Computer Networks 1

Lab 1

Network Devices

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I. <u>Objectives:</u>

- Get to know basic network devices
- Understand functions of network devices
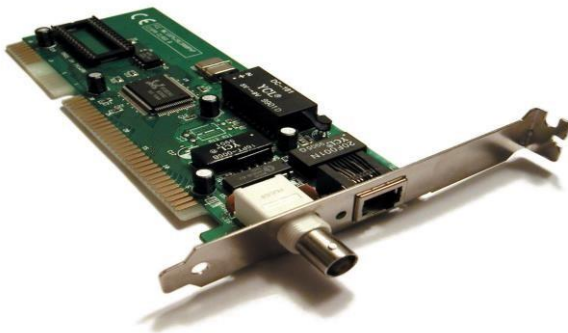- Able to connect different network devices together to form a simple network

II. <u>Content</u>

1. Get to know network devices:

Network Interface Card (NIC)
Cables
Hub
Switches
Routers
Access Points
Modems

2. Understanding functions of network devices

a. Network Interface Card (NIC)

NIC functions:

+ wired and wireless communications.

+ communications between computers connected via local area network (LAN) as well as communications over large-scale network through Internet Protocol (IP).

+ provides the necessary hardware circuitry so that the physical layer processes and some data link layer processes can run on it.
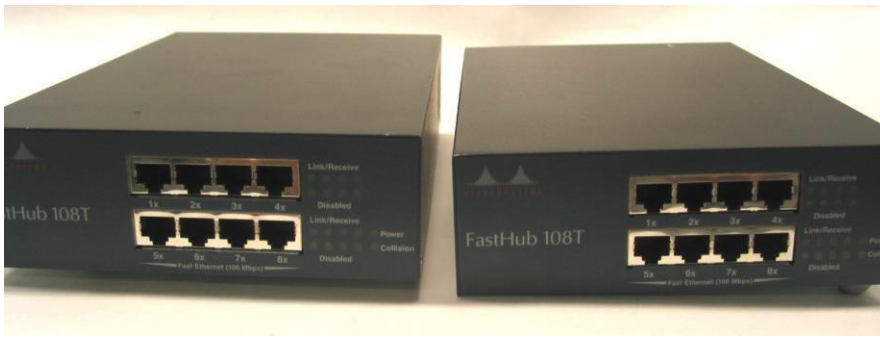
Code of NIC processors: _____
Check NIC of a computer, what is its MAC address?
➔ Wireless LAN adapter Wi-Fi: EC-2E-98-E2-39-DB
Cable to connect NIC to a network:
➔ Type: Ethernet Cable
➔ Standard: RJ-45 connector

b. Hubs

Roles of hub in a network: used to connect segments of a LAN (Local Area Network)
Main characteristics:
 + They operate in the physical layer of the OSI model.
 + It is a non-intelligent network device that sends message to all ports.
 + It primarily broadcasts messages.
 + Transmission mode is half duplex.
 + Collisions may occurs during setup of transmission when more than one computers place data simultaneously in the corresponding ports.
 + They are passive devices, they don't have any software associated with it.
 + They generally have few ports of 4/12.
Weaknesses of hub:
 + Collision Domain
The function of the collision domain and again transfer of packet does not affect actually it increases more chances of collision in between domains.

+ Full-Duplex Mode

Hubs cannot communicate fully duplex mode, it can only operate in half-duplex mode. Half-duplex mode, in essence, means data are often transmitted just one occasion at a given time. Therefore, the hub must constantly switch its modes.

+ Specification

Hubs cannot support networks that are large like a token ring. This is often because hubs must share data among all the devices within the network.

+ Network Traffic

As the attachment was received in the packet so it cannot reduce traffic. Hence, hubs make a high level of network traffic.

+ Bandwidth Wastage

Hubs cannot provide dedicated bandwidth for every device, it is to share them. When sending large pieces of information all the bandwidths are going to be occupied by the two computers leaving other computers with slow network.

Hub ports: 8P8C ("RJ45"), 10BASE2 or 10BASE5

c. Switches

Roles of switches in a network: enables connected devices to share information and talk to each other.

Main characteristics of switches:

- A switch operates in the layer 2, i.e. data link layer of the OSI model.

- It is an intelligent network device that can be conceived as a multiport network bridge.

- It uses MAC addresses (addresses of medium access control sublayer) to send data packets to selected destination ports.

- It uses packet switching technique to receive and forward data packets from the source to the destination device.

- It is supports unicast (one-to-one), multicast (one-to-many) and broadcast (one-to-all) communications.

- Transmission mode is full duplex, i.e. communication in the channel occurs in both the directions at the same time. Due to this, collisions do not occur.

- Switches are active devices, equipped with network software and network management capabilities.

- Switches can perform some error checking before forwarding data to the destined port.

- The number of ports is higher – 24/48.

Differences between hubs and switches:

S.NO	HUB	SWITCH
1.	Hub is operated on **Physical layer of OSI model**.	While switch is operated on **Data link layer of OSI Model**.
2.	Hub is a broadcast type transmission.	While switch is a Unicast, multicast and broadcast type transmission.
3.	Hub have 4/12 ports.	While switch can have 24 to 48 ports.
4.	In hub, there is only one collision domain.	While in switch, different ports have own collision domain.
5.	Hub is a half duplex transmission mode.	While switch is a full duplex transmission mode.
6.	In hub, Packet filtering is not provided.	While in switch, Packet filtering is provided.
7.	Hub cannot be used as a repeater.	While switch can be used as a repeater.
8.	Hub is not an intelligent device that sends message to all ports hence it is comparatively inexpensive.	While switch is an intelligent device that sends message to selected destination so it is expensive.
9.	Hub is simply old type of device and is not generally used.	While switch is very sophisticated device and widely used.
10.	Hacking of systems attached to hub is complex.	Hacking of systems attached to switch is little easy.

Weaknesses of switches:

+ Costly
They are more costly in contrast with network spans.

+ Tough Availability issues
Network availability issues are hard to be followed through the organization switch.

+ Issues in traffic broadcasting
Broadcast traffic might be problematic.

+ Defenseless
If switches are in the indiscriminate mode, they are defenseless against security assaults for example caricaturing IP address or catching Ethernet outlines.

+ Need for Proper Planning
Proper planning and arrangement are required to deal with multicast parcels.

+ Mechanical Component can wear out
The switch's mechanical component can wear out with time.

+ Physical contact is mandatory
Must have physical contact with the object to be actuated.

Switch ports: three common switch port types: access port, trunk port and hybrid port.
RJ45 Port, SFP Port, SFP+ Port, SFP28 Port, QSFP+ Port, QSFP28 Port

d. Routers
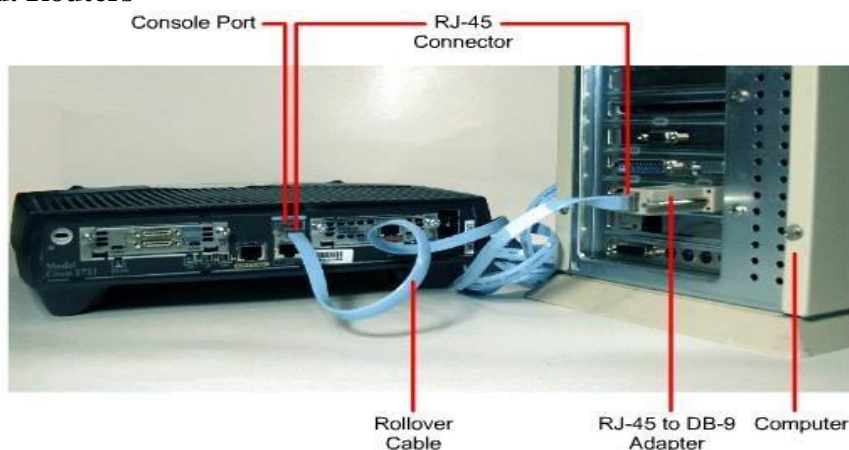
Roles of routers in a network:
A router is a networking device that forwards data packets between computer networks. Routers perform the traffic directing functions on the Internet. Routers make the Internet

work by forwarding data using a unified addressing system. They can send information to anywhere in the world as long as that location has an IP address.

Main characteristics of routers:

1. Routers are multi-port devices with high – speed backbones
2. Routers also support filtering and encapsulation like bridges
3. Like bridges routers are also self-learning, as they can communicate their existence. to other devices and can learn of the existence of new routers, nodes and LAN segments
4. As explained earlier, they route traffic by considering the network as a whole. It shows that they use a high level of intelligence to accomplish this task. This characteristic makes them superior than hubs and bridges because they simply view the network on a link-by-link basis
5. The packet handled by router may include destination address, packet priority level, least-cost route, minimum route delay, minimum route distance, and route congestion level
6. Routers constantly monitor the condition of the network, as a whole to dynamically adapt to changes in the condition of the network
7. They typically provide some level of redundancy so that they are less susceptible to catastrophic failure.

Differences between routers and switches:

Key	Router	Switch
Objective	Router main objective is to connect various networks.	Switch main objective is to connect various devices in a network.
Layer	Router works in Network Layer.	Switch works in Data Link Layer.
Usage	Router is used in LAN and MAN.	Switch is used only in LAN.
Data Format	Router sends data in form of packets.	Switch sends data in form of packets and frames.

Key	Router	Switch
Mode of Transmission	Router follows duplex mode of transmission.	Switch also follows duplex mode of transmission.
Collision	Less collision in case of Router.	In full duplex mode, no collision happens in switch too.
NAT Compatability	Compatible with NAT.	Not compatible with NAT.
Type	Routing type is Adaptive and Non-adaptive routing.	Switching type is Circuit, Packet and Message switching.

Router ports:
Aux port, Attachment Unit Interface (AUI) port, Serial, Ethernet/Fast Ethernet/Gigabit Ethernet, Console, WAN Interface Card (WIC) port, Hardware WAN Interface Card (WIC) port

d. Access Points

Roles of access points: allows wireless-capable devices to connect to a wired network
Main characteristics of access points:

¤ Access points are the basic elements of a wireless network – They scan for the wireless devices in its range and all the neighbouring Wi-Fi systems connect to the Access Point to communicate with the network.

¤ Access points offer a standard for connectivity – a, b/g, b/g/n which are all ratified by IEEE so that the Wi-Fi systems from various vendors can connect to the network.

¤ Access points connect to PC's, laptops, PDA's, mobiles, Wi-Fi phones, Wi-Fi Cameras, Wi-Fi display management systems and a host of other devices that work on the Wi-Fi standard.

¤ Access points can also scan the network for wireless threats and attacks.

Access point's interfaces:

command-line interface (CLI), the browser-based management system, or Simple Network Management Protocol (SNMP).

Compare access point and other networking devices mentioned above:

Access point vs Router:

The router acts as a hub that sets up a local area network and manages all of the devices and communication in it. **An access point**, on the other hand, is a sub-device within the local area network that provides another location for devices to connect from and enables more devices to be on the network.

Wireless routers can function as access points, but not all access points can work as routers. While routers manage local area networks, communicate with outside network systems, acquire, distribute, and dispatch data in multiple directions, establish a point of connectivity, and ensure security, access points typically only provide access to the router's established network.

Access point vs Switch:

These are two completely different devices.

A switch connects various Ethernet devices via individual cables, acting as the center of the star-shaped network.

An access point connects various Wi-Fi devices to the wired network (the access point itself is one of the Ethernet devices connected to the switch using a cable).

Access point vs Hub:

A hub can't identify the source or destination of the information it receives, so it sends the information to all of the computers connected to it, including the one that sent it. A hub can send or receive information, but it can't do both at the same time.

Access points provide wireless access to a wired Ethernet network. An access point plugs into a hub, switch, or wired router and sends out wireless signals. This enables computers and devices to connect to a wired network wirelessly.

e. Modem
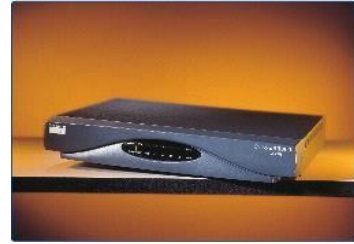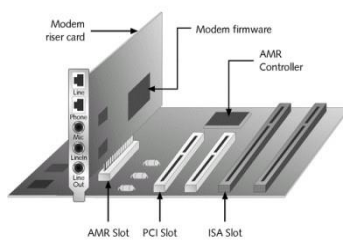
Differentiate:
* Dial-up modem
* ADSL Modem
* Cable Modem

For each type of modem describe **its roles and characteristics:**

Dial-up

This is the grandpappy of internet connections and just as slow… like, S-L-O-W, capable only of 56kbps or lower. However, for the most basic uses such as sending mails with small- to medium-sized files attached, dial-up should do.

Dial-up will also allow you to view most websites, generally content-heavy ones. But sites loaded with graphics, animations and other tricks will take a while to load. For real-time viewing and videos, dial-ups can't perform as well. The connection will also hog the phone line so making or receiving phone calls when internet access is on can only be done using a separate line.

DSL

DSL stands for Digital Subscriber Line. It is a type of broadband connection and considerably much faster than dial-up. The two most common types are ADSL (asymmetrical) and SDSL (symmetrical).

A DSL connection will not tie up a phone line. It's always available so there is no need to dial an ISP. DSL speeds can go from several hundred kbps to around 8 Mbps. This much speed allows high volume data use, loads websites quickly and is quite efficient to use with live chats, viewing videos in real time and playing online games.

Cable

Cable internet connection is faster than a dial-up but sometimes slower than DSL. Internet connection is obtained using a cable modem. This connection will be shared on lines used for cable TV. To transmit data, space reserved for TV channels are used, some to handle upstream transmissions and others for downstream transmissions.

3. Connecting network devices:

Identify the type of network cable can be used for below network connections:
a) Computer and hub _straight-through_____
b) Computer and switch __ straight-through _____
c) Computer and router ___ cross-over _____

d) Computer hub and hub __crossover_____
e) Hub and switch _____crossover_____
f) Hub and router _____straight-through__

g) Switch and switch_____cross-over_____
h) Swith and router _____straight-through_____
k) Router and router _____cross-over_____