Roll No. 24

CCN assignment No. 4.

Q1. Give IPv4 header format and explain functionality of each field.

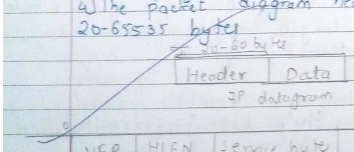
→ IPv4 header format:

i) IP datagram is unit of transfer in an IP network. It carries enough information about the network to get forwarded to its destination; it consists of a header followed by bytes of data.

a) The header contains information about the type of IP datagram, how long the datagram should stay on the network with special flags indicating any special purpose the datagram is supposed to serve.

3) The minimum size of the IP header is 20 bytes consisting of five 32 bit words.

4) The packet diagram header is as shown below 20-65535 bytes



VER	HLEN	Service byte	Total length
4 bits	4 bits	8 bits	16 bits
Identification		Flags	Fragmentation offset
16 bits		3 bits	13 bits
Time to live	Protocols	Header checksum	
8 bits	8 bits	16 bits	
Source IP address			
Destination IP address			
Option + padding (0 to 40 bytes)			

i) Version (4 bit):

It is used to define the IP version. The value 4 defines the packet as IPv4 while value 6 defines the packet as IPv6.

ii) Header length (4 bit)

It is used to define the length of the header. It does not include the data field of the value cannot be greater than 60 bytes. The default value of this field is no options present is 5.

iii) Service Type (8 bit)

Of the 8 bits, the first three bits are the precedence bits are ignored. The type of service is represented by the next 4 bit of the last bit of left unused. They are

Types of service	Description
0000	Normal service
0001	minimize monetary cost
0010	maximize reliability
0100	maximize throughput
1000	maximize delay

iv) Total length (16 bits)

It defines the total length of the datagram, header + data + the maximum size of IP datagram can be 65535 bytes.

v) Identification (16 bits)

Identifier is assigned by the host during

fragmentation. This helps in reassembling the fragmented datagrams. Each fragment of a single datagram has the same identification number.

vi) Flags (3 bits)
There are 3 types of flags & and only two of the three allocated bits are used. They are used to indicate three diff states namely reserved, Do not fragment & more fragments.

vii) Fragment offset (13 bit)
It is primarily used during fragmentation process. The fragmented datagrams are of 8 bytes. This is used in reassembly of fragmented IP datagrams.

viii) Time to live (8 bit)
It represent number of hops that the IP datagram will go through before being discarded. The value is decremented by one by every router that handles the datagram. When this field reaches 0, the datagram is thrown away & the sender is notified with an ICMP (Internet control message Protocol) message.

ix) Protocol (8 bit)
It identifies which upper layer protocol are encapsulated in the packets. for eg:- identifier 0 indicate reserved & similarly 6 indicate TCP.

x) Header checksum (16 bit)
It is a 16 bit checksum used for error detection. It is calculated by dividing the header byte into word (a word is 2 byte) & then adding them together. The operation is performed only on the header & not on the data.

xi) Source IP (32 bit).
It is the IP addr of the originator of the datagram packet.

xii) Destination IP (32 bit)
It is the IP addr of the intended recipient of the datagram packet.

xiii) Options (Variable length) & padding:- The options field is used for additional header or info if required. If one or more options are included & the number of bits used for them is not a multiple of 32 then padding field is used to make the header a multiple of 32.

(Q2) Explain classful addressing of IP addr with range of IP for each class. State different special IP addr.

→ IP address

IP address is an address having info about how to reach specific host, specially outside the LAN. An IP addr is a 32 bit unique addr having an addr space of 2^{32}.

Generally there are two notations in which IP addr is written, dotted decimal notation & hexadecimal notation.

(i) Dotted Decimal
10000000. 00001011 00000011 00011111
128.11.3.31

ii) Hexadecimal Notation

01110101	00011101	10010101	11101010
75	95	1D	EA

0x7595 1DEA

- Classful Addressing:

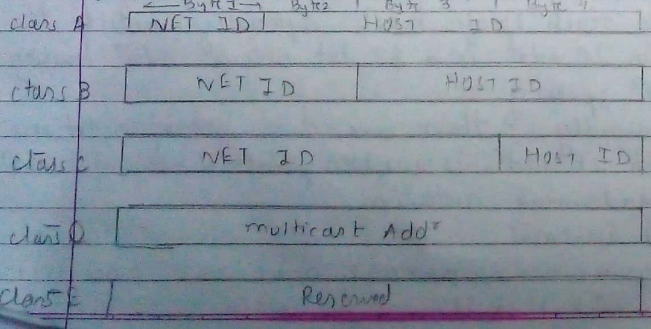
The 32 bit IP addr is divided into five sub class.

Class A
Class B
class C
class D
class E

Each of there classes has a valid range of IP addr Classes D & E are reserved for multicast & experimental purposes respectively. The order of bits in the first octet determine the classes of IP addr IPv4 addr is divided into two parts

i) Network ID
ii) Host ID

The class of IP addr is used to determine the bits used for n/w ID & host ID & the no. of total n/w & host possible in that particular class. Each ISP or n/w administrator assigns IP addr to each device that is connected to its network.



i) Class A:

IP address belonging to class A are assigned to the network that contains a large number of hosts.

- The network ID is 8 bits long
- The host ID is 24 bits long

The higher order bits of the first octet in class A is always set to 0. The remaining 7 bits in first octet are used to determine network ID. The 24 bits of host ID are used to determine the host in any network. The default subnet mask for class A is 255.x.x.x. Therefore class A has a total of:

- 2^7 = 128 n/w ID
- $2^{24} - 2$ = 16,777,214 host ID

IP addresses belonging to class A ranges from 1.x.x.x - 126.x.x.x.

7 bit	24 bit
0 network	Host

ii) Class B

IP addr belonging to class B are assigned to the network that ranges from medium-sized to large size n/w.

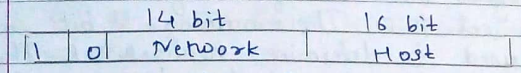
- The n/w ID is 16 bit long
- The host ID is 16 bit long

The higher order bits of the first octet of IP addresses of class B are always set by 10. The remaining 14 bits are used to determine network ID. The 16 bits of host ID is used to determine the host in any n/w. The default sub net mask for class B is 255.255.x.x.

class B has a total of.

- 2^{14} = 16384 network address
- $2^{16} - 2$ = 65534 host address.

IP addresses belonging to class B ranges from 128.0.x.x - 191.255.x.x.



class B

iii) Class C:

IP address belonging to class C are assigned to small-sized networks.

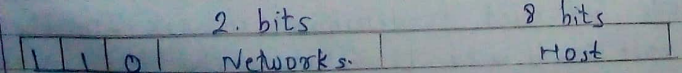
- The network ID is 24 bits long.
- The host ID is 8 bit long.

The higher order bits of the first octet of IP addresses of class C are always set to 110. The remaining 21 bits are used to determine network ID. The 8 bits of host ID is used to determine the host in any network. The default sub-net mask for class C is 255.255.255.x Class C has a total of

2^{21} = 2097152 network address

$2^8 - 2$ = 254 host address.

IP address belonging to class C ranges from 192.0.0.x - 223.255.255.x

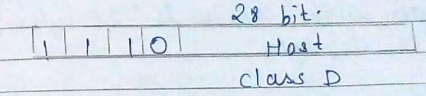


class C

iv) Class D

IP address belonging to class D are reserved for multi-casting. The higher order bits of the first octet of IP addresses belonging to class D are always set to 1110. The remaining bits are for the address that interested hosts recognize.

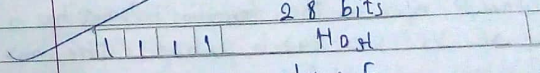
Class D does not passes any sub-net mask. IP addresses belonging to class D ranges from 224.0.0.0 - 239.255.255.255.



class D

v) Class E:

IP address belonging to class E are reserved for experimental & research purposes. IP addresses of class E ranges from 240.0.0.0 - 255.255.255.255 This class doesn't have any sub-net mask. The higher order bits of first octet of class E are always set of 1111



class E

Q3 IPv4, what is the length of the data field given an HLEN value of 12 & total length value 40,000?

→ Given

HLEN value = 12

Total length value = 40000

So header length = 12 x 4 = 48

Total length indicates total length of the packet including header.
So, packet length excluding header is
= 40000 - 48
= 49952
∴ The length of the data field = 39522

Q4. In IPv4, what is the value of the total length field in bytes if the header is 28 bytes & the data field is 400 bytes

→ Given:
Header length is = 28 bytes
Data field = 400 bytes
The total length indicates total length of the packet including header
∴ Then the value of total length field
= 400 + 28
= 428
The value of total length feild is 428 bytes.

Q5. If a ~~class~~ class B n/w on the ~~terminal~~ internet has a subnet mask of 255.255.248.0, what is the max no. of hosts per subnet?

→ Subnet mask is 255.255.248.0
The binary representation of subnet mask is
11111111 . 11111111 . 11111000 . 00000000
There are 21 bits set in subnet so 11 bits (32 to 21) from left are for host ID's. Total possible values of host ID's is $2^{11} = 2048$ values 2 add^{r} are reserved. The add^{r} with all bits as '1' is reserved as broadcast add^{r} & add^{r} with all host ID bits as '0' is used as a n/w add^{r} of subnet. In general, the no. of add^{r}'s usable for addressing specific hosts in each n/w is alway $2^{n}-2$ where n is the no. of bits for hosts ID.
∴ Max no. of hosts per subnet = $2^{11}-2 = 2046$
The max no. of hosts per subnet is 2046.

Q6. The add^{r} of a class B host is to be split into subnets with 6-bit subnet no. what is the max no. of subnets & the max no. of hosts in each subnet?

→ Subnet - number = 6 bit
max no. subnet = $2^{6}-2 = 62$.
max no. of hosts = $2^{10} = 1024$.
2 add^{r} are reserved. The add^{r} with all bits as '1' is reserved as broadcast add^{r} & the add^{r} with all host bits as '0' is used as n/w add^{r} of subnet.
Max. no. of hosts = $2^{10}-2 = 1022$

7) How is fragmentation is done?

→ Fragmentation is done by the n/w layer when the max size of datagram is greater than max size of data that can be held a frame ie its max tx unit (MTU). The n/w layer divides the datagram recieved from transport layer into fragments so that flow is not disturbed
Since, there are 16 bits for total length in IP header. So max size of IP datagram is $2^{16}-1$
= 65535 bytes.

Transport layer

(segment) | 20 | 65495 |

Max size of data in segment = 65515 - 20 = 65495.

n|w layer

(segment) | 20 | 65515 |

max size of data in segment = 65535 - 20 = 65515

- It is done by n|w layer at the destinat^n side & is usually done at routers.
- Source side does not req. fragmentation due to good segmentat^n by transport layer i.e instead of doing segmentation at transport layer & fragmentation at n|w layer, the transport layer looks at datagram at n|w data limit & frame data limit & does segmentation in such a way that resulting data can easily fit in a frame without the need of fragmentat^n
- Rx indentifies the frame with the indent^n (16 bit) field in IP header Each fragment of a frame has same identificat^n number.
- Rx identifies seq of frames using the fragment (13 bit) field in IP header
- An overhead at n|w layer is present due to extra header introduce due to fragmentat^n

fields in IP header for fragmentation.

- Identification (16 bits) use of identify fragments of same frame.
- fragment offset (13 bit). Use of to indentify req of fragments in the frame
- More fragments (MF = 1 bit). Tells if more fragments ahead of this fragment i.e if MF=1 more fragments are ahead of this fragment & if MF=0; it is the last fragment

- Don't fragment (DF=1 bit). If we don't want the packet to be fragmented then DF is set ie DF=1.
- Reassembly of fragments: It take place only at destinat^n & do not at routers since packets take independent path (datagram packet switching so all may not meet at a router & hence a need of fragmentat^n may arise again

MF	fragment offset	
1	0	1st packet
1	i ≠ 0	Intermediate packet
0	i ≠ 0	last packet
0	0	Invalid

Q8) What is the max no. of IP add^r that can be assigned to hosts on a local subnet the uses the 255.255.255.254 Subnet mask?

→ Give subnet mask is 255.255.255.254 binary representat^n of given subnet mask is, 11111111.11111111.11111111.11100000 ie 3 bits on & 5 bits off. This provides 8 subnet & the no of hosts for each subnet is $2^5 - 2 = 30$.

∴ The max no. of IP add^{r}s that can be assigned to hosts on a local subnet that uses the 255.255.255.224 subnet mask is 30.

Q9. What is broadcast IP add^r?

→ A broadcast add^r is a n|w add^r at which all devices connected to multiple access comm^n o|w are enabled to receive datagrams. A msg sent to a broadcast add^r may be received by all n|w attached hosts. In constracts, a multicast add^r is

used to addr a specific group of devices of a network addr is used to addr a single device. In IPv4 nlws broadcast add's are special values in the host identificatn part of an IP addr. The all ones values was established as the std broadcast addr for n/w that support broadcast. The intro of subnets & classless inter domain routing changed this slightly, so that the all-ones host addr of each subnet is that subnets broadcast addr

The broadband addr for an IPv4 for an IPv4 host can be obtained by performing a bitwise OR operation betn the bit complement of the subnet mask & the hosts IP addr for broadcasting a packet to an entire IPv4 subnet using the private IP addr space. 172.162.0.0112 which ~~each~~ has the subnet mask 255.240.0.0 the broadcast addr is 172.16.0.010
.15 2.255.255 = 172.31.255.255

A special defination exist for the IP broadcast addr 255.255.255.255. It is the broadcast addr of the zero n/w or 0.0.0.0 which in IP std's stands for this n/w ie the local n/w Transmission to this addr is limited, in that it is never forwarded by the router connecting the local n/w to other n/ws

Q10. What is the subnetwork for a host with the IP addr 200.10.5.68128?

→ IP addr = 200.10.5.68128

∴ /28 is 255.255.255.240 which means that the block size is 16 in 4th octet

0, 16, 32, 48, 64, 80 etc

∴ The host is in the 64 subnet

Subnetwork addr is 200.10.5.64