Data Communication

Data Link Layer Protocols

Standard Ethernet

Fast Ethernet

IEEE Standards

- The IEEE has standardized a number of local area networks and metropolitan area networks under the name of IEEE 802.
- These standards include:
  - IEEE 802.3 (Ethernet)
  - IEEE 802.11 (wireless LAN)
  - IEEE 802.15 (Bluetooth)
  - IEEE 802.16 (wireless MAN)

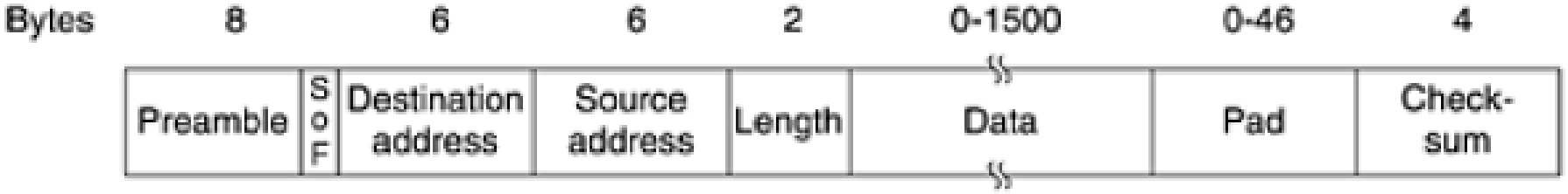
Ethernet

- Cabling

Name	Cable	Max. seg.	Nodes/seg.	Advantages
10Base5	Thick coax	500 m	100	Original cable; now obsolete
10Base2	Thin coax	185 m	30	No hub needed
10Base-T	Twisted pair	100 m	1024	Cheapest system
10Base-F	Fiber optics	2000 m	1024	Best between buildings

Ethernet

- Frame Layout



Ethernet

- Medium Access Control
  - Uses Manchester encoding
  - 1-persistent medium access
  - Carrier Sense Multiple Access with Collision Detection (CSMA/CD)
  - Max frame size = 1518 bytes
  - Min frame size = 64 bytes
  - Uses CRC32 for error detection

$$(x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^{8} + x^{7} + x^{5} + x^{4} + x^{2} + x + 1)$$

The Binary Exponential Backoff Algorithm

- The binary exponential backoff algorithm, was chosen to dynamically adapt to the number of stations trying to send.
- By having the randomization interval grow exponentially as more and more consecutive collisions occur, the algorithm ensures a low delay when only a few stations collide but also ensures that the collision is resolved in a reasonable interval when many stations collide.
- Truncating the backoff at 1023 keeps the bound from growing too large.

Fast Ethernet

- The work for a faster protocol was done by standards committees, and the result, 802.3u, was officially approved by IEEE in June 1995.
- Fast Ethernet data rate is 100Mbps compared to 10 Mbps of the standard Ethernet
- To avoid having collisions go undetected, the minimum frames size, or maximum segment size, or other protocol characteristics should be updated.

Fast Ethernet

- Cabling

Name	Cable	Max. segment	Advantages
100Base-T4	Twisted pair	100 m	Uses category 3 UTP
100Base-TX	Twisted pair	100 m	Full duplex at 100 Mbps (Cat 5 UTP)
100Base-FX	Fiber optics	2000 m	Full duplex at 100 Mbps; long runs

100 Base-T4

- 4 twisted pair cat. 3 cables are used, one is always to the hub, one is always from the hub, and the other two are switchable to the current transmission direction.
- In addition, ternary signals are sent, so that during a single clock period the wire can contain a 0, a 1, or a 2.
- Transmits 4 bits per signal

100 Base-T4

- Transmitting 4 bits in each of the 25 million clock cycles per second gives the necessary 100 Mbps.
- In addition, there is always a 33.3-Mbps reverse channel using the remaining twisted pair.
- This scheme is called 8B/6T encoding

100Base-TX

- Uses category 5 wiring.
- The design is simpler because the wires can handle clock rates of 125 MHz.
- Only two twisted pairs per station are used, one to the hub and one from it.
- Straight binary coding is not used; instead a scheme called 4B/5B is used

Interconnections

- Two kinds of interconnection devices are possible with 100Base-T: hubs and switches
- In a hub, all the incoming lines (or at least all the lines arriving at one plug-in card) are logically connected, forming a single collision domain.
- In a switch, each incoming frame is buffered on a plug-in line card and passed over a high-speed backplane from the source card to the destination card if need be.
- Hubs are not permitted with 100Base-FX.