



### Characteristics of Some High-Speed LANs

	Fast Ethernet	Gigabit Ethernet	Fibre Channel	Wireless LAN
Data Rate	100 Mbps	1 Gbps, 10 Gbps, 100 Gbps	100 Mbps - 3.2 Gbps	1 Mbps - 54 Mbps
Transmission Media	UTP, STP, optical fiber	UTP, shielded cable, optical fiber	Optical fiber, coaxial cable, STP	2.4-GHz, 5-GHz microwave
Access Method	CSMA/CD	Switched	Switched	CSMA/Polling
Supporting Standard	IEEE 802.3	IEEE 802.3	Fibre Channel Association	IEEE 802.11
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## Ethernet (CSMA/CD)

- Medium access control: Carrier Sense Multiple Access with Collision Detection
- Xerox Ethernet
- IEEE 802.3





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### **Slotted ALOHA**

- Time in uniform slots equal to frame transmission time.
- Need central clock (or other sync mechanism).
- Transmission begins at slot boundary.
- Frames either miss or overlap totally.
- Max utilization 37%.

#### CSMA

- Propagation time is much less than transmission time.
  All stations know that a transmission has started almost immediately.
- First listen for clear medium ("carrier sense").
- If medium idle, transmit.
- If two stations start at the same instant, collision.
- Wait reasonable time (round trip plus ACK contention).
- No ACK then retransmit.

### **CSMA (2)**

- Utilization far exceeds ALOHA.
- Max utilization depends on propagation time (medium length) and frame length.
  - Longer frame and shorter propagation gives better utilization.
- First listen for clear medium ("carrier sense").
- If medium idle, transmit.
- If medium is busy, wait for idle then transmit. — This is called 1-persistent CSMA. Stations are selfish.
- If two or more stations waiting, collision guaranteed.
  - Gets sorted out after collision.



#### **p-persistent CSMA**

- Compromise that attempts to reduce collisions.
  Like nonpersistent
- And reduce idle time.
  - Like 1-persistent
- Rules:
- 1. If medium idle, transmit with probability p, and delay one time unit with probability (1 p).
  - Time unit typically maximum propagation delay.
- 2. If medium busy, listen until idle and repeat step 1.
- 3. If transmission is delayed one time unit, repeat step 1.
- What is an effective value of p?





- With CSMA, collision occupies medium for duration of transmission ⇒ capacity wasted.
- To reduce this waste, stations continue to listen to medium while transmitting.
- Use CSMA/CD (see next slide).
- Important rule: frames should be long enough to allow collision detection prior to the end of transmission.
  - Shorter frames: collision detection does not occur.

CSMA/CD performance same as CSMA.









- Attempt to transmit repeatedly if repeated collisions
- First 10 attempts, mean value of random delay doubled
- Value then remains the same for 6 further attempts
- After 16 unsuccessful attempts, station gives up and reports error
- As congestion increases, stations back off by larger amounts to reduce the probability of collision.
- 1-persistent algorithm with binary exponential backoff efficient over wide range of loads
  - Low loads, 1-persistence guarantees station can seize channel once idle

- High loads, at least as stable as other techniques
- Backoff algorithm gives last-in, first-out effect
  - Stations with no or few collisions transmit first







	10BASE5	10BASE2	10BASE-T	10BASE-FP
Transmission medium	Coaxial cable (50 ohm)	Coaxial cable (50 ohm)	Unshielded twisted pair	850-nm optical fiber pair
Signaling technique	Baseband (Manchester)	Baseband (Manchester)	Baseband (Manchester)	Manchester/on- off
Topology	Bus	Bus	Star	Star
Maximum segment length (m)	500	185	100	500
Nodes per segment	100	30	-	33
Cable diameter (mm)	10	5	0.4 to 0.6	62.5/125 µm

#### **High Speed Ethernet (16.2)**

- 100-Mbps (Fast Ethernet)
- Gigabit Ethernet
- 10-Gbps Ethernet
- 40-Gbps Ethernet
- 100-Gbps Ethernet

# Reading

- Chapter 16, Stallings' book
- Assigned reading: Section 16.2 High Speed Ethernet

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