

**Hardware Networking**

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## Module 5. Network Fundamentals and Building Networks

### Topic: Network Basics

#### Beginner Questions

1. **What is a network?**
   * A network is a group of two or more computers or devices connected together to share resources and information.
2. **List Common Network Components**
   * **Router**: Directs data between networks.
   * **Switch**: Connects devices within a network and forwards data to the correct destination.
   * **Modem**: Converts digital data to analog signals and vice versa for internet access.
   * **Network Interface Card (NIC)**: Hardware that connects a computer to a network.
   * **Cables**: Physical wires (like Ethernet cables) that connect devices.
3. **Add and Configure Loopback Adapter in Network and Sharing Center**
   * **Steps**:
     1. Open **Control Panel**.
     2. Go to **Network and Sharing Center**.
     3. Click on **Change adapter settings**.
     4. Click **File** > **Add/Remove Snap-in**.
     5. Select **Microsoft Loopback Adapter** and install it.
     6. Configure IP settings if needed.

#### Intermediate Questions

1. **Explain Application of Network**
   * **File Sharing**: Share files between computers.
   * **Resource Sharing**: Share printers, scanners, and other peripherals.
   * **Communication**: Email, instant messaging, and video conferencing.
   * **Data Management**: Centralized data storage and management.
2. **What do you mean by Node?**
   * A node is any device connected to a network, such as a computer, printer, or router.
3. **Practice of Simple File Folder Sharing**
   * **Steps**:
     1. Right-click the folder you want to share.
     2. Select **Properties**.
     3. Go to the **Sharing** tab.
     4. Click **Share** and choose the users you want to share with.
     5. Set permissions and click **Share**.

#### Advanced Questions

1. **List Types of Devices**
   * **Computers**: Desktops, laptops.
   * **Networking Devices**: Routers, switches, modems.
   * **Peripheral Devices**: Printers, scanners.
   * **Storage Devices**: NAS (Network Attached Storage).
2. **Explain Types of Router**
   * **Wired Router**: Connects devices using Ethernet cables.
   * **Wireless Router**: Connects devices using Wi-Fi.
   * **Core Router**: Used in large networks to route data within the network.
   * **Edge Router**: Connects internal networks to external networks (like the internet).

### Topic: Types of Network

#### Beginner Questions

1. **What is the Difference between a LAN, MAN, WAN?**
   * **LAN (Local Area Network)**: Covers a small area like a home or office.
   * **MAN (Metropolitan Area Network)**: Covers a city or a large campus.
   * **WAN (Wide Area Network)**: Covers a large geographical area, like a country or continent.
2. **Common Network Components**
   * Same as listed above in the first section.

#### Intermediate Questions

1. **Explain Wide Area Network (WAN)**
   * A WAN connects multiple LANs over large distances using leased telecommunication lines.
2. **Explain Network Backbone**
   * The main infrastructure that connects different parts of a network, providing a path for data exchange.
3. **Explain CAN (Campus Area Network)**
   * A CAN connects multiple LANs within a limited geographical area, like a university campus.

#### Advanced Questions

1. **Define Physical Network Topologies**
   * **Bus Topology**: All devices share a single communication line.
   * **Star Topology**: All devices connect to a central hub.
   * **Ring Topology**: Devices are connected in a circular fashion.
   * **Mesh Topology**: Devices are interconnected, providing multiple paths for data.
2. **Network Architecture: Peer-to-Peer**
   * In a peer-to-peer network, each device can act as both a client and a server, sharing resources directly without a central server.
3. **Point-to-Multipoint Network**
   * A single central node communicates with multiple nodes. Common in wireless networks.

### Topic: Network Devices

#### Beginner Questions

1. **Why We Use Network and Devices**
   * To share resources, communicate, and manage data efficiently.
2. **Explain Switch**
   * A switch connects devices within a network and uses MAC addresses to forward data to the correct destination.

#### Intermediate Questions

1. **Define List of Cables in Use of Network**
   * **Ethernet Cables (Cat5, Cat6)**: For wired connections.
   * **Fiber Optic Cables**: For high-speed data transmission.
   * **Coaxial Cables**: For cable internet and TV.
2. **Explain Access Point**
   * A device that allows wireless devices to connect to a wired network using Wi-Fi.
3. **Types of Transmission Modes in Computer Network**
   * **Simplex**: One-way communication.
   * **Half-Duplex**: Two-way communication, but not simultaneously.
   * **Full-Duplex**: Two-way communication simultaneously.
4. **Practice on Remote Desktop Connection**
   * **Steps**:
     1. Open **Remote Desktop Connection**.
     2. Enter the IP address or name of the remote computer.
     3. Click **Connect** and enter credentials.
5. **Practice on Remote Assistance**
   * **Steps**:
     1. Open **Quick Assist**.
     2. Choose to **Give Assistance** or **Get Assistance**.
     3. Follow the prompts to connect.

#### Advanced Questions

1. **Explain Repeater and Router**
   * **Repeater**: Boosts signal strength to extend the range of a network.
   * **Router**: Directs data between different networks.
2. **What is Multiplexer?**
   * A device that combines multiple signals into one for transmission over a single medium.
3. **Explain MODEM**
   * A device that modulates and demodulates signals for internet access over telephone lines.
4. **Monitor “Event Viewer”**
   * **Steps**:
     1. Open **Event Viewer**.
     2. Navigate through **Windows Logs** to view system, application, and security events.

### Topic: Install and Configure DHCP, DNS

#### Beginner Questions

1. **Explain DHCP (Dynamic Host Configuration Protocol)**
   * DHCP automatically assigns IP addresses to devices on a network, simplifying network management.
2. **Application of DHCP with One Example**
   * **Example**: In a home network, DHCP assigns IP addresses to all connected devices, ensuring they can communicate without manual configuration.

#### Intermediate Questions

1. **Explain Domain Naming Services (DNS)**
   * DNS translates domain names (like www.example.com) into IP addresses, allowing browsers to load internet resources.
2. **Application of DNS with One Example**
   * **Example**: When you type a website address in your browser, DNS servers translate it into the IP address of the web server hosting the site.

### Topic: Network Topologies

#### Beginner Questions

1. **What are the 5 network topologies?**
   * **Bus Topology**: All devices share a single communication line.
   * **Star Topology**: All devices connect to a central hub.
   * **Ring Topology**: Devices are connected in a circular fashion.
   * **Mesh Topology**: Devices are interconnected, providing multiple paths for data.
   * **Tree Topology**: A combination of star and bus topologies, with groups of star-configured networks connected to a linear bus backbone.
2. **What is Internet topology?**
   * Internet topology refers to the structure and layout of the interconnected networks that make up the internet. It includes various types of networks (LANs, WANs) and how they are connected through routers, switches, and other devices.
3. **What is protocol?**
   * A protocol is a set of rules and conventions for communication between network devices. It ensures that data is transmitted accurately and efficiently.

#### Intermediate Questions

1. **What is the most common network topology?**
   * **Star Topology** is the most common because it is easy to install and manage. Each device is connected to a central hub, which simplifies troubleshooting.
2. **Explain star topology in networking?**
   * In a star topology, all devices are connected to a central hub or switch. The hub acts as a repeater for data flow. If one device fails, it does not affect the rest of the network, making it reliable and easy to manage.

#### Advanced Questions

1. **Explain Hybrid topology**
   * A hybrid topology combines two or more different types of topologies. For example, a network might use a star topology within individual departments and a bus topology to connect those departments.
2. **What is physical and logical topology?**
   * **Physical Topology**: The actual layout of the network cables and devices.
   * **Logical Topology**: The way data flows within the network, regardless of its physical design.
3. **What are the types of logical topology?**
   * **Bus Logical Topology**: Data is broadcast to all devices.
   * **Ring Logical Topology**: Data travels in a circular fashion.
   * **Star Logical Topology**: Data is sent to a central device and then forwarded to the destination.

### Topic: OSI Model

#### Beginner Questions

1. **What is OSI model explain?**
   * The OSI (Open Systems Interconnection) model is a conceptual framework used to understand and implement network protocols in seven layers:
     1. **Physical Layer**: Hardware transmission of raw data.
     2. **Data Link Layer**: Error detection and correction.
     3. **Network Layer**: Routing and forwarding.
     4. **Transport Layer**: Reliable data transfer.
     5. **Session Layer**: Managing sessions.
     6. **Presentation Layer**: Data translation and encryption.
     7. **Application Layer**: Network services to applications.
2. **List of Application layer protocols**
   * **HTTP**: HyperText Transfer Protocol.
   * **FTP**: File Transfer Protocol.
   * **SMTP**: Simple Mail Transfer Protocol.
   * **DNS**: Domain Name System.
3. **How many types of protocols are there?**
   * There are many types of protocols, including:
     1. **Network Protocols**: IP, ICMP.
     2. **Transport Protocols**: TCP, UDP.
     3. **Application Protocols**: HTTP, FTP, SMTP.

#### Intermediate Questions

1. **What is the difference between TCP/IP model and OSI model?**
   * **OSI Model**: 7 layers (Physical, Data Link, Network, Transport, Session, Presentation, Application).
   * **TCP/IP Model**: 4 layers (Network Interface, Internet, Transport, Application).
   * OSI is a theoretical model, while TCP/IP is practical and widely used.
2. **What is TCP/IP networking?**
   * TCP/IP (Transmission Control Protocol/Internet Protocol) is a set of protocols that governs the connection of computer systems to the internet. It ensures data is sent and received accurately.

#### Advanced Questions

1. **What is a wired Internet connection?**
   * A wired internet connection uses physical cables (like Ethernet) to connect devices to the internet, providing stable and high-speed connectivity.
2. **What are the disadvantages of wired networks?**
   * **Limited Mobility**: Devices are tethered to cables.
   * **Installation Complexity**: Requires physical cabling.
   * **Cost**: Higher installation and maintenance costs.
3. **How do I configure network authentication?**
   * **Steps**:
     1. Open **Network and Sharing Center**.
     2. Click on **Manage wireless networks**.
     3. Select the network and click **Properties**.
     4. Go to the **Security** tab and configure authentication settings.
4. **Practice of TeamViewer, AnyDesk, Google Hangout, Skype, Zoom**
   * **Steps**:
     1. **TeamViewer**: Install, open, and enter the partner ID to connect.
     2. **AnyDesk**: Install, open, and enter the remote address to connect.
     3. **Google Hangout**: Open in a browser, sign in, and start a chat or video call.
     4. **Skype**: Install, sign in, and start a call or chat.
     5. **Zoom**: Install, sign in, and start or join a meeting.
5. **Download Google Chrome**
   * **Steps**:
     1. Open a browser.
     2. Go to the Google Chrome download page.
     3. Click **Download Chrome** and follow the installation instructions.
6. **Configure “date and time” option in Control Panel**
   * **Steps**:
     1. Open **Control Panel**.
     2. Click on **Date and Time**.
     3. Click **Change date and time** and set the correct date and time.
     4. Click **OK** to save changes.

### Topic: TCP/IP

#### Assignment Level Basic

1. **What is TCP/IP?**
   * TCP/IP is a set of communication protocols used to connect network devices on the internet.
2. **What is the full form of TCP/IP?**
   * Transmission Control Protocol/Internet Protocol.

#### Assignment Level Intermediate

1. **List out the types of IP**
   * **IPv4**: 32-bit address.
   * **IPv6**: 128-bit address.
2. **What is protocol?**
   * A protocol is a set of rules for data communication between devices.
3. **Do a practical to set the TCP/IP in network adapter**
   * **Steps**:
     1. Open **Control Panel**.
     2. Go to **Network and Sharing Center**.
     3. Click on **Change adapter settings**.
     4. Right-click your network adapter and select **Properties**.
     5. Select **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties**.
     6. Configure the IP settings and click **OK**.

### Topic: Cables

#### Beginner Questions

1. **Types of cables and connectors?**
   * **Ethernet Cables**: Cat5, Cat6.
   * **Fiber Optic Cables**: Single-mode, multi-mode.
   * **Coaxial Cables**: RG6, RG59.
   * **Connectors**: RJ45, SC, ST, BNC.
2. **Explain twisted pair cable and shielded twisted pair cable**
   * **Twisted Pair Cable**: Consists of pairs of wires twisted together to reduce electromagnetic interference.
   * **Shielded Twisted Pair (STP) Cable**: Similar to twisted pair but with an additional shielding to further reduce interference.

#### Intermediate Questions

1. **Which of these cables connect computers to monitors?**
   * **VGA Cable**: Analog signal.
   * **DVI Cable**: Digital signal.
   * **HDMI Cable**: High-definition audio and video.
   * **DisplayPort Cable**: High-definition audio and video.
2. **How do I connect to a shared printer?**
   * **Steps**:
     1. Open **Control Panel**.
     2. Go to **Devices and Printers**.
     3. Click **Add a printer**.
     4. Select **Add a network, wireless or Bluetooth printer**.
     5. Choose the shared printer and follow the prompts.

#### Advanced Questions

1. **Which cable is commonly used to connect a computer to a printer?**
   * **USB Cable**: Commonly used for direct connections.
2. **What are the different ports and connectors?**
   * **USB Ports**: For peripherals.
   * **Ethernet Ports**: For network connections.
   * **HDMI Ports**: For audio and video.
   * **VGA Ports**: For video.
   * **Audio Jacks**: For sound devices.
3. **How do I connect my laptop to my printer without cable?**
   * **Steps**:
     1. Ensure the printer is connected to Wi-Fi.
     2. On your laptop, go to **Settings** > **Devices** > **Printers & scanners**.
     3. Click **Add a printer or scanner**.
     4. Select the wireless printer and follow the prompts.
4. **Application and Brief Explanation of Fiber Optic Cable and Coaxial Cable**
   * **Fiber Optic Cable**:
     + **Application**: Used for high-speed data transmission over long distances, such as internet connections, telecommunications, and cable TV.
     + **Explanation**:
       - Made of glass or plastic fibers.
       - Transmits data as light signals.
       - Offers high bandwidth and low signal loss.
       - Immune to electromagnetic interference.
   * **Coaxial Cable**:
     + **Application**: Commonly used for cable TV, internet connections, and connecting radio transmitters and receivers.
     + **Explanation**:
       - Consists of a central conductor, insulating layer, metallic shield, and outer insulating layer.
       - Transmits data as electrical signals.
       - Provides good shielding from interference.
       - Suitable for short to medium distances.
5. **Which of the Following Operates at the 5GHz Frequency Range?**
   * Wi-Fi standards such as **802.11a**, **802.11n** (dual-band), **802.11ac**, and **802.11ax** operate at the 5GHz frequency range.
6. **What Frequency Does 802.11g Use?**
   * The **802.11g** Wi-Fi standard operates at the **2.4GHz** frequency range.
7. **What Standard is Compatible with 802.11a?**
   * The **802.11n** standard is compatible with **802.11a**. It can operate in both the 2.4GHz and 5GHz frequency ranges, making it backward compatible with 802.11a (5GHz) and 802.11g (2.4GHz).

### Topic: TCP/IP Concepts - IPv6, IPv4

#### Beginner Questions

1. **What is the difference between IPv4 & IPv6?**
   * **IPv4**:
     + 32-bit address.
     + Format: 192.168.1.1.
     + Supports about 4.3 billion addresses.
   * **IPv6**:
     + 128-bit address.
     + Format: 2001:0db8:85a3:0000:0000:8a2e:0370:7334.
     + Supports a vast number of addresses (340 undecillion).
2. **Explain TCP/IP**
   * **TCP/IP (Transmission Control Protocol/Internet Protocol)**:
     + A set of protocols used for communication over the internet.
     + **TCP**: Ensures reliable data transmission.
     + **IP**: Handles addressing and routing of packets.
3. **Explain IPv6 Address with Address Structure**
   * **IPv6 Address**:
     + 128-bit address divided into eight groups of four hexadecimal digits.
     + Example: 2001:0db8:85a3:0000:0000:8a2e:0370:7334.
     + Each group is separated by a colon.
4. **Define IPv6 Reserve Address**
   * **Reserved Addresses**:
     + **::1**: Loopback address.
     + **::/128**: Unspecified address.
     + **ff00::/8**: Multicast addresses.
5. **Explain Difference between Public IP and Private IP**
   * **Public IP**:
     + Accessible over the internet.
     + Unique across the entire web.
   * **Private IP**:
     + Used within a private network.
     + Not routable on the internet.
     + Examples: 192.168.x.x, 10.x.x.x, 172.16.x.x.
6. **Create Straight and Cross Cables and Its Testing**
   * **Straight Cable**:
     + Used to connect different types of devices (e.g., computer to switch).
     + Wiring: Both ends follow the same wiring standard (e.g., T568A or T568B).
   * **Cross Cable**:
     + Used to connect similar devices (e.g., computer to computer).
     + Wiring: One end T568A, the other end T568B.
   * **Testing**:
     + Use a cable tester to check connectivity and correct wiring.

#### Intermediate Questions

1. **Brief Explanation of IP Addresses**
   * **IP Address**:
     + Unique identifier for a device on a network.
     + Can be IPv4 or IPv6.
     + Used for routing and addressing packets.
2. **What is the Advantage of IPv6 over IPv4?**
   * **Advantages**:
     + Larger address space.
     + Improved security features.
     + Better support for mobile devices.
     + Simplified header format.
3. **Assign Multiple IPv4 in Single Network Adapter (LAN Card)**
   * **Steps**:
     + Open **Control Panel**.
     + Go to **Network and Sharing Center**.
     + Click on **Change adapter settings**.
     + Right-click the network adapter and select **Properties**.
     + Select **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties**.
     + Click **Advanced** and add multiple IP addresses.
4. **Assign Simple IPv6 Between Two Systems and Ping It**
   * **Steps**:
     + Assign IPv6 addresses to both systems.
     + Open Command Prompt on one system.
     + Type ping <IPv6 address of the other system> and press Enter.
5. **Assign and Configure Simple IPv4 Between Systems**
   * **Steps**:
     + Assign IPv4 addresses to both systems.
     + Ensure both systems are on the same subnet.
     + Open Command Prompt on one system.
     + Type ping <IPv4 address of the other system> and press Enter.

#### Advanced Questions

1. **Which is Faster, IPv4 or IPv6?**
   * **Answer**: IPv6 can be faster due to more efficient routing and larger address space, but actual speed depends on network infrastructure.
2. **What Does TCP Do?**
   * **TCP (Transmission Control Protocol)**:
     + Ensures reliable data transmission.
     + Manages data packet sequencing and error checking.
3. **Give Security in Sharing**
   * **Steps**:
     + Use strong passwords.
     + Enable encryption.
     + Set appropriate permissions.
     + Use firewalls and antivirus software.
4. **Configure “Map Network Drive”**
   * **Steps**:
     + Open **File Explorer**.
     + Click on **This PC**.
     + Click on **Map network drive**.
     + Choose a drive letter and enter the folder path.
     + Click **Finish**.

### Topic: IP Routing and Routing Protocols

#### Beginner Questions

1. **What Is Routing?**
   * **Routing**:
     + The process of selecting paths in a network to send data packets from source to destination.
2. **How Routing Starts Up?**
   * **Routing Startup**:
     + Routers exchange information about network topology.
     + Routing tables are built and updated.

#### Intermediate Questions

1. **What Is Hybrid Routing Protocol?**
   * **Hybrid Routing Protocol**:
     + Combines features of distance-vector and link-state protocols.
     + Example: EIGRP (Enhanced Interior Gateway Routing Protocol).
2. **What Are the Range of AD Values?**
   * **Administrative Distance (AD)**:
     + A value that indicates the trustworthiness of a route.
     + Lower AD values are preferred.
     + Example ranges: Directly connected (0), Static route (1), EIGRP (90), OSPF (110).
3. **What Is an Autonomous System?**
   * **Autonomous System (AS)**:
     + A collection of IP networks and routers under the control of a single organization.
     + Uses a common routing policy.

#### Advanced Questions

1. **Define Static Routing**
   * **Static Routing**:
     + Manually configured routes.
     + Does not change unless manually updated.
     + Suitable for small, stable networks.
2. **Explain Dynamic Routing**
   * **Dynamic Routing**:
     + Automatically adjusts routes based on network changes.
     + Uses routing protocols like OSPF, EIGRP, BGP.
     + Suitable for large, complex networks.

### Topic: Switching and VLANs

#### Beginner Questions

1. **What is VLAN?**
   * **VLAN (Virtual Local Area Network)**:
     + A logical grouping of devices in a network.
     + Segments a network into smaller, isolated parts.
2. **Which Two Benefits of Creating VLANs?**
   * **Benefits**:
     + Improved security by isolating sensitive data.
     + Better network management and reduced broadcast traffic.
3. **What is Dynamic VLAN?**
   * **Dynamic VLAN**:
     + Automatically assigns VLANs based on criteria like MAC addresses or protocols.
4. **What is Static VLAN?**
   * **Static VLAN**:
     + Manually assigns VLANs to ports.
     + Provides consistent and predictable network segmentation.

#### Intermediate Questions

1. **What is VLAN and INTERVLAN?**
   * **VLAN**:
     + A logical network segment within a physical network.
   * **InterVLAN**:
     + Communication between different VLANs.
     + Requires a router or Layer 3 switch.
2. **What is Trunk Port?**
   * **Trunk Port**:
     + A port that carries traffic for multiple VLANs.
     + Uses tagging protocols like IEEE 802.1Q.

#### Advanced Questions

1. **How to Configure Trunk Port?**
   * **Steps**:
     1. Access the switch CLI.
     2. Enter global configuration mode.
     3. Select the interface to configure.
     4. Use the command switchport mode trunk.
     5. Specify allowed VLANs with switchport trunk allowed vlan <VLAN IDs>.
2. **How to Delete VLAN Information from Switch?**
   * **Steps**:
     1. Access the switch CLI.
     2. Enter global configuration mode.
     3. Use the command no vlan <VLAN ID> to delete a specific VLAN.
     4. Save the configuration with write memory.