Assignment 4 - Solution

Covered Topics: -
Network Layer (IP)

Problem 1

Complete the following table which provides practice in converting a number from binary notation to decimal format.

Binary	128	64	32	16	8	4	2	1	Decimal
11001100	1	1	0	0	1	1	0	0	**204**
10101010	1	0	1	0	1	0	1	0	**170**
11100011	1	1	1	0	0	0	1	1	**227**
10110011	1	0	1	1	0	0	1	1	**179**
00110101	0	0	1	1	0	1	0	1	**53**

Complete the following table which provides practice in converting a number from decimal notation to binary format

Decimal	128	64	32	16	8	4	2	1	Binary
48	0	0	1	1	0	0	0	0	**0011 0000**
222	1	1	0	1	1	1	1	0	**1101 1110**
119	0	1	1	1	0	1	1	1	**0111 0111**
135	1	0	0	0	0	1	1	1	**1000 0111**
60	0	0	1	1	1	1	0	0	**0011 1100**

Problem 2

Find the class of the following IP addresses:

1) 123.56.77.32 – Class A
2) 200.50.7.11 – Class C
3) 12.5.17.2 – Class A
4) 128. 4.1.2 – Class B

Find the maximum number of hosts that can be connected to the network in the following cases:

1) class A IP address 24 bits for host. Max. number of hosts = 2^{24} - 2 = 16,777,214 hosts. You must subtract 2 because the base network represents host "0" and the last host on the network is actually used for "1" s broadcast and may not be assigned to any host.
2) Class B IP address 16 bits for host. Max. number of hosts = 2^{16} - 2 = 65634 hosts.
3) Class C IP address 8 bits for host. Max. number of hosts = 2^{8} – 2 = 254 hosts

Write the following netmasks in slash (/n) notation

1) 255.255.255.0 /24
2) 255.255.254.0 /23

Problem 3

1. Network address for each LAN

We have only 4 LANS with routable IPs, so we only need 2 bits for subnetting

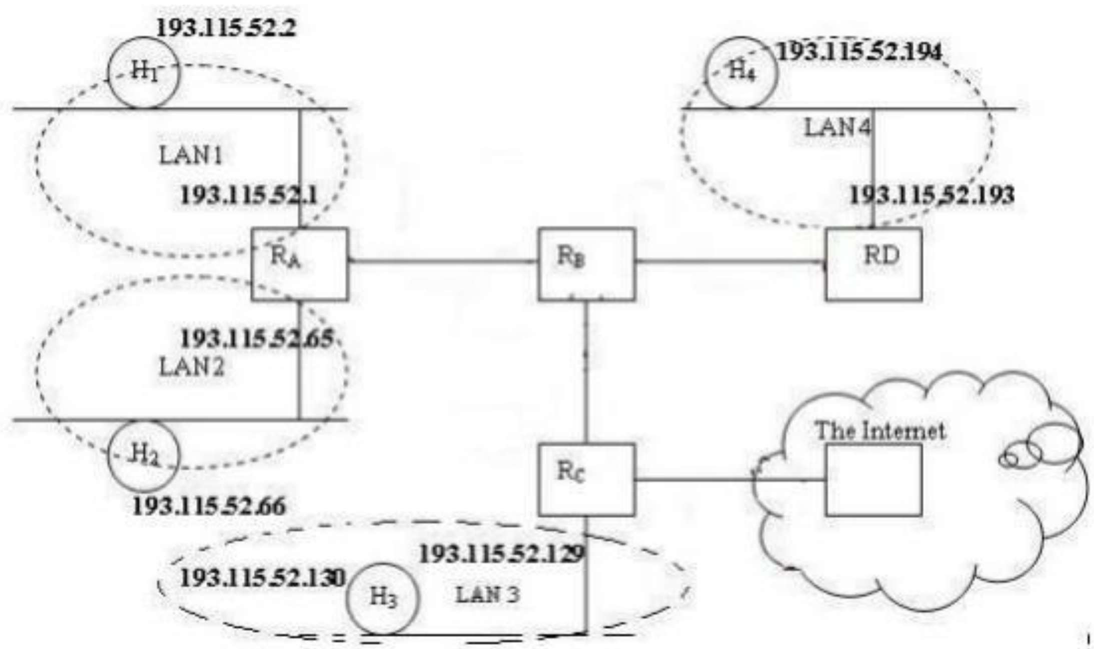
Network (24 bits)	Subnet(2 bits)	Host(6 bits)

32 Bits

Subnet Mask: 255.255.255.192
LAN1: 193.115.52.0
LAN2: 193.115.52.64
LAN3: 193.115.52.128
LAN4: 193.115.52.192

2. The IP address for all the hosts in the figure

Addresses for all hosts and routers shown below



Problem 4

1. A minimum of 5 bits are required to define 20 hosts so the extended network prefix is /27 (27 = 32-5)
2. The maximum number of hosts on each subnet is 25 -2, or 30.
3. The maximum number of subnets is 23, or 8.
4. The subnets of 200.35.1.0/24 in binary format and dotted-decimal notation.

   Subnet #0: 11001000.00100011.00000001. 000 00000 = 200.35.1.0/27.

   Subnet #1: 11001000.00100011.00000001. 001 00000 = 200.35.1.32/27

   Subnet #2: 11001000.00100011.00000001. 010 00000 = 200.35.1.64/27

   Subnet #3: 11001000.00100011.00000001. 011 00000 = 200.35.1.96/27

   Subnet #4: 11001000.00100011.00000001. 100 00000 = 200.35.1.128/27

   Subnet #5: 11001000.00100011.00000001. 101 00000 = 200.35.1.160/27

   Subnet #6: 11001000.00100011.00000001. 110 00000 = 200.35.1.192/27

   Subnet #7: 11001000.00100011.00000001. 111 00000 = 200.35.1.224/27
5. The range of host addresses that can be assigned to Subnet #6 (200.35.1.192/27).

   Subnet #6: 11001000.00100011.00000001. 110 00000 = 200.35.1.192/27

   Host #1: 11001000.00100011.00000001.110 00001 = 200.35.1.193/27

   Host #2: 11001000.00100011.00000001.110 00010 = 200.35.1.194/27

   Host #3: 11001000.00100011.00000001.110 00011 = 200.35.1.195/27

   :

   Host #29: 11001000.00100011.00000001.110 11101 = 200.35.1.221/27

   Host #30: 11001000.00100011.00000001.110 11110 = 200.35.1.222/27
6. The broadcast address for subnet 200.35.1.192/27

   11001000.00100011.00000001.110 11111 = 200.35.1.223

Problem 6

Before entering the first network, we have an IP datagram of 2048 + 20 (TCP header) + 20 (IP header) = 2088 bytes. So, the IP payload is 2068 bytes. This datagram needs to split into 3 fragments.

- Fragment 1: IP header of 20 bytes, and data of 1000 bytes. Offset is 0.
- Fragment 2: IP header of 20 bytes, data of 1000 bytes. Offset is 1000/8 = 125.
- Fragment 3: IP header of 20 bytes, and data of 68 bytes. Offset is (1000+1000)/8 = 250.

When fragment 1 goes through the second network, it needs to be split into three fragments. Each fragment can contain at most 512.20 = 492 bytes of data. Since 492 is not a multiple of 8, each fragment can, in fact, contain at most 488 bytes of data. So, we have the following 3 fragments:

- Fragment 4: IP header of 20 bytes, and data of 488 bytes. Offset is 0.
- Fragment 5: IP header of 20 bytes, data of 488 bytes. Offset is 488/8 = 61.
- Fragment 6: IP header of 20 bytes, and data of 1000-(488x2) =24 bytes. Offset is (488+488)/8 = 122.

Similarly, when fragment 2 goes through the second network, it needs to be split into three fragments.

- Fragment 7: IP header of 20 bytes, and data of 488 bytes. Offset is 125.
- Fragment 8: IP header of 20 bytes, data of 488 bytes. Offset is 125+61= 186.
- Fragment 9: IP header of 20 bytes, and data of 1000-(488x2) =24 bytes. Offset is 125+122=247.

Finally, fragment 3 goes as is through the second network since it is of size 88 bytes. The fragment that reaches the destination are 4,5,6,7,8,9, and 3. They are assembled in this order. This is because their offsets are in increasing order (0, 61, 122, 125, 186, 247, and 250). Also note that fragment 4 through 9 will have their fragmentation bit set while fragment 3 will not, indicating that it is the last fragment of the original datagram.

Problem 7

The allowable data length = 1500-20-20= 1460 bytes. Because 1460 is not divisible by 8, the allowable data length is limited to 1456 byes. Including the headers, the data to be transmitted is then 3540 bytes to be split into fragments of 1456, 1456, and 628 bytes. Here, fragment 1 = total length 1456, MF=1, and offset =0; fragment 2= total length 1456, MF=1, offset = 182; and fragment 3= total length 628, MF=0, offset = 364.