CSIS 4222

Ch 13, 15: LAN Technologies
and Network Topology
Ethernet

Classification of Networks

Network technologies are classified into three broad categories

Local Area Network (LAN)
Metropolitan Area Network (MAN)
Wide Area Network (WAN)

LANs
late 1960s - early 1970s

Key ideas

- Reduce the number of connections by *sharing* connections among many computers
- Relatively low cost
- High throughput
- Limited to short distances

Network Topology

Topology is a mathematical term

- Specifies the general "shape" of a LAN
- Primarily refers to interconnections
- Hides details of actual devices

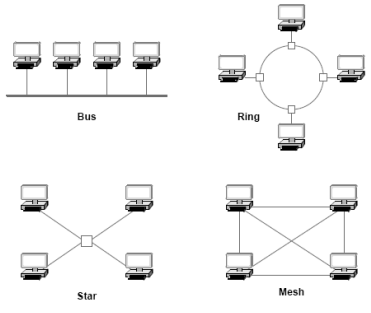
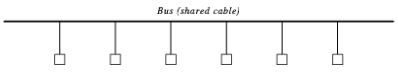


Figure 13.7 Four network topologies used with LANs.

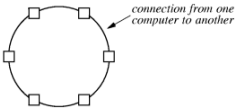
Bus Topology - single cable connects all computers

- Each computer has a connection to the shared cable
- Computers must synchronize and allow only one computer to transmit at a time

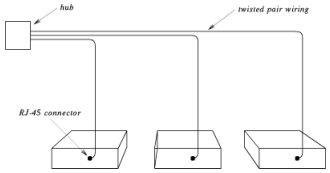


Ring Topology - computers connected in a closed loop

- Connections go directly from one computer to its neighbor
- Each needs a device to maintain ring integrity if computer is disconnected



Star Topology - all computers attached to a central point



Why Multiple Topologies?

Each has advantages and disadvantages:

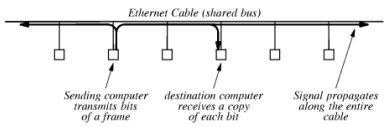
- Ring eases synchronization. May be disabled if any cable is cut
- Star easy to manage. More robust but requires more cables
- Bus requires fewer cables. May be disabled if cable is cut
- Mesh is fast but expensive. The number of connections needed grows faster than the number of computers

Ethernet

- Has been the most widely used LAN technology
  - Invented at Xerox PARC (Palo Alto Research Center) in 1970s
  - IEEE Standard 802.3 - defines formats, voltages, cable lengths, ...
- Bus topology
  - Originally a single coax cable - the *ether*
- One Ethernet cable is sometimes called a *segment*
  - Limited to 500 meters in length
  - Minimum separation between connections is 3 meters

Ethernet Operation

- Signal is a modulated carrier which propagates from transmitter in both directions along the length of a segment
- All stations receive transmission
- Only one station transmits at any time



Ethernet Wiring

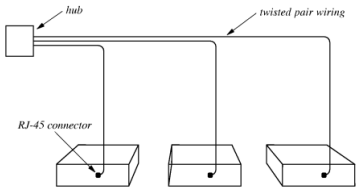
Three generations

- Thicknet
- Thinnet
- Twisted pair

All use the same frame format

10Base-T (Twisted Pair)

Uses twisted pair cable connected to a *hub*



Hub: Ethernet-in-a-box
In effect, a very short Ethernet with long connecting cables

Twisted Pair Ethernet and Speeds

Designation	Name	Data Rate	Cable Used
10BaseT	Twisted Pair Ethernet	10 Mbps	Category 5
100BaseT	Fast Ethernet	100 Mbps	Category 5E
1000BaseT	Gigabit Ethernet	1 Gbps	Category 6

Figure 15.8 Three types of twisted pair Ethernet, their data rates, and the cable used with each.

As the figure shows, the first version of twisted pair Ethernet was given the formal designation *10BaseT*.

Physical vs. Logical Topology

It looks like
- Original Ethernet uses bus topology
- Modern Ethernet uses star topology

In fact, modern Ethernet is
- Physical star
- Logical bus
- Called *star-shaped bus*

Ethernet Frame Format

An Ethernet frame consists of
- a fixed-length header
- a variable-length payload,
- a fixed-length CRC

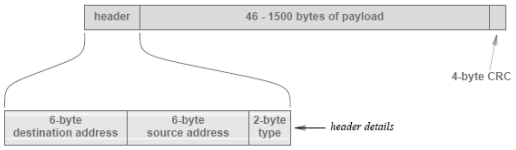
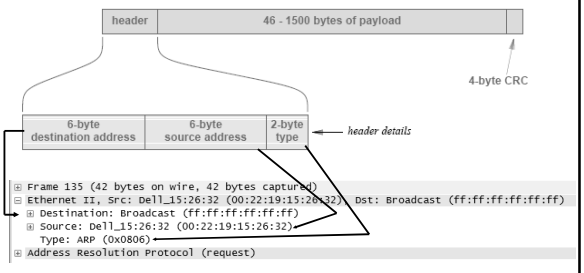
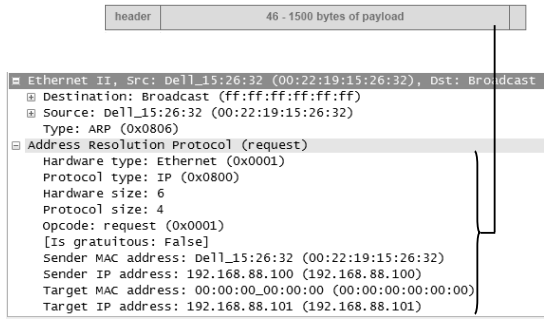


Figure 15.1 Illustration of the Ethernet frame format and header details.

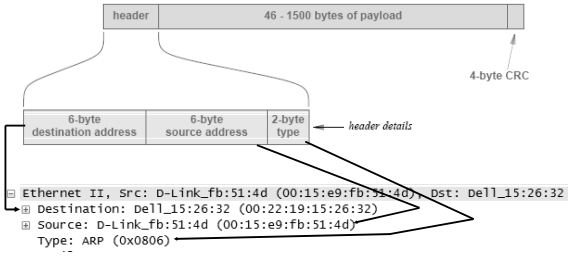
Ethernet Frame – ARP Request



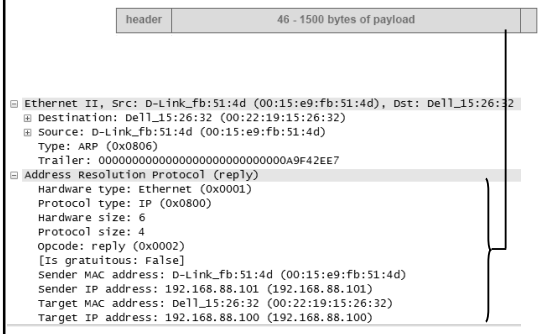
ARP Request Payload



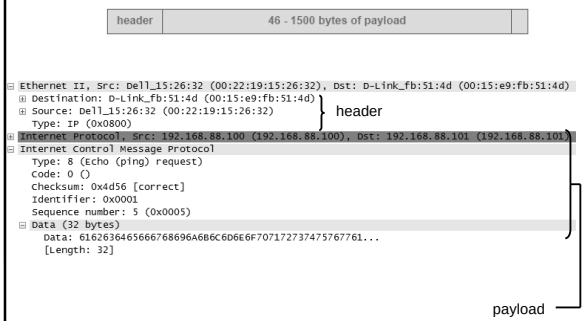
Ethernet Frame – ARP Reply



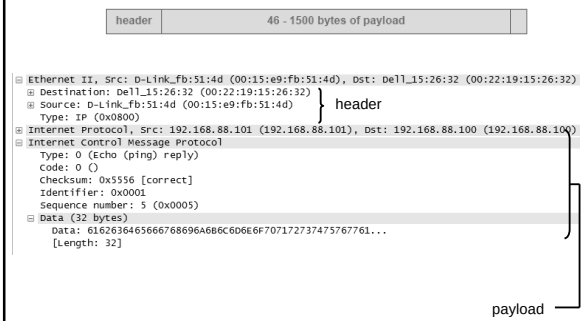
ARP Reply Payload



Ethernet Frame – ping Request



Ethernet Frame – ping Reply



Frame Identification, Demultiplexing, MAC Addresses

- Each frame on a shared medium is intended for a specific recipient
- Demultiplexing uses the unique Ethernet (MAC) address to identify the recipient

EtherType Field and Demultiplexing

- The type field in an Ethernet frame provides multiplexing and demultiplexing
- Protocols used on the Internet send IP datagrams and ARP messages over Ethernet
  - Each is assigned a unique Ethernet type (x0800 for IP datagrams and x0806 for ARP messages)

EtherType Field and Demultiplexing

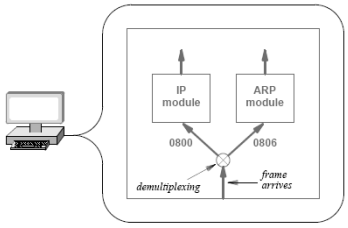


Figure 15.2 Illustration of using the frame type field for demultiplexing.