**CIS 350 – INFRASTRUCTURE TECHNOLOGIES**

**HOMEWORK #6 – 70 points**

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

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**Show your calculations**!

**Problem 1** (2 points)

A mask representing some IP address is 255.252.0.0. Write the mask in

the binary form: 11111111.11111100.00000000.00000000

the prefix notation: /14

**Problem 2** (3 points)

What is the class of the following IP addresses?

00011110.10000111.11001100.00000011 Class A

130.80.42.0 Class B

11000011.10000111.11001100.00000011 Class C

**Problem 3** (5 points)

Your start-up company has been assigned the following IP address by IANA: 130.155.0.0. You are to design 600 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? You must show your calculations.

2n−2 ≥m

2n−2 ≥600

log2(602)=n

n = 9.23 -> we need 10 bits to support 600 subnets, so we have 6 bits left over considering that the IP address is of Class B and has 16 bits available to represent the subnets and hosts.

26−2 ≥500

64≥502 is not true so 6 remaining bits is not enough to support the design. We would need to have at least

Log2(502)=8.97=9 in addition to the first ten bits used by the subnetworks to support the entire design for a total required bit count of 19. We would need a Class A IP address to be able to support the network design with its 24 available bits

**Problem 4**

Your company has been assigned the following IP address by IANA: 130.155.0.0. Design a network that consists of 500 subnetworks with each subnetwork having up to 60 hosts.

1. What address class is it? (2 points) Class B

Express this IP address in the binary form: 10000010.10011011.00000000.00000000

1. What is the network mask associated with this IP address? Write the mask in the decimal, binary and prefix form. (3 points)

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. Show your calculations. (5 points)

2n−2 ≥m

2n−2 ≥500

log2(502)=8.97=9

bits needed for 500 subnetworks. 7 left over for the 60 hosts:

2n−2 ≥m

27−2 ≥60

27 ≥62

128 ≥62

is true so 7 bits is enough to support the 60 hosts per subnetwork. If we use all the bits in the last octet, the design is able to support up to 126 hosts. (27 – 2 = m 🡪 126 = m)

1. What is the subnetwork mask? Write the subnetwork mask in the decimal, binary and prefix form. (3 points)

Subnet mask in decimal 255.255.255.128

Subnet mask in binary 11111111.11111111.11111111.10000000

Subnet 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.

**Note**: Your computations in 4(c) should show that you need a minimum of 9 bits for the 500 subnets and a minimum of 6 bits for the 60 hosts. As a result, 1 bit is left to design more subnets or more hosts. To make the computations and the design simpler, use 7 bits in the last octet to design the hosts.

1. Write the address for the 1st subnetwork as well as the 1 host, 2nd host, the 60th host, and the broadcast address for the 1st subnetwork. Present the addresses in the binary and decimal forms. (10 points)

130.155.0.128 – 10000010.10011011.00000000.1||0000000 - 1st subnetwork

130.155.0.129 – 10000010.10011011.00000000.1||0000001 - 1st host

130.155.0.130 – 10000010.10011011.00000000.1||0000010 – 2nd host

130.155.0.188 – 10000010.10011011.00000000.1||0111100 – 60th host

130.155.0.255 – 10000010.10011011.00000000.1||1111111 - 1st subnetwork broadcast address

1. Write the address for the 2nd subnetwork as well as the 1 host, 2nd host, the 60th host, and the broadcast address for the 2nd subnetwork. Present the addresses in the binary and decimal forms. (10 points)

130.155.1.0 – 10000010.10011011.00000001.0||0000000 – 2nd subnetwork

130.155.1.1 – 10000010.10011011.00000001.0||0000001 – 1st host

130.155.1.2 – 10000010.10011011.00000001.0||0000010 – 2nd host

130.155.1.60 – 10000010.10011011.00000001.0||0111100 – 60th host

130.155.1.127 – 10000010.10011011.00000001.0||1111111 – 2nd subnetwork broadcast address

1. Write the address for the 500th subnetwork as well as the 1 host, 2nd host, the 60th host, and the broadcast address for the 500th subnetwork. Present the addresses in the binary and decimal forms. (10 points)

130.155.255.0 – 10000010.10011011.11111111.1||0000000 – 500th subnetwork

130.155.255.1 – 10000010.10011011.11111111.1||0000001 – 1st host

130.155.255.2 – 10000010.10011011.11111111.1||0000010 – 2nd host

130.155.255.60 – 10000010.10011011.11111111.0||0111100 – 60th host

130.155.255.127 – 10000010.10011011.11111111.1||1111111 – 500th subnetwork broadcast address

1. Use the masking operation (the AND logical operator) to show explicitly that the 60th host residing on the 2nd subnetwork indeed belongs to this subnetwork. Align bits when you perform the AND bit-by-bit operation on the subnetwork mask and the 60th host on the 2nd subnetwork. Show your calculations. (5 points).

Subnet Mask 255.255.255.128 11111111.11111111.11111111.10000000

AND Operation

IP Address 130.155.1.60 10000010.10011011.00000001.00111100

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Address of 2nd subnet: 130.155.1.0 10000010.10011011.00000001.00000000

**Problem 5** (6 points)

A signal travels from point A to B in a communication channel. The signal power at points A and B are 10 watts and 10,000 watts, respectively. Calculate the signal gain/loss in [decibels – dB] at point B. Was the signal attenuated or amplified? Show your calculations. (For help, see slide 24 in chapter 14 posted on BB.)

Loss/Gain [dB] = 10 log10 (10/10,000) = 10 log10 (0.001) = 10 (-3) = -30 dB

The signal was attenuated

**Problem 6** (6 points)

You should know from the slides of chapter 14 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 signal of the 16KHz bandwidth, 100,000 watts of power and 50 watts of noise? Show your calculations.

(Note that the log function uses base 2.)

The bandwidth is expressed in KHz so remember to convert it to Hz. 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).

S = f × log2 (1+W/N)

S = 16kHz× log2 (1+ (100,000/50))

S = 16kHz× log2 (1+(2,000))

S = 16,000Hz× (10.966)

S = 175,464 bps = 175.464 Kbs