



# COMPUTER COMMUNICATION NETWORK

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## Multiple access link and protocol

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### Access Links

- Two types of network links:
  - ❖ point-to-point links
  - ❖ broadcast links
- A point-to-point link consists of a single sender at one end of the link and a single receiver at the other end of the link
- A broadcast link, can have multiple sending and receiving nodes all connected to the same, single, shared broadcast channel.
- The term broadcast is used because when any one node transmits a frame, each of the other nodes receives a copy

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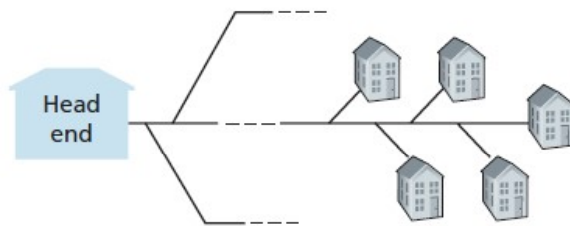


- How to coordinate the access of multiple sending and receiving nodes to a shared broadcast channel—the multiple access problem
- When more than two nodes transmit frames at the same time, the transmitted frames collide at all of the receivers
- Clearly, if many nodes want to transmit frames frequently, and much of the bandwidth of the broadcast channel will be wasted
- In order to ensure that the broadcast channel performs useful work when multiple nodes are active, we need multiple access protocols

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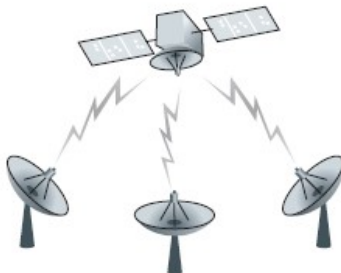
Shared wire  
(for example, cable access network)



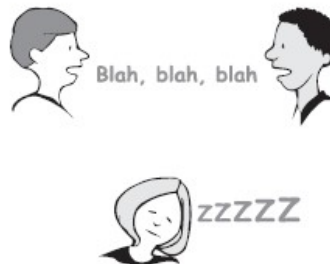
Shared wireless  
(for example, WiFi)



Satellite



Cocktail party



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### Access methods

- Access methods depends on network topology
- Access methods depends on presence of central controller
- Access methods can be classified as
  - ❖ Guaranteed access
  - ❖ Random access
- Criteria for evaluating access methods
  - ❖ Amount of message overhead
  - ❖ Algorithmic complexity
  - ❖ Total access delay
  - ❖ Link utilization (or throughput)

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### Types of access methods

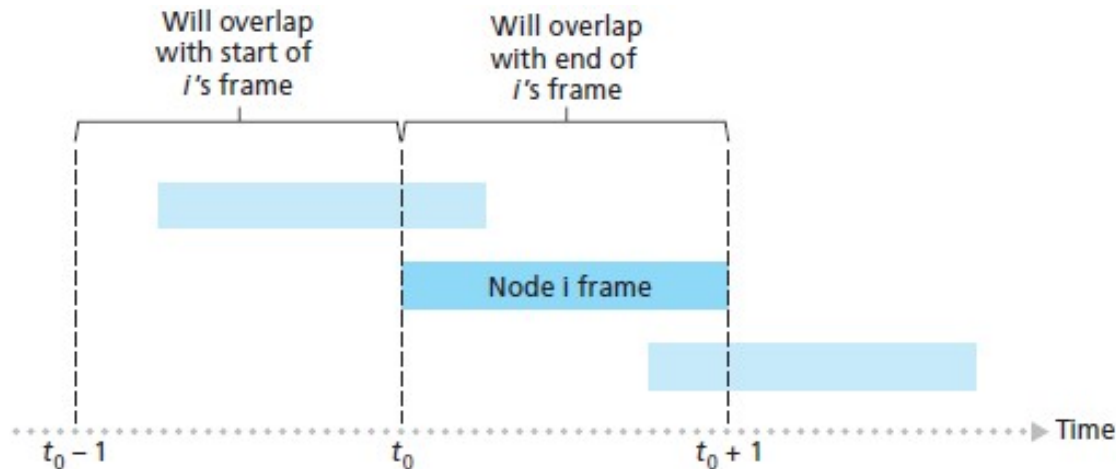
- Guaranteed access
  - ❖ Time division multiplexing
  - ❖ Frequency division multiplexing
  - ❖ Code division multiplexing
  - ❖ Space division multiplexing
  - ❖ Orthogonal frequency division multiplexing
  - ❖ Polling methods
- Random access techniques
  - ❖ Pure Aloha, Slotted Aloha
  - ❖ CSMA/CD and CSMA/CA
  - ❖ IEEE 802.3, IEEE 802.11, IEEE 802.15, IEEE 802.16 protocols

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### Pure ALOHA

- Immediately transmit when a packet is generated
- Users randomly wait before retransmission
- Waiting time is an integral multiple of the transmission delay
- How is the performance?



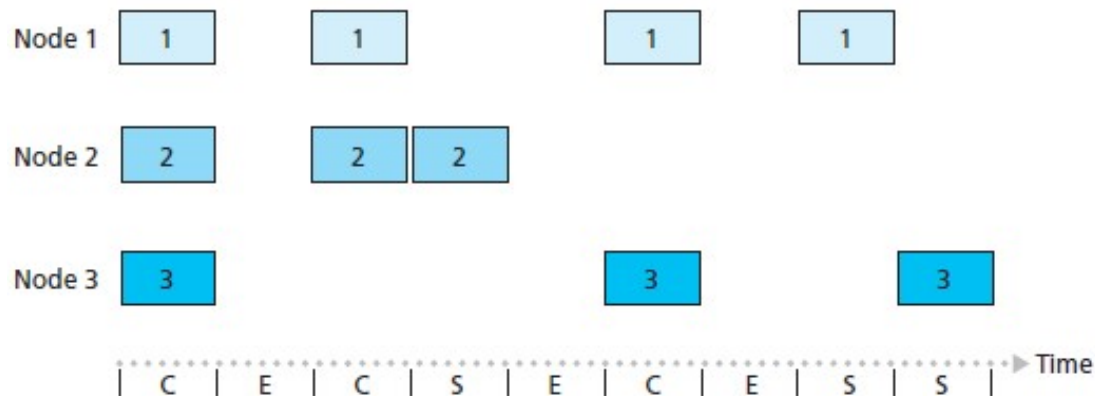


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### Slotted ALOHA

- Time is divided into equal length slots
  - ❖ Slot length equals transmission delay
- Users can transmit at the start of a slot
- If collision occurs then retransmit with probability  $p$  in the subsequent slots



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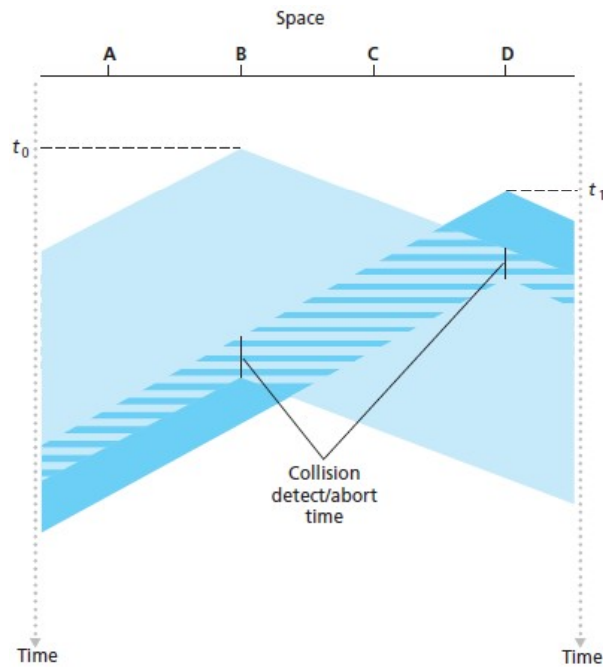
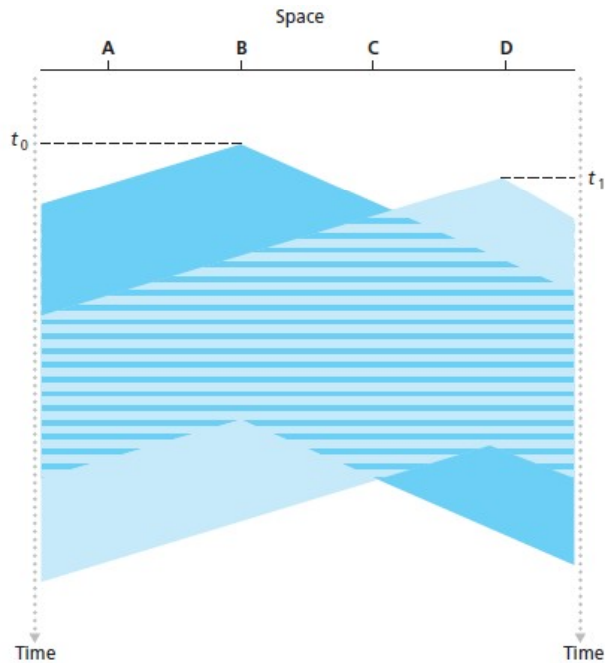
### CSMA/CD

- Listen before talking increases efficiency than ALOHA
- A sender listens to channel for busy/idle status
- Sends the frame if channel is sensed idle
- If collisions are heard during transmission, then the transmission is aborted
- A retransmission occurs after channel is sensed idle and a random waiting time elapsed
- The waiting time is chosen by first picking a random value (say  $x$ ) from  $\{0, \dots, 2^n - 1\}$  and then multiplying the random number  $x$  with  $W$ 
  - ❖ Here  $n$  is the collision round
- In Ethernet,  $W = 512$  bit times (approximately  $0.01\mu\text{s}$  for 100Mbps)

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### CSMA versus CSMA/CD



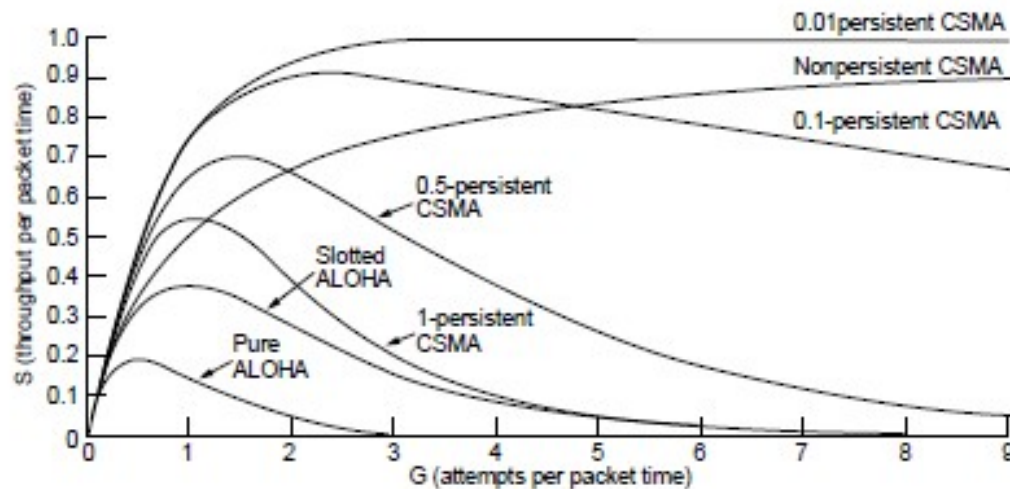
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### CSMA/CD efficiency

- As  $d_{\text{trans}}$  increases, the efficiency approaches 1
- As  $d_{\text{prop}}$  decreases, the efficiency approaches 1

$$\text{Efficiency} = \frac{1}{1 + 5d_{\text{prop}}/d_{\text{trans}}}$$





**THANK YOU**

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