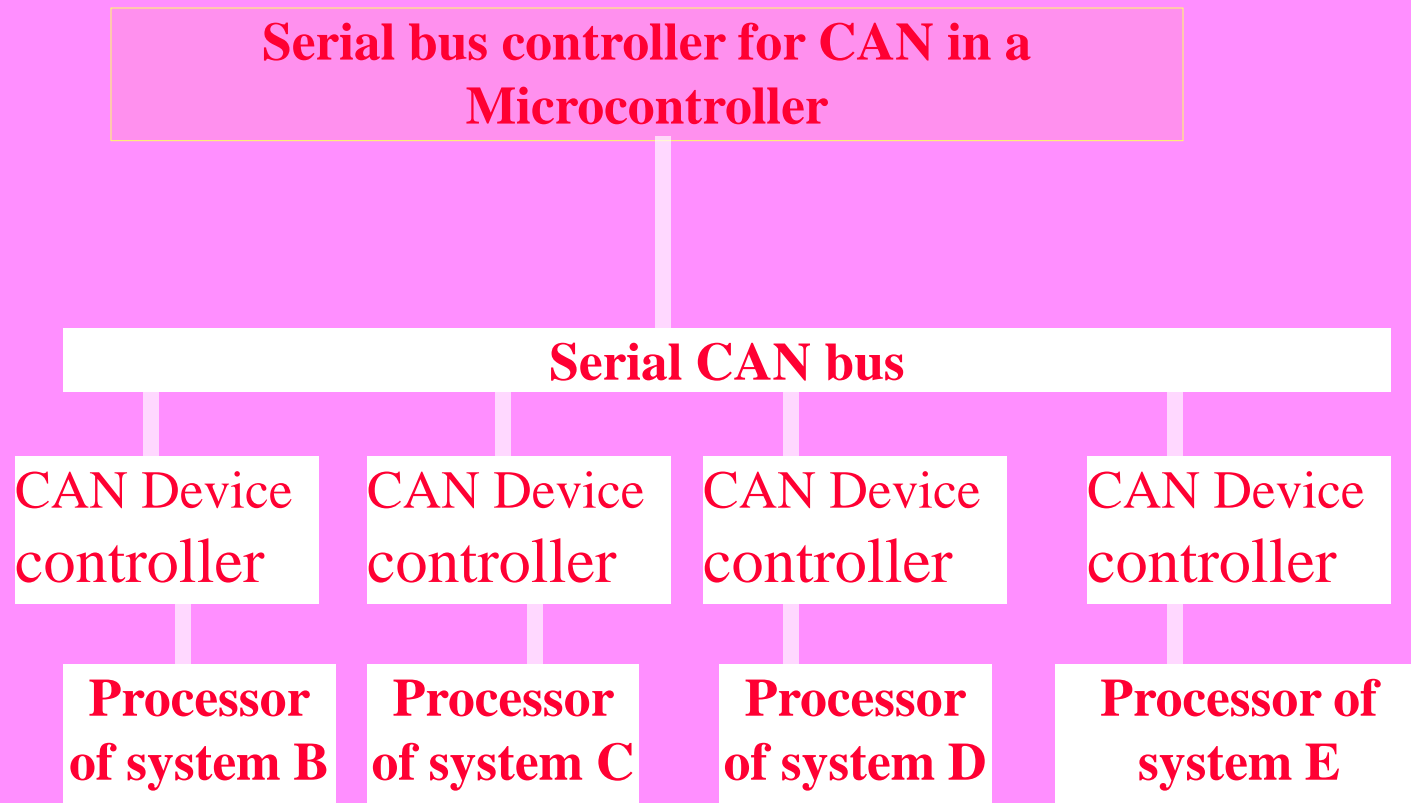
CAN Serial Bus Communication for networking

- CAN-bus line usually interconnects to a CAN controller between the line and host at the node
- CAN protocol for the input and output between the physical and data link layers at a host node

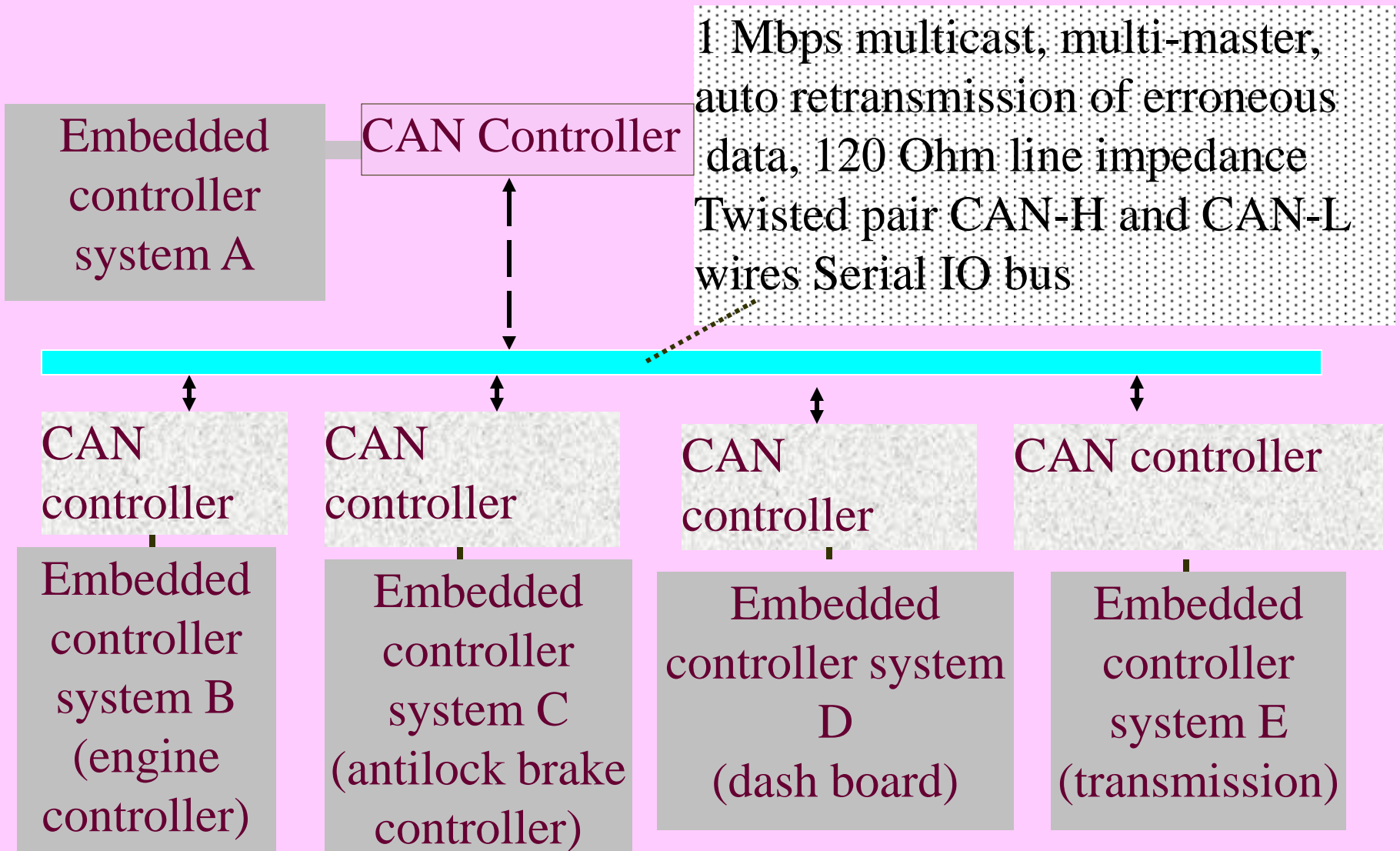
CAN Serial Bus Communication for networking

- The CAN controller has a BIU (bus interface unit consisting of buffer and driver), protocol controller, status-cum-control registers, receiver-buffer and message objects
- These connect the host node through the host interface circuit

Serial IO CAN bus



Serial IO CAN bus in automobile



Three standards:

- 33 kbps CAN,
- 110 kbps Fault Tolerant CAN,
- 1 Mbps High Speed CAN

CAN protocol

A CAN controller between the CAN line and the host node.

- CAN controller —BIU (Bus Interface Unit) consisting of a buffer and driver
- Method for arbitration— CSMA/AMP (Carrier Sense Multiple Access with Arbitration on Message Priority basis)

Each Distributed Node Uses:

- Twisted Pair Connection up to 40 m – for bi-directional data
- Line, which pulls to Logic 1 through a resistor between the line and + 4.5V to +12V. :
- Line Idle state Logic 1 (Recessive state)

Each Distributed Node:

- Uses a buffer gate between an input pin and the CAN line
- Detects Input Presence at the CAN line pulled down to dominant (active) state logic 0 (ground ~ 0V) by a sender to the CAN line

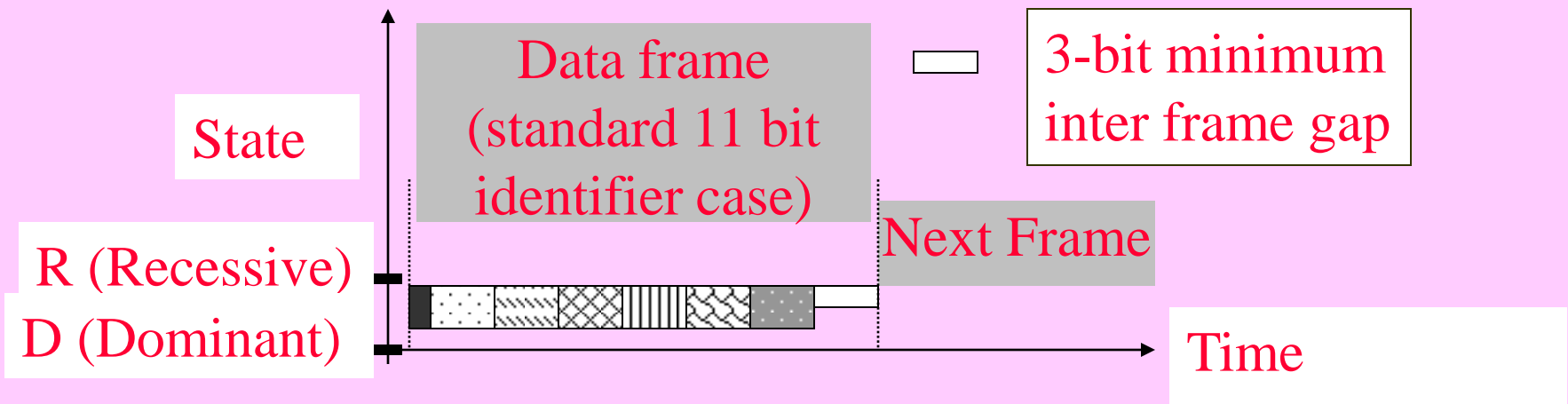
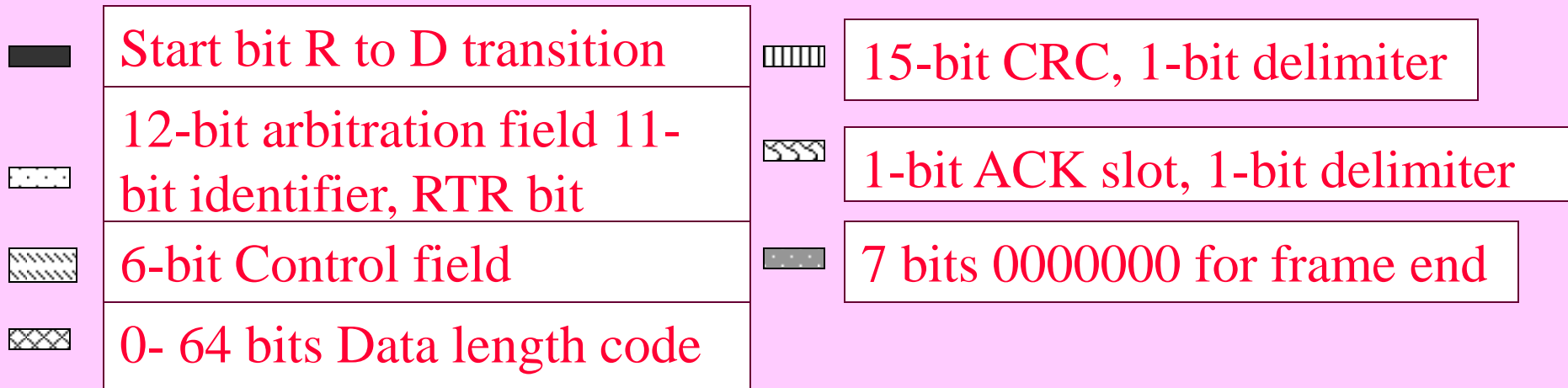
Each Distributed Node:

- Uses a current driver between the output pin and CAN line and pulls line down to dominant (active) state logic 0 (ground ~ 0V) when sending to the CAN line

Protocol defined start bit followed by six fields of frame bits

- Data frame starts after first detecting that dominant state is not present at the CAN line with logic 1 (R state) to 0 (D state transition) for one serial bit interval
- After start bit, six fields starting from arbitration field and ends with seven logic 0s end-field
- 3-bit minimum inter frame gap before next start bit (R→D transition) occurs

CAN Protocol defined frame bits



Protocol defined First field in frame bits

- First field of 12 bits —'arbitration field.
- 11-bit destination address and RTR bit (Remote Transmission Request)
- Destination device address specified in an 11-bit sub-field and whether the data byte being sent is a data for the device or a request to the device in 1-bit sub-field.
- Maximum 2^{11} devices can connect a CAN controller in case of 11-bit address field standard

11-bit address standard CAN

- Identifies the device to which data is being sent or request is being made.
- When RTR bit is at '1', it means this packet is for the device at destination address. If this bit is at '0' (dominant state) it means, this packet is a request for the data from the device.

Protocol defined frame bits Second field

- Second field of 6 bits— control field. The first bit is for the identifier's extension.
- The second bit is always '1'.
- The last 4 bits specify code for data length

Protocol defined frame bits Third field

- Third field of 0 to 64 bits— Its length depends on the data length code in the control field.

Protocol defined frame bits Fourth field

- Fourth field (third if data field has no bit present) of 16 bits— CRC (Cyclic Redundancy Check) bits.
- The receiver node uses it to detect the errors, if any, during the transmission

Protocol defined frame bits Fifth field

- Fifth field of 2 bits— First bit 'ACK slot'
- ACK = '1' and receiver sends back '0' in this slot when the receiver detects an error in the reception.
- Sender after sensing '0' in the ACK slot, generally retransmits the data frame.

Protocol defined frame bits Fifth field

- Second bit 'ACK delimiter' bit. It signals the end of ACK field.
- If the transmitting node does not receive any acknowledgement of data frame within a specified time slot, it should retransmit.

Protocol defined frame bits Sixth field

- **Sixth field of 7-bits** — end- of- the- frame specification and has seven '0's

Summary

We learnt

- CAN serial bus for interconnecting a central control network.
- Widely used in automobiles.
- Fields for bus arbitration bits, control bits for address and data length, data bits, CRC check bits, acknowledgement bits and ending bits.

End of Lesson 15 of Chapter 5
on
Serial Bus Communication Protocol-
CAN