CIS 350 – INFRASTRUCTURE TECHNOLOGIES
GROUP HOMEWORK #8 – 70 points

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Logistics

1. Get in touch with your group. (See Groups folder on Blackboard.)
2. Discuss and work **all** problems collectively with your group via E-mail, Discussion Forum, Blackboard Collaborate Ultra, and/or MS Teams. (Do not divide the work among group members.)
3. Choose a recorder to prepare the final copy (**one per group**) and submit it via the Blackboard Assignments/Homeworks folder by the due date.
4. Be sure all group members' names are on final copy. Do **not** add names of your group members who did not participate in the assignment or whose contribution was minimal.

Topics: Networks and Data Communications (Chapter 12), Ethernet and TCP/IP Networking (Chapter 13), Communication Channel Technology (Chapter 14), Modern Networked Computer Systems (Chapter 15)

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**
255/2 = 127 (1)
127/2 =63 (1)
63/2 = 31 (1)
321/2 = 15 (1)
15/2 = 7 (1)
7/2 = 3(1)
3/1 = 1(1)
½ =0 (1)

192/2 = 96
96/2 = 48
48/2 = 24
24/2 = 12
12/2 = 6
6/2 = 3
3/2 = 1 (1)
½ = 0 (1)

0/0 = 0
the prefix notation: 255.255.192.0/18

18 1s in a row

Problem 2 (3 points)

What is the class of the following IP addresses?
10000111.10000111.11001100.00000011 **B Starts With 10**

70/2 = 35
35/2 = 17 (1)
17/2 = 8 (1)

8/2 =4
4/2 = 2
2/2 = 1
½ = 0 (1)
01000110
70.80.42.0 **Class A**
200/2 = 100
100/2 =50
50/2 =25
25/2 = 12 (1)
12/2 = 6
6/2 = 3
3/2 = 1 (1)
½ = 0 (1)
11001000
200.135.204.3 **Class C**

Problem 3 (5 points)

The following IP address has been assigned to the University of Louisville by IANA: 136.165.0.0. Octets 1 and 2 of the address represent the network part. You are to design 200 subnetworks within this network, with each subnetwork supporting up to 400 hosts. Can these subnetworks and hosts be designed? If not, which address class A, B, or C would allow for this particular design? <u>You must show your calculations.</u>

2^n -2 >= 200
2^n >= 202
N = 8

Nnnnnnnn.nnnnnnnn.hhhhhhhh || hhhhhhhh

2^8 -2 >= 400
256 >= 402
This is not true.
Therefore 400 hosts cannot be hosted on the B class IP

A Class ~~C~~ would be required. -1

A

Problem 4

The following IP address has been assigned to the University of Louisville by IANA: 136.165.0.0. Octets 1 and 2 of the address represent the network part. Design a network that consists of 50 subnetworks with each subnetwork having up to 1000 hosts.

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

Express this IP address in the binary form: **10001000.10100101.00000000.00000000**

(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	**255.255.0.0/16**

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

2^n -2 >= 50
2^n >= 52
N = 6
2^6 >= 52
64 >= 52 this works

Nnnnnnnn.nnnnnnnn.hhhhhh || hh hhhhhhhh

2^10-2 >= 1000
2^10 >= 1002
1024 >= 1002
This is true.
Therefore 1000 hosts can be hosted on the B class IP

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

Subnet mask in binary 11111111.11111111.11111100.00000000

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

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 addresses in the binary and decimal forms for … (10 points). The network address (octets 1 & 2) does not change.

10001000.10100101.00000000.00000000	**136.165.0.0**	the 1st subnet
10001000.10100101.00000000.00000001	**136.165.0.1**	the 1st host on the 1st subnet
10001000.10100101.00000000.00000010	**136.165.0.2**	the 2nd host on the 1st subnet
10001000.10100101.00000011.10111111	**136.165.3.191**	the 1000th host on the 1st subnet 232
10001000.10100101.00000011.11111111	**136.165.3.255**	the broadcast address for the 1st subnet

(f) Write the addresses in the binary and decimal forms for … (10 points). The network address (octets 1 & 2) does not change.

-3

10001000.10100101.00000100.00000000	**136.165.4.0**	the 2nd subnet
10001000.10100101.00000100.00000001	**136.165.4.1**	the 1st host on the 2nd subnet
10001000.10100101.00000100.00000010	**136.165.4.2**	the 2nd host on the 2nd subnet
10001000.10100101.00000111.10111111	**136.165.7.191**	the 1000th host on the 2nd subnet
10001000.10100101.00000111.11111111	**136.165.7.255**	the broadcast address for the 2nd subnet

(g) Write the addresses in the binary and decimal forms for … (10 points). The network address (octets 1 & 2) does not change.

10001000.10100101.11000100.00000000	**136.165.196.0**	the 50th subnet
10001000.10100101.11000100.00000001	**136.165.196.1**	the 1st host on the 50th subnet

10001000.10100101.11000100.00000010 | **136.165.196.2** the 2^{nd} host on the 50^{th} subnet

10001000.10100101.11000111.10111111 | **136.165.199.191** the 1000^{th} host on the 50^{th} subnet

10001000.10100101.11000111.11111111 | 136.165.199.255 the broadcast address for the 50^{th} subnet

(h) Use the masking operation (the AND logical operator) to show explicitly that the 1000^{th} host residing on the 2^{nd} subnetwork indeed belongs to this subnetwork. **Align bits** when you perform the AND bit-by-bit operation on the subnetwork mask and the 1000^{th} host on the 2^{nd} subnetwork. Show your calculations. (5 points).

The subnet mask: **255.255.252.0 → 11111111.11111111.11111100.00000000**

The 1000^{th} host on the 2^{nd} subnet: **136.165.7.191 → 10001000.10100101.00000111.10111111**

The result of the AND operation **10001000.10100101.00000100.00000000 →**

10001000 converts to 136

10100101 converts to 165

00000100 converts to 4

00000000 converts to 0

Making the resulting network Address:136.165.4.0

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 1,000 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 or Gain [dB] = 10 log10 (P2/P1)

- ***P1(input)*=1,000 watts (at point A)**
- ***P2(output)*=10,000*P*output=10,000 watts (at point B)**

P2 / P1 → 10,000 / 1,000 = 10

log10(10) = 1

Gain (dB) → 10 × log10 (10) → 10×1 = 10 dB

Answer: +10dB

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 20KHz bandwidth, 40 watts of power and 5 watts of noise? Show your calculations.

(Note that the log function uses base 2.)

The bandwidth above 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 $\log_2(x) = \log_{10}(x)/\log_{10}(2)$.

SNR → W / N → 40 / 5 = 8

1+SNR → 1 + 8 = 9

Log2(9)→ 0.954 / 0.301 = 3.17

S → 20,000 * 3.17 = 63,400bps