5

Ethernet (802.3) Switched LANs

# HOmework

Last Name:

First Name:

# Instructions

# Ethernet Begins

1. a) What IEEE committee creates LAN standards?

b) **What working group of this committee creates Ethernet standards**?

c) Are the terms *802.3* and *Ethernet* synonymous today?

# Introduction

Ethernet Local Area Networks

2. What is a local area network (LAN)?

Layer 1 and Layer 2 Standards

3. a) **At what two layers are Ethernet standards defined**?

b) Are Ethernet messages packets or frames?

c) Are Ethernet forwarding devices switches or routers?

d) **Is the path an Ethernet message takes from the source host to the destination host a physical link, a data link, or a route**?

e) **Does Ethernet use data link layer addresses or IP addresses**?

f) **What type of addresses does Ethernet use**?

g) Do vendors wait for Ethernet standards become OSI standards?

A Closer Look

4. **a) \_\_\_\_\_ switches connect users to the network**.

b) \_\_\_\_\_ switches connect switches to other switches.

c**) \_\_\_\_\_ links connect users to workgroup switches**.

d) \_\_\_\_\_ links connect switches to other switches.

e) Which needs more capacity—workgroup switches or core switches? Explain.

**f) Which needs higher speed—access links or trunk links? Explain**.

# Ethernet Physical Layer Standards

5. What three things do physical layer standards govern?

## Signaling

6. a) What must a sender do to send the bits of a frame over a transmission medium?

**b) Distinguish between binary and digital signaling**.

c**) if you wish to transmit 3 bits per clock cycle, how many states must the system have**?

d) **If you want to transmit 5 bits per clock cycle, how many states must the system have**?

e) **If you know that a system has 64 states, how many bits can it send per clock cycle**?

f) If **you know that a system has 256 states, how many bits can it send per clock cycle**?

g) **In general, to transmit twice as many bits per clock cycle, how much must you increase the number of alternatives? (The answer is not in the text**.)

Test Your Understanding

7. a) Why is binary transmission error-resistant?

**b) In Figure 5-6, by what percentage could the signal attenuate before it became unreadable**?

c) Compare error resistance in binary and digital signaling.

**d) If the binary transmission rate is 100 Mbps, how long will a clock cycle be? Express you answer as a fraction of a second**.

## UTP and Optical Fiber

8. a) How many wires are there in Ethernet cable?

**b) How is each pair organized**?

**c) What are the two names for connectors and jacks**?

d) How does Ethernet use parallel transmission?

e**) What is the benefit of parallel transmission**?

9. a) **How does fiber usually transmit a 1**?

b) How does fiber usually transmit a 0?

c) **What is full-duplex transmission, and how do fiber cords typically provide it**?

d) In what units are light waves measured?

e) What wavelength dominates in local area networking?

f) Why does this wavelength dominate?

g) What is amplitude?

## Transmission Distances

10. a) Compare UTP and fiber in terms of signal energy loss to the environment.

b) **Compare them for transmission distance**.

## Ethernet Signaling Standards, Media Quality Standards, and Maximum Transmission Distance

11. **a) For Ethernet, what organization creates standards for transmission media? Just give the abbreviation**.

b) **What organization creates signaling standards for transmission over these media**?

12. **a) If I wish to run Ethernet over UTP using 1000BASE-T signaling over a distance of 90 meters, what are my options**?

**b) If I wish to run Ethernet over UTP using 10GBASE-T signaling over a distance of 90 meters, what are my options**?

**c) If I wish to run Ethernet over UTP using 10GBASE-T signaling over a distance of 30 meters, what are my options**?

**d) If I wish to connect two switches with UTP at a speed of 2 Gbps, what options do I have**?

**e) Which should I choose? Justify your answer**.

Test Your Understanding

13. **a) If I wish to run Ethernet over fiber using 1000BASE-SX signaling over a distance of 500 meters, what are my options**?

**b) Which should I choose? Justify your answer**.

c**) If I wish to run Ethernet over fiber using 10GBASE-SR signaling over a distance of 250 meters, what options do I have**?

**d) Which should I choose? Justify your answer**.

**e) If I wish to run Ethernet over fiber using 10GBASE-SR signaling over a distance of 700 meters, what options do I have**?

**f) What is the farthest I can transmit a signal with 100GBASE-SR signaling**?

14. **a) If I wish to connect two switches with fiber at a speed of 30 Gbps, what options do I have**?

**b) Which would you choose? Justify your answer**.

15. **a) Who creates UTP and optical fiber cable standards**?

**b) What does the 802.3 Working Group add to these standards**?

c**) Is “Cat 6” an 802.3 standard or an ISO standard**?

d**) Is OM3 an 802.3 standard or an ISO standard**?

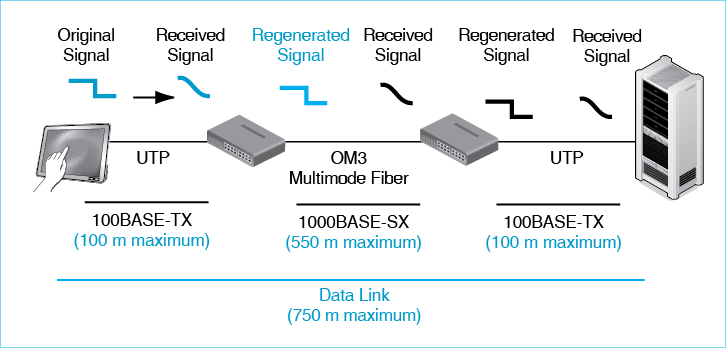
e**) Is 1000BASE-SX an Ethernet standard or an ISO standard**?

f) **At what layer is 1000BASE-SX a standard**?

# Ethernet Data Link Layer Standards

## Physical Link and Data Link Length Restrictions

Figure 5-17: Physical Links versus Data Links



16. a) **Were the maximum distances on UTP and optical fiber transmission in Figure 5-13 and Figure 5-14 limits for physical links or data links**?

b) **In Figure 5-17, what would the maximum data length be if both the physical link on the left and the physical length in the middle were changed to OM4 fiber**?

**c) If you need to span 600 meters at 1 Gbps, what options do you have? (Include the possibility of using an intermediate switch**.)

**d) How would you decide which option to choose**?

## Ethernet Data Link Layer Switch Operation

17. a) Do switches know the entire data link between the source and destination host?

b) What does a switch know?

18. a) How are switches in an Ethernet LAN organized?

b) Because of this organization, how many possible paths can there be between any two hosts?

**c) In Figure 5-2, what is the single possible path between Client PC 1 and Server X? Just give the letters of the switches**.

**d) Between Client PC 1 and Server Y? Just give the letters of the switches**.

19. **a) What is the benefit of having a single possible path through an Ethernet network**?

b) Why has Ethernet become the dominant LAN technology?

## The Ethernet Frame

Figure 5-20: Hexadecimal Notation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 4 Bits | Decimal (Base 10) | Hexadecimal (Base 16) |  | 4 Bits\* | Decimal (Base 10) | Hexadecimal (Base 16) |
| 0000 | 0 | 0 hex |  | 1000 | 8 | 8 hex |
| 0001 | 1 | 1 hex |  | 1001 | 9 | 9 hex |
| 0010 | 2 | 2 hex |  | 1010 | 10 | A hex |
| 0011 | 3 | 3 hex |  | 1011 | 11 | B hex |
| 0100 | 4 | 4 hex |  | 1100 | 12 | C hex |
| 0101 | 5 | 5 hex |  | 1101 | 13 | D hex |
| 0110 | 6 | 6 hex |  | 1110 | 14 | E hex |
| 0111 | 7 | 7 hex |  | 1111 | 15 | F hex |

Divide a 48-bit Ethernet address into 12 four-bit “nibbles.” (1010, 0001, etc.)

Convert each group of 4 bits into a Hex symbol. (A, 1, etc.)

Combine two hex symbols into pairs and place a dash between pairs A1-etc.)

For example, 10100001 becomes 1010 0001, which becomes A 1, which becomes A1 (followed by a dash)

The finished hex expression might be: A1-36-CD-7B-DF-01 hex

20. a) **What were Ethernet addresses originally called**?

b) **What are they called today**?

c) What are the steps in converting EUI-48 addresses into hex notation?

d) **Convert 11000010 to hex**.

e) **Convert 7F hex to binary**.

f) **Convert the EUI-48 address A1-B2-C3-44-5D-3C to binary. Leave a space between each octet. As a check, there must be 48 bits**.

21. a) **In what fields is priority and VLAN information conveyed**?

b) **What are the two components of the Ethernet data field**?

c) **What is the purpose of the LLC subheader**?

d) What is the purpose of the Frame Check Sequence Field?

e) What happens if the receiver detects an error in a frame?

# Ethernet Security

## Port-Based Access Control (802.1X)

22. **a) What threat does 802.1X address**?

**b) In 802.1X, what device is the authenticator**?

c) What are the four benefits of using a central authentication server instead of having the individual authenticators do all authentication work?

Virtual LANs (VLANs)

23. **a) In Figure 5-22, what servers can Host C reach**?

b) Why do VLANs add to security?

**c) What is the benefit of a host being able to keep its IP address after a physical move**?

# Conclusion

## End-of-Chapter Questions

Thought Questions

5-1 a) List the security planning principles from Chapter 4.

b) When implementing SNMP for managed switches, what security planning principle must be considered?

5-2. If you add VLANs to your network, what security planning principle is enhanced?

5-3. In Chapter 3, we saw the distinction between supplicants and verifiers. In Figure 5-21, the peer is the supplicant. Which device is the verifier? (This is a trick question, but it gets at an important point.)

5-4. In Figure 5-22, which server host(s) can Host C access?

Design Questions

5-5. Design an Ethernet network to connect a single client PC to a single server. Both the client and the server will connect to their workgroup switches via UTP. The two devices are 900 meters apart. They need to communicate at 800 Mbps. Your design will specify the locations of any switches and the transmission link between the switches.

5-6. Add to your design in the previous question. Add another client next to the first client. Both connect to the same switch. This second client will also communicate with the server and will also need 800 Mbps in transmission speed. Again, your design will specify the locations of switches and the transmission link between the switches.

Troubleshooting Question

5-7. You connect two switches in a large Ethernet switch with 32 switches. You are using 4-pair UTP. Immediately after you make the connection, the network stops transmitting traffic. What do you think might have happened? If you cannot come up with a good hypothesis, reread the synopsis and see which points might apply. Do not do other steps in the troubleshooting process.

Perspective Questions

5-8. What was the most surprising thing you learned in this chapter?

5-9. What was the most difficult part of this chapter for you?