**CIS 350 – INFRASTRUCTURE TECHNOLOGIES**

**HOMEWORK # 6**

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**Topics**: Networks and Data Communications (Chapter 12), Ethernet and TCP/IP Networking (Chapter 13), Communication Channel Technology (Chapter 14)

**Show your calculations**!

**Problem 1**

A mask representing some IP address is 255.192.0.0. Write the mask in

the binary form: 11111111.11000000.00000000.00000000

the prefix notation: 10

**Problem 2**

What is the class of the following IP addresses?

10000011.10000111.11001100.00000011 Class B

01111110.10000111.11001100.00000011 Class A

200.10.56.0 (decimal form) Class C

**Problem 3**

Your start-up company has been assigned the following IP address by IANA: 138.226.0.0. You are to design 200 subnetworks within this network, with each subnetwork supporting up to 500 hosts. Can these subnetworks and hosts be designed? If not, which address class A, B, or C would allow for this particular design?

Mask: 255.255.0.0

Prefix: /16

32-16=16 bits

N = 7.66 ≈ 8

N=8

8 bits need to be borrowed from host

16-8=8 bits available for nodes

256 is not greater than 502

9 bits are needed for 500 hosts, but only 8 bits are available. These subnetworks cannot be designed as Class B, so Class A should be used.

**Problem 4**

Your company has been assigned the following IP address by IANA: 135.100.0.0. Design a network that consists of 500 subnetworks with each subnetwork having up to 60 hosts.

1. What address class is it? Class B

Express this IP address in the binary form: 10000111.01100100.00000000.00000000

1. What is the mask associated with this IP address? Write the mask in the decimal, binary and prefix form.

Mask in decimal 255.255.0.0

Mask in binary 11111111.11111111.00000000.00000000

Mask in prefix form /16

1. Perform calculations below to check if this network can be designed.

2N-2 >= 500

2N = 502

N = 8.9 ≈ 9 bits need to be borrowed from the host

16 – 9 = 7 bits available for nodes

27-2 >= 60

128 - 2 >= 60

126 >= 60 so yes, the network can be designed.

1. What is the subnetwork mask? Write the subnetwork mask in the decimal, binary and prefix form.

Mask in decimal 255.255.255.128

Mask in binary 11111111.11111111.11111111.10000000

Mask in prefix form /25

For questions (e) through (h) do **not** follow the Cisco approach with AllZero and AllOnes addresses for subnetworks briefly discussed in class and described at this link <http://www.cisco.com/en/US/tech/tk648/tk361/technologies_tech_note09186a0080093f18.shtml>,

but rather use the approach covered in the class examples.

1. Write the address for the 1st subnetwork as well as the 1 host, 2nd host, the last host, and the broadcast address for the 1st subnetwork. Present the addresses in the binary and decimal forms.

1st Subnetwork – 135.100.0.128 10000111.01100100.00000000.10000000

1st  Host - 135.100.0.129 10000111.01100100.00000000.10000001

2nd Host - 135.100.0.130 10000111.01100100.00000000.10000010

Last Host - 135.100.0.254 10000111.01100100.00000000.11111110

1st Subnetwork - 135.100.0.255 10000111.01100100.00000000.11111111

1. Write the address for the 2nd subnetwork as well as the 1 host, 2nd host, the last host, and the broadcast address for the 2nd subnetwork. Present the addresses in the binary and decimal forms.

2nd Subnetwork – 135.100.1.0 10000111.01100100.00000001.00000000

1st  Host - 135.100.1.1 10000111.01100100.00000001.00000001

2nd Host - 135.100.1.2 10000111.01100100.00000001.00000010

Last host - 135.100.1.126 10000111.01100100.00000001.01111110

2nd subnetwork - 135.100.1.127 10000111.01100100.00000001.01111111

1. Write the address for the last subnetwork as well as the 1 host, 2nd host, the last host, and the broadcast address for the last subnetwork. Present the addresses in the binary and decimal forms.

Last subnetwork – 135.100.255.0 10000111.01100100.11111111.00000000

1st host - 135.100.255.1 10000111.01100100.11111111.00000001

2nd host - 135.100.255.2 10000111.01100100.11111111.00000010

Last host - 135.100.255.126 10000111.01100100.11111111.01111110

Last subnetwork - 135.100.255.127 10000111.01100100.11111111.01111111

1. Use the masking operation to show explicitly that the last host residing on the 2nd subnetwork indeed belongs to this subnetwork

Subnetwork mask (binary) 11111111.11111111.11111111.10000000

Last host on the 2nd subnetwork 10000111.01100100.00000001.01111110

10000111.01100100.00000001.00000000

This is the 2nd subnet address as well, so it does belong to this network.

**Problem 5**

A signal travels from point A to B in a communication channel. The signal power at points A and B are 100000 and 100 watts, respectively. Calculate the signal gain/loss in [decibels – dB] at point B. Was the signal attenuated or amplified? (For help, see slide 24 in chapter 14 posted on BB.)

10log10(100/100000) = -30 dB

The signal attenuated since the result was negative.

**Problem 6**

A signal travels from point A to B in a communication channel. The signal power at points A and B are 100 and 100000 watts, respectively. Calculate the signal gain/loss in [decibels – dB] at point B. Was the signal attenuated or amplified? (For help, see slide 24 in chapter 14 posted on BB.)

10log10(100000/100) = 30 dB

The signal amplified since the result was positive.

**Problem 7**

You should know from the slides on chapter 14 covered in the classroom that the speed of data transmission over a communication channel depends on the bandwidth of the channel [expressed in Hz] as well as the power of the signal and noise of the channel [both expressed in Watts]. Shannon proposed a formula that allows one to calculate the maximum data rate [expressed in bps (bits/second)] for an analog signal with noise send over a channel. (For help, see slide 25 in chapter 14 posted on BB.)

S = f × log2 (1+W/N)

where:

* S – data transfer rate in bps
* f – signal bandwidth [expressed in Hz]
* W – signal power [in Watts], and
* N – noise power [in Watts]

Calculate the data rate (speed of transmission) of the telephone signal of 8 KHz bandwidth, 2 watts of power, and 0.002 watts of noise? (Note that the log function uses base 2.)

You may use Excel function =LOG(x, 2) to calculate log2(x), where x is an argument and 2 is the base; or you may use your calculator with the LOG10(x) function knowing that log10(x)/log10(2) = log2(x).

8 KHz = 8000 Hz

S = 8000Hz x log2 (1 + 2/0.002)

S = 8000Hz x log2 (1001)

S = 8000Hz x 9.97

S = 79760 bps