
**KULLIYYAH OF INFORMATION & COMMUNICATION
TECHNOLOGY**

**BICS 1303 COMPUTER NETWORKING
SEMESTER I, 2025/2026
SECTION 1**

**BASIC NETWORK DESIGN &
IMPLEMENTATION FOR REAL
ORGANIZATION**

PREPARED BY: GROUP 11

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1. Introduction

In the contemporary business landscape, a dependable and meticulously organized network infrastructure is indispensable for enterprises, irrespective of their scale. Even nascent startup ventures necessitate an effective network to facilitate communication, data dissemination, and routine operational functions. This document furnishes a detailed account of the design and execution of a fundamental wired network tailored for a startup company, utilizing Cisco Packet Tracer.

The project simulates a real-world situation where a junior network technician is responsible for planning, configuring, and validating a small organizational network. The implementation focuses on basic networking concepts, including IPv4 addressing, subnetting, router and switch configuration, router-based Dynamic Host Configuration Protocol (DHCP), and network testing using Internet Control Message Protocol (ICMP). This report aims to demonstrate a working network and also to clearly explain the design decisions, configuration processes, and verification steps used to build a basic wired network that meets the organization's needs.

2. Organization Background

The chosen entity for this undertaking is a **startup company**. This small and expanding organization functions with a restricted workforce, which is structured into two primary divisions: Administration and Operations. Each department undertakes specific responsibilities that are crucial to the company's day-to-day operations.

The Administration department oversees managerial duties, documentation, coordination, and internal communication. Conversely, the Operations department is dedicated to operational and technical functions that underpin the fundamental business activities. Given the organization's characteristics, a straightforward yet adaptable network infrastructure is necessary to facilitate effective internal communication while accommodating future growth as the company develops.

3. Network Design Objectives

The principal aim of this network design endeavor is to establish a structured and operational wired network, tailored to the functional requirements of a nascent company. This network architecture is conceived to facilitate dependable communication both within and across departmental boundaries, while simultaneously adhering to the project's stipulated constraints and prioritizing operational simplicity.

The project's specific objectives encompass a comprehensive analysis of the organization's network prerequisites, the formulation of an efficient IPv4 addressing strategy employing subnetting techniques, and the practical implementation of the network topology utilizing routers, switches, and end-user devices within the Cisco Packet Tracer environment. Furthermore, the project seeks to ensure the accurate configuration of network devices, the deployment of router-based DHCP services, the assignment of suitable default gateways, and the validation of network connectivity through methodical testing procedures. Consequently, the successful attainment of these objectives will serve as a demonstration of a robust comprehension of fundamental networking principles and their practical implementation.

4. Network Requirements Analysis

A thorough examination of the startup's operational framework indicates the necessity of distinct network segments for each departmental unit. The segregation of departments into separate local area networks (LANs) facilitates improved network organization, streamlines the troubleshooting process, and augments overall manageability.

Each department necessitates multiple personal computers for its personnel, in addition to access to shared network resources, including printers. Assuming a reasonable distribution, the network is engineered to accommodate a minimum of eight end devices, evenly allocated across the two departments. Furthermore, the network must facilitate inter-LAN communication via routing, while ensuring the correct configuration of IP addressing and default gateways.

Department	Users	PCs	Printers
Administration	4	4	1
Operations	4	4	1

5. IP Addressing and Subnetting Plan

To facilitate effective IP address management and departmental isolation, a private IPv4 address space was implemented within the network infrastructure. The 192.168.10.0/24 address block was adopted, chosen for its straightforwardness and appropriateness for small-scale organizational networks.

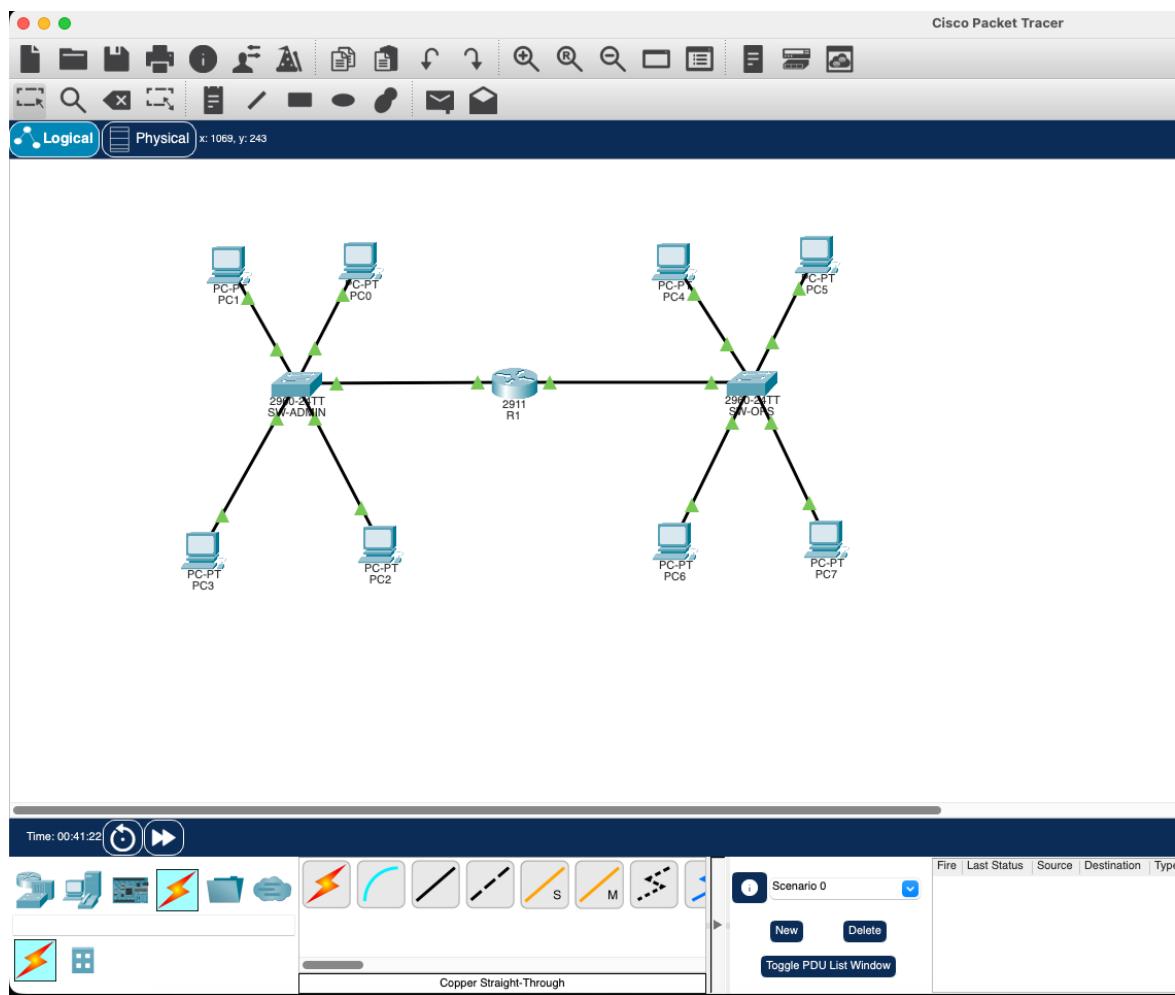
This /24 network was subsequently subnetted into two /25 subnets, thereby permitting each department to function within its designated address range. Subnetting offers an adequate number of host addresses for existing devices, while simultaneously accommodating future growth. Each subnet is allocated a specific default gateway, configured on the router, which facilitates inter-LAN communication.

LAN	Network Address	Subnet Mask	Default Gateway	Host Range
Administration	192.168.10.0	255.255.255.128	192.168.10.1	192.168.10.2 – 192.168.10.126
Operations	192.168.10.128	255.255.255.128	192.168.10.129	192.168.10.130 – 192.168.10.254

6. Network Topology Design

The network topology employed in this project is a straightforward hierarchical structure, comprising a single router, two switches, and eight end devices. Each departmental unit connects to the router via a dedicated physical interface, thereby facilitating inter-LAN communication through routing protocols.

This particular design was chosen to reduce complexity while simultaneously satisfying all project specifications. By deliberately omitting advanced technologies like VLANs and trunking, the topology maintains a high degree of accessibility for understanding, configuration, and troubleshooting. Furthermore, the utilization of a single router ensures centralized management of routing and DHCP services, whereas the two switches furnish connectivity for end devices within each respective department.



7. Device Configuration

Network devices were configured utilizing the Cisco IOS command-line interface and the Packet Tracer graphical interface as needed. The router, designated R1, was provisioned with two GigabitEthernet interfaces, each representing a distinct LAN. IP addresses were allocated in accordance with the established subnetting plan, and all interfaces were activated via the no shutdown command.

Router-based DHCP was deployed for the Administration LAN, facilitating the automatic assignment of IP addresses to end devices; this approach diminished the need for manual configuration and mitigated the potential for IP address conflicts. Switches were assigned hostnames to facilitate accurate identification, and display names were also employed to enhance visual clarity within the topology. End devices within the Operations LAN were configured with static IP addressing to ensure consistent and predictable network identification.



```
R1
Physical Config CLI Attributes
IOS Command Line Interface

Router(config-if)#ip address 192.168.10.1 255.255.255.128
Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#exit
Router(config)#interface GigabitEthernet0/0
Router(config-if)#
Router(config-if)#x
Router(config)#interface GigabitEthernet0/1
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up
%LINKPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
ip address 192.168.10.129 255.255.255.128
Router(config-if)#ip address 192.168.10.129 255.255.255.128
Router(config-if)#
Router(config-if)#
Router(config-if)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#hostname R1
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#interface gigabitEthernet0/0
R1(config-if)#ip address 192.168.10.1 255.255.255.128
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#interface gigabitEthernet0/1
R1(config-if)#ip address 192.168.10.129 255.255.255.128
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0    192.168.10.1    YES manual up           up
GigabitEthernet0/1    192.168.10.129  YES manual up           up
GigabitEthernet0/2    unassigned      YES unset administratively down down
Vlan1               unassigned      YES unset administratively down down
R1#
```

Top

R1

Physical Config **CLI** Attributes

IOS Command Line Interface

```
R1#
%SYS-5-CONFIG_I: Configured from console by console

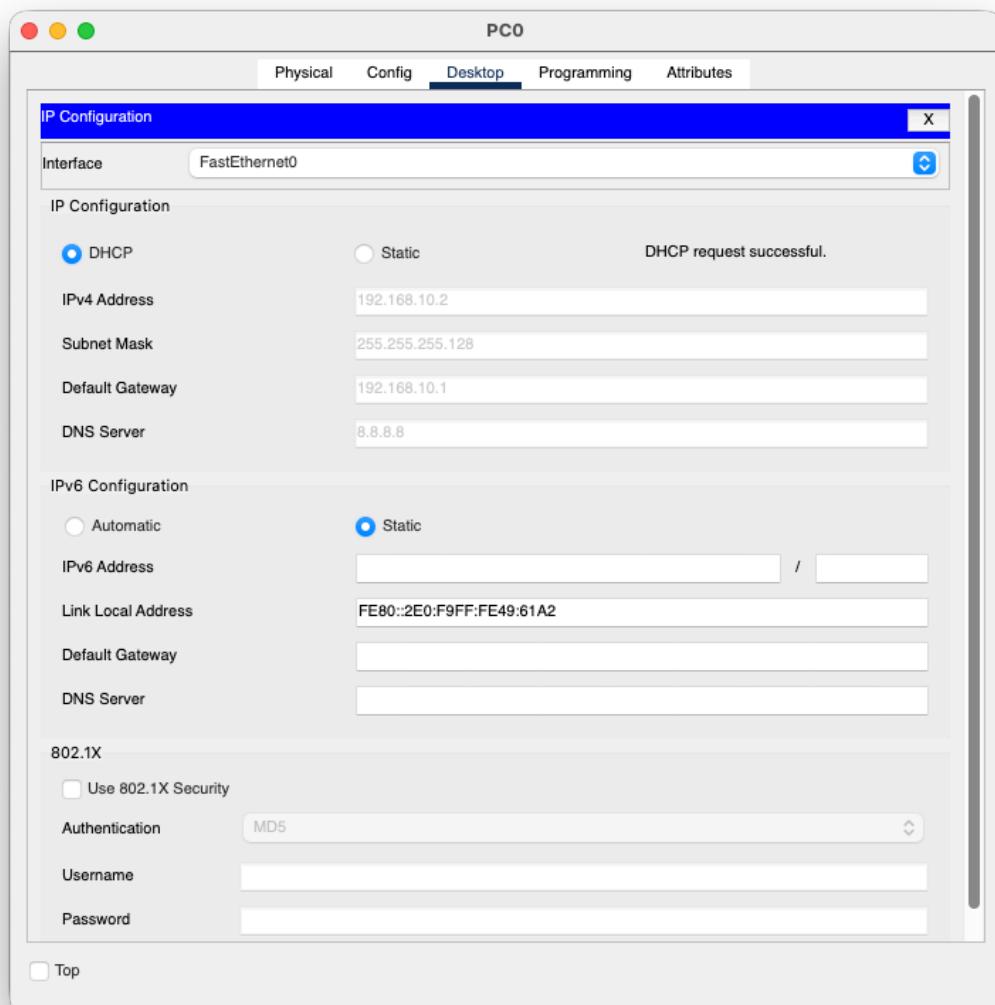
R1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#interface gigabitEthernet0/0
R1(config-if)#ip address 192.168.10.1 255.255.255.128
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#interface gigabitEthernet0/1
R1(config-if)#ip address 192.168.10.129 255.255.255.128
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0   192.168.10.1   YES manual up
GigabitEthernet0/1   192.168.10.129  YES manual up
GigabitEthernet0/2   unassigned      YES unset administratively down down
Vlan1              unassigned      YES unset administratively down down
R1#write memory
Building configuration...
[OK]
R1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#ip dhcp excluded-address 192.168.10.1
R1(config)#ip dhcp pool ADMIN
R1(dhcp-config)#network 192.168.10.0 255.255.255.128
R1(dhcp-config)#default-router 192.168.10.1
R1(dhcp-config)#dns-server 8.8.8.8
R1(dhcp-config)#exit
R1(config)#write memory
^
% Invalid input detected at '^' marker.

R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
R1#show running-config | section dhcp
ip dhcp excluded-address 192.168.10.1
ip dhcp pool ADMIN
  network 192.168.10.0 255.255.255.128
  default-router 192.168.10.1
  dns-server 8.8.8.8
R1#
```

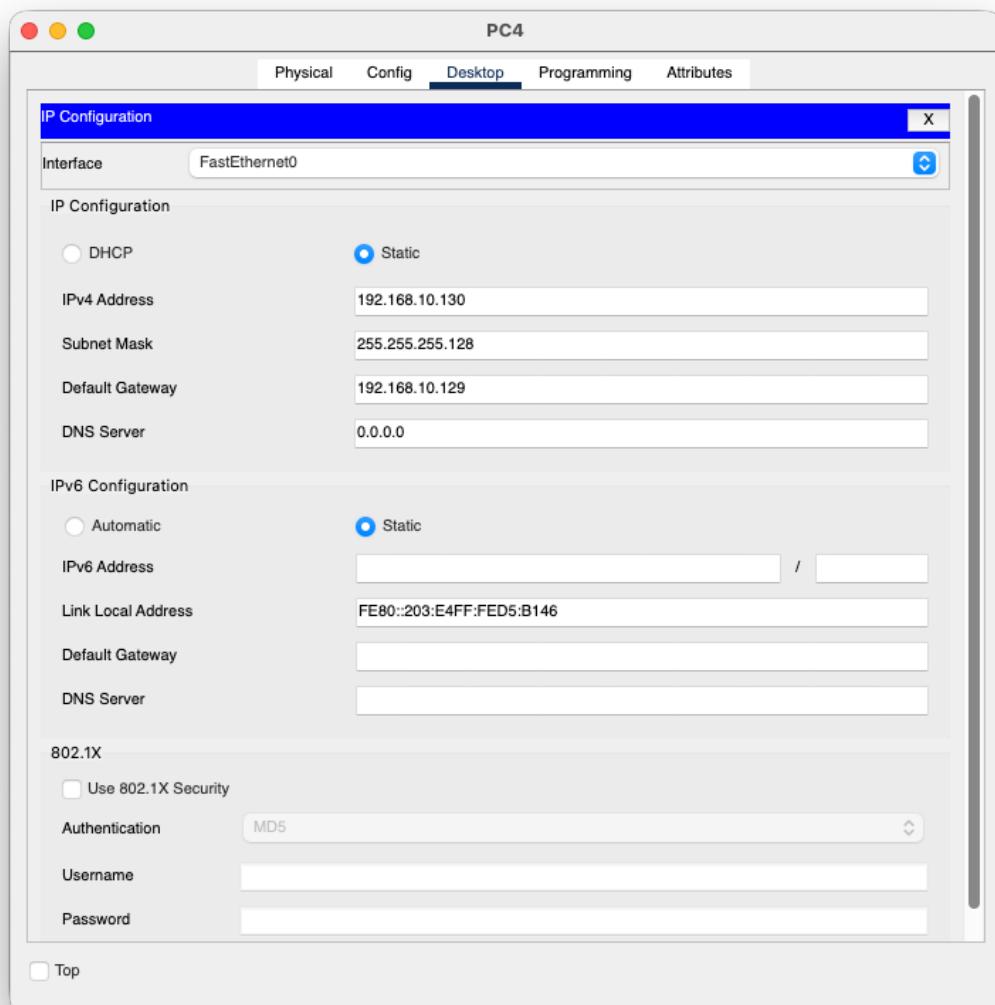
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Router DHCP Config



Admin PC IP Config - DHCP

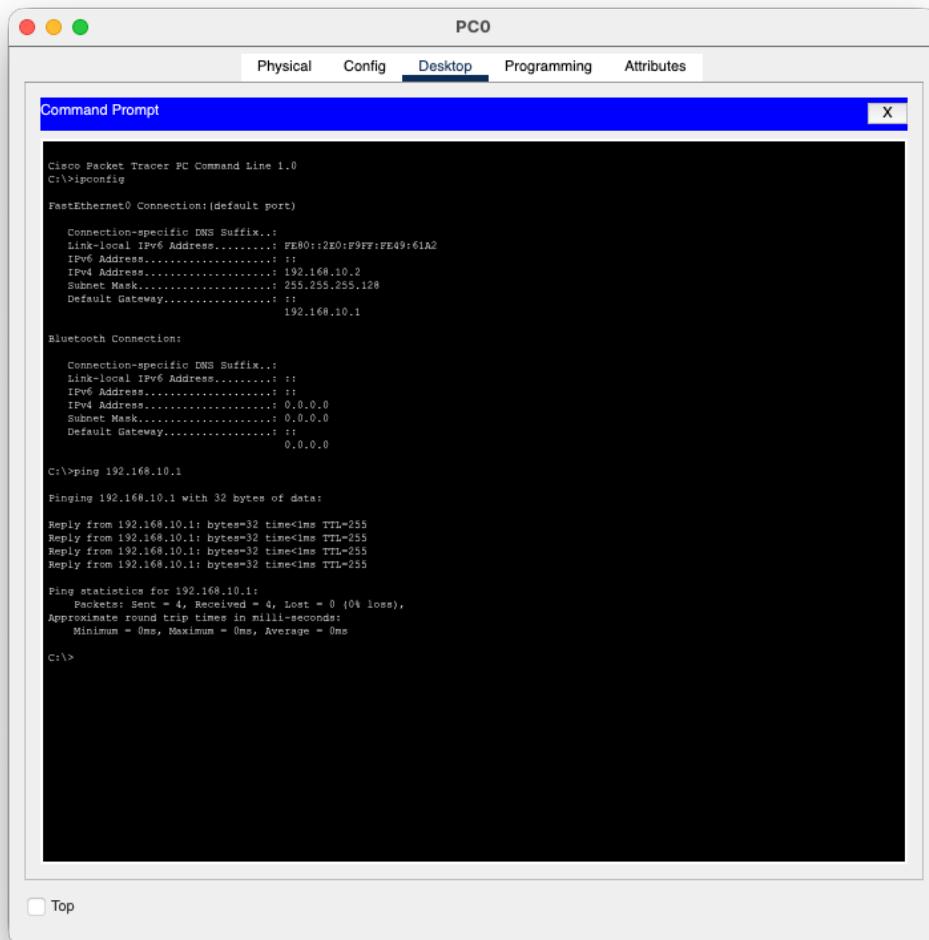


Operations PC IP Config - Static

8. Network Testing and Verification

Following the completion of device configurations, extensive testing was undertaken to validate network functionality and connectivity. ICMP ping tests were employed to ascertain communication between end devices and the router, and also between devices situated within distinct LANs.

Successful ping responses serve as an indicator that IP addressing, default gateway configuration, DHCP operation, and routing were implemented accurately. It is not uncommon for an initial ping request to experience a timeout, a consequence of Address Resolution Protocol (ARP) resolution. This behavior is expected and arises when a device is initially learning the MAC address of a destination. Subsequent ping attempts then confirm successful connectivity.



The screenshot shows a Cisco Packet Tracer Command Prompt window titled "Command Prompt". The window has tabs at the top: Physical, Config, Desktop (which is selected), Programming, and Attributes. The main area displays the following text:

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

PartEthernet0 Connection:(default port)
Connection-specific DNS Suffix.:
Link-local IPv6 Address.....:: FE80::2E0:F9FF:FE49:61A2
IPv6 Address.....:: ::1
IPv4 Address.....:: 192.168.10.2
Subnet Mask.....:: 255.255.255.128
Default Gateway.....:: 192.168.10.1

Bluetooth Connection:
Connection-specific DNS Suffix.:
Link-local IPv6 Address.....:: ::1
IPv6 Address.....:: ::1
IPv4 Address.....:: 0.0.0.0
Subnet Mask.....:: 0.0.0.0
Default Gateway.....:: 0.0.0.0

C:\>ping 192.168.10.1
Pinging 192.168.10.1 with 32 bytes of data:
Reply from 192.168.10.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Ping PC to Router

PC0

Physical Config Desktop Programming Attributes

Command Prompt X

```
Bluetooth Connection:  
Connection-specific DNS Suffix.:  
Link-local IPv6 Address.....: ::  
IPv6 Address.....: ::  
IPv4 Address.....: 0.0.0.0  
Subnet Mask.....: 0.0.0.0  
Default Gateway.....: ::  
0.0.0.0  
C:\>ping 192.168.10.1  
Pinging 192.168.10.1 with 32 bytes of data:  
Reply from 192.168.10.1: bytes=32 time<1ms TTL=255  
Ping statistics for 192.168.10.1:  
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 0ms, Maximum = 0ms, Average = 0ms  
C:\>ping 192.168.10.130  
Pinging 192.168.10.130 with 32 bytes of data:  
Request timed out.  
Reply from 192.168.10.130: bytes=32 time<1ms TTL=127  
Reply from 192.168.10.130: bytes=32 time<1ms TTL=127  
Reply from 192.168.10.130: bytes=32 time<1ms TTL=127  
Ping statistics for 192.168.10.130:  
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 0ms, Maximum = 1ms, Average = 0ms  
C:\>ping 192.168.10.130  
Pinging 192.168.10.130 with 32 bytes of data:  
Reply from 192.168.10.130: bytes=32 time=3ms TTL=127  
Reply from 192.168.10.130: bytes=32 time<1ms TTL=127  
Reply from 192.168.10.130: bytes=32 time<1ms TTL=127  
Reply from 192.168.10.130: bytes=32 time<1ms TTL=127  
Ping statistics for 192.168.10.130:  
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 0ms, Maximum = 3ms, Average = 0ms  
C:\>
```

Top

Ping Admin to Operations

9. Configuration Evidence

The project's configuration evidence comprises command-line outputs and screenshots, which collectively validate the successful implementation of network functionalities. These encompass router interface status, DHCP configuration, switch hostname configuration, and end device IP settings.

The furnished evidence substantiates that all mandated configurations were executed in accordance with the design specifications and project limitations. Screenshots function as verifiable proof of correct implementation and successful testing outcomes.

10. Discussion and Common Issues

Throughout the implementation phase, a number of prevalent networking problems were anticipated and subsequently mitigated. These encompassed erroneous subnet masks, misconfigured default gateway settings, disabled router interfaces, and DHCP pool discrepancies. Rigorous planning, meticulous configuration verification, and incremental testing were instrumental in averting these complications.

Furthermore, the project underscores the significance of grasping fundamental networking principles, including subnetting and routing protocols. Even within modest network environments, flawed configurations can precipitate connectivity disruptions. This undertaking illustrates how systematic troubleshooting and verification procedures can facilitate the establishment of a stable and operational network infrastructure.

11. Conclusion

In summation, this undertaking effectively illustrates the design and execution of a fundamental wired network tailored for a nascent enterprise, utilizing Cisco Packet Tracer. All stipulated objectives were met within the established parameters and limitations, culminating in a dependable and well-organized network framework. This project reinforces fundamental networking principles, including IPv4 addressing, subnetting, router and switch configuration, DHCP deployment, and network diagnostics.

The insights acquired through this project furnish valuable practical expertise, readily transferable to practical networking scenarios. Furthermore, the network architecture is readily scalable, allowing for future expansion to incorporate additional departments or devices as the organization evolves.

12. Appendix

1. Paket Tracer Configuration Files :

https://drive.google.com/file/d/1_Nkzkrk6TQflds4c6-V5GvHMKbt2-hLg/view?usp=sharing

2. GitHub Repositories to YouTube Presentation Link :

<https://github.com/syazmadzlyz/Computer-Networking-Presentation.git>