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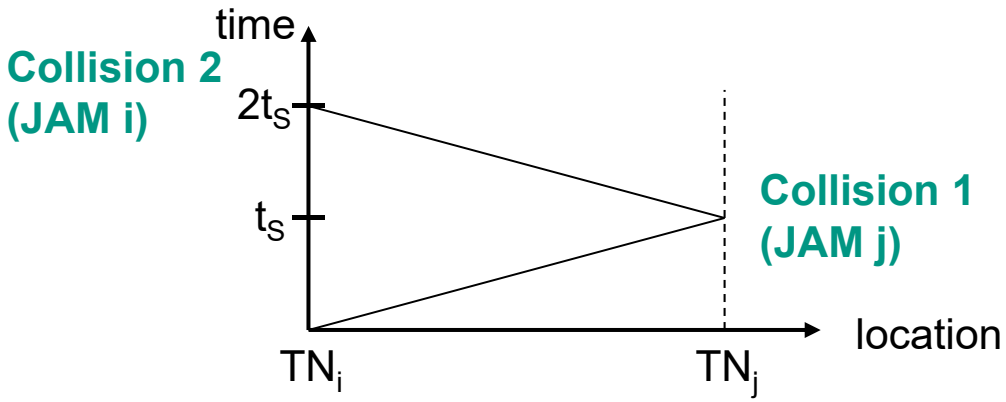
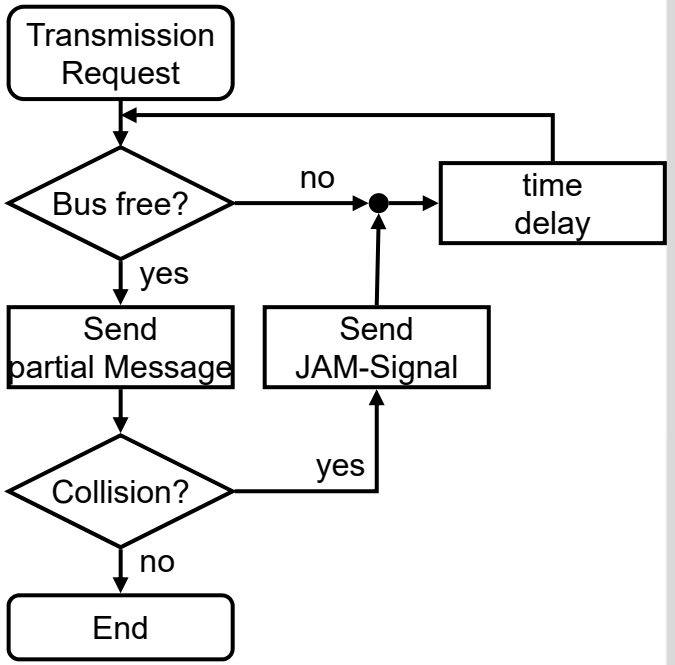
Communication Systems and Protocols

Exercise 3

CSMA/CD (CD = Collision Detect)

- Direct detection of collisions
- Sender is always reading the channel and checks if the signal sent is identical to the one being read.
  - Fast detection if a collision has occurred
- Sender detects a collision:
  - Transmission of a JAM signal, transmission is ceased
  - Node that is transmitting simultaneously is detecting the JAM signal and ceases its transmission as well
- Receivers will discard data as soon as JAM signal occurs
- Collision is detected after a maximal propagation time t_S
  - Minimal packet length: 2 t_S, maximum wire length must be defined.

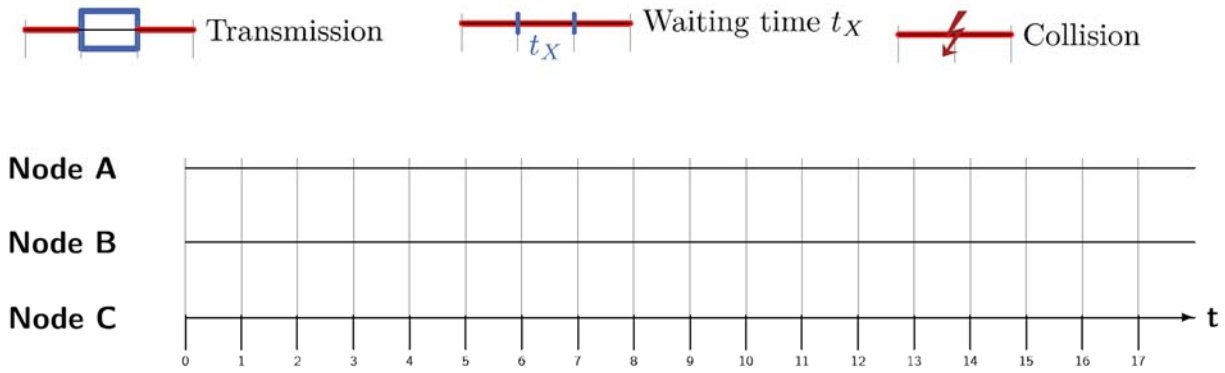




Properties of CSMA/CD

- Easy to be extended, no configuration needed
- Data destruction possible
- Need to discard already sent data after collision has occurred
- Bad channel utilization
  - Rule of thumb: 30%-70%
- No guaranteed Real-Time Capability

Task 1: CSMA/CD



Time remaining ‘10

CSMA/CA (CA = Collision Avoidance)

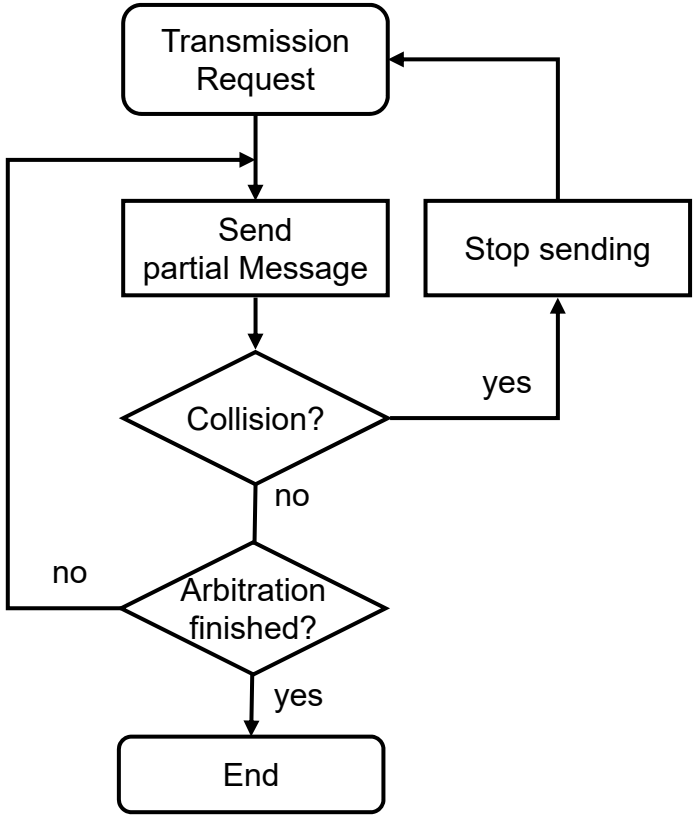
- Avoidance of collisions by priority controlled bus arbitration.
- Every node is assigned an identifier (ID) that equals its priority.

- After completing a transmission on the bus, all nodes with a transmission request start to send their ID. All nodes are connected via wired-OR or via wired-AND respectively.
  - wired-OR: „1“ dominant, „0“ recessive
  - wired-AND: „0“ dominant, „1“ recessive

- A transmission starts with the most significant bit (MSB).
  - Each sender monitors the bus level during each bit being send
  - As soon as the bit currently being read from the bus is not identical with the bit send by the node, the node retreats and retries the transmission later.

Arbitration process for CSMA/CA

- Requirements
  - Unique ID per message/node
  - All nodes start arbitration at the same time
  - Bitwise arbitration
  - Bit is long enough, so that all nodes can read it
- Procedure
  - Send arbitration ID bit per bit
  - If data on bus is the same as sending data → continue arbitration
  - If data is different → arbitration lost, withdraw from bus



Properties of CSMA/CA

- No data destruction
- No need to discard already sent data
- 100% channel utilization is possible
- Limited length of bus and/or transmission rate
- Very limited Real-Time Capability
  - If the packet length is finite, the node with the highest priority can adhere to real-time constraints.
  - Bus can be blocked if node with highest priority is constantly transmitting.
    - In general each node has to wait after a transmission for a predefined time before transmitting a new message.
  - Other nodes can adhere to real-time constraints as well if waiting time is long enough.

Task 2: CSMA/CA

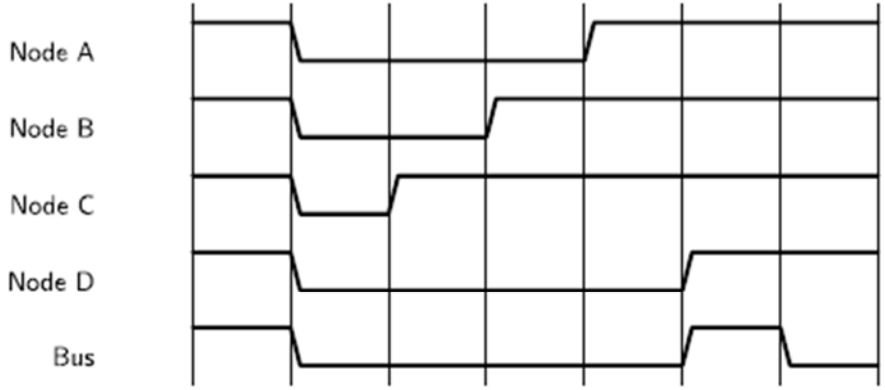


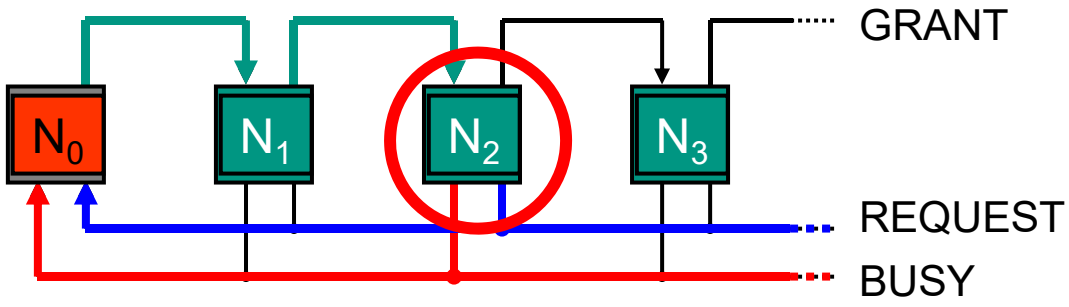
Figure 3.3: Bus Access

Node	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4
A					
B					
C					
D					

Time remaining ‘10

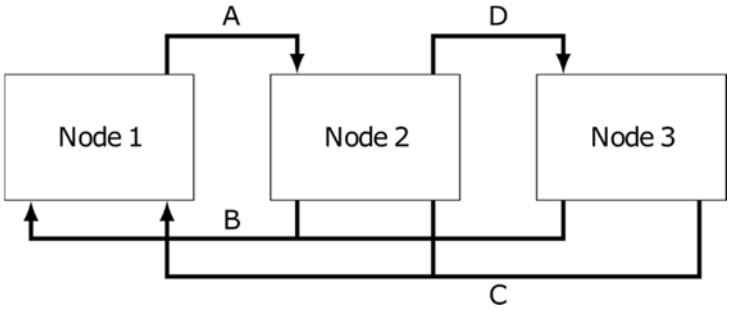
Daisy-Chain

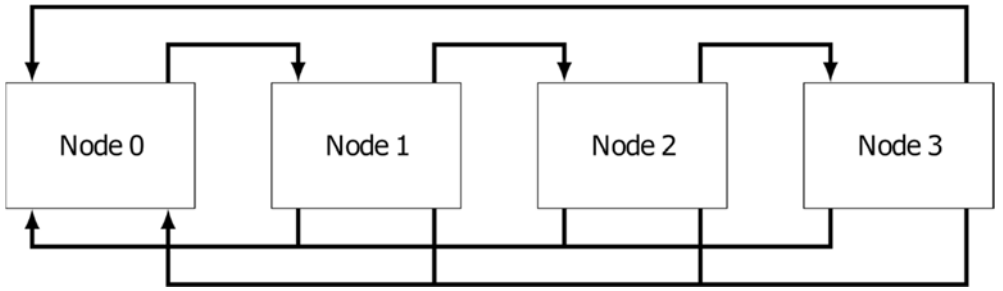
- Example:



- N_2 has a transmit request (wants to send data)
- N_2 activates *REQUEST*-line
- Arbiter N_0 asserts *GRANT*-signal
- N_1 has no data to send and passes *GRANT*-signal
- N_2 asserts *BUSY*-signal, removes *REQUEST* and takes control of the bus
- N_2 de-asserts *BUSY*-signal thus freeing the bus for other transmissions

Task 3: Arbitration





Time remaining ‘10