

Ethernet network

Chapter 4

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IEEE 802 Standards

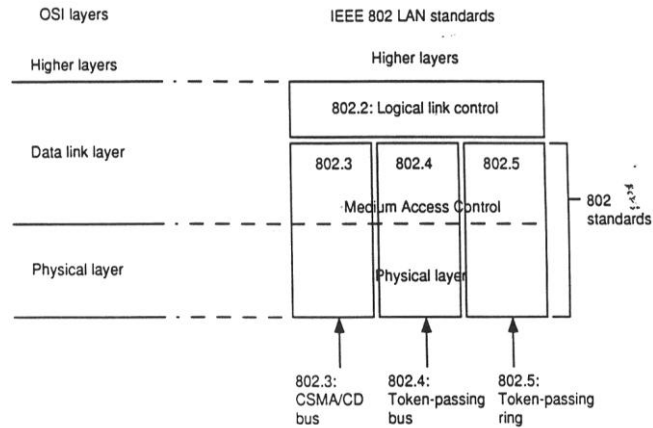
- 802 standards define:
 - Physical layer protocol
 - Data link layer protocol
 - Medium Access (MAC) Sublayer
 - Logical Link Control (LLC) Sublayer

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OSI Layers and IEEE 802



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Ethernet

■ Possible Topologies:

1. Bus

→ Branching non-rooted tree for large Ethernets

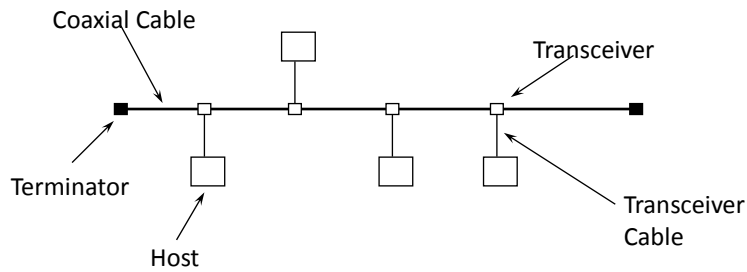
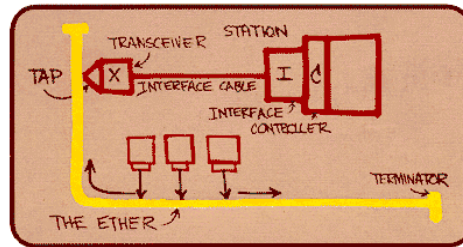
2. Star

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Minimal Bus Configuration

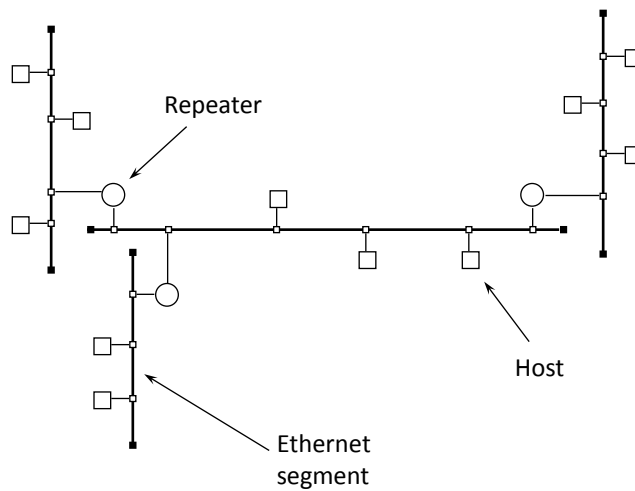


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Typical Large-Scale Configuration



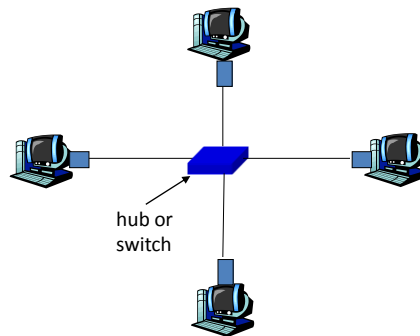
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Star topology

- Bus topology popular through mid 90s
- Now star topology prevails
- Connection choices: hub or switch

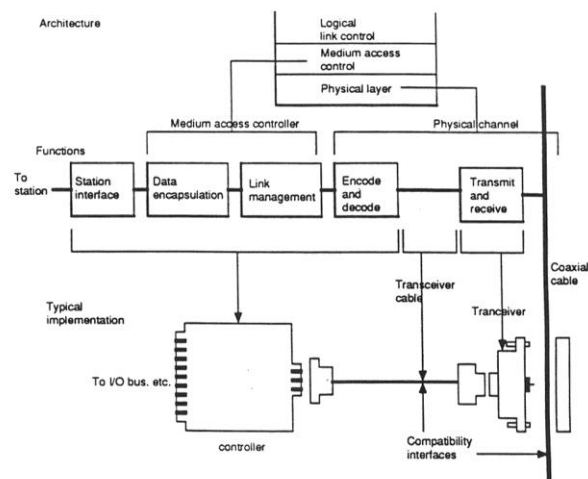


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Ethernet Configuration



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Unreliable, connectionless service

- **Connectionless:** No handshaking between sending and receiving adapter.
- **Unreliable:** receiving adapter doesn't send acks or nacks to sending adapter
 - stream of datagrams passed to network layer can have gaps
 - gaps will be filled if app is using TCP
 - otherwise, app will see the gaps

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Ethernet Synchronization

- 64-bit frame preamble used to synchronize reception
- 7 bytes of 10101010 followed by a byte containing 10101011
- Manchester encoded, the preamble appears like a sine wave

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Ethernet: MAC Layer

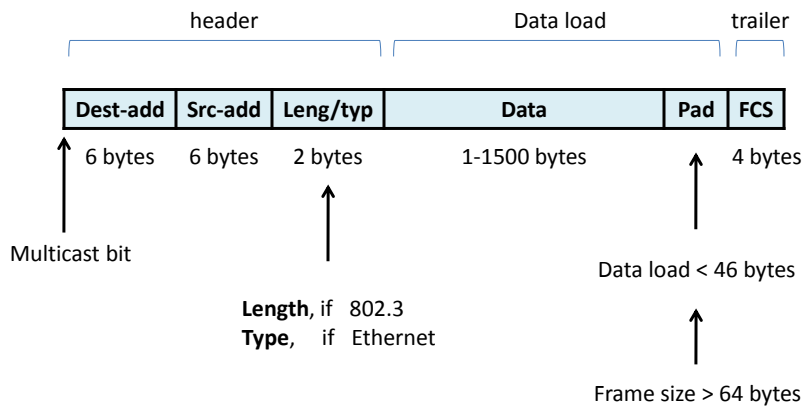
- Data encapsulation
 - Frame Format
 - Addressing
 - Error Detection
- Link Management
 - CSMA/CD
 - Backoff Algorithm

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MAC Layer Ethernet Frame Format



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Ethernet MAC Frame Address Field

- Destination and Source Addresses:
 - 6 bytes each (6a.23.b7.59.ec.8f)
- Two types of destination addresses
 - Physical address: Unique for each user
 - Multicast address: Group of users
 - First bit of address determines which type of address is being used
 - 0 = physical address
 - 1 = multicast address

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Ethernet MAC Frame Other Fields

- 2 bytes Field
 - determines length of data payload (802.3),
 - Determines type of protocol in network layer (Ethernet).
- Data Field: between 1 and 1500 bytes,
- Pad: Filled when data field < 46 bytes,
- Frame Check Sequence Field
 - 4 bytes
 - Cyclic Redundancy Check (CRC-32)

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CSMA/CD

- Recall:
 - CSMA/CD is a “carrier sense” protocol.
 - If channel is idle, transmit immediately,
 - If busy, wait until the channel becomes idle.
 - CSMA/CD can detect collisions.
 - Abort transmission immediately if there is a collision,
 - Try again later according to a backoff algorithm.

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CSMA/CD (*cont'd*)

- **Carrier Sense (CS)** reduces the number of collisions.
- **Collision Detection (CD)** reduces the impact of collisions.

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CSMA/CD principle

1. First listen for clear medium (Carrier Sense) 9.6 μ sec (IFG),
2. If medium idle, transmit
If two stations start at the same instant, collision
3. Wait listening for 51.2 μ sec (slot time) during transmission,
4. If collision detected, jam (4 bytes) then cease transmission,
5. After jam, wait random time (backoff) then start from step 1.

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Backoff algorithm

The backoff algorithm provides the time period after which the sender restart transmitting the same frame.

$$t = K * \text{slot time}$$

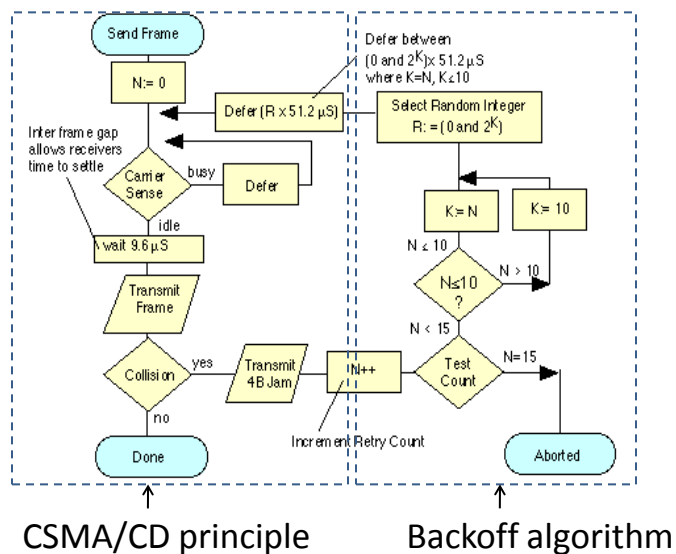
- slot time = 51.2 μ sec = 512 bit times at 10 Mbps,
- $K = \text{random from } \{0,1,2, \dots, 2^m-1\}$,
- where $m = \min(n,10)$ and
- n is the number of retransmission already achieved for this frame.

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CSMA/CD and backoff



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Binary Exponential Backoff (*cont'd*)

- In Ethernet,
 - Backoff algorithm will allow a maximum of 15 retransmission attempts
 - If 16 backoffs occur, the transmission of the frame is considered a failure.

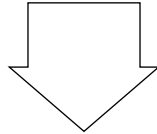
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Ethernet Features and Advantages

1. Passive interface: No active element
2. Broadcast: All users can listen
3. Distributed control: Each user makes own decision



Simple
Reliable
Easy to reconfigure

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Ethernet Disadvantages

- Lack of priority levels
- Cannot perform real-time communication
- Security issues

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