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CS 542 – Computer Networks I – Homework 1

1. Explain the responsibilities of the Transport layer (1 point)

A: The transport layer oversees the process-to-process delivery of the entire message.
It is responsible for:

a. Dividing the message into manageable segments
b. Reassembling it at the destination
c. Flow and error control

Transport Layer is the second layer of the TCP/IP model. The transport layer is responsible for error-free, end to end delivery of the data from the host to destination. It can carry out error checking, flow control, and verification. The unit of encapsulation at the transport layer is Segment. The standard protocols that are used at the transport layer are TCP (Transmission Control Protocol), UDP (User Datagram Protocol), DCCP (Datagram Congestion Control Protocol). The main duties of the transport layer are stated below:

· Port addressing - The transport layer must include the port address to the packet the network layer gets each packet to the correct computer, the transport layer gets the entire message to the correct process of the computer.

· Segmentation and Readdressing - The message is divided into transmittable segments and each segment contains a sequence number and the number enables the transport layer to assemble the message correctly at the receiver's side.

· Connection control - The transport layer can be either connectionless or connection-oriented

A connectionless transport layer treats each data unit as an independent unit and delivers it to the transport layer at the destination machine.

The connection-oriented transport layer makes a connection with the transport layer at the destination machine before delivering the segment. After the data is transferred the connection is terminated.

· Flow control - The transport layer provides the flow control mechanism between the sender and the receiver so that if the data absorbed by the receiver's side is less than the senders sending speed this mechanism manages the data loss due to the difference in the speed. Here a sliding window method is used to prevent data loss the receiver sends a window size to the sender informing the amount of data it can receive. The flow control is performed end to end rather than across a single link.

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2. What is the difference between a physical address and a logical address? (2 points)
A: Physical address is the local address of a node, it is used by the data link layer to deliver data from one node to another within the same network. It is the MAC Address

A logical address defines the sender and receiver at the network layer and is used to deliver messages across multiple networks. It is the IP address

3. Convert the number C02F84B1 in the hexadecimal base to the 256-base system. (3 points)
A: First we will convert C02F84B1 from hexadecimal to decimal and then from decimal to 256 base system

C 0 2 F 8 4 B 1 - 12 0 2 15 8 4 11 1
* * * * * * * *
16^7 16^6 16^5 16^4 16^3 16^2 16^1 16^0
3221225472 + 0 + 2097152 + 983040 + 32768 + 1024 + 176 + 1
= 3224339633_{10}

256	3224339633	177
256	12595076	132
256	49199	47
	192	

$192.47.132.177_{256}$

4. Give the ranges of different classes of IP addresses in classful addressing. (3 points)
A: IP addresses belonging to

class A ranges from 1.x.x.x – 127.x.x.x (x - 0 to 255)
The network ID is 8 bits long, host ID is 24 bits long.
class B ranges from 128.0.x.x – 191.255.x.x.
The network ID is 16 bits long, the host ID is 16 bits long.
class C ranges from 192.0.0.x – 223.255.255.x.

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The network ID is 24 bits long, the host ID is 8 bits long.
class D ranges from 224.0.0.0 – 239.255.255.255.
Class D is reserved for multi-casting and does not possess any sub-net mask
class E ranges from 240.0.0.0 – 255.255.255.255
class E is reserved for experimental and research purposes

169.254.0.0 – 169.254.0.16 : Link local addresses
127.0.0.0 – 127.0.0.8 : Loop-back addresses
0.0.0.0 – 0.0.0.8 : used to communicate within the current network.

5. What is the range of IP address that can assign to users in the 100th block of class A? (3 points)
A: Class A starts with 0.0.0.0 to 127.0.0.0 with the first byte as net id.
Class A block starts with 0, the 100th block will be 99(100-1) to be added to the first block of class A

100th block of class A = 99.0.0.0

Therefore the range of address for 100th block of class A is, 99.0.0.0 to 99.255.255.255

6. What is the 100th IP address of the 10000th block of class C? (4 points)
A: Class C addresses start with 192.0.0.0 to 223.255.255.255 with the first 3 bytes as net id.

As the block number starts with 0, the 10000th block will be 9999(10000-1) to be added to the first block of class C.

10000th block
Converting 9999 into base 256:
9999/256 = 39.086
256 * 39 = 9984
9999 - 9984 = 15
$(9999)_{10} = (39.15)_{256}$

The 10000th block will be 192.39.15.0
100th IP of 10000th block is 192.39.15.99

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7. What is the value of 103.230.250,90.245 - 103.220.250,90.225? (3 points)
A: 103.230.250,90.245
= $103 * (256)^2 + 230 * (256)^1 + 250 * (256)^0 + 90 * (256)^{-1} + 245 * (256)^{-2}$
= 6750208 + 58880 + 250 + 0.3515625 + 0.00373840332
= 6,809,338.3553009

103.220.250,90.225
= $103 * (256)^2 + 220 * (256)^1 + 250 * (256)^0 + 90 * (256)^{-1} + 225 * (256)^{-2}$
= 6750208 + 56320 + 250 + 0.3515625 + 0.0034332275390625
= 6806778.3549957275390625

103.230.250,90.245 - 103.220.250,90.225
= 6809338.3553009 - 6806778.3549957275390625
= 2560.0003051725

8. The 45th address of a block assigned to a certain organization is 107.96.200.44. The organization needs 129 addresses. Find the mask and define this block of addresses. Is there any wastage of the IP addresses? If yes, how many? (4 points)
A: The organization needs 129 addresses. No. of addresses in a block of should be of power 2. So, for 129, the nearest power of 2 is 256. Hence, the suffix will be 8 and the prefix will be (32-8) = 24.

Mask = /24 or 255.255.255.0

The 45th address of a block assigned to a certain organization is 107.96.200.44. Masking this address with the above mask will give the first address or network address of the block it belongs to.

First address (Network address):
107.96.200.44 (**AND**) 255.255.255.0
= **107.96.200.0/24**

Last address = First address + No. of addresses in a block -1
= 107.96.200.0/24 + 256 - 1
= **107.96.200.255/24**

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Wastage of addresses:
Yes, there are a few unused addresses. No. of allocated addresses are 256. The organization only requires 129 addresses. So, no. of wasted addresses are = (256-129) = 127 addresses.

9. A packet arrives at the router R2 in the below figure with destination address 180.245.7.25. Show how it is forwarded. Also, create routing tables for R1. (Assume classful addressing) (4 points)

The routing table for R1:

IP Class	Network Address	Next-Hop Address	Interface Number
A	110.0.0.0	----------	m0
B	145.80.0.0	----------	m1
B	170.14.0.0	----------	m2
C	192.16.7.0	110.15.17.32	m0
	Default	110.30.31.18	m0

1. Destination address 180.245.7.25 which can be converted in binary, as 10110100 11110101 00000111 00011001
2. To find the class of IP address, we will check the first part of the IP address which is 180 and it lies between 128 - 191 so this IP is of class B.

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3. The network address is extracted by performing logical AND operation with the default mask of class B, which is /16 (255.255.0.0). The network address is 180.245.0.0.
4. Here the network address is 180.245.0.0 which does not belong to this network given above so the packet will be returned back. We will assign 0.0.0.0 and the packet will be returned. First the IP will be checked if it belongs to this network if yes then it is routed to its destination otherwise sent back which in our case will be sent back.

10. A block of addresses 108.180.202.0/20 granted to an ISP. These addresses allocated between two groups of customers. The first group has 20 customers, each of which needs 64 addresses, the second group has 20 customers, each of which needs 128 addresses. Show the subblocks and range of addresses for the 11th customer of the first group and the 11th customer of the second group. How many addresses are still available after this allocation? (5 points)

Group 1: 64 Addresses per customer(2^6)
n= 32-6-26
1st Customer: 108.180.202.0/26
to: 108.180.202.63/26
20th Customer: 108.180.205.64/26
to: 108.180.205.127/26

Group 2: 128 Addresses per customer(2^7)
n=32-7=25
1st Customer: 108.180.205.128/25
to: 108.180.205.255/25
20th Customer: 108.180.215.0/25
to: 108.180.215.127/25

11th Customer (Group 1): 108.180.210.128/26
to: 108.180.210.191/26

11th Customer (Group 2): 108.180.210.128/25
to: 108.180.210.255/25

Total Addresses: 2^(32-20) = 2^12 = 4096

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Total Addresses allocated to the two groups: 20*64 + 20*128 = 3840
Total Addresses available: 4096-3840 = 256

11. Give the mask in 256 base system, which combines 128 blocks of class C into a supernet? (2 points)
A: Class C default mask is /24
To combine 128 blocks, we need 7 (2^7 = 128) less 1's to the default mask.
Hence, the mask is 24-7 = **/17 or 255.255.128.0**

12. Find the network address, the direct broadcast address, and the number of addresses in a block, if one of the addresses in this block is 180.230.90.25/20. (3 points)
A:
Network Address: 180.230.90.25 **(** 10110100 11100110 01011010 00011001)
(AND) 255.255.240.0 (11111111 11111111 11110000 00000000)

180.230.80.0/20 (10110100 11100110 01010000 00000000)

Number of addresses in the block: $2^{32-20} = 2^{12} = 4096$

Direct Broadcast address: First address + 15.255 (4095 in base 256)
= 180.230.80.0 + 15.255
= **180.230.95.255**

13. The block 180.22.120.0/24 granted to an organization. The administrator wants to create 64 subnets. Find:
- **The subnet mask (1 point)**
- **Number of address in each subnet (1 point)**
- **Subnet and a direct broadcast address of 1st subnet (2 points)**
- **Subnet and a direct broadcast address of 10th subnet (2 points)**
- **Subnet and a direct broadcast address of last subnet (2 points)**

A:

a. No. of extra 1s added to default mask = $\log_2$ (No. of subnets)
= $\log_2$ (64)
= 6

Prefix length = 24 + 6 = 30.

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Subnet mask = /30 or 255.255.255.252

b. Suffix length = 32 – 30 = 2

No. of addresses in each subnet = 2^2 = 4

An organization is granted the block 180.22.120.0/24.

c. First subnet:

First address: 180.22.120.0 (AND) 255.255.255.252 = **180.22.120.0/30**
Last address: First address + No. of address in each subnet -1
= 180.22.120.0 + 0.0.0.4 -1
= **180.22.120.3/30 (direct broadcast address of 1st subnet)**

d. 10th subnet:

Subnet address:
There are 64 subnets in the block. As, the address starts with 0, we have to multiply (10-1) = 9 with no. of addresses in each subnet and add to the first address of the first subnet to get the subnet address of the last(10th) subnet.

Hence, 9*4 = 36
First address: 180.22.120.0 + 0.0.0.36
= **180.22.120.36**
Direct broadcast address:
= Subnet address + No. of addresses in each subnet – 1
= 180.22.120.36 + 4 -1
= **180.22.120.39**

e. Last subnet:

Subnet address:
There are 64 subnets in the block. As the address starts with 0, we have to multiply (64-1) = 63 with no. of addresses in each subnet and add to the first address of the first subnet to get the subnet address of the last(64th) subnet.

Hence, 63*4 = 252
Subnet address (First address) = 180.22.120.0 + 0.0.0.252

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= **180.22.120.252/30**

Direct broadcast address:

= Subnet address + No. of addresses in each subnet – 1

= 180.22.120.252 + 0.0.0.4 -1

= **180.22.120.255/30**