Unit – 05: Network Addressing and Management

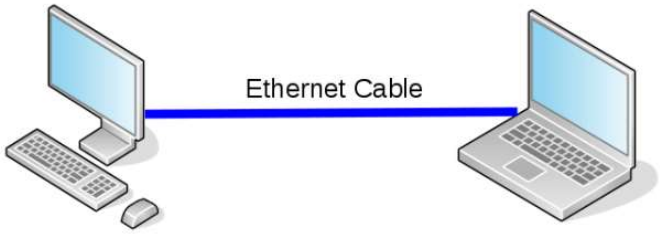
- Introduction to Network Addressing,
- Components of IP Address,
- IP Address Classes,
- IP Sub-netting,
- Classify the two types of Internet Protocol addressing IPv4 and IPv6 and state the need for IPv6, explain classful addressing and classless addressing in IPv4,
- State the need for protocols in computer networks,
  - Hyper Text Transfer Protocol (HTTP),
  - File Transfer Protocol (FTP),
  - Simple Mail Transfer Protocol (SMTP),
  - Telnet.

Questions to be discussed:

1. What is IP address? What are the components of IP Address?
2. What are the different classes of IP addresses and give the range of each class?
3. Explain the difference between Static and Dynamic IP?
4. Differentiate between classful and classless addressing.
5. What is subnet mask? Also explain sub-netting.
6. What is the LOOPBACK address?
7. State the need for protocol. Also differentiate between IPv4 and IPv6.
8. What are the important differences between MAC address and IP address?
9. Write short notes on:
   a) HTTP
   b) FTP
   c) SMTP
   d) TELNET

Computer Network:

- A computer network is a group of interconnected computers that are sharing a resources provided by network nodes.
- These sharing is governed by some set of rules called network protocols.
- These computers are identified by network addresses, and may have hostnames.



Network Address:

- It is a type of address that uniquely identifies a computer (host) in a network.
- Network Address may be logical or physical.
- IP address, MAC address and telephone numbers are some basic examples of network addresses.
- It can be of numeric type or symbolic or both in some cases.

Network Addressing:

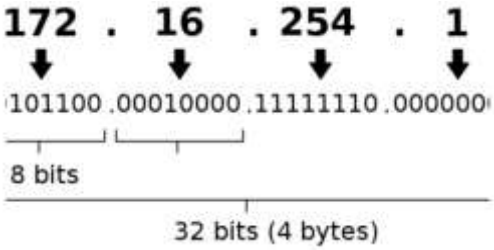
- The process of assigning a address of computer in a network is called network addressing.
- It is the responsibility of the network layer to assign unique addresses to the nodes in a network.
- The most widely used network address is an IP address.
- There are two types of network addressing:
  1. Classful addressing
  2. Classless addressing

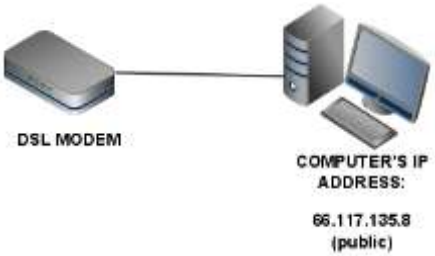
Difference between classful and classless addressing:

Classful Addressing	Classless Addressing
Classful addressing categorizes the IP addresses into five major classes: class A, B, C, D, and E.	Classless addressing is also called Classless Inter-Domain Routing (CIDR**).**
It follow the IP Address classes and subnet mask.	Doesn't follow IP Address classes & subnet mask.
NID and HID changes depending on class.	There is no boundary of NID and HID.
Not support VLSM(Variable Length Subnet Mask)	Support VLSM.
In classful routing, fault can be detected easily.	Here, fault detection is little tough.

What is an IP address?

- An IP address is a unique address that identifies a device on the internet or network.
- IP stands for "Internet Protocol," which is the set of rules governing the format of data sent via internet.
- An IP Address is an address of node (computer) within the network.
- It is used to uniquely identify a node in a network.
- An IP address consist of 32-bits address that is split into four sections separated by dots.
- The IP address is made up of four parts, each of which is 8 bits long (1 byte).
- Example:





IP address classes:

- **Class A:** An IP address is assigned to those networks that include large number of hosts.
- **Class B:** An IP address is assigned to networks range from small sized to large sized.
- **Class C:** An IP address is assigned to networks that are small sized.
- **Class D:** IP address are reserved for multicast address and does not possess sub-netting.
- **Class E:** An IP address is used for the future use and for the research and development purposes.

- By reading the first octet, we can determine the class of an address to which it belongs.
  - 1 – 126 – Class A address
  - 128 – 191 – Class B address
  - 192 – 223 – Class C address
  - 224 – 239 – Class D address
  - 240 – 254 – Class E address

Note: the IP address 0.0.0.0 is used for broadcasting while 127.0.0.1 is used as a loopback address.

What is the LOOPBACK address?

- The IP address **127.0. 0.1** is called a loopback address.
- This can be used for diagnostic purposes to verify that the internal path through the TCP/IP protocols is working.
- Loopback Address is used to send a message to itself to make sure that the TCP/IP stack is installed correctly on the machine.

Components of IP Address:

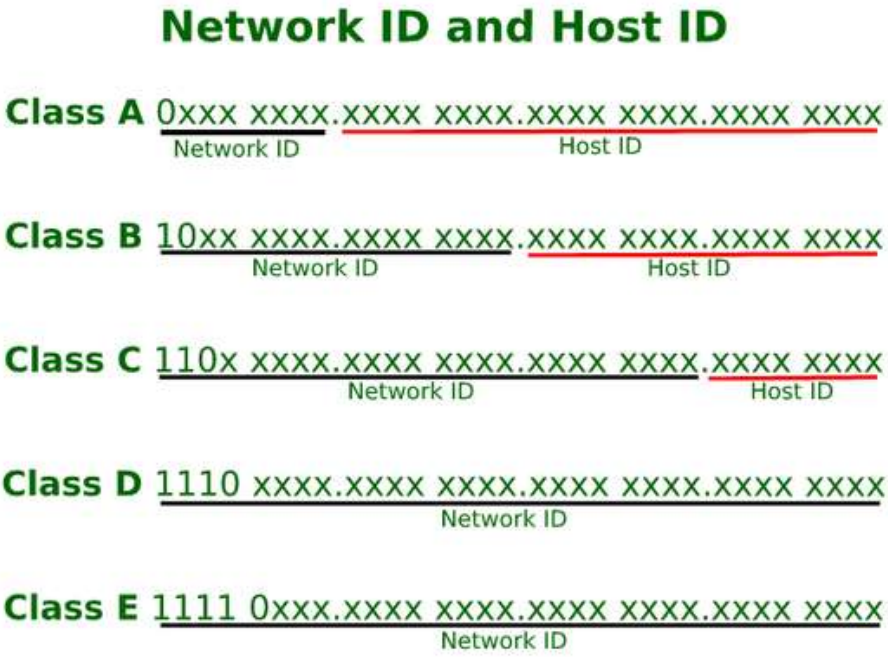
- Network ID(NID)
- Host ID(HID)

Network ID:

- The NID is the fragment of IP address identifies the network segment to which the host belongs.

Host ID:

- The HID is the fragment of an IP address that identifies an individual host on specific network segment.



CLASS	LEADING BITS	NET ID BITS	HOST ID BITS	NO. OF NETWORKS	ADDRESSES PER NETWORK	START ADDRESS	END ADDRESS
CLASS A	0	8	24	2^7 (128)	2^{24} (16,777,216)	0.0.0.0	127.255.255.255
CLASS B	10	16	16	2^{14} (16,384)	2^{16} (65,536)	128.0.0.0	191.255.255.255
CLASS C	110	24	8	2^{21} (2,097,152)	2^8 (256)	192.0.0.0	223.255.255.255
CLASS D	1110	NOT DEFINED	NOT DEFINED	NOT DEFINED	NOT DEFINED	224.0.0.0	239.255.255.255
CLASS E	1111	NOT DEFINED	NOT DEFINED	NOT DEFINED	NOT DEFINED	240.0.0.0	255.255.255.255

Difference between static and dynamic IP Address:

Static IP Address	Dynamic IP address
It is provided by ISP. (ISP - Internet Service Provider).	While it is provided by DHCP. (DHCP - Dynamic Host Configuration Protocol).
It does not change at IP any time.	It change at IP any time.
A static IP address is less secure.	A dynamic IP address is more secure.
The device designed by static IP address can be trace.	The device designed by dynamic IP address can't be traced.
It is more stable than a dynamic IP address.	It is less stable than static IP address.
Maintaining cost of static IP address is higher.	Maintaining cost of dynamic IP address is less.

Difference between MAC Address and IP Address:

MAC Address	IP Address
MAC stands for Media Access Control.	IP stands for Internet Protocol.
MAC Address is a 6 byte hexadecimal address.	IP Address is either 4 byte or 16 byte address.
NIC Card's Manufacturer provides the MAC Address.	Internet Service Provider provides IP Address.
MAC Address is the physical address of computer.	IP Address is the logical address of the computer.
MAC Address operates in the data link layer.	IP Address operates in the network layer.
MAC Address of computer cannot be changed.	IP Address can be changed network to network.
MAC Address can't be found easily by third party.	IP Address can be found by third party.

What is subnet mask?

- A subnet mask is like an IP address, but for only internal usage within a network.
- Routers use subnet masks to route data packets to the right place.
- A subnet mask is a 32-bit number created by setting host bits to all 0s and setting network bits to all 1s.
- The "255" address is always assigned to a broadcast address, and the "0" address is always assigned to a network address.
- By default subnet mask:
  - Class A - 255.0.0.0
  - Class B - 255.255.0.0
  - Class C - 255.255.0.0

What is sub-netting?

- When a bigger network is divided into smaller networks, to maintain security, then it is known as Sub-netting.
- In other words, the process of dividing a network into two or more networks is called sub-netting.
- So, maintenance is easier for smaller networks.
- For example, if we consider a class A address, the possible number of hosts is 2^{24} for each network.
- It is obvious that it is difficult to maintain such a huge number of hosts, but it would be quite easier to maintain if we divide the network into small parts.

Difference between IPv4 and IPv6:

IPv4	IPv6
IPv4 stands for internet protocol version 4.	IPv6 stands for internet protocol version 6.
IPv4 has a 32-bit address length	IPv6 has a 128-bit address length
IPv4 has a header of 20-60 bytes.	IPv6 has header of 40 bytes fixed
IPv4 can be converted to IPv6	Not all IPv6 can be converted to IPv4
IPv4 consist of 4 fields which are separated by dot (.)	IPv6 consist of 8 fields, which are separated by colon (:)
In IPv4, IP addresses are divided into 5 classes. Class A , Class B, Class C , Class D & Class E.	IPv6 does not have any classes of IP address.
Example of IPv4: 66.94.29.13	Example of IPv6: 2001:0000:3238:DFE1:0063:0000:0000:FEFB

Network protocol:

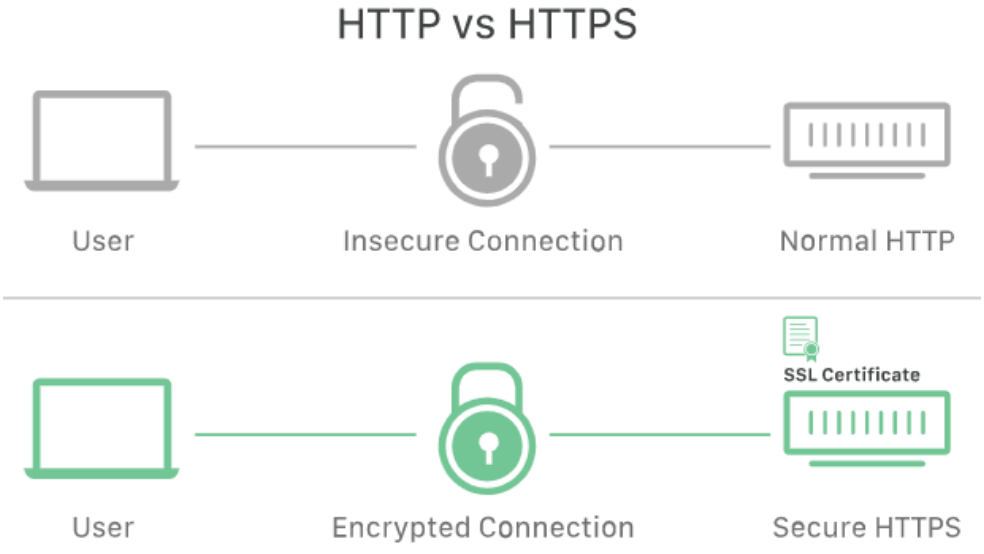
- Network protocol is a set of rules that is required for communication.
- It determine how data is transmitted between different devices in the same network.
- Network protocols are like a common language for computers.
- It also allows connected devices to communicate with each other.
- Network protocols are the reason you can easily communicate with people all over the world.
- Some popular network protocols are HTTP, FTP, SMTP, TCP, UDP, Telnet etc.

State the need of network protocol:

- As we know that, the set of rules and regulations is called a Protocol.
- A set of rules is needed for any means of communication.
- Human intercommunication requires rules of conversation to function effectively.
- Computers are no different.
- If the two people talk at the same time then we get what is known as data collision.
- Therefore, we need regulations and rules to how we communicate over a computer network.

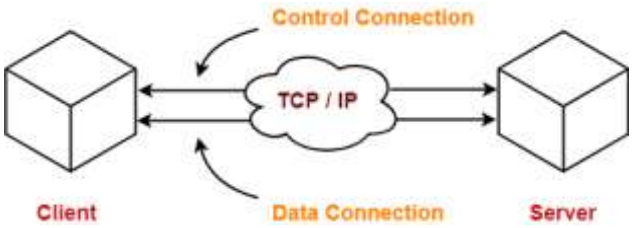
HTTP:

- HTTP stands for Hypertext Transfer Protocol.
- It is a protocol used to access the data on the WWW.
- It is used for transferring data between devices.
- It can be used to transfer the data in the form of plain text, hypertext, audio, video, and so on.
- HTTP belongs to the application layer (layer 7).
- It is invented by Tim Berner**.**
- HTTP is a connectionless protocol.
- By default, the standard port number of 80 for HTTP and 443 for HTTPS.



FTP

- FTP stands for File transfer protocol.
- It is a internet protocol provided by TCP/IP used for transmitting the files from one host to another.
- It is also used for downloading the files to computer from other servers.
- FTP is an application layer protocol.
- There are two types of connections in FTP:
  1. Control connection
  2. Data connection
- Port 21 for the control port and port 20 for the data port.



SMTP:

- SMTP stands for Simple Mail Transfer Protocol.
- It is a set of communication guidelines that allow software to transmit an electronic mail over the internet.
- It is a program used for sending messages to other computer users based on e-mail addresses.
- SMTP is an application layer protocol.
- SMTP is used to send the mail whereas POP/IMAP are used to retrieve those emails at receiver's side.
- Port 25 is the original standard email SMTP port.

  - ✓ POP - Post Office Protocol
  - ✓ IMAP - Internet Message Access Protocol

TELNET

- Telnet stands for **Tel**etype **Net**work.
- It is a client/server application protocol.
- It provides access to virtual terminals of remote systems on the Internet.
- The first version of Telnet was created for the ARPANET.
- Telnet uses the port 23 to establish a connection with remote computers.
- Telnet consists of two components:
  - ➢ The protocol itself which specifies how two parties communicate and
  - ➢ The software application that provides the service