

## **Important question in computer's networking (CC-211)**

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### **Questions:**

#### **Question # 01:**

List all the layered protocols in detail.

### **Answer:**

#### **Protocol:**

Protocol refers to a set of rules, guidelines, or standards that govern the behavior, communication, or interaction between entities, system, or individuals.



**List of layered protocols:** Here's we overview the list of layered protocols.



#### **OSI Model (7 layers):**

- **Physical layer(L-1):**

It defines the physical transmission of data.

It species cable, wireless, or other transmission medium.

-Key functions: Bit-level transmission, signal encoding, data rate, topology. -Protocols: Ethernet, Wi-Fi, Bluetooth. -Devices: NICs, hubs, repeaters, modems, cables.

- **Data link layer(L-2):**

It ensures error-free transfer of data frames. It provides logical linking devices.

- Key functions: Framing, error detection, flow control.
- Protocols: Ethernet, Wi-Fi, PPP, HDLC.
- Devices: Switches, bridges, NICs.

- Network layer(L-3): It routes data between networks. Provides logical addressing (IP addresses). -Key functions: Routing, addressing, congestion control.

-Protocols: IP, ICMP, IGMP, RIP, OSPF

-Devices: Routers, gateways.

- Transport layer(L-4):

It ensures reliable data transfer. It provides segments and reassembly.

-Key functions: Connection establishment, segmentation, flow control.

-Protocols: none (software-based).

-Devices: TCP, UDP, SCTP.

- Session Layer (L-5):

Establishes, maintains, and terminates connections. Manages dialogues between applications.

- Key functions: Connection establishment, token management.

- Devices: none (software-based).

- Protocols: NetBIOS, SSH, SSL.

- Presentation Layer (L-6):

Converts data into readable format. Ensures data syntax and semantics - Key functions: Encryption, compression, formatting

- Devices: none (software-based) - Protocols: SSL, TLS, MIME.

- Application Layer (L-7):

Provides services to end-user applications.

Supports functions like email, file transfer. -Key functions: email, file transfer, web browsing

- Devices: none (software-based).

- Protocols: HTTP, FTP, SMTP, DNS, SNMP.



## TCP/IP:

### Layer 1: Network Access Layer

#### (NAL):

Combines OSI layers 1-2 (Physical and Data Link). Define how devices access the network - Key functions:

- Physical transmission
- Error detection/correction
- Framing
- Protocols: Ethernet, Wi-Fi, PPP, ARP.

- Layer 2: Internet Layer (IL):

Corresponds to OSI layer 3 (Network). Route data between networks - Key functions:

Logical addressing (IP addresses).

Routing.

Congestion control.

- Protocols: IP, ICMP, IGMP, RIP, OSPF.

Layer 3: Transport Layer (TL):

Combines OSI layers 4-5 (Transport and Session). Ensure reliable data transfer.

- Key functions:

Connection establishment

Segmentation

Flow control

Error detection/correction - Protocols: TCP, UDP, SCTP.

Layer 4: Application Layer (AL):

Combines OSI layers 6-7 (Presentation and Application). Provides services to end-user applications.

- Key functions: Email

File transfer

Web browsing

Remote access

- Protocols: HTTP, FTP, SMTP, DNS, SNMP, SSH.

- **Wireless Networking Protocols:**

- Wi-Fi (IEEE 802.11): Wireless LAN.
- Bluetooth: Wireless personal area network.
- Zigbee: Low-power wireless networking.

- **Security Protocols:**

- SSL/TLS (Secure Sockets Layer/Transport Layer Security): Encryption.
- SSH (Secure Shell): Secure remote access.
- IPsec (Internet Protocol Security): Encryption and authentication.
- HTTPS (Hypertext Transfer Protocol Secure): Secure web browsing.

- **Other Protocols**

- FTP (File Transfer Protocol): File transfer.
- SMTP (Simple Mail Transfer Protocol): Email transfer.
- SNMP (Simple Network Management Protocol): Network management.
- RTP (Real-time Transport Protocol): Audio/video streaming.

## Internet Protocol Suite:

- IP (Internet Protocol): Routing and addressing. ○ TCP (Transmission Control Protocol): Reliable data transfer. ○ UDP (User Datagram Protocol): Best-effort data transfer.
- ICMP (Internet Control Message Protocol): Error reporting. ○ IGMP (Internet Group Management Protocol): Multicast management.
- DNS (Domain Name System): Name resolution. ○ DHCP (Dynamic Host Configuration Protocol): IP address assignment.

## 2.NETWORK CABLES:

“A physical medium used to connect devices, such as computers, routers, and switches, to form a computer network.”

Here we explain many types of cable :



### **Straight-through cable:**

#### **Usage scenarios:**

- Connecting a computer to a router or a switch.
- Connecting a device to hub or a network.

### Benefits:

- Simple and widely available.
- Supports most network configuration.
- Cost effective

### Drawbacks:

- Not suitable for direct-toconnections.
- May require a crossover cable or a hub/switch for a certain connection.

### Performance:

Straight-through cables are suitable for most network configurations and provide reliable connections.



### Crossover cable:

#### Usage scenarios:

- Directly connecting two devices (computer-to-computer or router to router).
- Connecting a device to a router or switch that does not support Auto MIDX (Automatic Medium Dependent Interface Crossover).

### Benefits:

- Enable direct device-to-device connections.
- Supports high-speed applications.
- Reduces the need for hub or switches.

*Drawbacks:*

- Less widely available than straightthrough cables.
- May not be necessary for modern networks with Auto-MDIX support.

*Performance:*

Crossover cables provide reliable connections for direct device-to device communications.



**DTT (Direct-to-Television) cable:**

*Usage scenarios:*

- Connecting a digital TV antenna or a satellite receiver to a television.
- Delivering digital signals directly to a television. *Benefits:*
- Enables direct digital signal delivery to television.
- Provides high-quality digital video and audio. • Simplifies the connection process.

*Drawbacks:*



- Limited to digital signal delivery.
- May not be compatible with other televisions or analog signals.

### Performance:

DTT cables provide high-quality digital signals directly to televisions •



### **Fiber optic cables:**

#### Usage scenarios:

- High-speed data centers and networks
- Long-distance telecommunications and internet connectivity
- High-bandwidth applications (e.g., video streaming, online gaming).

#### Benefits:

- Extremely high bandwidth and speed.
- Long-distance signal transmission without degradation.
- Immunity to electromagnetic interference (EMI).

#### Drawbacks:

- Higher cost compared to traditional copper cables.
- Requires specialized equipment and installation.

- May be more prone to physical damage.

*Performance:*

Fiber optic cables offer unparalleled bandwidth and speed, making them ideal for high-bandwidth applications.

○ When to use a Straight-Through cable versus a Crossover cable:

- Use a Straight-Through cable for connections between devices and hubs/switches or routers.
- Use a Crossover cable for direct device-to device connections or when connecting a device to a router or switch that doesn't support Auto MDIX.

○ **Specific devices connected using each type of cable:**

- Straight-Through cable: Computers, routers, switches, hubs, and other network devices.
- Crossover cable: Computers, routers, switches, and other network devices for direct device-to-device connections.
- DTT cable: Digital TV antennas, satellite receivers, and televisions.

- Fiber Optic cable: High-speed network devices, data centers, and telecommunications equipment.

## ○ **How DTT cables differ from traditional network cables:**

- DTT cables are designed specifically for digital signal delivery to televisions.
- They provide high-quality digital video and audio.
- They simplify the connection process.

## ○ **Where DTT cables are commonly used:**

- Home entertainment systems.
- Digital television broadcasting.
- Satellite television reception.

## ○ **Impact of DTT cables on television and digital signal delivery:**

- Improved digital video and audio quality • Simplified connection process.

- Increased adoption of digital television technology.

- **Classification of Routing protocols:**

- **Routing protocol:**

“Routing protocols are standardized communication process that enable routers to exchange information and select the best path forwarding traffic between networks.

- **Significance:**

They play a crucial role in ensuring efficient and reliable data transmission in computer networks.

- **Classification of routing protocols:**

Routing protocols can be classified based on different criteria, including.

- **Operation:**

Static routing protocol: Manually configured routing tables that do not adapt to network changes. Examples: RIP, OSPF, EIGRP.

Dynamic routing protocol: automatically adjust routing tables in response to network changes. Examples: OSPF, IS-IS.

- **Behavior:**

Distance – vector routing protocols: Routers exchange routing tables with neighbors, calculating the best path based on distance (hop count). Examples: RIP, IGRP.

Link-State Routing Protocols: Routers maintain a map of the network topology, calculating the best path based on link state.

Examples: OSPF, IS-IS.

- **Protocol Types:**

Interior Gateway Protocols (IGPs): Used within an autonomous system (AS) to exchange routing information.

Examples: RIP, OSPF, EIGRP.

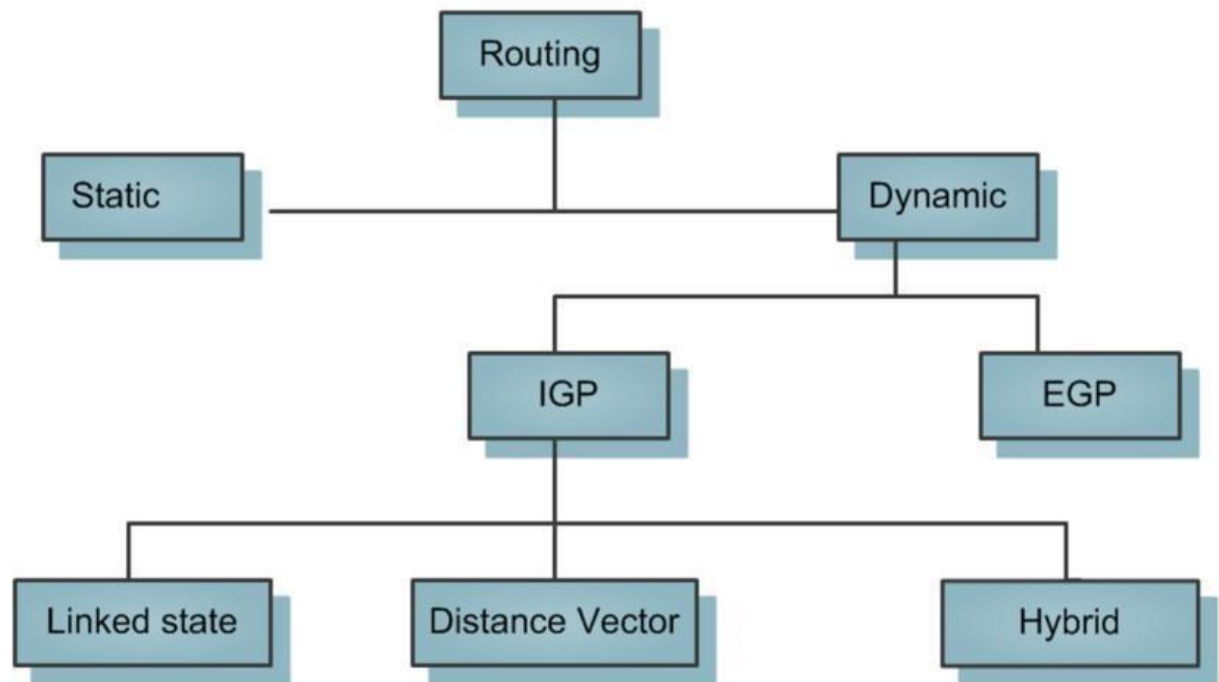
Exterior Gateway Protocols (EGPs): Used between autonomous systems to exchange routing information.

Examples: BGP.

Hybrid Routing Protocols: Combine elements of distancevector and link-state.

Example: EIGRP.

**FLOWCHART:**



“Each classification has its strengths and weaknesses, and the choice of routing protocol depends on the specific network requirements and architecture.”

- **Overview of Distance Vector Routing Protocols:**

- **Distance vector routing protocol:**

Distance vector routing protocols are a type of routing protocol that uses the distance-vector algorithm to calculate the best path between nodes in a network.

- **Characteristics:**

- Each node maintains a routing table that lists the best path to each destination node.
- The routing table is updated periodically by exchanging routing information with neighboring nodes.
- The distance-vector algorithm is used to calculate the best path based on the minimum distance (hop count) to the destination node.

### **Operation of Distance Vector Routing Protocols:**

The Bellman-Ford algorithm is a widely used distance-vector algorithm that operates as follows:

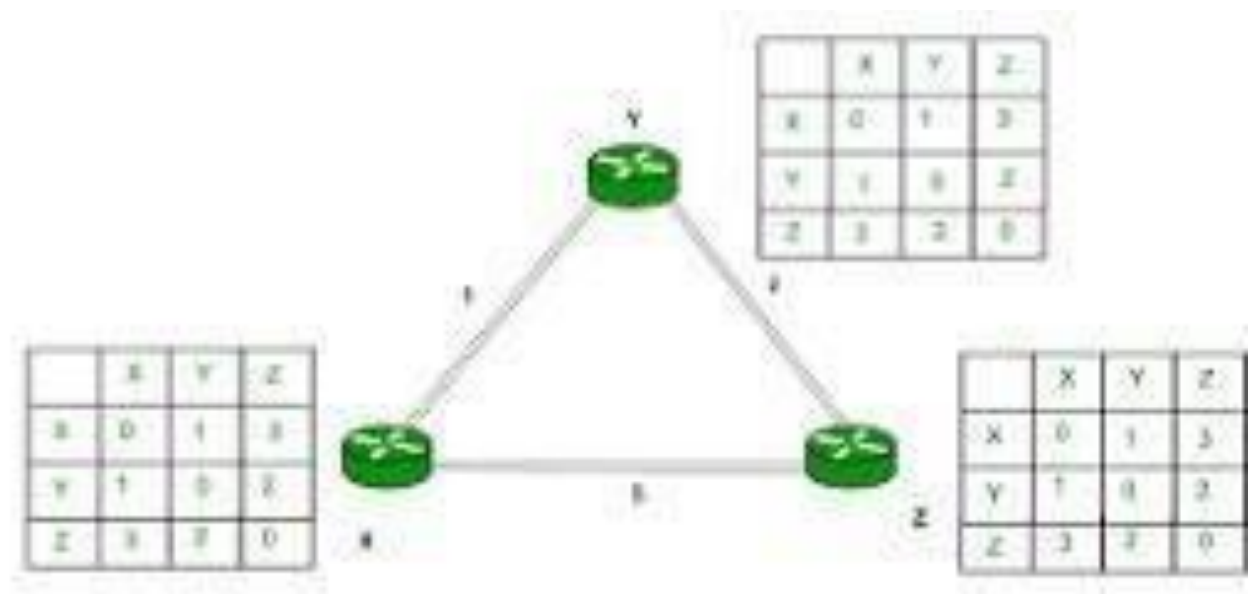
- Each node initializes its routing table with the directly connected neighbors and their corresponding distances.
- Each node exchanges its routing table with its neighbors.
- Each node updates its routing table based on the received routing information.
- The

algorithm iterates until the routing tables converge.

## Examples of Distance Vector Routing Protocols:

- RIP (Routing Information Protocol): A widely used distance vector routing protocol that uses the Bellman-Ford algorithm.

RIP has a maximum hop count of 15 and is suitable for small to medium-sized networks. ○ EIGRP (Enhanced Interior Gateway Routing Protocol): A proprietary distance vector routing protocol developed by Cisco Systems.





“In summary, distance vector routing protocols are a type of routing protocol that uses the distance-vector algorithm to calculate the best path between nodes in a network. RIP and EIGRP are two examples of distance vector routing protocols that are widely used in computer networks.”

- **Overview of Link-State Routing Protocols:**

- *link-state routing protocols:*

Link-state routing protocols are a type of routing protocol that uses the link state algorithm to calculate the best path between nodes in a network.

- **Characteristics:**

- Each node maintains a map of the network topology, including the state of each link (up or down).
- Each node exchanges its link-state information with its neighbors.
- The link-state algorithm is used to calculate the best path based on the shortest path to the destination node.
- Link-state protocols are more scalable and efficient than distance vector protocols

## **Operation of Link-State Routing Protocols:**

Dijkstra's algorithm is a widely used link state algorithm that operates as follows:

- Each node initializes its link-state database with the directly connected neighbors and their corresponding link states. ○

Each node exchanges its linkstate information with its neighbors. ○ Each node updates its link-state database based on the received linkstate information.

- Dijkstra's algorithm is used to calculate the shortest path to each destination node. ○ The algorithm iterates until the linkstate database converges.

## **Examples:**

- OSPF (Open Shortest Path First): A widely used link-state routing protocol that uses Dijkstra's algorithm.

OSPF is suitable for large and complex networks. ○ IS-IS (Intermediate System to Intermediate System): A linkstate routing protocol that uses Dijkstra's algorithm.

IS-IS is suitable for large and complex networks, particularly in service provider environments.

“ In summary, link-state routing protocols are a type of routing protocol that uses the linkstate algorithm to calculate the best path between nodes in a network. OSPF and IS-IS are two examples of link-state routing protocols that are widely used in computer networks.”

- **Overview of hybrid routing protocols:**

- **Hybrid routing protocol:**

“Hybrid routing protocols are a type of routing protocol that combines the characteristics of distance-vector and link-state protocols. Hybrid protocols aim to leverage the strengths of both types of protocols to provide a more efficient and scalable routing solution”

- **Characteristics:**

- Use a combination of distance-vector and link-state algorithms to calculate the best path.
- Maintain a routing table that includes information about neighboring routers and their distances.
- Exchange routing information with neighboring

routers to update the routing table. ○ Use a metric or cost function to determine the best path.

**Advantages:**

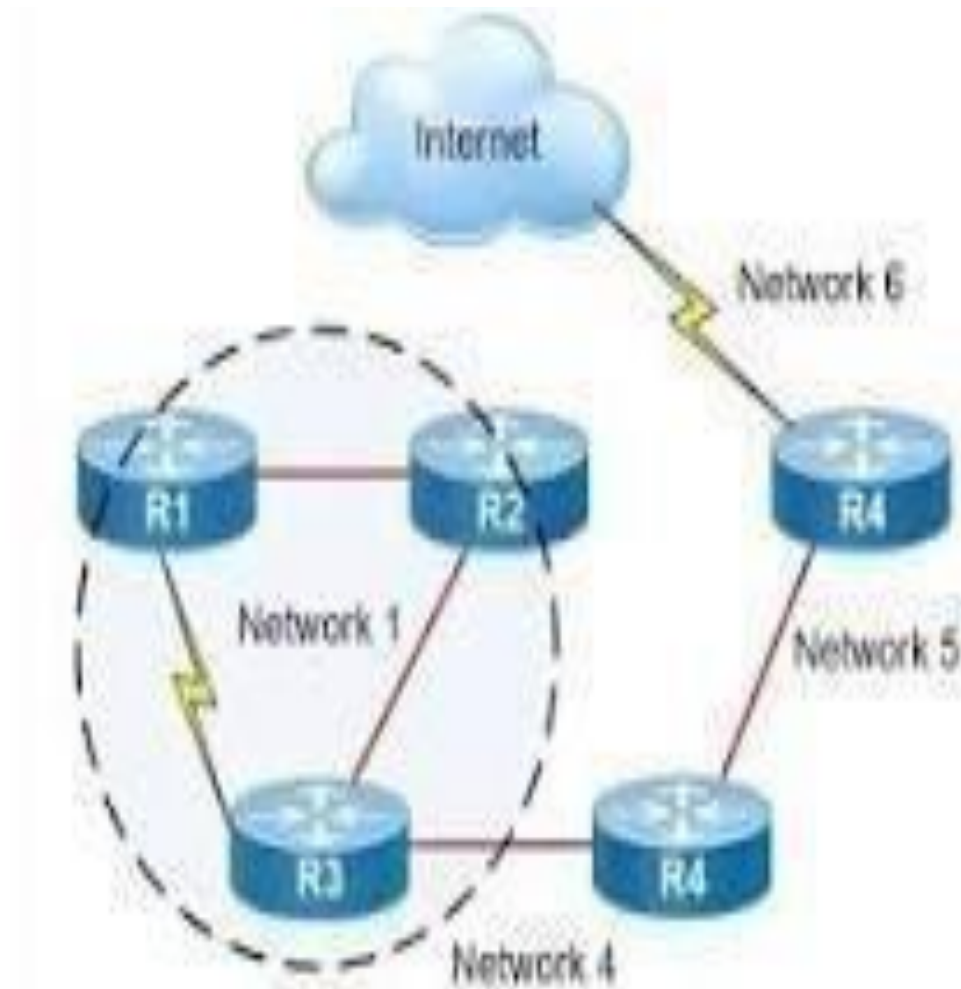
- Improved scalability: Hybrid protocols can handle large networks with many routers.

- Increased flexibility: Hybrid protocols can be used in a variety of network topologies.
- Better performance: Hybrid protocols can provide faster convergence times and improved routing decisions.
- Simplified configuration: Hybrid protocols can be easier to configure than link-state protocols.

### **Examples:**

- BGP (Border Gateway Protocol): A hybrid routing protocol used for interdomain routing. BGP uses a combination of distancevector and linkstate algorithms to calculate the best path.
- EIGRP (Enhanced Interior Gateway Routing Protocol): A hybrid routing protocol developed by Cisco Systems. EIGRP uses a combination of distance-vector and link-state algorithms to calculate the best path.
- DUAL (Diffusing Update Algorithm): A hybrid routing protocol used in EIGRP. DUAL uses a combination of

distancevector and link-state algorithms to calculate the best path.



“In summary, hybrid routing protocols combine the strengths of distancevector and link-state protocols to provide a more efficient and scalable routing solution. BGP, EIGRP, and DUAL are examples of hybrid routing protocols used in computer networks”.

#### ○ Comparison of Routing Protocols:

Here's a comparative analysis of distance vector, link-state, and hybrid routing protocols:

	Distance Vector	Link-State	Hybrid
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Algorithm	Bellman-Ford	Dijkstra's	Combination
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Scalability	Limited	High	High
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Convergence Time	Slow	Fast	Fast
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Overhead	Low	High	Medium
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## ○ **Conclusion:**

In conclusion, routing protocols play a crucial role in computer networks.

Understanding the different types of routing protocols, including distance vector, link-state, and hybrid protocols, is essential for designing and managing efficient and reliable networks.

These all protocols have their own unique properties. Above we discuss all the advantages and characteristics which are efficient for our network.

## ○ **References**

"Computer Networks" by Andrew S.



Tanenbaum.

"Routing Protocols and Concepts" by Cisco Systems.

Also from Meta AI and google.

### **3.DHCP configuration:**

#### **Table of Contents**

1. Introduction
2. Network design and topology
3. Hardware and software configuration
4. Implementation of protocols / services
5. Testing and validation
6. Conclusion
7. References
8. Appendix

#### **1. Introduction:**

“The object of this project to configure DHCP on cisco router to assign IP addresses to assign Ips dynamically.”

### DHCP:

DHCP (Dynamic host configuration protocol) is a network protocol that allows a router to dynamically assign IP addresses on each device.

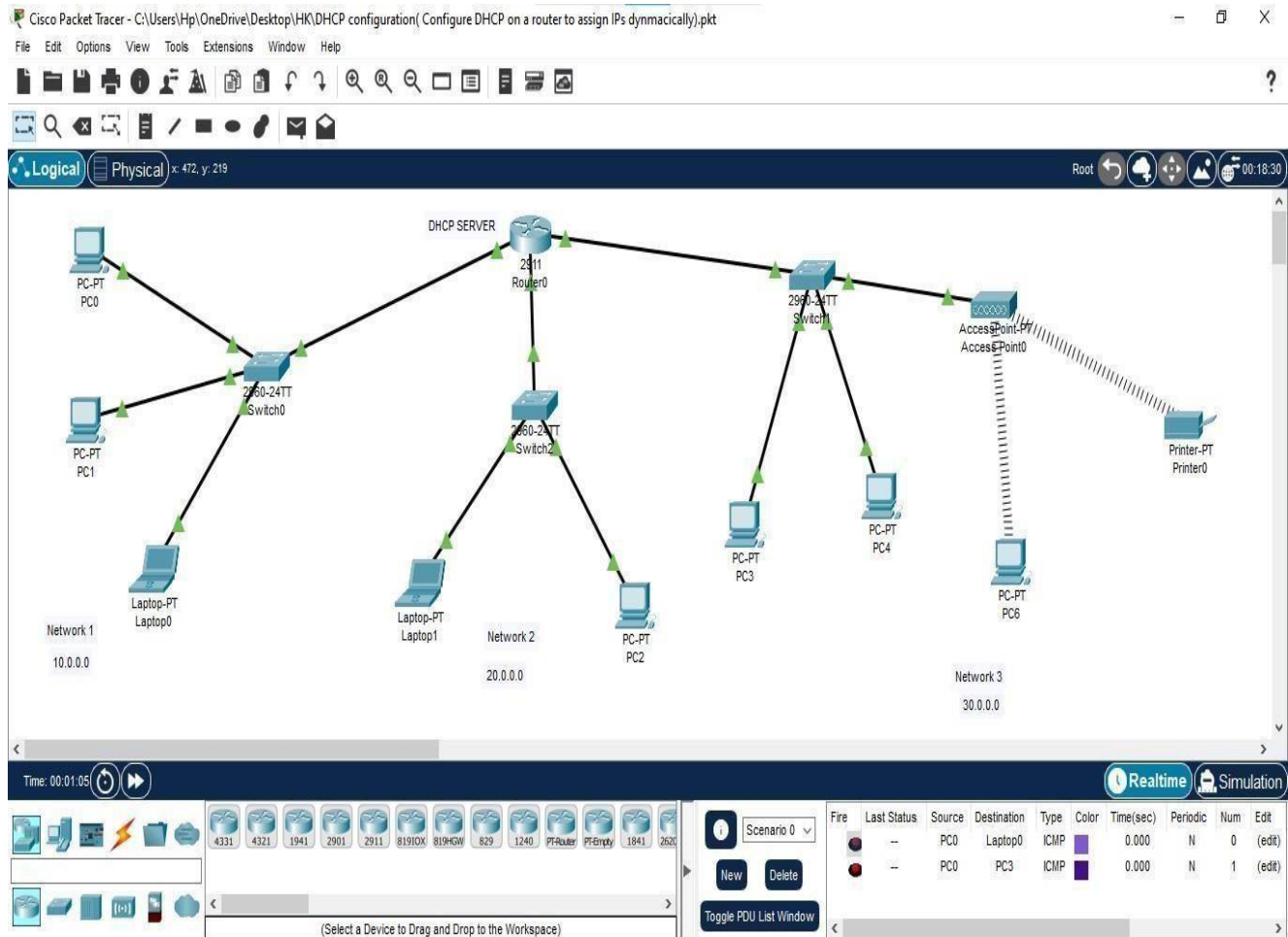
### Configure DHCP on router:

Here we configure DHCP on a router to assign IPs dynamically. It is an easy way to assign IPs on clients instead of using manual process. DHCP Server is also used to assign IPs dynamically but here we use cisco router as a DHCP server.

### Key points:

- Automatically assigns IP addresses to devices, reducing manual configuration errors.
- Centrally unique IP address.
- Devices can move between networks/subnets seamlessly.
- Supports large numbers of devices.
- Reduces IP address spoofing risks.
- New devices receive IP addresses instantly.
- Centrally manages IP address, reducing administrative burden.
- Enables seamless connectivity for laptops, tablets and smartphones.

### NETWORK:



## 2. Network design and topology:

- Add diagram of network topology.
- This network consists of three switches that are connected to a router.
- First switch is connected to 2 PCs and one laptop. Second switch is connected to 2 PCs and last switch is connected to 2 PCs.
- Access point is connected to third switch and a printer and one PC is connected to this AP wirelessly.

- Then router is to be configured

### **3. Hardware and software configuration:**

#### *Router configuration:*

- A cisco router is used and is configured.
- A router can be configured into two ways. First method is to go on interface.
- Second way is to be configured on CLI.
- Go to CLI write no and press

“Enter.” • After that do the following steps on CLI:

```
Router>enable
Router# conf t
Router(config)#int gig0/0
Router (config if) #ip address 10.0.0.1 255.0.0.0.
Router (config if) #no shutdown Router(config)#exit
Router(config)#ip dhcp pool lan1
Router ( dhcp config)# net 10.0.0.0 255.0.0.0. Router
( dhcp config)# default-router 10.0.0.1 Router (dhcp
config)# exit.
```

- Do the same process for all networks on the router and we get all IPs dynamically.
- The other addresses are:  
“20.0.0.0 255.0.0.0.  
30.0.0.0 255.0.0.0.”

```

2940-24TT
swach0

Router>enable
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip dhcp pool lan1
Router(dhcp-config)#net 10.0.0.0 255.0.0.0
Router(dhcp-config)#default-router 10.0.0.1
Router(dhcp-config)#exit
Router(config)#int gig0/0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
WR

```

```

Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip dhcp pool lan2
Router(dhcp-config)#net 20.0.0.0 255.0.0.0
Router(dhcp-config)#default-router 20.0.0.1
Router(dhcp-config)#exit
Router(config)#
Router(config)#int gig0/1
Router(config-if)#ip add 20.0.0.1 255.0.0.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console

```

```

Router#
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip dhcp pool lan3
Router(dhcp-config)#net 30.0.0.0 255.0.0.0
Router(dhcp-config)#default-router 30.0.0.1
Router(dhcp-config)#exit
Router(config)#
Router(config)#int gig0/2
Router(config-if)#ip add 30.0.0.1 255.0.0.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up
^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console

```

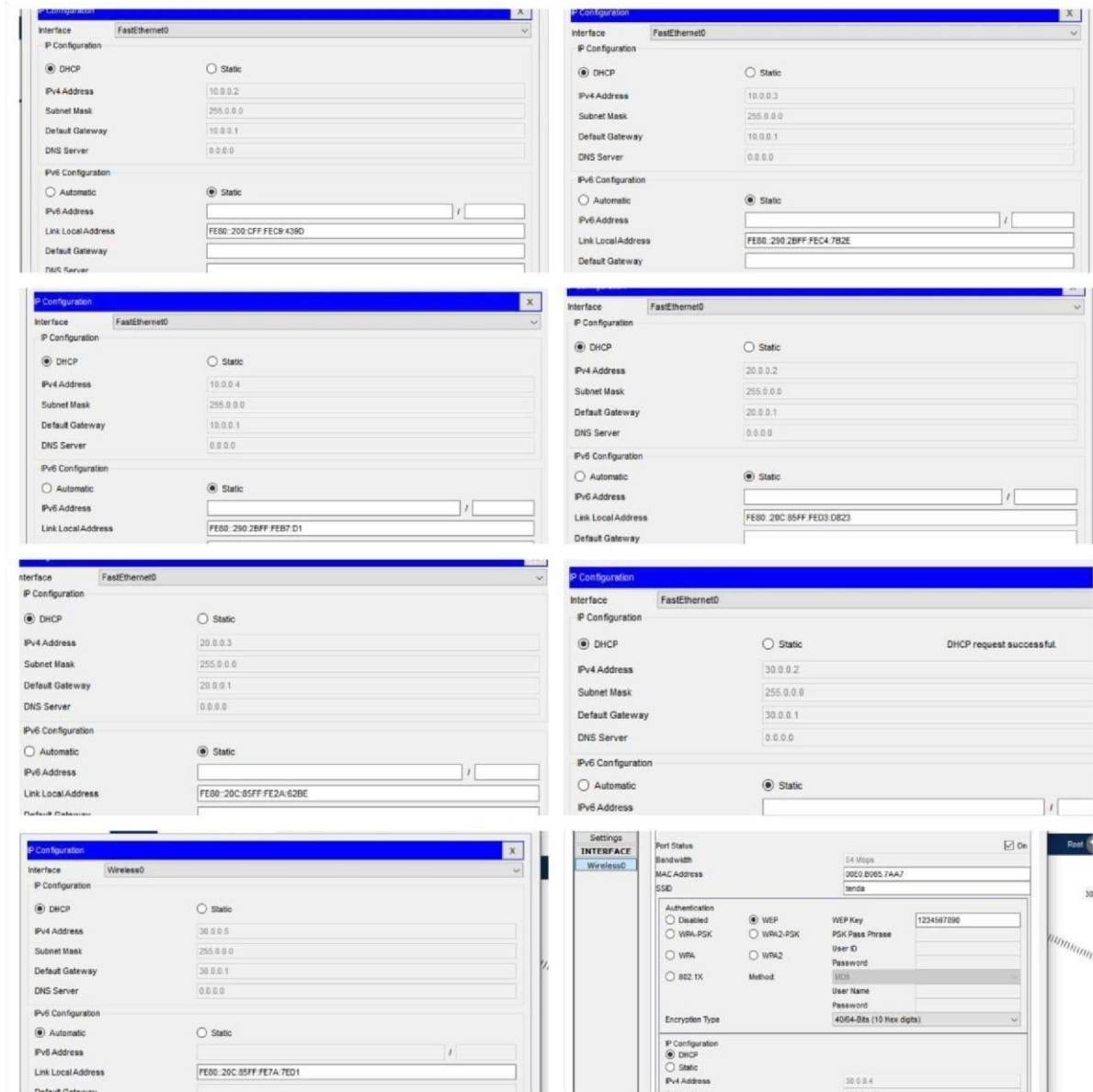
#### 4. Implementations of protocols:

##### IP configuration:

- Automatically IPs are assigned to each device.
- First network has IP from 10.0.0.2 to 10.0.0.3.

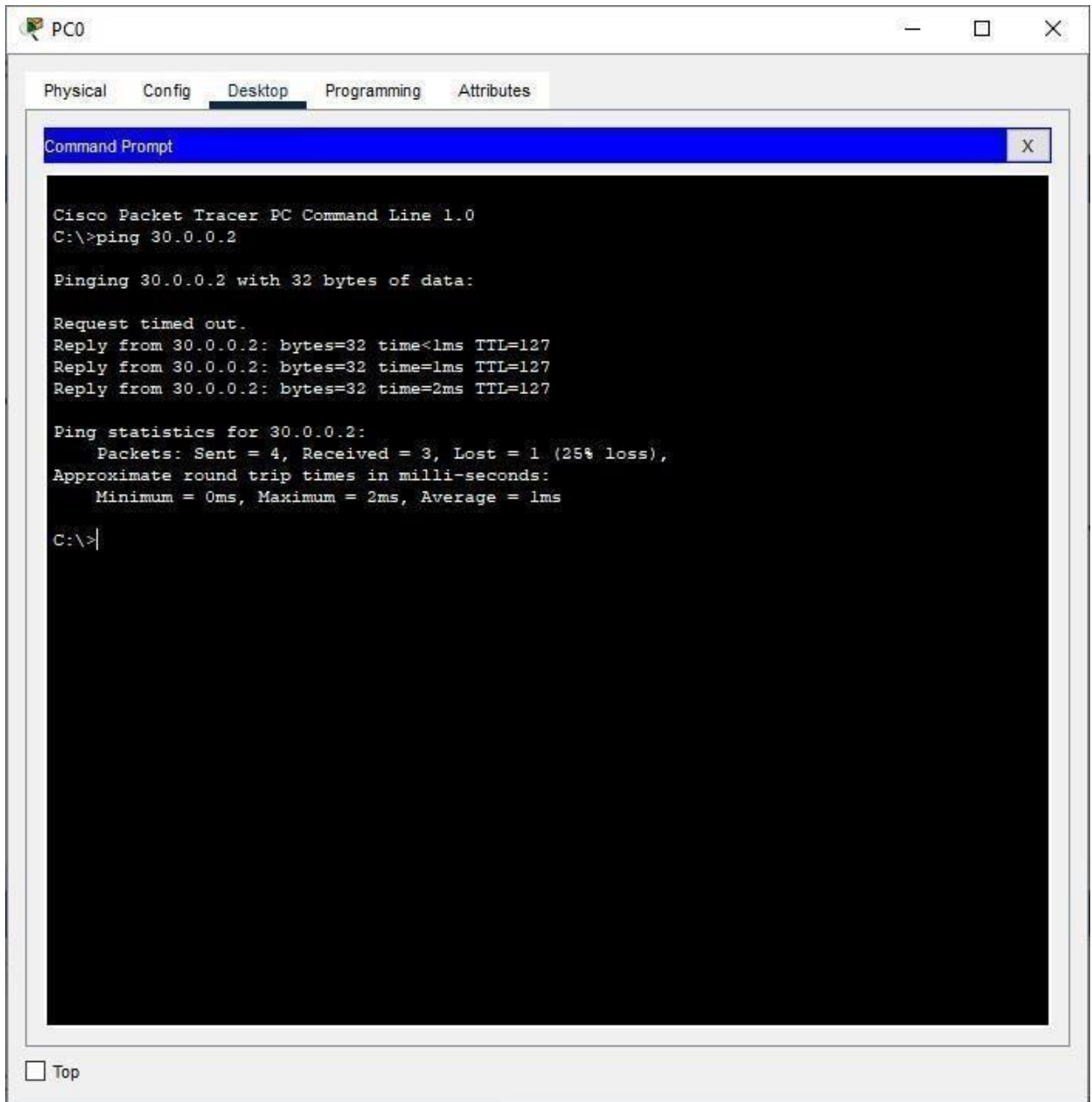
- Second network has IP from 20.0.0.2 to 20.0.0.3.
- Third has IP from 30.0.0.2 to 30.0.0.5.
- DHCP uses UDP as its transport protocol.

Specifically, DHCP messages are sent using UDP ports 67 (DHCP server) and 68 (DHCP client).



- IP is used as the network-layer protocol for routing DHCP messages between the DHCP server and clients.

## 5. Testing and validation:



The screenshot shows a Cisco Packet Tracer PC Command Prompt window for PC0. The window has tabs for Physical, Config, Desktop, Programming, and Attributes. The Desktop tab is active, displaying a Command Prompt window. The Command Prompt shows the following text:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 30.0.0.2

Pinging 30.0.0.2 with 32 bytes of data:

Request timed out.
Reply from 30.0.0.2: bytes=32 time<1ms TTL=127
Reply from 30.0.0.2: bytes=32 time=1ms TTL=127
Reply from 30.0.0.2: bytes=32 time=2ms TTL=127

Ping statistics for 30.0.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 2ms, Average = 1ms

C:\>|
```

At the bottom left of the window, there is a checkbox labeled "Top" which is currently unchecked.

After all the configuration and after assigning IPs, to each device and after the configuration of specific services pinning was done on different devices. The packets are sent from one network to another network.

## **6. Conclusion:**

- By configuring DHCP on a router, network administrators can ensure that devices on the network receive the necessary IP addresses and network settings to communicate effectively.
- It is an easy way to assign IPs to the clients instead of assigning IPs manually.
- It consumes less time than manually.
- Thus, this project gives us hands-on experience in setting up and manage to assign IPs dynamically.

## **7. References:**

- [https://youtu.be/3CcjEOVnmT0?si=jA\\_CMnLtUgPETnQ](https://youtu.be/3CcjEOVnmT0?si=jA_CMnLtUgPETnQ).
- [https://youtu.be/V6edd3bQ7CY?si=hC2UR5\\_5zjLfJW7QP](https://youtu.be/V6edd3bQ7CY?si=hC2UR5_5zjLfJW7QP).
- [https://youtu.be/a03R7um3JBQ?si=WlwZjS\\_l349ltbrl](https://youtu.be/a03R7um3JBQ?si=WlwZjS_l349ltbrl).

## **8. Appendix:**

Some of the screenshots are pasted above.



Cisco Packet Tracer - C:\Users\Hp\OneDrive\Desktop\HK\DHCP configuration( Configure DHCP on a router to assign IPs dynamically).pkt

File Edit Options View Tools Extensions Window Help

Logical Physical x: 472, y: 219

Root 00:18:30

Network 1 10.0.0.0

Network 2 20.0.0.0

Network 3 30.0.0.0

Time: 00:01:05

Scenario 0

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
	--	PC0	PC3	ICMP		0.000	N	0	(edit)

PC6

Physical Config Desktop Programming Attributes

Link Information Connect Profiles

More Information Infrastructure Mode

You have successfully connected to the access point

Signal Strength

Link Quality

Wireless-N Notebook Adapter Wireless Network Monitor v1.0 Model No. WPC300N

2.4GHz

Adapter is Active

25:0-2411  
Switch0

```
Router>enable
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip dhcp pool lan1
Router(dhcp-config)#net 10.0.0.0 255.0.0.0
Router(dhcp-config)#default-router 10.0.0.1
Router(dhcp-config)#exit
Router(config)#int gig0/0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
WE
```

```
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip dhcp pool lan2
Router(dhcp-config)#net 20.0.0.0 255.0.0.0
Router(dhcp-config)#default-router 20.0.0.1
Router(dhcp-config)#exit
Router(config)#
Router(config)#int gig0/1
Router(config-if)#ip add 20.0.0.1 255.0.0.0
Router(config-if)#no shutdown

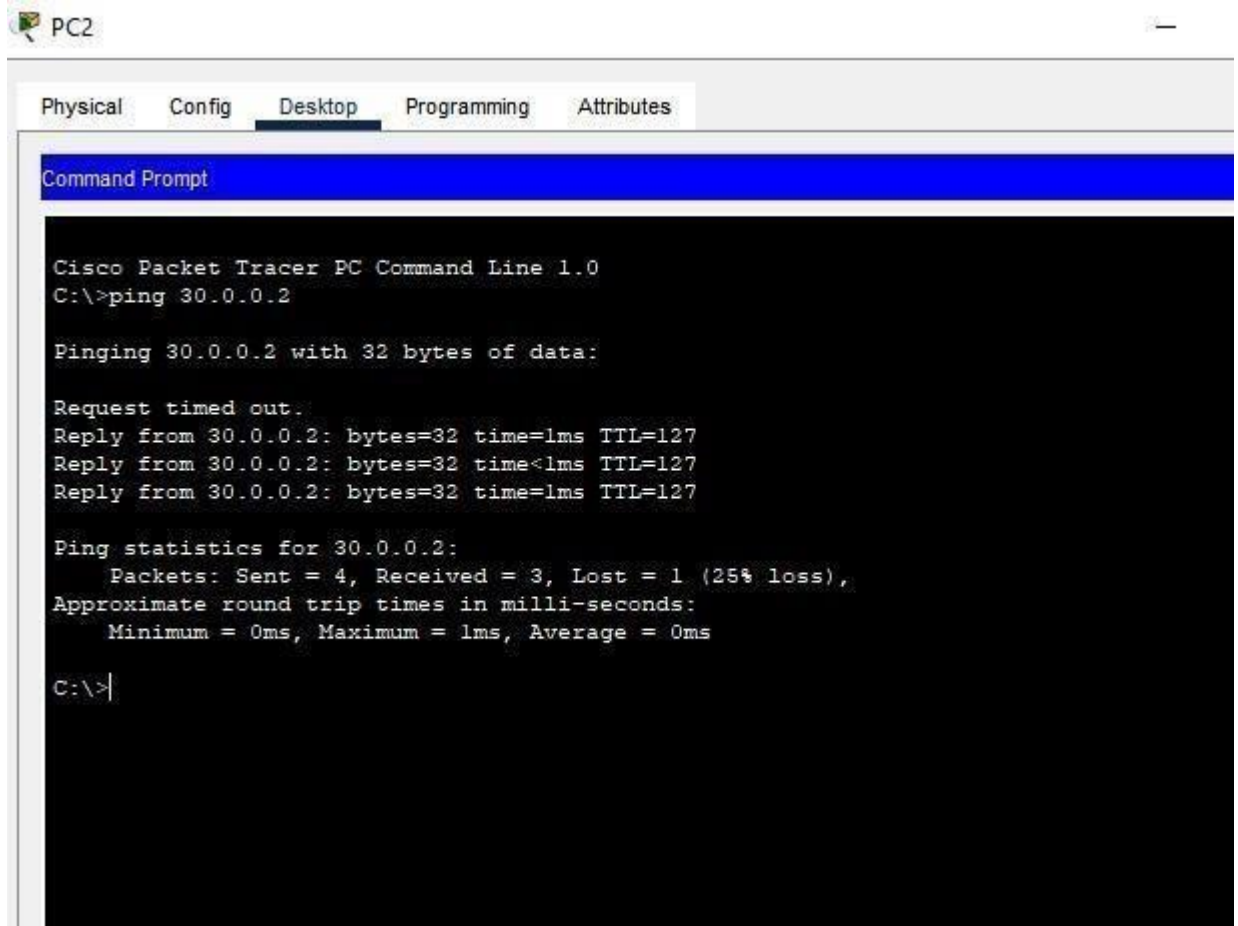
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Router#
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip dhcp pool lan3
Router(dhcp-config)#net 30.0.0.0 255.0.0.0
Router(dhcp-config)#default-router 30.0.0.1
Router(dhcp-config)#exit
Router(config)#
Router(config)#int gig0/2
Router(config-if)#ip add 30.0.0.1 255.0.0.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up
^Z
Router#
%SYS-5-CONFIG_I: Configured from console by console
```



The screenshot shows a Cisco Packet Tracer PC Command Line window for PC2. The window has tabs for Physical, Config, Desktop, Programming, and Attributes. The Desktop tab is active, displaying a Command Prompt. The Command Prompt shows the execution of the command 'ping 30.0.0.2'. The output indicates that the ping was successful, with 3 packets received out of 4 sent, resulting in a 25% loss. The round trip times are 0ms, 1ms, and 0ms.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 30.0.0.2

Pinging 30.0.0.2 with 32 bytes of data:

Request timed out.
Reply from 30.0.0.2: bytes=32 time=1ms TTL=127
Reply from 30.0.0.2: bytes=32 time<1ms TTL=127
Reply from 30.0.0.2: bytes=32 time=1ms TTL=127

Ping statistics for 30.0.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

Above are the appendix of this project.

**Question # 04:**

Discuss the evolution of computer networks, tracing their historical development from early concepts to modern implementations. Highlight key milestones, technological advancements, and the impact of networking on various industries.

Provide critical analysis and insights into the challenges faced during different stages of network evolution.

## **Answer:**

The evolution of computer networks has undergone significant transformations since its inception, shaping the modern digital landscape. Here's a comprehensive overview of the historical development, key milestones, technological advancements, and impacts on various industries.

### **○ Early concepts (1960s-1970s):**

- ARPANET (1969):

First operational packet-switching network, precursor to the network.

- Network pioneers:

Vint Cerf, Bob Kahn and Jon Postel.

- Early networking protocols:

TCP/IP, HTTP.

### **○ LANs and WANs (1980s):**

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Ethernet (1983): Developed by Robert Met Calfe and David Boggs.

- Token ring: Developed by IBM.
- WAN technologies: X.25, Frame Relay.

## ○ **Internet Expansion(1990s):**

- World Wide Web: Developed by Tim Berners Lee.
- ISPs: America online (AOL).
- Broadband technologies: DSL, Cable modem.

## ○ **Wireless networking(2000s):**

- Wi-Fi (2001): Standardized wireless networking.
- Mobile devices: Laptops, smartphones and tablets.
- Wireless protocols: 802.11a/b/g/n/ac.

## ○ **Modern Implementations (2010s):**

- Cloud Computing: Amazon Web Services (AWS), Microsoft Azure.
- Software-Defined Networking:  
Separating control and data planes.
- Network Functions Virtualization (NFV): Virtualizing network functions.
- Internet of Things (IoT): Connecting devices, sensors, and actuators.
- 5G Networks: Enhanced mobile broadband, low latency.



### **Key milestones:**

- Internet Protocol version 6 (IPv6) adoption.
- Secure Sockets Layer (SSL) and Transport Layer Security (TLS).
- Quality of Service (QoS) and traffic management.
- Network virtualization and containerization.



### **Technological Advancements:**

- Fiber-optic cables.
- Network processors and Application Specific Integrated Circuits (ASICs).
- Artificial Intelligence (AI) and Machine Learning (ML) in networking.
- Quantum Computing and post-quantum cryptography.



### **Industry Impact:**

- E-commerce and online banking.
- Remote work and collaboration.
- Healthcare: Telemedicine, medical imaging.
- Education: Online learning platforms.
- Manufacturing: Industrial IoT, automation.



### **Challenges and Critical Analysis:**

- Security: Cyber threats, data breaches.
- Scalability: Network congestion, capacity planning.
- Interoperability: Standardization, compatibility.
- Reliability: Network downtime, fault tolerance.
- Energy efficiency: Power consumption, sustainability.



### **Future Directions:**

- Edge Computing: Distributed computing, reduced latency.
- 6G Networks: Terahertz frequencies, quantum computing.
- Artificial Intelligence-driven networking.
- Blockchain-based network security.
- Quantum-resistant cryptography.

### **Conclusion:**



- In conclusion, the evolution of computer networks has transformed the way we communicate, collaborate, and access information.
- Understanding the historical context, technological advancements, and challenges faced during different stages of network evolution is crucial for shaping the future of networking.

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