LAB 1A

Network Devices

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II. Content

2. Understanding functions of network devices

a. Network Interface Card (NIC)

- NIC functions:

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

    NIC is both a physical layer and a data link layer device, i.e. it 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:

    Code NIC 6311

    63111 Data processing activities including report writing

    63112 Web hosting activities

    63113 Providing general time-share mainframe facilities to clients

    63114 Providing data entry services

    63119 Other data processing, hosting and related activities n.e.c.

- Check NIC of a computer, what is its MAC address?

    94-B8-6D-63-8F-99

- Cable to connect NIC to a network:

    Type: coaxial, twisted pair, and fiber-optic cabling

    Standard: CAT5e, CAT6, CAT6a, CAT7, CAT8

b. Hubs

- Roles of hub in a network:

    Hub is commonly used to connect segments of a LAN (Local Area Network). A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets. Hub acts as a common connection point for devices in a network.

- Main characteristics:

It works with broadcasting and shared bandwidth.

It has 1 broadcast domain and 1 collision domain

Works at the physical layer of the OSI model

A virtual LAN can't be created using a hub

Provides support for half-duplex transmission mode

A hub has just a single broadcast domain

Does not support spanning tree protocol

Packet collisions occur mostly inside a hub

- Weaknesses of hub:

    It's mostly half-Duplex

    Does not offer dedicated bandwidth

    It can not select Network's Best Path.

    There is no mechanism of any kind to reduce network traffic.

    Possibility of the device differentiation

    Network size

- Hub ports:

c. Switches

- Roles of switches in a network:

    In a network, a switch is a hardware device that filters and forwards network packets from one networking device (switch, router, computer, server, etc.) to another.

- Main characteristics of switches:

    It is Datalink layer device (Layer 2)

    It works with fixed bandwidth

    It maintains a MAC address table

    Allows you to create virtual LAN

    It works as a multi-port bridge

    Mostly comes with 24 to 48 ports

    Supports half and full-duplex transmission modes

- Differences between hubs and switches:

Hub	Switch

A hub operates on the physical layer.	A switch operates on the data link layer.
Hubs perform frame flooding that can be unicast, multicast, or broadcast.	It performs broadcast, then the unicast and multicast as needed.
Just a singular domain of collision is present in a hub.	Varied ports have separate collision domains.
Transmission mode is Half-duplex	Transmission mode is Full duplex
Hubs operates as a Layer 1 devices per the OSI model.	Network switches help you to operate at Layer 2 of the OSI model.
To connect a network of personal computers should be joined through a central hub.	Allow connecting multiple devices and ports.
Uses electrical signal orbits	Uses frame & packet
Does not offer Spanning-Tree	Multiple Spanning-Tree is possible
Collisions occur mostly in setups using hubs.	No collisions occur in a full-duplex switch.
Hub is a passive device	A switch is an active device
A network hub can't store MAC addresses.	Switches use CAM (Content Accessible Memory) that can be accessed by ASIC (Application Specific Integrated Chips).
Not an intelligent device	Intelligent device
Its speed is up to 10 Mbps	10/100 Mbps, 1 Gbps, 10 Gbps
Does not use software	Has software for administration

- Weaknesses of switches:

    Not as good as a router for limiting Broadcasts

    Communication between VLAN's requires inter VLAN routing, but these days, there are many Multilayer switches available in the market.

    Handling Multicast packets that requires quite a bit of configuration & proper designing.

    Reduces the number of Broadcast domains

- Switch ports:

    Switch Ports for Device Connections

A switch maintains the MAC addresses of its connected devices and knows into which port a transmission should be directed. Small business switches can be 8-port models, while industrial-grade equipment might supply 48 switch ports.

d. Routers

- Roles of routers in a network:

A router is a switching device for networks, which is able to route network packets, based on their addresses, to other networks or devices. Among other things, they are used for Internet access, for coupling networks or for connecting branch offices to a central office via VPN (Virtual Private Network).

- Main characteristics of routers:

A router works on the 3rd layer (Network Layer) of the OSI model, and it is able to communicate with its adjacent devices with the help of IP addresses and subnet.

A router provides high-speed internet connectivity with the different types of ports like gigabit, fast-Ethernet, and STM link port.

It allows the users to configure the port as per their requirements in the network.

Routers' main components are central processing unit (CPU), flash memory, RAM, Non-Volatile RAM, console, network, and interface card.

Routers are capable of routing the traffic in a large networking system by considering the sub-network as an intact network.

Routers filter out the unwanted interference, as well as carry out the data encapsulation and decapsulation process.

Routers provide the redundancy as it always works in master and slave mode.

It allows the users to connect several LAN and WAN.

Furthermore, a router creates various paths to forward the data.

- Differences between routers and switches:

Router	Switch
Routers operate at Layer 3 (Network) of the OSI model.	Network switches operate at layer two (Data Link Layer) of the OSI model.
Router will offer NAT, NetFlow and QoS Services	Switch will not offer such services.
Store IP address in the routing table and maintain an address on its own.	Store MAC address in a lookup table and maintain an address on its own. However, Switch can learn the MAC address.
Networking device 2/4/8 ports.	A switch is a multi-port bridge. 24/48 ports.

Less Duplex	In Full Duplex, So, no Collision occurs.
The speed limit is 1-10 Mbps for wireless and 100 Mbps for wired connection.	The speed limit for the switch is 10/100Mbps.
Helps users to take the faster routing decision	Likely to take a more complicated routing decision
The router can perform NAT	Switches can't perform NAT
In various types of network environments (MAN/ WAN), the router works faster compares to Switch.	In a LAN environment, a switch is faster than Router.
In Router, every port has its own broadcast domain.	The switch has one broadcast domain except VLAN implemented.
Router operations revolve around IP Addresses.	Switches work with MAC addresses as it operates within the confines of a single network.
Routers can work within both wired and wireless network situations.	Switches are restricted to wired network connections.

- Router ports:

Aux port: This auxiliary port is used to connect a modem to the router, which can then be used to remotely modify the configuration on the router.

Attachment Unit Interface (AUI) port: Before the WIC became a standard for providing expansion through an add-on port, the AUI allowed transceivers to be used, providing you with the ability to add various types of network connections, such as fiber or copper Ethernet connections.

A transceiver is a small electronic device that converts electrical signals from the AUI specification on one side of the transceiver to that of the connection type on the other side of the transceiver. An AUI port is shown in the following figure.

Serial: Connects a modem or other serial device to allow a WAN network interface to be used on the router.

Ethernet/Fast Ethernet/Gigabit Ethernet: Standard network interfaces used to connect different network segments.

Console: Serial configuration port for command-line access to router management and configuration. Refer to Figure 3-1 to see the console port.

WAN Interface Card (WIC) port: Because a wide variety of WAN connectivity options are available (for example, T1, ISDN, ADSL), you can use this port to add different interfaces to a standard router.

Hardware WAN Interface Card (HWIC) port: With the integration of services into routers, the WIC interface became too limiting. The HWIC interface was created to support a wider variety of hardware expansion options, such as switches and service cards. This port is backward compatible with most older WIC hardware.

e. Access Points

- Roles of access points:

Access points are used for extending the wireless coverage of an existing network and for increasing the number of users that can connect to it. A high-speed Ethernet cable runs from a router to an access point, which transforms the wired signal into a wireless one.

- Main characteristics of access points:

Single Radio/ Dual Radio Access Points

External Antennas/ In-built Antennas

IEEE Standard supported: 802.11a,b,g,n:

Support for Mesh Networking

Controller based Access Points and Stand-Alone Access Points

Support for Multiple Services

- Access point's interfaces: An access point only provides an interface/portal for wireless clients to connect to your existing LAN. It does not route traffic between different networks, rather provides wireless access to an already existing local wired network.

- Compare access point and other networking devices mentioned above:

Hubs:

Hubs are used to connect computers on a network so as to communicate with each other. Each computer plugs into the hub with a cable, and information sent from one computer to another passes through the 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.

Switches:

Switches functions the same way as hubs, but they can identify the intended destination of the information that they receive, so they send that information to only the computers that its intended for.

Switches can send and receive information at the same time, and faster than hubs can. Switches are best recommended on a home or office network where you have more computers and want to use the network for activities that require passing a lot of information between computers.

Routers:

Routers are better known as intermediary devices that enable computers and other network components to communicate or pass information between two networks e.g. between your home network and the Internet.

The most astounding thing about routers is their capability to direct network traffic. Routers can be wired (using cables) or wireless. Routers also typically provide built-in security, such as a firewall.

Access Points:

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.

You can move from one location to another and continue to have wireless access to a network. When you connect to the Internet using a public wireless network in an airport, hotel or in public, you are usually connecting through an access point. Some routers are equipped with a wireless access point capability, in this case you don't need a wireless access Point.

f. Modem

Differentiate:

- Dial-up modem

- ADSL Modem

- Cable Modem

For each type of modem describe its roles and characteristics:

- Dial-up modem: Dial-up Internet access is a form of Internet access that uses the facilities of the public switched telephone network (PSTN) to establish a connection to an Internet service provider (ISP) by dialing a telephone number on a conventional telephone line. Dial-up connections use modems to decode audio signals into data to send to a router or computer, and to encode signals from the latter two devices to send to another modem

- ADSL Modem: Asymmetric digital subscriber line (ADSL) is a type of digital subscriber line (DSL) technology, a data communications technology that enables faster data transmission over copper telephone lines than a conventional voiceband modem can provide. ADSL differs from the less common symmetric digital subscriber line (SDSL). In ADSL, bandwidth and bit rate are said to be asymmetric, meaning greater toward the customer premises (downstream) than the reverse (upstream).

- Cable Modem: A cable modem is a type of network bridge that provides bi-directional data communication via radio frequency channels on a hybrid fibre-coaxial (HFC), radio frequency over glass (RFoG) and coaxial cable infrastructure. Cable modems are primarily used to deliver broadband Internet access in the form of cable Internet, taking advantage of the

high <u>bandwidth</u> of a HFC and RFoG network. They are commonly deployed in the <u>Americas</u>, <u>Asia</u>, <u>Australia</u>, and <u>Europe</u>.

3.   Connecting network devices:

Identify the type of network cable can be used for below network connections:

a) Computer and hub: straight-through cable

b) Computer and switch: straight-through cable

c) Computer and router: cross-over cable

d) Computer hub and hub: cross-over cable

e) Hub and switch: cross-over cable

f) Hub and router: straight-through cable

g) Switch and switch: cross-over cable

h) Switch and router: straight-through cable

k) Router and router: cross-over cable