LIS565 Lecture 2

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Reading

Tanenbaum: chapter 3

comp.dcom.networks.ethernet FAQ, at ftp://rtfm.mit.edu/pub/faqs/LANs/ethernet-faq

Network+ certification guide

Comer chapter 1

Rich Seifert "The Switch Book", Wiley Computer Publishing 2000.

there is also a list of books at http://www.cnx.org/reading.htm

structure

- fundamentals about Ethernet
- clarification of some concepts

not enough structure

First, for an intro

What did Tanenbaum write on page 87?

Recall OSI reference model

- Physical
- Data Link
- Network
- ...

For broadcasting networks, there is an addition problem of allocation of the shared medium. This is solved in the medium access control MAC layer, a sublayer of the network layer. There are many protocol, this overview is partial

The access control problem

- Frequency Division Multiplexing
- ALOHA (not carrier sensitive), early 70s
- CSMA (carrier sensitive multiple access), 76
- CSMA/CD, with Collision detection

Ethernet

name from “luminiferous ether”

nowadays a generic term for any device that obeys a CSMA/CD protocol

initially referred only for IEEE 802.3 standard

IEEE 802.3

Standard based on work by XEROX, DEC and Intel

It is a whole family of standards that run on different physical media, which range from speeds of 1 Mb/s through 1000 Mb/s.

Design goals of IEEE 802.3

- simply defined topology
- efficient resource usage
- easy to reconfigure and maintain
- used by many manufacturers
- low cost

History

1980 Ethernet version 1

1982 Ethernet version 2

1983 Novell creates its own Ethernet imitation

1985 IEEE 802.3 completed

1990 twisted pair cabling added

CSMA/CD

- listen
- if no-one transmit, transmit
- if collision is recognized, stop transmitting
- wait for a random period of time, then start transmitting

Ethernet network topologies

- listen A bus topology is a networking architecture that is linear, usually by using one or more pieces of cable to form a single line, or bus. The signals sent by one station extend the length of this cable to be heard by other stations.
- A star topology is an architecture that includes a central device or hub to connect all stations together. Signals sent by a station must pass through (and are usually regenerated) by these central hubs. Since the hub sits in the center and all other stations are linked through the hub, the architecture resembles a star.

which one is better?

Physical layers: 10base–5

10BASE5 aka “thick Ethernet” is the original Ethernet backbone, Thick 50 ohm coax that was used as the physical medium. 10BASE5 is a bus topology that uses transceiver cables to attach stations to the central 10BASE5 cable.

Maximum segment length: 500 meters Maximum number of segments connected with repeaters: 5 (2500 meters) Maximum attachments per segment: 100 Minimum separation between attachments: 2.5 meters Propagation speed: 77c (231,000 km/sec)

Physical layers: 10base–2

10BASE2 aka “thin ethernet” is designed as a smaller and less expensive alternative to 10BASE5, and is sometimes referred to as Thinnet or Thin Ethernet because of the much smaller cables. 10BASE2 is also a bus topology, but each of the workstations use a 'T' BNC connector to connect workstations to the central bus.

Maximum segment length: 200 meters Maximum number of segments connected with repeaters: 5 (1000 meters) Maximum attachments per segment: 30 Minimum separation between attachments: .5 meters Propagation speed: .65c (195,000 km/sec)

Physical layers: 10base–T

10BASE–T provides Ethernet services over twisted pair copper wire. Uses R–45 jack.

It can be used for a star architecture only, because the maximum length of cable to hub about 100 to 150 meters.

Propagation speed: .59c (177,000 km/sec)

Very cheap.

Physical layers: others

- 10BASE–F is a set of optical fiber medium specifications which define connectivity between devices, expensive but noise immune. Can do bus and star

  Speed: 66c (198,000 km/sec)

- 100BASE–T is a series of specifications that provides 100 megabit speeds over copper or fiber. These topologies are often referred to as Fast Ethernet.

Question: how can the maximum delay on the network be determined?

The R–45 jack

Contact 1 Transmit +
Contact 2 Transmit -
Contact 3 Receive +
Contact 4 Not Used
Contact 5 Not Used
Contact 6 Receive -
Contact 7 Not Used
Contact 8 Not Used

When looking at the RJ–45 connector on the end of a cable (male) with the tab on the bottom and the contacts on the top, contact 8 is on the left and contact 1 is to the right.

The MAC address

A physical address burned onto each network interface card.

It is 6 bytes long, written in hex numbers 0..F. Thus 10 is A, 15 is F, 16 is 10 etc...

usually written with each byte separated by ":".

2 power 48 addresses, that is about 281000000000000, even if we take account that some addresses are reserved, we would have 12,000 machines on every desk of every person.

Or if industry were to produce 500 item the current level of NIC devices, it would need 2000 years to produce that many cards.

The Ethernet frame

preamble: 62 bits of alternating 0101...

start of frame: 10101011

destination: 6 bytes MAC address

source: 6 byte MAC address

source service access point: 1 byte

destination service access point: 1 byte

frame length: 2 bytes

data: 46 to 1500 bytes

frame check sequence: 4 bytes

within the Ethernet frame data

The lower protocol data unit has to hold the protocol data units of all the layers above.

For the TCP/IP protocol stack

- Inside the Ethernet frame we hold the IP data for the network layer. The PDU is called a packet
- Inside the the IP packet we hold the TCP data for the transport layer. The PDU is called a "segment".

draw diagram

Repeater and Hub

There is a lot of confusion about those intermediate devices between the cable that are not end-user workstations.

- A "repeater" is a device that amplifies an electric signal so that it can travel over some more wire.
- A "hub" is a repeater with a lot of outgoing wires. Hubs are dump, or smart. A smart hub can be inspected by a monitoring device to see what the traffic is doing there.
- A "bridge" or "switch" is a device that links different LANs together. In normal "promiscuous" mode, it receives signals from all LANs It will know which MAC address is on which LAN. and transmit echo signal to the right LAN.

If someone talks about a gateway, you do not know what (s)he is talking about, and chances are (s)he does not know either.