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"Implementation of DHCP using Cisco Packet Tracer tool"

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Course: Computer Communication Networks **Course Code:**BET503

POs Addressed : PO5-3, PO9-3, PO10-3,PO12-3

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ABSTRACT:

Here a DHCP Protocol implemented using Cisco Packet tracer tool. Dynamic Host Configuration Protocol (DHCP) is a network protocol used to automatically assign IP addresses and other network configuration parameters to devices in a network. Using Cisco Packet Tracer, this protocol can be implemented to simulate the process of dynamically assigning IP addresses to client devices (e.g., PCs, laptops, or IoT devices) in a network. Here a topology of 6 nodes with one router and 2 switches has been considered.

Results and Observations

- **Dynamic IP Assignment:** PCs were dynamically assigned IP addresses from the DHCP pool without manual configuration.
- **Network Automation:** Automating the IP address allocation process reduced errors and ensured efficient address management.
- **Scalability:** The implementation demonstrated how DHCP simplifies configuration in large networks by eliminating the need for static IP assignment.

I. INTRODCUTION:

The Dynamic Host Configuration Protocol (DHCP) is a standardized network protocol that dynamically assigns IP addresses and other network configuration parameters to devices on a network. This ensures that devices, such as computers, smartphones, printers, and IoT devices, can seamlessly communicate within the network without requiring manual configuration.

DHCP operates at the application layer of the TCP/IP model and simplifies network management by automating the assignment of network settings. It is particularly useful in large-scale networks, where manually assigning IP addresses to every device would be inefficient, time-consuming, and prone to errors.

Steps to Implement DHCP Protocol in Cisco Packet Tracer

1. **Create the Network Topology**
   - Launch Cisco Packet Tracer and create a basic network topology.
   - Add devices such as routers, switches, and PCs to simulate a real-world network.
   - Connect all devices using appropriate cables (e.g., straight-through or crossover). Use the "Connections" tool to ensure that each device is properly connected.
2. **Enable DHCP on the Router**
   - Select a router from the workspace.

- Enter the CLI (Command Line Interface) of the router by clicking on it and navigating to the "CLI" tab.
- Configure the router to act as a DHCP server by enabling the DHCP service and defining the address pool. Use the following commands:

  Router> enable

  Router# configure terminal

  Router(config)# ip dhcp pool <pool_name>

  Router(dhcp-config)# network <network_address> <subnet_mask>

  Router(dhcp-config)# default-router <default_gateway>

  Router(dhcp-confi g)# dns-server <dns_server_address>

  Router(dhcp-config)# exit
- Optional: Exclude specific IP addresses from the pool (e.g., for static devices like servers):

  Router(config)# ip dhcp excluded-address <start_ip> <end_ip>

3. **Configure the PCs to Use DHCP**
   - Click on each PC and go to the "Desktop" tab.
   - Select the "IP Configuration" tool and set the "IP Configuration" mode to DHCP.
   - The PC will now request an IP address dynamically from the router's DHCP service
4. **Verify DHCP Assignment**
   - After configuring the PCs, they will send DHCP Discover messages to request IP addresses.
   - The router acting as the DHCP server will respond with a DHCP Offer, followed by DHCP Request and DHCP Acknowledgment. This completes the address assignment process.
   - To verify, return to the PC’s "IP Configuration" and check that the device has obtained an IP address, subnet mask, default gateway, and DNS server information.
5. **Monitor DHCP Messages (Optional)**
   - Use the Simulation Mode in Cisco Packet Tracer to observe the exchange of DHCP messages (Discover, Offer, Request, Acknowledge).
   - This visual representation helps to understand the DHCP protocol workflow.
6. **Test Connectivity**
   - Use the ping command from the PCs to test connectivity between devices and ensure that IP addresses have been assigned correctly. For example:

     PC> ping <another_PC_IP>.

Key Features of DHCP Protocol:

- **Dynamic IP Address Assignment**: Automatically allocates IP addresses from a predefined range (IP pool) to devices on the network.
- **Efficient IP Management**: Prevents address conflicts by ensuring that each device receives a unique IP address.
- **Ease of Configuration**: Simplifies the process of adding or removing devices in the network, as devices obtain necessary settings automatically.
- **Support for Additional Parameters**: Provides other essential network settings, such as:
  - Subnet Mask
  - Default Gateway
  - DNS Server Addresses
  - Lease Time (duration for which an IP address is assigned)

II. ABOUT PACKET TRACER TOOL:

1. **Network Design and Simulation**:

   Packet Tracer enables users to create and simulate complex network topologies using a wide variety of Cisco devices such as routers, switches, wireless access points, PCs, and servers.

2. **Protocol Support**:

   The tool supports a broad range of networking protocols, including:
   - DHCP
   - OSPF
   - RIP
   - EIGRP
   - VLANs
   - VPNs and many more.

3. **User-Friendly Interface**:

   It offers a drag-and-drop interface to quickly connect and configure devices, making it accessible for both beginners and professionals.

4. **Simulation and Real-Time Modes**:
   - **Real-Time Mode**: Shows how devices communicate in a real-time environment.
   - **Simulation Mode**: Allows users to visualize and analyze packet flow through the network, making it ideal for protocol study and troubleshooting.

5. **Cross-Platform Compatibility**:

   Packet Tracer is available on multiple platforms, including Windows, macOS, and Linux. A mobile version is also available for Android and iOS.

6. **Scalability**:

   The tool supports networks of varying sizes, from small home networks to enterprise-scale networks with hundreds of devices.

7. **IoT and Programming Features**:

   It allows simulation of IoT (Internet of Things) devices and supports programming via Python, adding an extra dimension for modern network design.

Educational Uses:

- **Learning Networking Concepts**:

  Packet Tracer helps students understand how protocols work, such as DHCP, DNS, and HTTP, through hands-on practice.

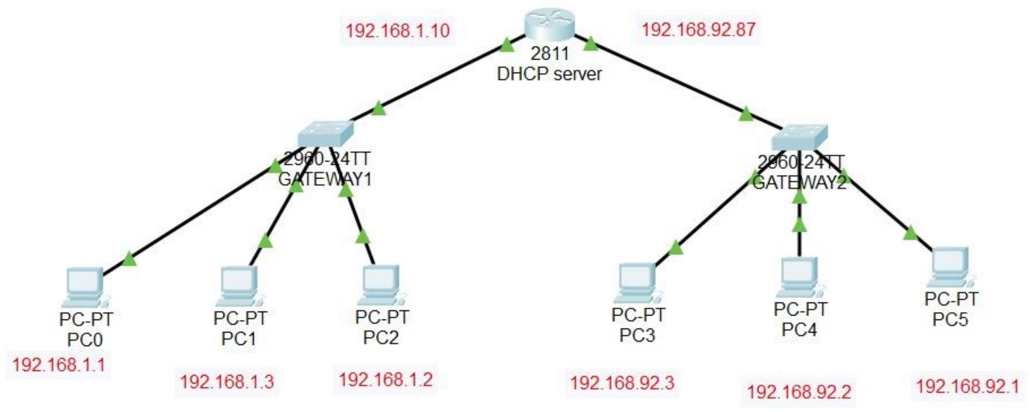
- **Certifications**:

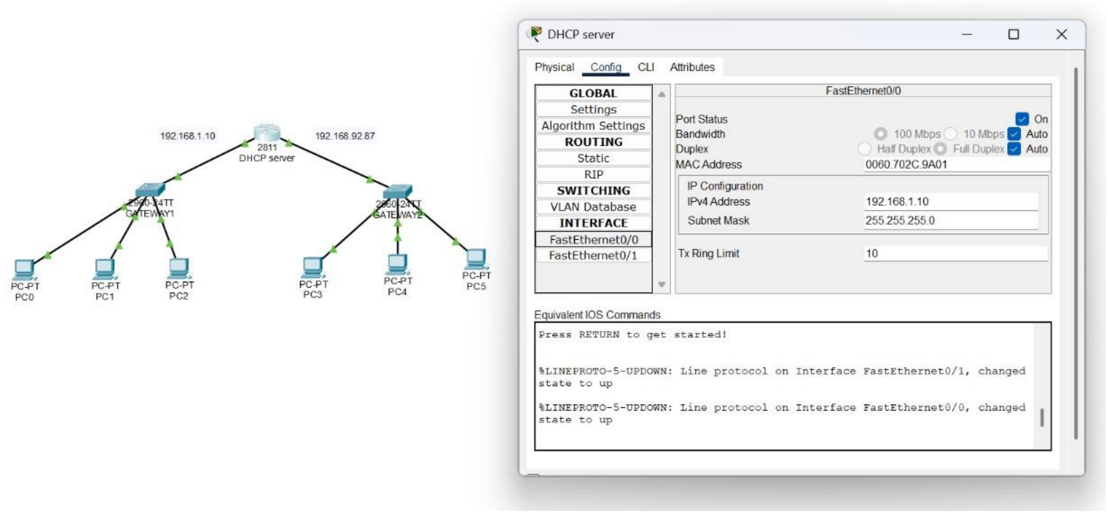
  It is widely used for Cisco certifications, such as CCNA (Cisco Certified Network Associate) and CCNP (Cisco Certified Network Professional), to practice networking concepts.

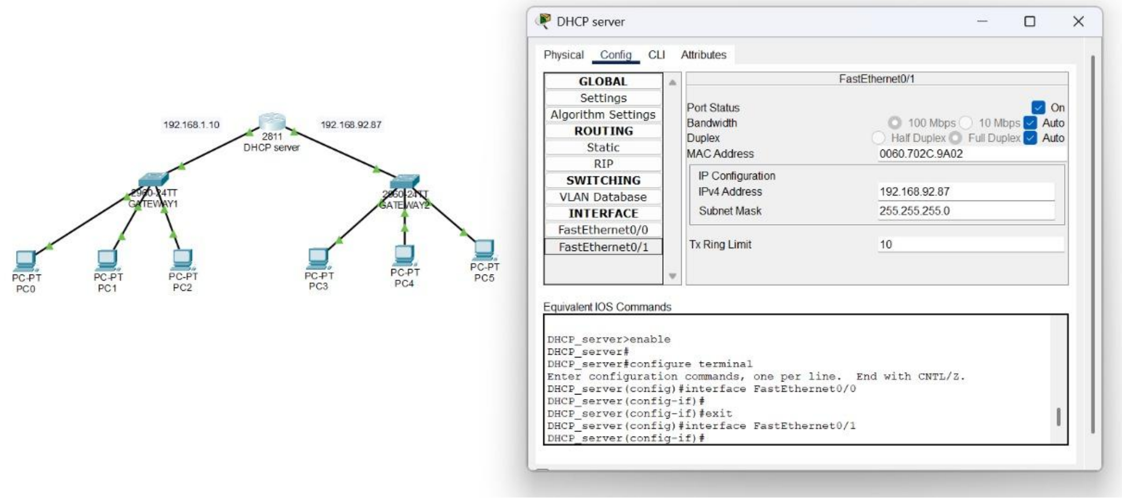
- **Problem-Solving Skills**:

  Users can troubleshoot and optimize network configurations in a risk-free environment.

III. TOPOLOGY:







IOS Command Log

	Time	Device	Prompt	Command	Resolved Command
1	Thu Jan 23 08:58:15 2025	Router0	Router>	en	enable
2	Thu Jan 23 08:58:21 2025	Router0	Router#	config t	configure terminal
3	Thu Jan 23 08:58:25 2025	Router0	Router(config)#	host	hostname
4	Thu Jan 23 08:58:36 2025	Router0	Router(config)#	hostname DHCP_server	hostname DHCP_server
5	Thu Jan 23 08:59:32 2025	DHCP server	DHCP_server(config)#	int f0/0	interface FastEthernet0/0
6	Thu Jan 23 09:00:10 2025	DHCP server	DHCP_server(config-if)#	ip add 192.168.1.10 255.255.255.0	ip address 192.168.1.10 255.255.255.0
7	Thu Jan 23 09:00:24 2025	DHCP server	DHCP_server(config-if)#	int f0/1	interface FastEthernet0/1
8	Thu Jan 23 09:00:44 2025	DHCP server	DHCP_server(config-if)#	ip add 192.168.92.87 255.255.255.0	ip address 192.168.92.87 255.255.255.0
9	Thu Jan 23 09:00:55 2025	DHCP server	DHCP_server(config-if)#	do sh ip int br	do sh ip int br
10	Thu Jan 23 09:01:36 2025	DHCP server	DHCP_server(config-if)#	no sh	no shutdown
11	Thu Jan 23 09:01:47 2025	DHCP server	DHCP_server(config-if)#	do sh ip int br	do sh ip int br
12	Thu Jan 23 09:02:04 2025	DHCP server	DHCP_server(config-if)#	int f0/0	interface FastEthernet0/0
13	Thu Jan 23 09:02:22 2025	DHCP server	DHCP_server(config-if)#	int add 192.168.1.10 255.255.255.0	
14	Thu Jan 23 09:02:53 2025	DHCP server	DHCP_server(config-if)#	no sh	no shutdown
15	Thu Jan 23 09:03:08 2025	DHCP server	DHCP_server(config-if)#	do sh ip int br	do sh ip int br
16	Thu Jan 23 09:15:32 2025	DHCP server	DHCP_server>	config dhcp server	config
17	Thu Jan 23 09:15:44 2025	DHCP server	DHCP_server>	config DHCP_server	config
18	Thu Jan 23 09:16:03 2025	DHCP server	DHCP_server>	config dhcp server	config
19	Thu Jan 23 09:16:17 2025	DHCP server	DHCP_server>	config dhcpserver	config
20	Thu Jan 23 09:16:27 2025	DHCP server	DHCP_server>	en	enable
21	Thu Jan 23 09:16:36 2025	DHCP server	DHCP_server#	config dhcp server	configure

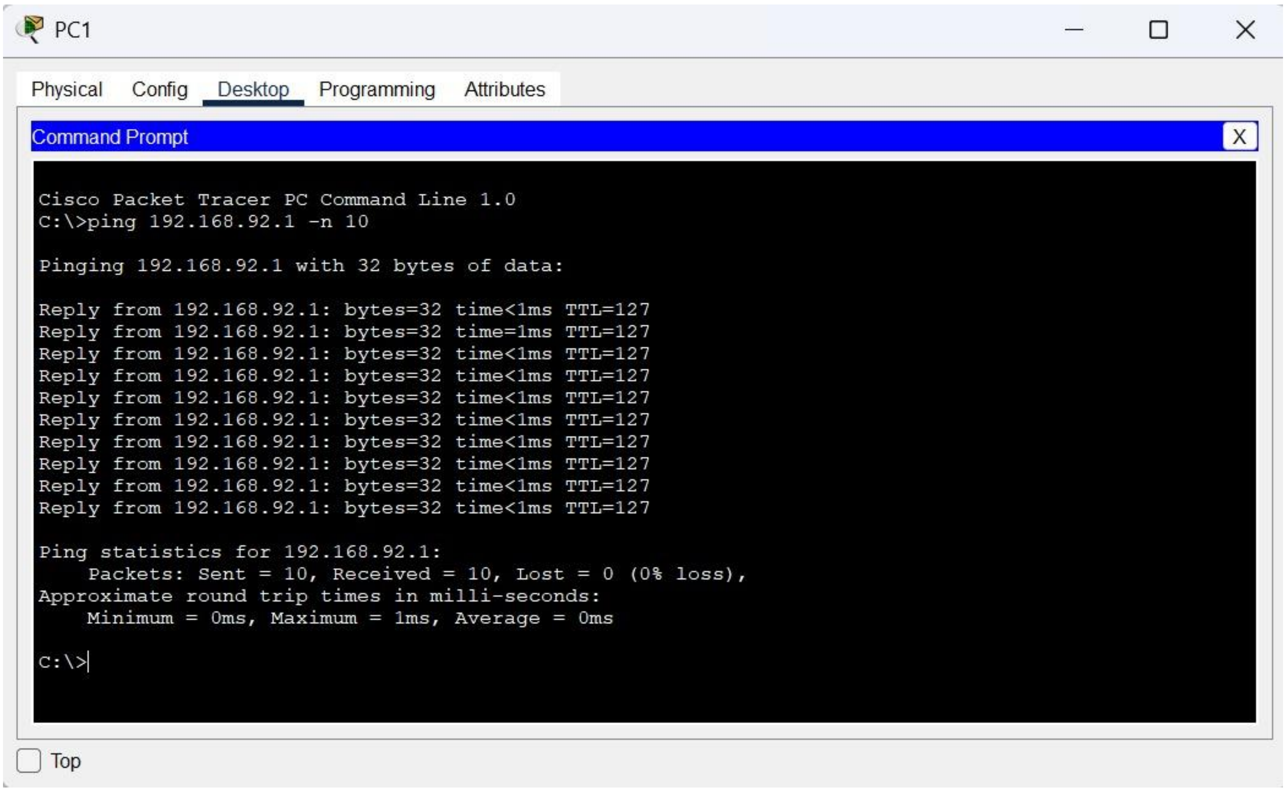
Update

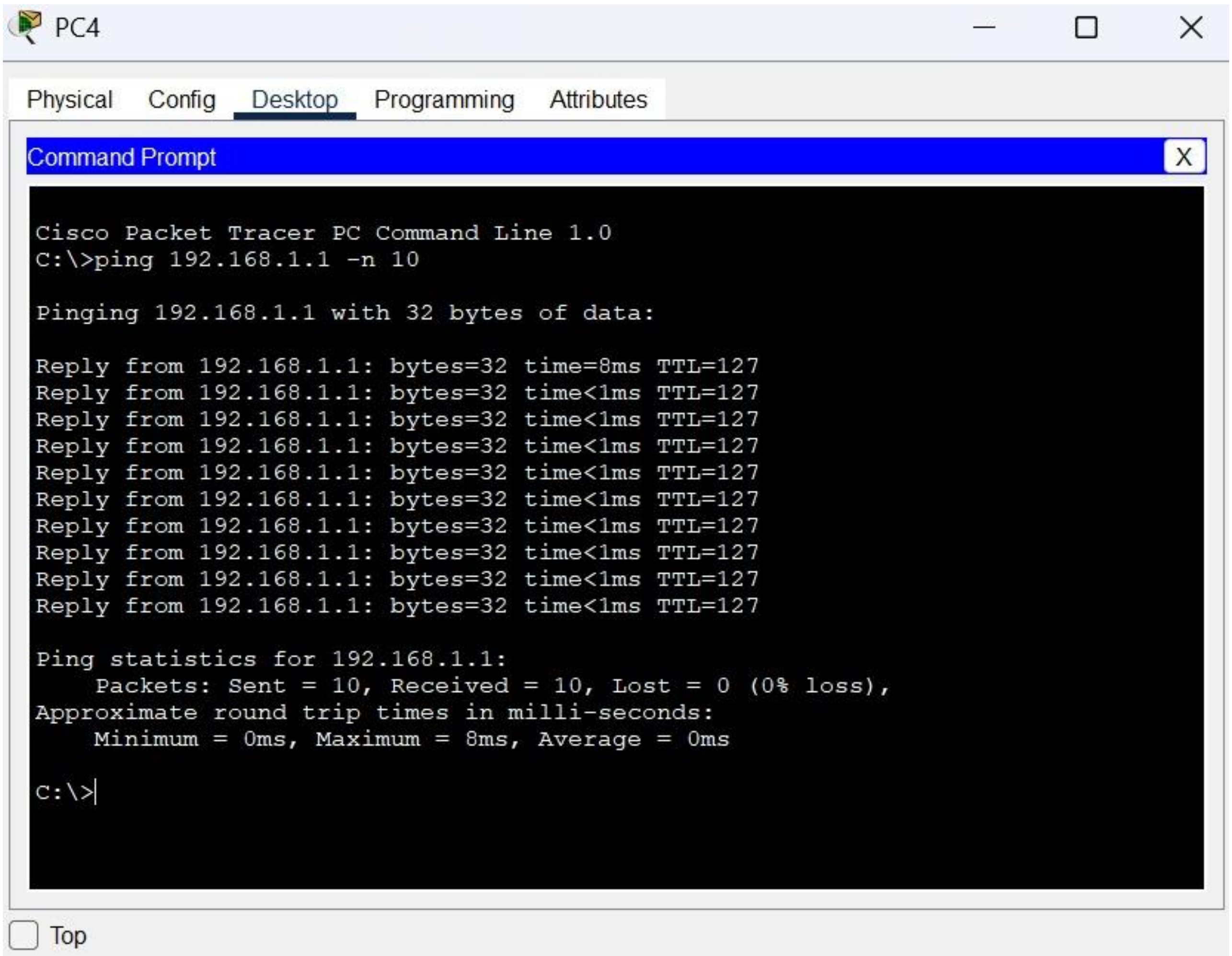
IOS Command Log

	Time	Device	Prompt	Command	Resolved Command
22	Thu Jan 23 09:16:46 2025	DHCP server	DHCP_server#	config t	configure terminal
23	Thu Jan 23 09:16:57 2025	DHCP server	DHCP_server(config)#	config dhcp server	config-register dhcp
24	Thu Jan 23 09:17:13 2025	DHCP server	DHCP_server(config)#	do sh ip int br	do sh ip int br
25	Thu Jan 23 09:17:51 2025	DHCP server	DHCP_server(config)#	ip dhcp ex	ip dhcp excluded-address
26	Thu Jan 23 09:18:44 2025	DHCP server	DHCP_server(config)#	ip dhcp excluded-address 192.168.1.10	ip dhcp excluded-address 192.168.1.10
27	Thu Jan 23 09:18:54 2025	DHCP server	DHCP_server(config)#	ip dhcp excluded-address 192.168.92.87	ip dhcp excluded-address 192.168.92.87
28	Thu Jan 23 09:19:07 2025	DHCP server	DHCP_server(config)#	ip dhcp pool 192.168.1.10	ip dhcp pool 192.168.1.10
29	Thu Jan 23 09:19:09 2025	DHCP server	DHCP_server(dhcp-config)#	net	network
30	Thu Jan 23 09:19:25 2025	DHCP server	DHCP_server(dhcp-config)#	network 192.168.1.10 255.255.255.0	network 192.168.1.10 255.255.255.0
31	Thu Jan 23 09:19:48 2025	DHCP server	DHCP_server(dhcp-config)#	default-router 192.168.1.10	default-router 192.168.1.10
32	Thu Jan 23 09:20:01 2025	DHCP server	DHCP_server(dhcp-config)#	dns-ser	dns-server
33	Thu Jan 23 09:20:11 2025	DHCP server	DHCP_server(dhcp-config)#	dns-server 8.8.8.8	dns-server 8.8.8.8
34	Thu Jan 23 09:20:14 2025	DHCP server	DHCP_server(dhcp-config)#	exit	exit
35	Thu Jan 23 09:20:27 2025	DHCP server	DHCP_server(config)#	ip dhcp 192.168.92.87	ip dhcp
36	Thu Jan 23 09:20:45 2025	DHCP server	DHCP_server(config)#	ip dhcp pool 192.168.92.87	ip dhcp pool 192.168.92.87
37	Thu Jan 23 09:21:07 2025	DHCP server	DHCP_server(dhcp-config)#	network 192.168.92.87 255.255.255.0	network 192.168.92.87 255.255.255.0
38	Thu Jan 23 09:21:30 2025	DHCP server	DHCP_server(dhcp-config)#	default-router 192.168.92.87	default-router 192.168.92.87
39	Thu Jan 23 09:21:42 2025	DHCP server	DHCP_server(dhcp-config)#	dns-server 8.8.8.8	dns-server 8.8.8.8

Update

IV. OUTPUT:


PC1
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.92.1 -n 10
Pinging 192.168.92.1 with 32 bytes of data:
Reply from 192.168.92.1: bytes=32 time<1ms TTL=127
Reply from 192.168.92.1: bytes=32 time=1ms TTL=127
Reply from 192.168.92.1: bytes=32 time<1ms TTL=127
Reply from 192.168.92.1: bytes=32 time<1ms TTL=127
Reply from 192.168.92.1: bytes=32 time<1ms TTL=127
Reply from 192.168.92.1: bytes=32 time<1ms TTL=127
Reply from 192.168.92.1: bytes=32 time<1ms TTL=127
Reply from 192.168.92.1: bytes=32 time<1ms TTL=127
Reply from 192.168.92.1: bytes=32 time<1ms TTL=127
Reply from 192.168.92.1: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.92.1:
Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>
Top


PC4
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.1 -n 10
Pinging 192.168.1.1 with 32 bytes of data:
Reply from 192.168.1.1: bytes=32 time=8ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Reply from 192.168.1.1: bytes=32 time<1ms TTL=127
Ping statistics for 192.168.1.1:
Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 8ms, Average = 0ms
C:\>
Top