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 255.192.0.0. Write the mask in

the binary form: **11111111.11000000.00000000.00000000**
the prefix notation: **/10**

Problem 2 (3 points)

What is the class of the following IP addresses?

11000110.10000111.11001100.00000011	**C**
100.8.32.0	**A**
10000011.10000111.11001100.00000011	**B**

Problem 3 (5 points)

Your start-up company has been assigned the following IP address by IANA: 155.130.0.0. You are to design 400 subnetworks within this network, with each subnetwork supporting up to 750 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.

$2^n - 2 >= 400$
n = 9 bits
16 – 9 = 7 bits left
$2^n - 2 >= 750$
n = 10 bits

10 bits are needed, 7 are only available. This needs to be in a class A network.

Problem 4

Your company has been assigned the following IP address by IANA: 155.130.0.0. Design a network that consists of 50 subnetworks with each subnetwork having up to 600 hosts.

(a) What address class is it? (2 points) **B**

Express this IP address in the binary form: **10011011.100000010.00000000.00000000**

(b) 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**

(c) Perform calculations below to check if this network can be designed. Show your calculations. (5 points)

2^n - 2 >= 50
n = 6 bits
16 – 6 = 10 bits left
2^n - 2 >= 600
n = 10 bits

Yes, this network can be designed.

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

Subnet mask in decimal **255.255.252.0**
Subnet mask in binary **11111111.11111111.11111100.00000000**
Subnet mask in prefix form **/22**

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.

(e) Write the address for the 1st subnetwork as well as the 1 host, 2nd host, the 600th host, and the broadcast address for the 1st subnetwork. Present the addresses in the binary and decimal forms. (10 points)

nnnnnnnn.nnnnnnnn.ssssshh.hhhhhhhh

binary	decimal
10011011011.10000010.00000000.00000000	155.130.0.0
1st subnet address 10011011011.10000010.00000100.00000000	155.130.4.0
1st host on 1st subnet 10011011011.10000010.00000100.00000001	155.130.4.1
2nd host on 1st subnet 10011011011.10000010.00000100.00000010	155.130.4.2
600th host on 1st subnet 10011011011.10000010.00000110.01011000	155.130.6.88
Broadcast for 1st subnet 10011011011.10000010.00000110.01011001	155.130.6.89

(f) Write the address for the 2nd subnetwork as well as the 1 host, 2nd host, the 600th host, and the broadcast address for the 2nd subnetwork. Present the addresses in the binary and decimal forms. (10 points)

2nd subnet address 10011011011.10000010.00001000.00000000	155.130.8.0
1st host on subnet 10011011011.10000010.00001000.00000001	155.130.8.1
2nd host on subnet 10011011011.10000010.00001000.00000010	155.130.8.2
600th host on subnet 10011011011.10000010.00001010.01011000	155.130.10.88
Broadcast 10011011011.10000010.00001010.01011001	155.130.10.89

(g) Write the address for the 50th subnetwork as well as the 1 host, 2nd host, the 600th host, and the broadcast address for the 50th subnetwork. Present the addresses in the binary and decimal forms. (10 points)

10011011011.10000010.11**00100**00.00000000 155.130.200.0 50th subnet

$2^5 2^4$. 2^0
10011011011.10000010.11**00100**10.01011000 155.130.202.88 50th subnet, 600th host
2^7 2^0
128+64+8

512+64+16+8

10011011011.10000010.11**00100**10. 01011001 155.130.202.89 50th subnet, broadcast

10011011011.10000010.11**00100**00.00000001 155.130.200.1 50th subnet, 1st host

10011011011.10000010.11**00100**00.00000010 155.130.200.2 50th subnet, 2nd host

(h) Use the masking operation (the AND logical operator) to show explicitly that the 2nd 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 600th host on the 2nd subnetwork. Show your calculations. (5 points).

11111111.11111111.11111100.00000000 – subnet mask
10011011011.10000010.00001000.00000010 – 600th host on 2nd subnet
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10011011011.10000010.00001000.00000000

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 100000 and 100 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.)

$$\mathbf{10}\ log\frac{\mathbf{100}}{\mathbf{100000}} = \mathbf{-3}$$

Loss of -3dB, attenuated signal

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.)

$S = f \times \log_2 (1+W/N)$

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 8 KHz bandwidth, 10000 watts of power, and 20 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 $\log_2(x)$, where x is an argument and 2 is the base; or you may use your calculator with the $LOG_{10}(x)$ function knowing that $\log_{10}(x)/\log_{10}(2) = \log_2(x)$.

$8000 * \log_2(1 + \frac{10000}{20}) = 8000 * 8.97$
$S = 71{,}749.33\ bps$