IP Addresses

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IP Address:-

An internet protocol address, abbreviated as IP address, is a unique 32 bit binary number assigned to a host and used for all communication with the host.

Dotted Decimal Notation:-

Dotted Decimal Notation is a syntactic form that IP software uses to express 32 bit binary values when interacting with humans. Dotted Decimal represents each octet in decimal and uses a dot to separate octets.

The following is an example.

10000001	00110100	00000110	00000000	129.52.6.0
32-bit binary number				equivalent dotted decimal

Public IP and Private IP:-

IP addresses that are unique in the world are called public IP addresses. IP addresses that are not unique and can be used by many users are called private IP addresses.

Since IP addresses are of 32 bits, 2^{32} addresses can be declared as either public or private. If private addresses are of number 2^{x}. then, there should be 2^{32-x} public IPs left.

Difference between Public IP and Private IP:-

Public IP	Private IP
Public IP addresses are unique in the world.	Private IP addresses are not unique, in different networks, they can be duplicated.
For communication over the internet, public IP addresses can send their own IPs.	For communication over the internet, private IP addresses can't send their own IPs.
They identify themselves by their own IPs.	They identify themselves by taking a proxy IP.
Public IPs are to be bought before using.	Private IPs are not to be bought. Any private IP within its range can be used any time.

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Private Addresses

A number of blocks in each class are assigned for private use. They are not recognized globally.

Class	*Netids*	*Blocks*
A	10.0.0	1
B	172.16 to 172.31	16
C	192.168.0 to 192.168.255	256

More about IP addresses:-

- All 0's combination and all 1's combination are not used as addresses.
- All 0's combination represents network address.
- All 1's combination represents broadcast address.
- All bits are divided into two parts. Left side bits are network bits and right side bits are called host bits.

*What is ARPANET?

*What is Inter-NIC?

*What is Coaxiable Cable?

*What is difference bteween Straight-through and Crossover Cable?

*What are IEEE Standard of Wimax, Wifi, Bluetooth?

*Describe Cracker?

Network Address:-

It is convenient to have an address that can be used to denote the prefix assigned to a given network. IP reserves host address zero and uses it to denote a network. Thus the address 128.211.0.0/16 denotes a network that has been assigned the prefix 128.211.

The network address refers to the network itself and not to the host computers attached to that network. Thus, the network address should never appear as the destination address in a packet.

Broadcast Address:-

When the reserve host bits are all 1, the address is referred to as broadcast address, using broadcast address any message can be sent to all computers connected to the network. Example can be- 128.211.255.255/16.

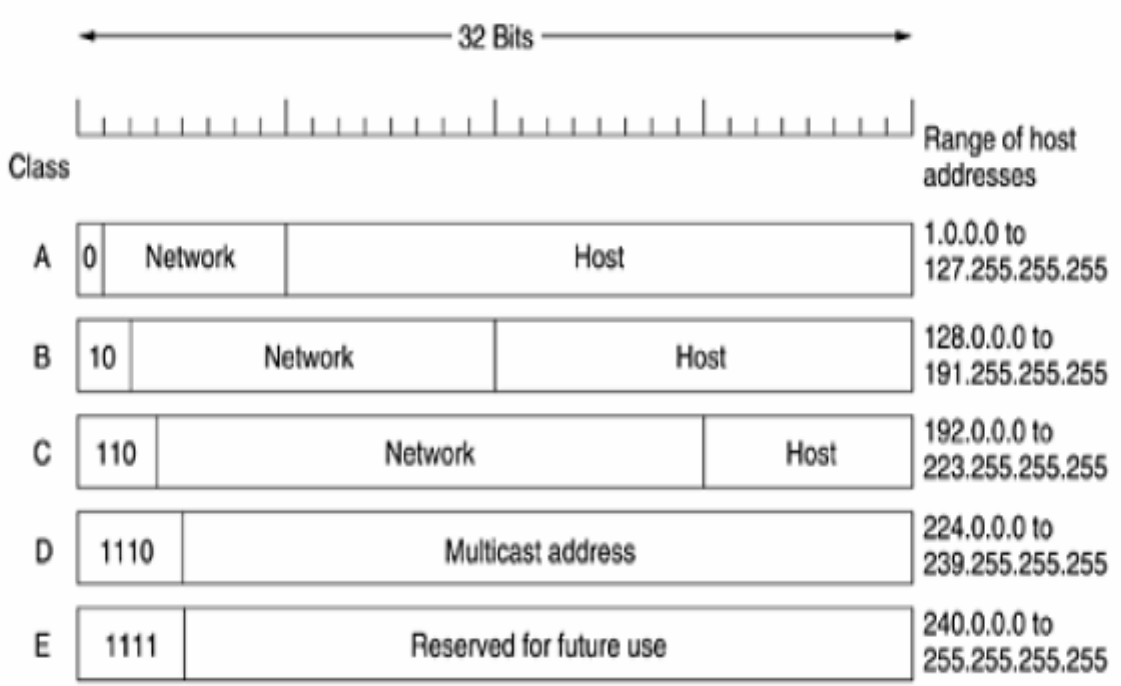
This type of broadcast address is called directed broadcast address.

Limited Broadcast Address:-

The term limited broadcast refers to a broadcast on a local physical network; informally, we say that the broadcast is limited to a single wire. Limited broadcast is used during system startup by a computer that does not yet know the network number.

IP reserves the address consisting of all 1 bits to refer to limited broadcast. Thus IP will broadcast any packet sent to the all-ones address across the local network.

Classification of IP address:-



Range Calculation:

For class A: 00000001-01111111 i.e. 1-127 [only first octet should be taken.]
For class B: 10000000-10111111 i.e. 128-191
For class C: 11000000-11011111 i.e. 192-223
For class D: 11100000-11101111 i.e. 224-239
For class E: 11110000-11111110 i.e. 240-254(?)

Division of the Address Space:-

We know in class A, one network bit is kept fixed while 7 network bits(prefix) can be combined. Thus, in class A, 2^7=128 different networks can be obtained. Again, class A IPs have 24 bits in host part. Thus, 2^{24}=16777216 hosts can be connected to each of the 128 networks. The following table briefs the idea.

Address Class	Network Bits	Maximum Networks	Host Bits	Maximum hosts/network.
A	7	128	24	16777216
B	14	16384	16	65536
C	21	2097152	8	256

Private IPs for class-full addresses:-

Class A(private)→ 10.0.0.0-10.255.255.255 [2^{24} combination]
Class B(private)→ 172.16.0.0-172.31.255.255 [2^{20} combination]
Class C(private)→ 192.168.0.0-192.168.255.255 [2^{16} combination]

Multicast and Broadcast:-

In multicast, destination addresses are fixed within a network while in broadcast, any machine in the network may receive the packet sent.

Unicast, Multicast, and Broadcast Addresses

Unicast communication is *one-to-one*.

Multicast communication is *one-to-many*.

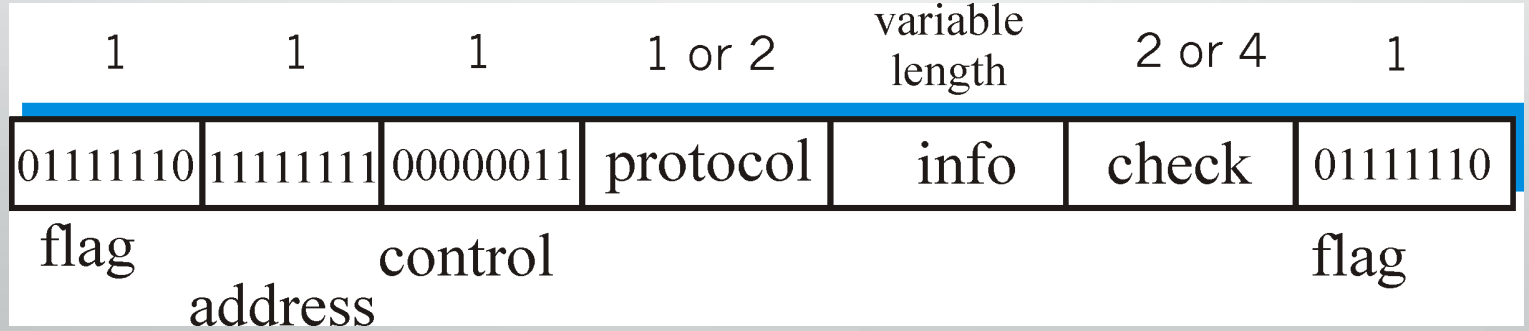
Broadcast communication is *one-to-all*.

Point to Point Data Link Control

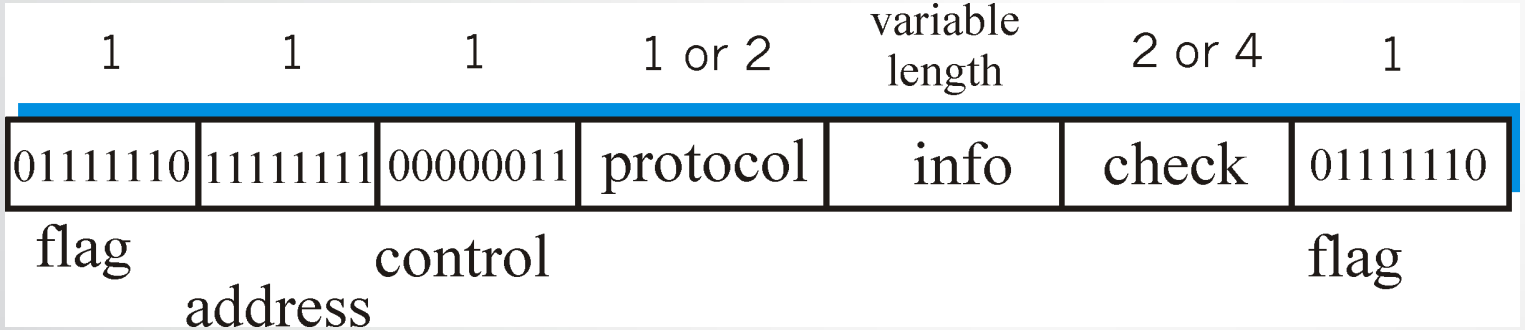
- one sender, one receiver, one link: easier than broadcast link:
  - no Media Access Control
  - no need for explicit MAC addressing
  - e.g., dialup link, ISDN line
- popular point-to-point DLC protocols:
  - **PPP** (point-to-point protocol)
  - **HDLC**: High level data link control (Data link used to be considered "high layer" in protocol stack!)

PPP Data Frame

- Flag: delimiter (framing)
- Address: does nothing (only one option)
- Control: does nothing; in the future possible multiple control fields
- Protocol: upper layer protocol to which frame delivered (eg, PPP-LCP, IP, IPCP, etc)



PPP Data Frame



- info: upper layer data being carried
- check: cyclic redundancy check (CRC) for error detection

Maths

➔Given the network address 132.21.0.0, find the class, the block, and the range of the addresses.

➔Given the network address 220.34.76.0, find the class, the block, and the range of the addresses.

Loopback Address:-

IP reserves the network prefix 127/8 for use with loopback. The host address used with 127 is irrelevant- all host addresses are treated as same. By convention, programmers often use host number 1, making 127.0.0.1 the most popular form of loopback.

Loopback addresses are used for checking the NIC card of the computer. The command is *ping 127.0.0.1*.

Subnet Mask:-

A subnet mask is a 32 bit value that specifies the boundary between the network prefix and suffix, 1 bits mark the network prefix and 0 bits mark the host portion. For example,

192.168.35.5 255.255.0.0 [both 35 and 5 can be changed]	192.168.35.5 255.255.0.0 [only 5 can be changed]

The best way to find out how many bits are being used as network bits, just make the binary of the given subnet mask. For example, from the subnet mask 255.255.240.0, we get- 11111111.11111111.11110000.00000000 i.e. 20 network bits and 12 host bits.

Classless IP address:-

Class-full addressing scheme has a limitation. Let us consider a network that contains 9 hosts. Only four bits of host suffix are needed to represent all possible host values. However, a class C address, which has the fewest hosts possible, devotes eight bits to the host suffix. Classless addressing solves the problem by allowing us to assign a prefix that is 28 bits long. (i.e. the network can have up to 14 hosts)

CIDR notation:-

CIDR notation is a modified form of dotted decimal format that specifies the mask associated with each address by appending a slash and the size of the mask in decimal. For example, a network may have 128.10.0.0/16 meaning that 16 bits are network bits.

Subnetting:-

Subnetting is the task of sub dividing the networks by increasing network bits and reducing host bits.

Let an address be 192.168.5.0/24

That is rest eight bits are host bits as shown below.

H	H	H	H	H	H	H	H

Now, let us consider the left most host bits as network bit.

N	H	H	H	H	H	H	H

This N can either be 0 or 1, thus, keeping the original 24 bits(network) fixed, now we have 21 different networks each containing 27 hosts.

Similarly-

N	H	H	H	H	H	H	H	2^2 subnets, each containing 2^6 hosts
N	N	H	H	H	H	H	H	2^3 subnets, each containing 2^5 hosts
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N	N	N	N	N	N	N	H	2^7 subnets, each containing 2^1 hosts (in this case, no valid host address)

 # MAC address:-

Most LAN technologies use an addressing scheme to provide direct communication. Each station on the LAN is assigned a numeric value which is known as physical address or media access (MAC) address.

Socket Number:-

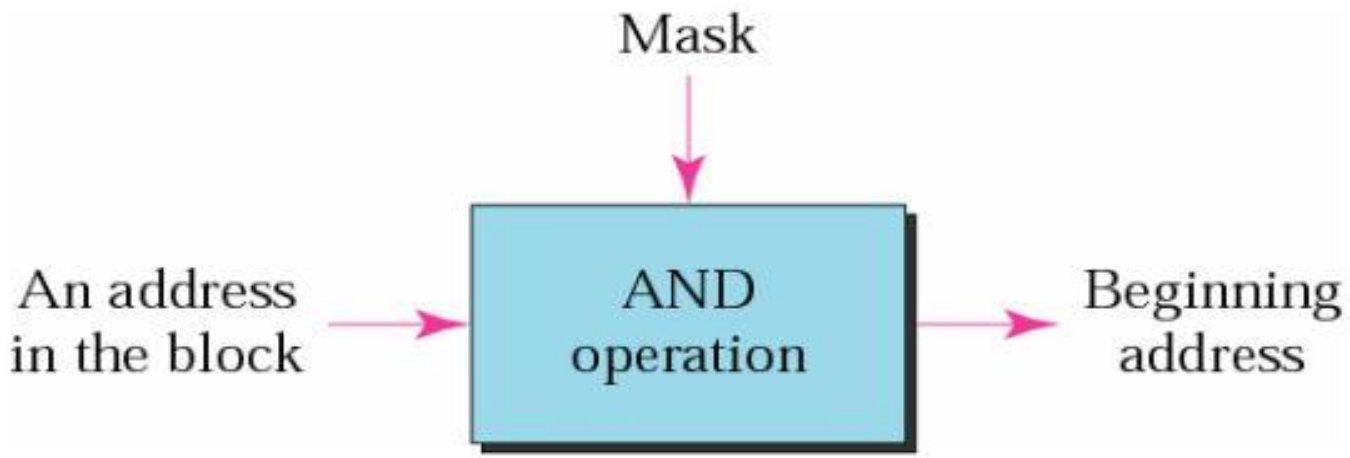
Socket number is the number that is made up of the combination of private IP addresses and MAC addresses.

Port Number:-

From two parallel browsers, data is never overlapped though both browsers contain the combination of same IP and MAC number (socket number). It is port numbers for which the data for parallel browsers choose different path.

Mask

A mask is a 32-bit binary number that gives the first address in the block (the network address) when bitwise ANDed with an address in the block.



➔ Suppose Varendra University has a range of IP address 200.200.0.0.16/16.You have to create at least 15 usable subnets so that each subnet contains as many subnet as possible. Answer the following

1. What is the class of the given IP block ?
2. How many usable subnet will be created ?
3. How many usable Ip address there in each subnet ?
4. What will be the subnet mask of the fourth subnet ?
5. What will be the second usable IP address of the third subnet ?

Subnet the address 200.200.200.0/24 in such a way that you can make 4 usable subnets and maximum number of addresses can be used. Hence answer the following-

(i) Define subnet mask for the first usable subnet.

(ii) Find out the first usable host address of first subnet.

(iii)Find out the last usable host of last subnet.

(iv)Find out how many IPs are being lost in this subnetting.

Life is not fear, get used to it.

Bill Gates