

Fundamentals of Networking

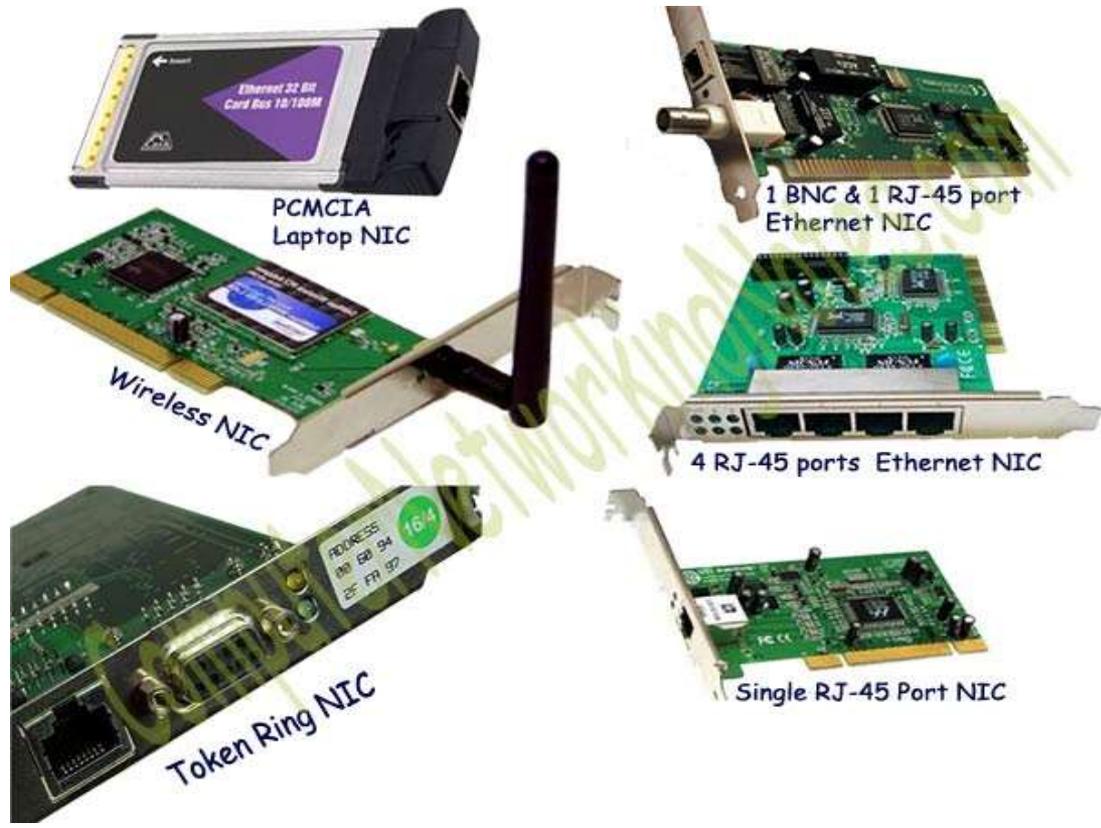
Introduction to Networking Devices

NIC (Network Interface Card)

- A network interface provides connectivity from an end-user PC or laptop to the public network.
- In earlier time it was a separate card and need to be installed on motherboard. All modern computers have it as the integral part of motherboard.
- Also called as Network adapter card, Ethernet Card and LAN card

There are two types of NICs

- **Media Specific :-** Different types of NICs are required to connect with different types of media. For example we cannot connect wired media with wireless NIC card. Just like this, we cannot connect coaxial cable with Ethernet LAN card. We have to use the LAN card that is particularly built for the media type which we have.
- **Network Design Specific :-** A specific network design needs a specific LAN card. For example FDDI, Token Ring and Ethernet have their own distinctive type of NICs card. They cannot use other's NIC card.



Network Repeater

- A repeater connects two segments of your network cable. It retimes and regenerates the signals to proper amplitudes and sends them to the other segments.
- When talking about, Ethernet topology, you are probably talking about using a hub as a repeater. Repeaters require a small amount of time to regenerate the signal.
- This can cause a propagation delay which can affect network communication when there are several repeaters in a row.
- Many network architectures limit the number of repeaters that can be used in a row. Repeaters work only at the physical layer of the OSI network model.





Hub

HUB is used to connect multiple computers in a single workgroup LAN network. Typically HUBs are available with 4,8,12,24,48 ports.

Based on port type, there are two types of HUB:-

- **Ethernet HUB :-** In this type of HUB all ports have RJ-45 connectors.
- **Combo HUB :-** In this type of HUB ports have several different types of connectors such as RJ-45, BNC, and AUI.

Based on functionality, there are two types of HUB:-

- **Passive HUB:-** It forwards the data signal from all ports except the port on which signal arrived. It doesn't interfere in data signal.
- **Active HUB:-** It also forwards the data signal from all ports except the port on which signal arrived. But before forwarding, it improves quality of data signal by amplifying it. Due to this added features active HUB is also known as repeaters.
- **Logically HUB creates** a star topology where it sits in the centre of the topology and all connected systems stay at the points of the star.
- **Physically HUB creates** a bus topology where all connected systems share the same bus connection.

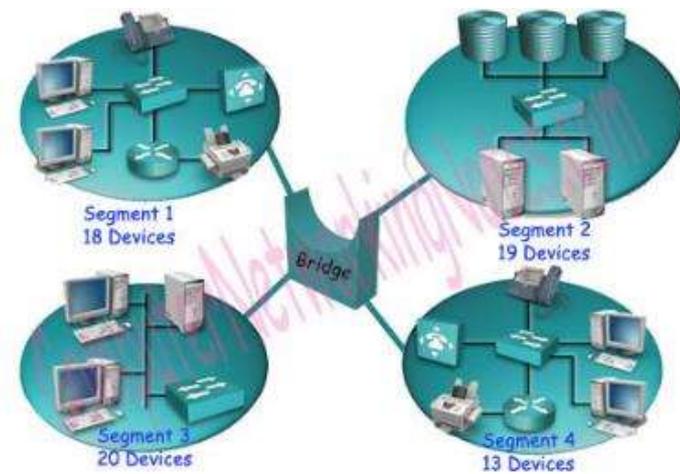


MAU & Patch Panel

- **MAU** :- MAU (Multi Access Unit) is the sibling of HUB for token ring network. The only differences between HUB and MAU are :-
- HUB is used for Ethernet Network while MAU is used for Token ring network.
- HUB creates logically star topology while MAU creates logically ring topology.
- **Patch Panel** :- It is used to organize the UTP cables systematically. It doesn't interfere in data signal.



Bridge



Basic function of Bridge are following :-

- Break a large network in smaller segments.
- Join different media types such as UTP with fiber optic.
- Join different network architectures such as Ethernet with Token Ring.
- A bridge can connect two different types of media or network architecture but it cannot connect two different types of network layer protocol such as TCP/IP or IPX. Bridge requires same network layer protocol in all segments.

Bridges have following issues :-

- Bridges have limited ports.
- In bridge forward decision are made through the software which slow down overall performance of network.
- Bridges use age old technology which is not capable to fulfill the requirement of modern networks effectively.

Local Bridge :- This bridge connects two LAN segments directly. In Ethernet Implementation it is known as Transparent bridge. In Token Ring network it is called Source-Routed bridge.



Remote Bridge :- This bridge connects with another bridge over the WAN link.



Wireless Bridge :- This bridge connects with another bridge without wiring between them.



Switches



- When a switch receives frame, it checks FCS (Frame Checksum Sequence) field in it. Switch process the frame only if it is valid.
- All invalided frames are automatically dropped.
- All valid frames are processed and forwarded to their destination MAC address.
- Switch makes their switching decisions in hardware by using **Application Specific Integrated Circuits (ASICs)**. Unlike generic processor such as we have in our PC, ASICs are specialized processors built only to perform very few particular tasks

Store and Forward

This is the basic mode of switching. In this mode Switch buffers entire frame into the memory and run FCS (Frame Check Sequence) to ensure that frame is valid and not corrupted. A frame less than 64bytes and higher than 1518bytes is invalid. Only valid frames are processed and all invalid frames are automatically dropped. Among these three methods, this method has highest latency. Latency is the time taken by device in passing frame from it.

Cut and Through

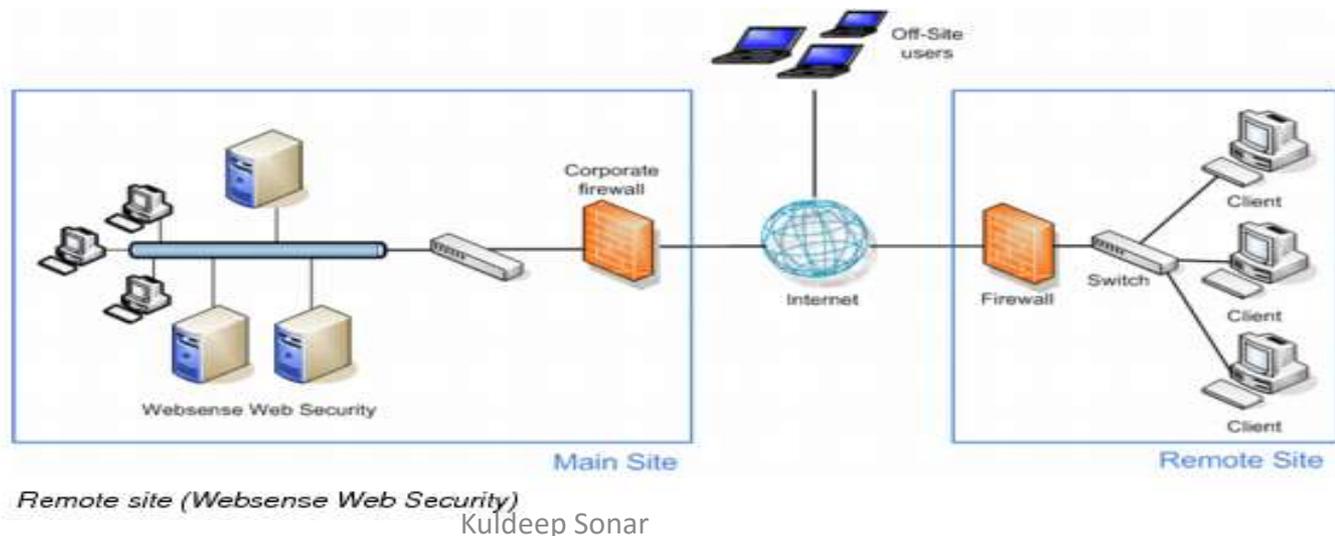
Cut and Through method has lowest latency. In this method Switch only read first six bytes from frame after the preamble. These six bytes are the destination address of frame. This is the fastest method of switching. This method also process invalid frames. Only advantage of this method is speed.

Fragment Free

This is a hybrid version of **Store and Forward** method and **Cut and Through** method. It takes goodies from both methods and makes a perfect method for switching. It checks first 64 bytes of frame for error. It processes only those frames that have first 64bytes valid. Any frame less than 64 bytes is known as runt. Runt is an invalid frame type. This method filters runt while maintaining the speed.

Gateway

- Gateway is used to forward the packets which are intended for remote network from local network. Till host is configured with default gateway address, every packet should have default gateway address.
- A default gateway address is the address of gateway device. If packet does not find its destination address in local network then it would take the help of gateway device to find the destination address in remote network.
- A gateway device knows the path of remote destination address. If require, it also change the encapsulation of packet so it can travel in other network to get its destination address.



Router



Router is a layer three device which forwards data packet from one logical network segment to another. Router forwards packets on the bases of their destination address. For this router keeps record of the path that packets can use as they move across the network. These records are maintained in a database table known as routing table. Routing table can be built statically or dynamically.

Basically routers are used :-

- To connect different network segments.
- To connect different network protocols such as IP and IPX.
- To connect several smaller networks into a large network (known as internetwork)
- To break a large network in smaller networks (Known as subnet usually created to improve the performance or manageability)
- To connect two different media types such as UTP and fiber optical.
- To connect two different network architectures such as token ring and Ethernet.

Brouters

- Brouters are the combination of router and bridge. It can be used as a bridge or router. Brouters are the earlier implementation of the routers.
- At layer two it's a fairly expensive device. which cost more than other high end switches that work much faster than it. At layer three it has a lot of complexity. Due to these drawbacks it is rarely used. Gradually it has been replaced by high end switch at layer 2 and by router at layer three.



Modem

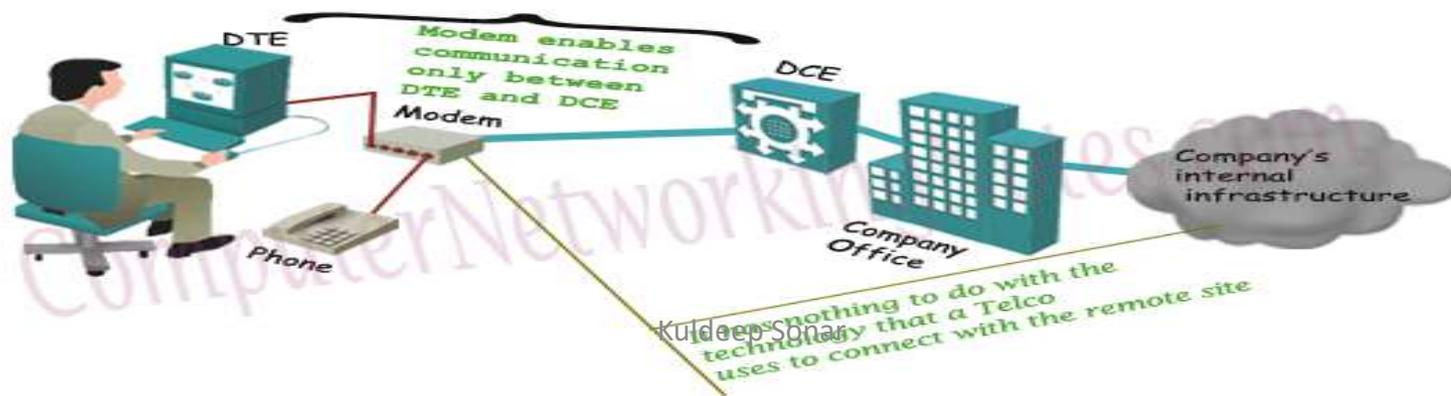
- In simple language modem is a device that is used to connect with internet. Technically it is a device which enables digital data transmission to be transmitted over telecommunication lines. A Telco company uses entirely different data transmission technology from the technology that a PC uses for data transmission.

Analog connection line

- An existing telephone or cable TV network line that uses analog signals (sound waves) for transportation. Instead of supporting Internet, these lines were primarily installed for their respective requirements.

Digital connection Line

- A separate connection line between DTE and DCE. Since it is installed primarily for internet, it uses digital signals for data transportation.



Analog Modem

Analog modem converts analog signal in digital signal and vice versa. There are two types of analog modem; internal and external.

1 Internal Modem

Internal modem is available as interface card for desktop and as PCMCIA card for laptop . We need to install it on available slot of motherboard. In comparison with external modem these are inexpensive. As these modems usage computer's CPU for data encoding and decoding. We have to purchase these modem separately.

2 External Modem

External modem is a separate device that has its own CPU and memory.

Digital Modem

Instead of signal conversion, digital modem performs modulation known as line coding. Line coding is used to modulate the digital signal in such a way that they can be transmitted over the digital line. DSL, ADSL and ISDN modem are the examples of digital modems.



DTE (Data Terminal Equipment) is a device (usually a router or PC) that converts data frame into signals and reconvert received signals in data frame. DTE device communicates with DCE device.

DCE (Data circuit terminating equipment) is a device (usually modem, CSU/DSU or Frame Relay switch) that provides clock rate and synchronization.

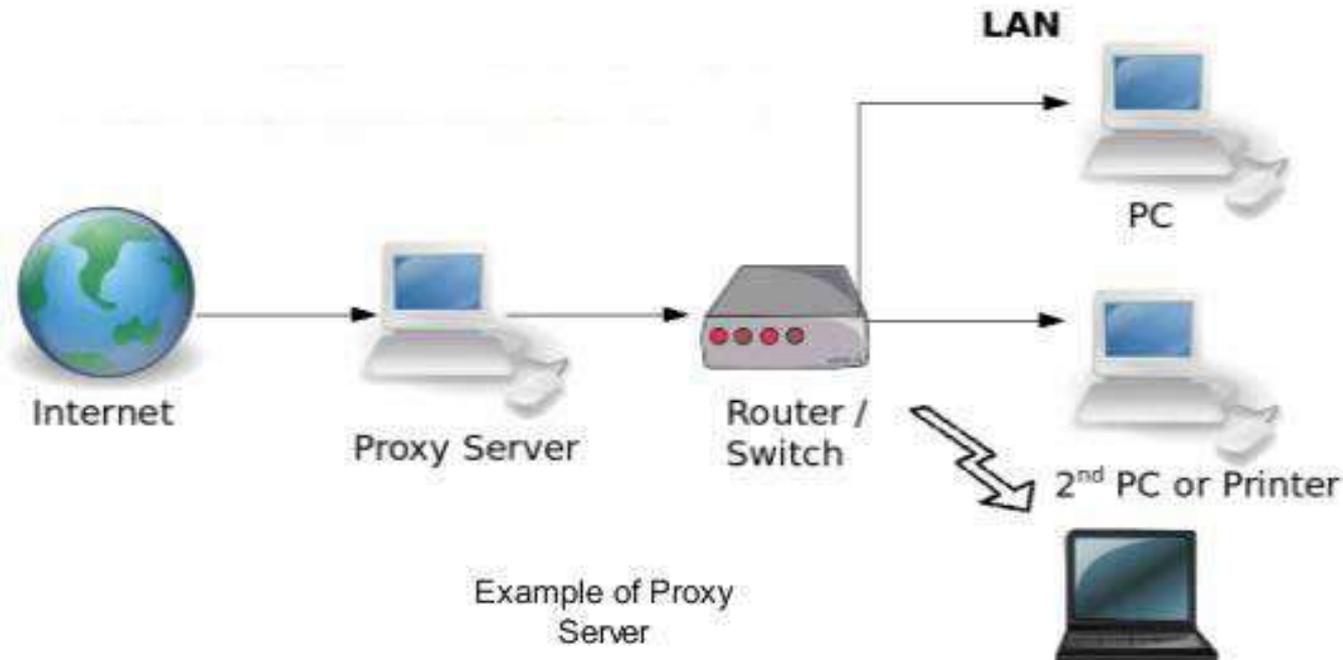
CSU/DSU

A CSU/DSU (Channel Service Unit/Data Service Unit) is a device that converts data signal between LAN network and WAN network. LAN network and WAN network uses separate communication technology. A CSU/DSU understands both technologies. DSL and cable modems are the example of CSU/DSU.



Proxy

Proxy can be a dedicated device or software. Proxy is used to hide the internal network from the external world. If we use proxy then there would be no direct communication between the internal network and the external network. All communication will go through the proxy. External computers will be able to access only the proxy. Thus, proxy makes tampering with an internal system from the external network more difficult.





Transceivers (Media Converters)

- Transceiver is a small device that has capability of receiving and sending both analog and digital signals. Usually it is inbuilt in network interface card. But it is also available separately in market. It detects the type of signal from network wire and converts the passing signal to match with it.
- For example a transceiver is attached with a device that transmit signal in digital form. Now suppose this device is connected with the network wire that uses analog form for data transmission. In this case transceiver will convert digital signal in analog signal before placing them in network wire.

Client & Server

Client

- End devices that users use to access the shared resources. Usually they run desktop version of OS such as Window 10, Window 7, and Window XP. Client computers are also known as **workstations**.

Server

- Computers that provide shared resources. Usually they run sever version of OS such as Window Server 8 or 2003, Linux and NetWare. Server computers run many specialized services to control the shared resources.



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