CIS 350 – INFRASTRUCTURE TECHNOLOGIES
HOMEWORK # 6 – 70 points

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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 (2 points)

A mask representing some IP address is 255.255.192.0. Write the mask in

the binary form: **11111111.11111111.11000000.00000000**
the prefix notation: **/18**

Problem 2 (3 points)

What is the class of the following IP addresses?

11000011.10000111.11001100.00000011	____**Class C**_____
10000110.10000111.11001100.00000011	____ **Class B** _____
120.10.56.0 (decimal form)	____ **Class A** _____

Problem 3 (5 points)

Your start-up company has been assigned the following IP address by IANA: 155.132.0.0. You are to design 500 subnetworks within this network, with each subnetwork supporting up to 600 hosts. Can these subnetworks and hosts be designed? If not, which address class A, B, or C would allow for this particular design? Show your calculations.

Class B Address
2^n >= 502
n = 9
16-9 = 7 bits left to represent host.

2^n >= 602
n >= 10 bits

No, a Class A address would be needed for this design.
24 - 9 = 15 bits left for the 600 host.
2^15>= 602
32766>=602 With 15 bits, 2^15-2 = 32766 hosts

Problem 4

Your company has been assigned the following IP address by IANA: 158.80.0.0. Design a network that consists of 50 subnetworks with each subnetwork having up to 300 hosts.

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

Express this IP address in the binary form: **10011110.01010000.00000000.00000000**

(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)

Class B
50 subnetworks
2^n – 2 >= 50
2^n >= 52
n = 6

16-6 = 10 bits left for the host
300 hosts
2^10 >= 1024
1024 >= 302

Yes, this class B address can handle 50 subnetworks and 300 hosts.

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

Mask in decimal **255.255.252.0**
Mask in binary **11111111.11111111.11111100.00000000**
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 last host, and the broadcast address for the 1st subnetwork. Present the addresses in the binary and decimal forms. (10 points)

1st subnet-
10011110.01010000.000001||00.00000000
158.80.4.0
1st host –
10011110.01010000.000001||00.00000001
158.80.4.1
2nd host -
10011110.01010000.000001||00.00000010
158.80.4.2
Last host -
10011110.01010000.000001||11.11111110
158.80.7.254
Broadcast address for the 1st subnet –
10011110.01010000.000001||11.11111111
158.80.7.255

(f) 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. (10 points)

2nd subnet -
10011110.01010000.000010||00.00000000
158.80.8.0
1st host -
10011110.01010000.000010||00.00000001
158.80.8.1
2nd host -
10011110.01010000.000010||00.00000010
158.80.8.2
Last host
10011110.01010000.000010||11.11111110
158.80.11.254
Broadcast address for the 2nd subnet –
10011110.01010000.000010||11.11111111
158.80.11.255

(g) 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. (10 points)

Last subnet –
10011110.01010000.110010||00.00000000
158.80.200.0
1st host –
10011110.01010000.110010||00.00000001
158.80.200.1
2nd host –
10011110.01010000.110010||00.00000010
158.80.200.2
Last host –
10011110.01010000.110010||11.11111110
158.80.203.254
Broadcast address for the last subnet –
10011110.01010000.110010||11.11111111
158.80.203.255

(h) Use the masking operation (the AND logical operator) to show explicitly that the last host residing on the 2nd subnetwork indeed belongs to this subnetwork. Show your calculations bit by bit and align bits (5 points).

10011110.01010000.00001011.11111110	158.80.11.254
11111111.11111111.11111100.00000000	255.255.252.0
=	=
10011110.01010000.00001000.00000000	**158.80.8.0**

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 10000 and 1000 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.)

$10 \log_{10} (1000/10000) = 10 (-0.999999) \approx -10$ dB
The signal was attenuated, a signal loss.

Problem 6 (6 points)

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.)

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

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 telephone signal of 3.4 KHz bandwidth, 20 watts of power, and 0.02 watts of noise? Show your calculations. (Note that the log function uses base 2.)
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 $\log_{10}(x)/\log_{10}(2) = \log_2(x)$.

$S = 3.4 \times \log_2 (1+20/.02) = 3.4 \times \log_2 (1001) = 3.4 \times 9.9672 \approx$ **33.889**