Article

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Design and Implementation of a Secure and Scalable LAN for a Midsized Company Using Cisco Packet Tracer

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Abstract: This project is the implementation and design of a secure and scalable local area network (LAN) for a midsized organization using Cisco Packet Tracer as the simulator software. The methodology involved eight key phases: requirement analysis, hierarchical network design, IP addressing and subnetting, device configuration, client installation, connectivity testing, troubleshooting, and final documentation. A Layered three-layer architecture (access, distribution, and core) was adopted to enhance manageability and performance. Security and segregation were enforced using VLANs and subnetting, while DHCP and static addressing were used to manage IPs effectively. Wired and wireless access was configured on devices, with separate SSIDs for employee and guest networks using WPA2 encryption. Routing protocols such as RIP and OSPF were used to facilitate effective inter-network communication. Extensive testing and optimization ensured the functionality, robustness, and scalability of the network. This deployment gives a good foundation for enterprise networking scenarios in real-world environments and offers a good foundation for future development.

Keywords: VLAN; DHCP; OSF network; security; robustness

1. Introduction

The aim of this project is to design, model, and execute a stable Local Area Network (LAN) for a midsized company using Cisco Packet Tracer. The network shall provide for a maximum of 30 workers and their corresponding devices like laptops, desktops, mobile phones, and guest users. In addition to conventional client devices, the architecture incorporates Internet of Things (IoT) devices such as webcams and smart door locks to make the network current, scalable, and future-proof for technological demands yet to emerge. The network must also offer secure and reliable connections to internal and external servers to support the company's day-to-day operations and data needs[1-2].

To begin with, there was an extensive analysis of business requirements. This included considering the wired and wireless connectivity requirements, the number and nature of devices to be supported, as well as security requirements to protect sensitive business data. Based on this assessment, there was a deployment of a hierarchical network design model to enhance manageability, performance, as well as scalability in the long run. This design includes core, distribution, and access layers that logically organize the network and facilitate easy troubleshooting and maintenance[3].

Implementation entailed several important steps. IP address schemes were first designed using static or dynamic addressing depending on device type and network segment. Subnetting was employed to organize the network in an efficient way and enhance security. Network hardware, including routers, Layer 2 and Layer 3 switches, and wireless access points, was installed to provide faultless connectivity in the LAN. VLANs were utilized to compartmentalize traffic between departments and improve security overall. Wireless networks were established using SSIDs for

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employees and visitors, including encryption standards like WPA2 to secure wireless communications[4-9].

Connectivity testing was an integral part of the project. It involved checking connections between all devices to ensure that the network provided access to necessary services while isolating unauthorized access. Furthermore, routing protocol configuration like RIP or OSPF ensured correct data exchange across different network segments and any external networks connected[10-15].

Through this practical project, we gained significant practical experience with network management and design[16-17]. Using Cisco Packet Tracer, we were able to model real-world environments, discover and correct configuration errors, and reinforce our theory-based networking principles with real-world practice. The finished network design addresses all the company's requirements and places the central elements of basic networking such as reliability, security, performance, and scalability at the top. The project not only serves the technical purpose but also prepares us for actual problems in enterprise networking situations[18-20].

2. Methodology

1. Requirement Analysis

The project began with an in-depth analysis of the firm's business and technical requirements. This included defining the number and type of devices (desktops, laptops, mobile phones, IoT devices), user capacity (up to 30 workers) estimation, and security and connectivity needs for wired and wireless networks[21].

2. Network Design

A hierarchical network design model was used, dividing the network into access, distribution, and core layers. The model is more manageable, scalable, and performant. Features that were included are:

- Subnetting to efficiently organize devices and bolster security
- VLANs to separate departmental traffic and safeguard sensitive data
- Planning for employee and visitor wireless networks, each with distinct SSIDs and WPA2 encryption

3. IP Addressing and Subnetting

An IP addressing scheme was put in place, using static or dynamic addressing based on device roles. DHCP was enabled on the wireless router to automatically assign IPs within a specific range (192.168.0.1 to 192.168.0.200), while static IPs were assigned to servers and network devices.

4. Device Configuration

Wireless Router: Assigned a LAN IP (192.168.0.1), subnet mask (255.255.255.0), and DHCP service. The Internet interface of the router was configured to talk to the core router with a point-to-point subnet (10.0.0.0/30).

Router: Static routes were set up to forward traffic between the external and internal networks. NAT was set up to provide secure access from internal devices to external resources.

Switches and Access Points: Deployed to provide secure wired and wireless access throughout the network.

5. Client Device Configuration

Client devices (laptops, PCs, smartphones) were configured to connect through DHCP. Wireless modules were installed in laptops and devices were tested for network connectivity.

6. Connectivity Testing and Verification

Comprehensive connectivity testing was performed to confirm all devices could access required services and resources, and unauthorized use was prohibited. Routing protocols (RIP or OSPF) were configured and tested for effective data transmission between segments.

7. Troubleshooting and Optimization

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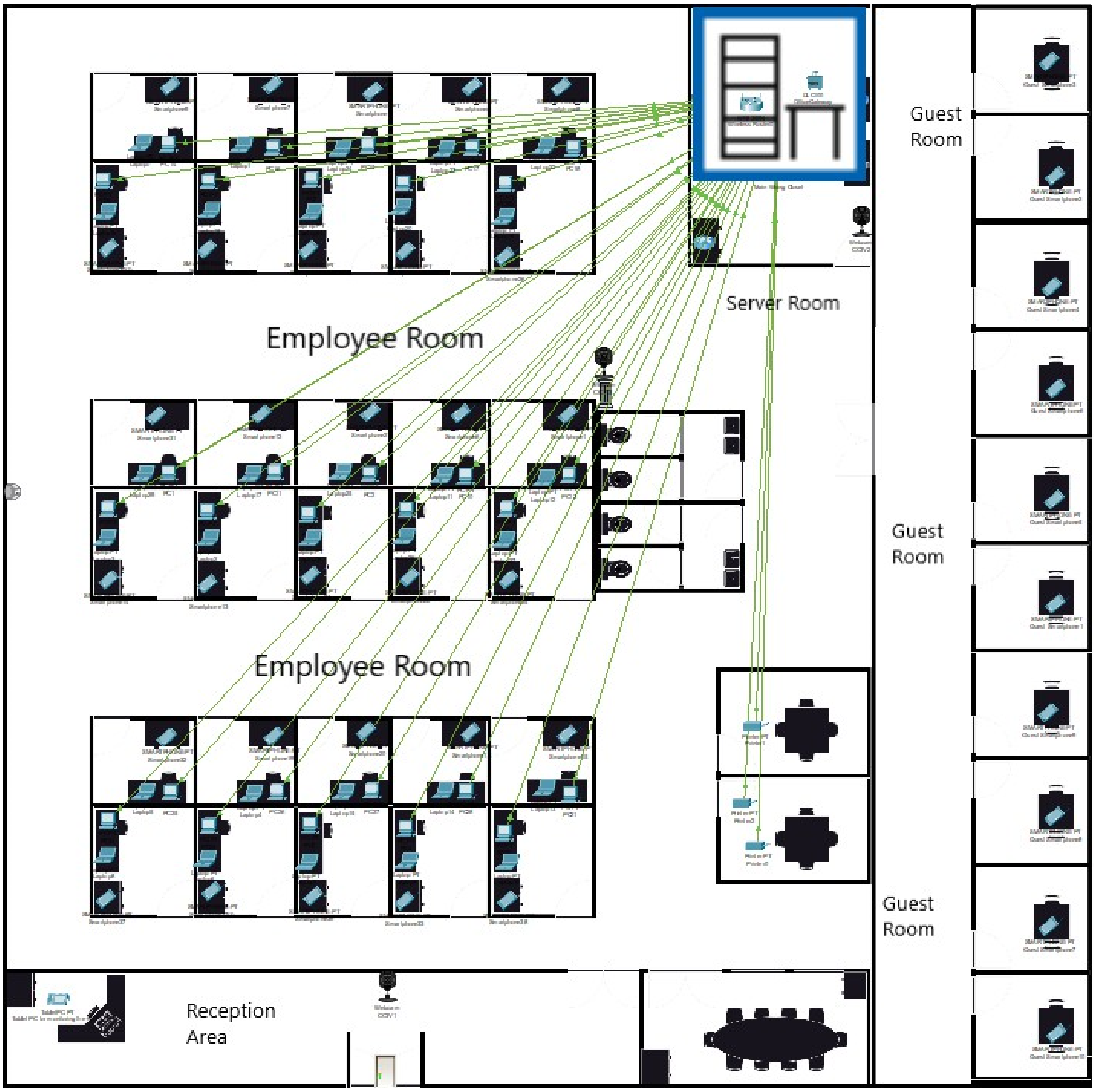
Barriers such as selecting the appropriate routers, server configuration, and topology optimization were resolved through repetitive testing and debugging. Parameters were optimized for maximum performance, dependability, and security.

8. Documentation and Review

All the steps, settings, and design decisions were documented. The resultant network was tested to ensure that it met all provided requirements for reliability, security, scalability, and future growth.

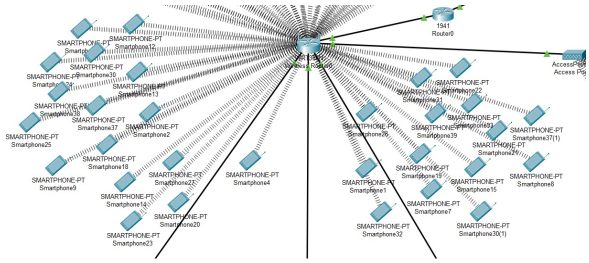
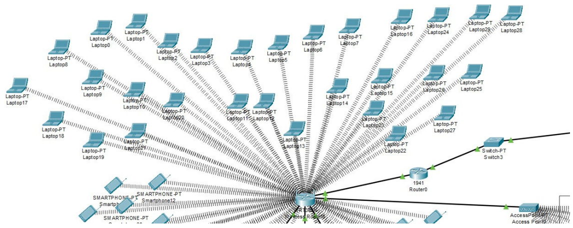
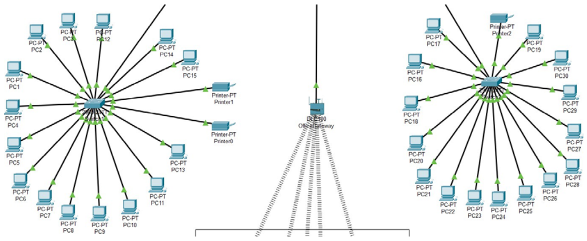
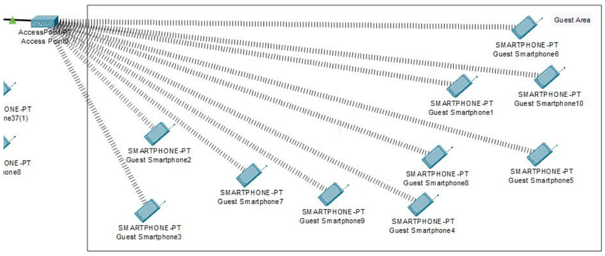
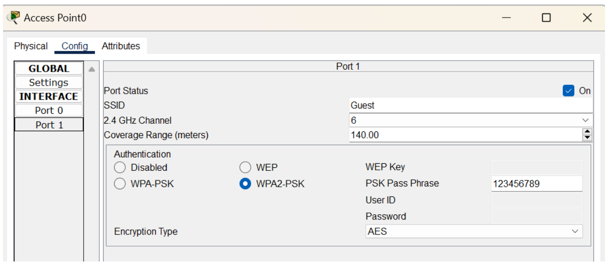
This method gave a secure, stable, and scalable network design, closely replicating real-world enterprise networking scenarios using Cisco Packet Tracer.

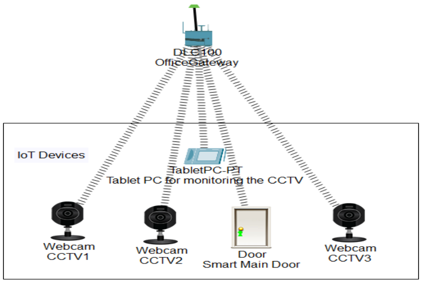
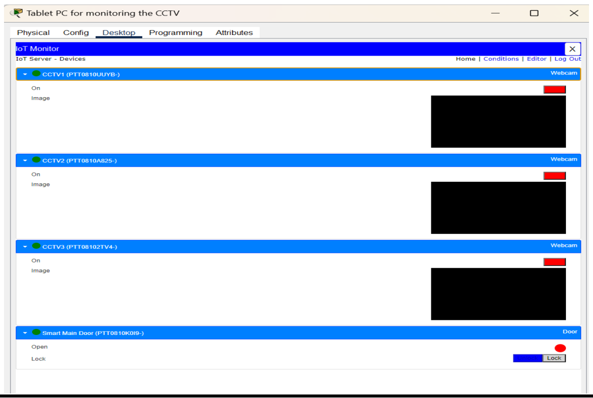
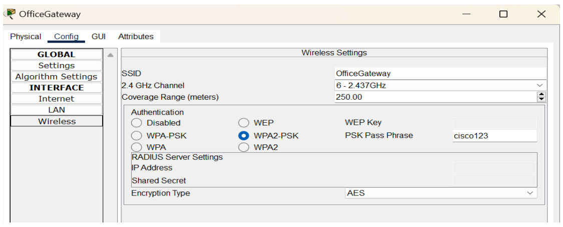
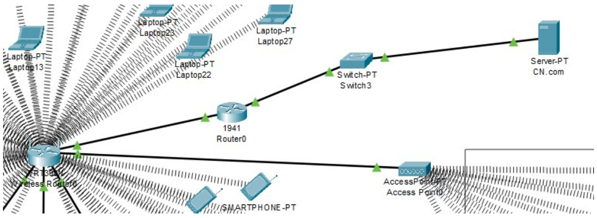
3. Physical Workspace



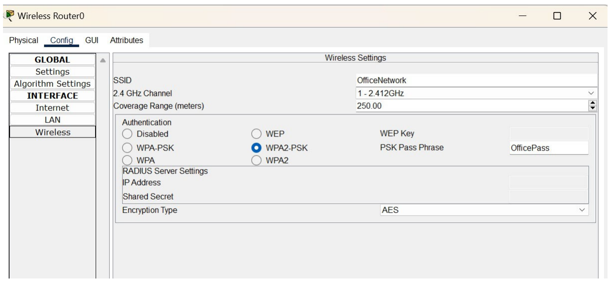
3.1. Build a Simple Network in the Logical Topology Workspace

Explanation	Screenshot

The image shows multiple smartphones connected wirelessly to the network. These are the required 30 smartphones that the employees will be using. It is also worth noting that the connection is wired.	
The second image highlights the wireless connections for employee laptops. Each laptop is linked to the network, to make sure they are all connected and Ready to use. The connection is also wireless, so it is more convenient.	
This picture displays the wired connections of PCs and printers to switches. Each employee has a PC connected via Ethernet. Notice how This setup has a wired connection for reliability and a faster connection. Printers are also wired to the switch.	
This occupied area is the guest room, where a maximum of 10 people can fit inside. The phone connections are all wireless. All the devices get their connection from access point directly connected to the wireless router.	
For providing the wireless connection to 10 guest devices. access point is used, and inside the configuration of port 1 of the access point, the SSID is set as **Guest** and in authentication, **WPA2-PSK** is selected, which assigns login information for each device for them to connect to the network as an added security measure.	 Access Point0 Physical Config Attributes GLOBAL Settings INTERFACE Port 0 Port 1 Port 1 Port Status ☑ On SSID Guest 2.4 GHz Channel 6 Coverage Range (meters) 140.00 Authentication ○ Disabled ○ WEP WEP Key ○ WPA-PSK ● WPA2-PSK PSK Pass Phrase 123456789 User ID Password Encryption Type AES

The IoT devices section contains 3 webcams (one for the main door, one for employee space, and one for the server room), a smart door that can be opened and closed, and a tablet PC to monitor these devices. All the IoT devices are connected to a home gateway (renamed to OfficeGateway) while the gateway is connected to the wireless router via a copper straight-through wire.	 DLC100 OfficeGateway IoT Devices TabletPC-PT Tablet PC for monitoring the CCTV Webcam CCTV1 Webcam CCTV2 Door Smart Main Door Webcam CCTV3
The tablet PC is used to monitor the IOT devices. Inside the desktop, click on the IOT monitor, and you will be able to check all the IOT devices.	 Tablet PC for monitoring the CCTV Physical Config Desktop Programming Attributes IoT Monitor IoT Server - Devices Home | Conditions | Editor | Log Out CCTV1 (PTT0810UUYB-) Webcam On Image CCTV2 (PTT0810A825-) Webcam On Image CCTV3 (PTT08102TV4-) Webcam On Image Smart Main Door (PTT0810K0I9-) Door Open Lock
Inside the config of HomeGateway, the SSID is changed to OfficeGateway and for extra security measures in authentication, **WPA2-PSK** is selected, which assigns login information for each IOT device and connects them to the network.	 OfficeGateway Physical Config GUI Attributes GLOBAL Settings Algorithm Settings INTERFACE Internet LAN Wireless Wireless Settings SSID: OfficeGateway 2.4 GHz Channel: 6 - 2.437GHz Coverage Range (meters): 250.00 Authentication ○ Disabled ○ WEP WEP Key ○ WPA-PSK ● WPA2-PSK PSK Pass Phrase: cisco123 ○ WPA ○ WPA2 RADIUS Server Settings IP Address Shared Secret Encryption Type: AES
The WRT300N wireless router is connected to the server through a 1941 router, which gets its connection from a switch. The reason for choosing a 1941 router is that it is specifically designed for small-to-medium-sized businesses and can handle multiple connections all at once, all while having a wired connection option as well. As for the WRT300N wireless router, it is used for mobile devices, computers, and laptops on most occasions, all while being affordable and having a decent range.	 Laptop-PT Laptop23 Laptop-PT Laptop27 Laptop-PT Laptop13 Laptop-PT Laptop22 Switch-PT Switch3 Server-PT CN.com 1941 Router0 WRT300N Wireless Router0 SMARTPHONE-PT AccessPoint-PT Access Point0

Inside the config of wireless router, the SSID is set as OfficeNetwork and for security in the authentication, we selected WPA2-Enterprise (WiFi Protected Access 2), which assigns login information for each device for them to connect to the network.


Wireless Router0

Wireless Settings

SSID: OfficeNetwork
2.4 GHz Channel: 1 - 2.412GHz
Coverage Range (meters): 250.00

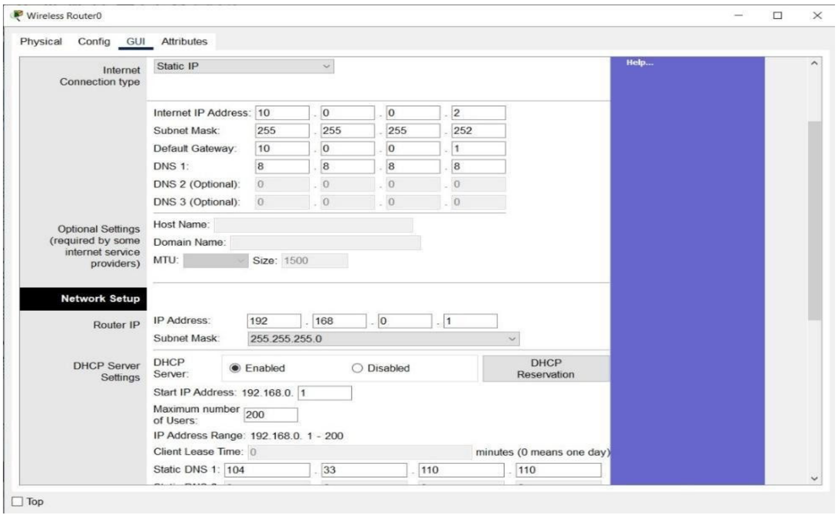
Authentication
○ Disabled ○ WEP WEP Key
○ WPA-PSK ● WPA2-PSK PSK Pass Phrase: OfficePass
○ WPA ○ WPA2

RADIUS Server Settings
IP Address
Shared Secret

Encryption Type: AES

Configure the Network Devices

1) Configuration for Wireless_Router0


Wireless Router0

Internet Connection type: Static IP

Internet IP Address: 10 . 0 . 0 . 2
Subnet Mask: 255 . 255 . 255 . 252
Default Gateway: 10 . 0 . 0 . 1
DNS 1: 8 . 8 . 8 . 8
DNS 2 (Optional): 0 . 0 . 0 . 0
DNS 3 (Optional): 0 . 0 . 0 . 0

Optional Settings (required by some internet service providers)
Host Name:
Domain Name:
MTU: Size: 1500

Network Setup

Router IP
IP Address: 192 . 168 . 0 . 1
Subnet Mask: 255.255.255.0

DHCP Server Settings
DHCP Server: ● Enabled ○ Disabled
Start IP Address: 192.168.0. 1
Maximum number of Users: 200
IP Address Range: 192.168.0. 1 - 200
Client Lease Time: 0 minutes (0 means one day)
Static DNS 1: 104 . 33 . 110 . 110

1. Click on the wireless router0 and go to the GUI tab to access the settings
2. Set LAN IP to 192.168.0.1 and Subnet Mask to 255.255.255.0 as stated in the
3. requirements and enable DHCP. The starting IP for devices is 192.168.0.1 and the maximum number of users is 200, which sets the IP Address Range from 192.168.0.1 to 192.168.0.200.
4. The Static DNS 1 is set to 104.33.110.110 to ensure communication from the external server.
5. The Internet interface above is configured to allow Wireless_Router0 to communicate with an external network such as CN.com. The Internet IP Address 10.0.0.2 has the same network IP as Router0's Gig0/1. The subnet 10.0.0.0/30 only allows for two usable IPs, which are 10.0.0.1 for Router0 and 10.0.0.2 for Wireless_Router0.

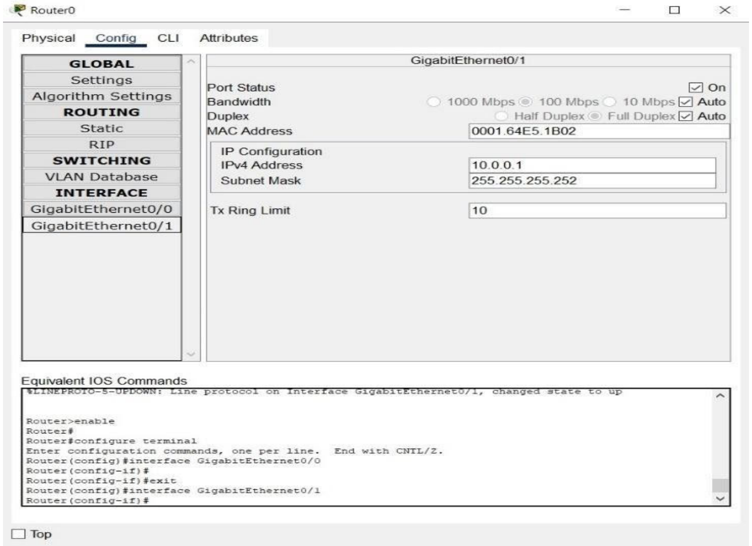
2) Configuration for Router0

Before configuring the interfaces, it is important to configure the static route to forward packets from 192.168.0.0/24 to 10.0.0.2. We have to use the CLI in Router0 to configure the IP route, using the command "ip route 192.168.0.0 255.255.255.0 10.0.0.2".

We also configured each interface NAT to allow devices in 192.168.0.x range to

communicate with external IPs like 104.33.110.110 by translating internal IPs to the external IPs range.

3.2. Interface GigabitEthernet0/1



GigabitEthernet0/1

Port Status ☑ On

Bandwidth ○ 1000 Mbps ● 100 Mbps ○ 10 Mbps ☑ Auto

Duplex ○ Half Duplex ● Full Duplex ☑ Auto

MAC Address 0001.64E5.1B02

IP Configuration

IPv4 Address 10.0.0.1

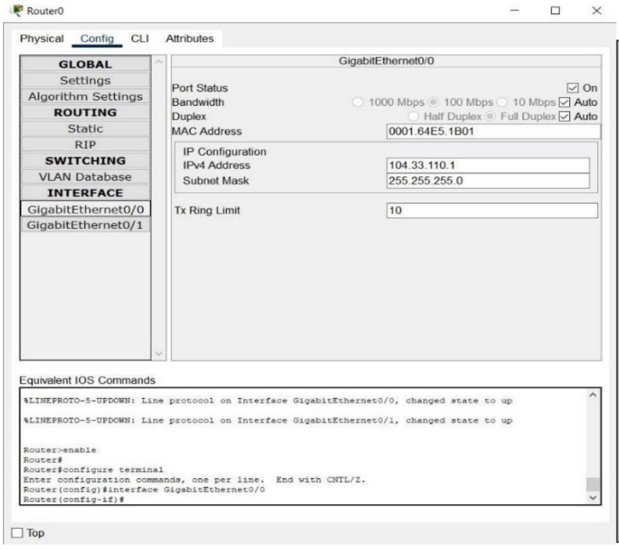
Subnet Mask 255.255.255.252

Tx Ring Limit 10

Equivalent IOS Commands

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up


Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface GigabitEthernet0/1
Router(config-if)#
```

Interface GigabitEthernet0/0



GigabitEthernet0/0

Port Status ☑ On

Bandwidth ○ 1000 Mbps ● 100 Mbps ○ 10 Mbps ☑ Auto

Duplex ○ Half Duplex ● Full Duplex ☑ Auto

MAC Address 0001.64E5.1B01

IP Configuration

IPv4 Address 104.33.110.1

Subnet Mask 255.255.255.0

Tx Ring Limit 10

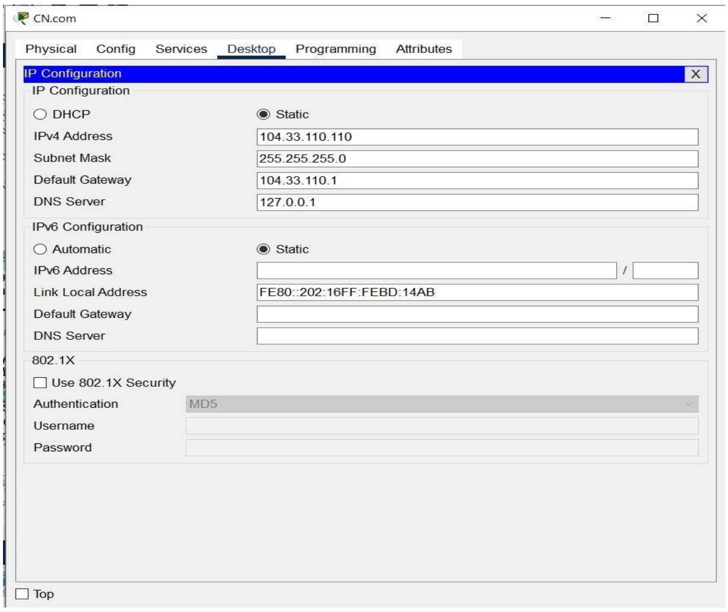
Equivalent IOS Commands

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up


Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0
Router(config-if)#
```

Explanation:

1. GigabitEthernet0/0 is connected to a Switch. This interface is configured to communicate with a Switch in our topology and CN.com (104.33.110.110).

3) Configure CN.com



IP Configuration

○ DHCP ● Static

IPv4 Address 104.33.110.110

Subnet Mask 255.255.255.0

Default Gateway 104.33.110.1

DNS Server 127.0.0.1

IPv6 Configuration

○ Automatic ● Static

IPv6 Address /

Link Local Address FE80::202:16FF:FEBD:14AB

Default Gateway

DNS Server

802.1X

□ Use 802.1X Security

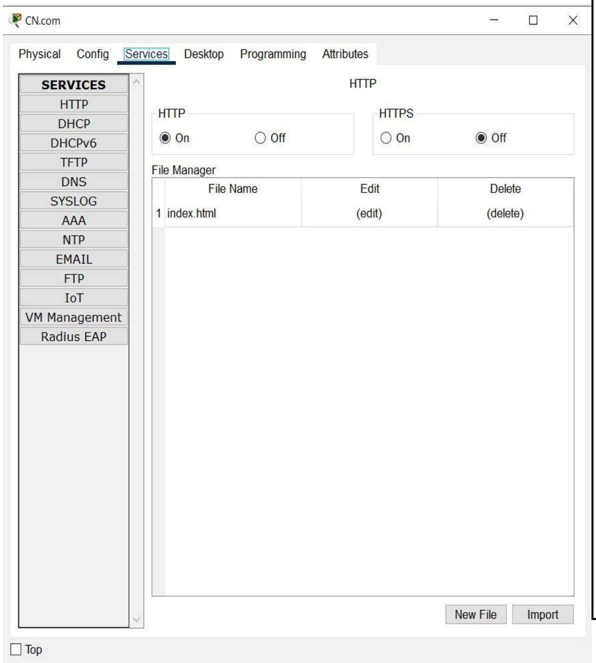
Authentication MD5

Username

Password

Explanation:

1. CN.com serves as a DNS server and a web server. The IP address of CN.com is 104.33.110.110 and the subnet mask 255.255.255.0. The default gateway is pointed to the Router0 because it allows to forward traffic from 192.168.0.x to CN.com. DNS server is set to 127.0.0.1 because CN.com is functioning as its own DNS server, we could also set the DNS to 104.33.110.110 and it would work the same way.



HTTP

HTTP: ● On ○ Off

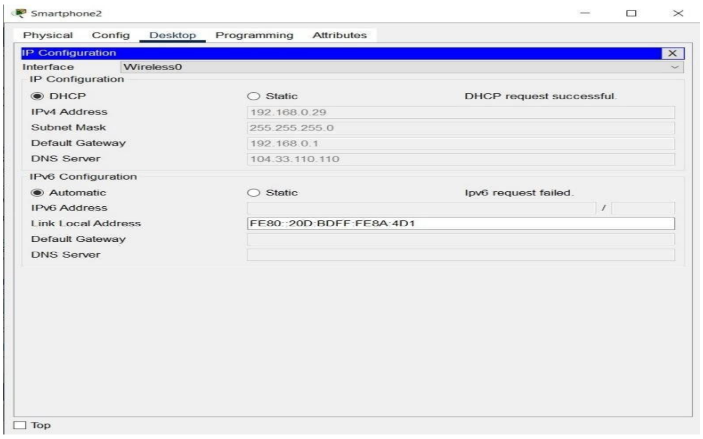
HTTPS: ○ On ● Off

File Manager

	File Name	Edit	Delete
1	index.html	(edit)	(delete)

Explanation:

1. Click on CN.com, go to services and HTTP. We enabled HTTP because searching CN.com in the web browser directs to the http protocol, enabling HTTPS is optional for our assignment. It is important to enable HTTP because CN.com server is a web server, and by enabling HTTP, it allows us to view the webpage.



IP Configuration

Interface: Wireless0

IP Configuration

● DHCP ○ Static DHCP request successful.

IPv4 Address: 192.168.0.29

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.0.1

DNS Server: 104.33.110.110

IPv6 Configuration

● Automatic ○ Static Ipv6 request failed.

IPv6 Address: /

Link Local Address: FE80::20D:BDFF:FE8A:4D1

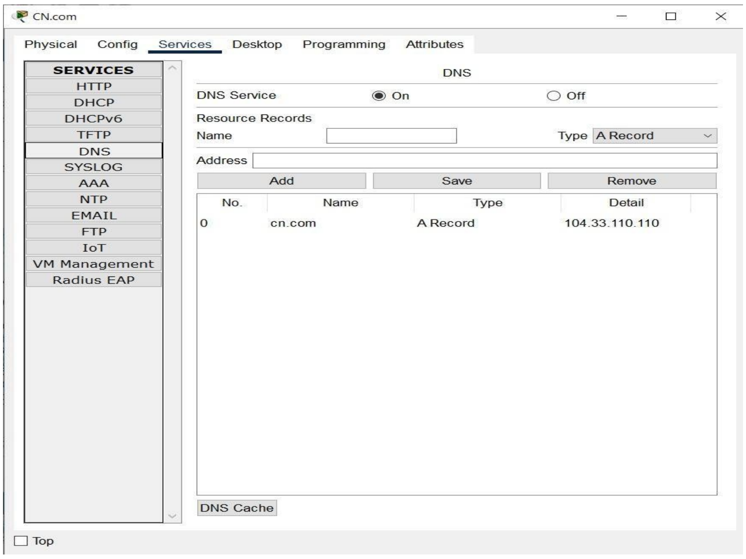
Default Gateway:

DNS Server:

Explanation:

1. Enabling DNS service allow CN.com to handle DNS queries.

2. Points cn.com to 104.33.110.110 which allows PCs, Laptops and Smartphones to access the website by typing cn.com instead of remembering the IP address of CN.com.



DNS

DNS Service ● On ○ Off

Resource Records

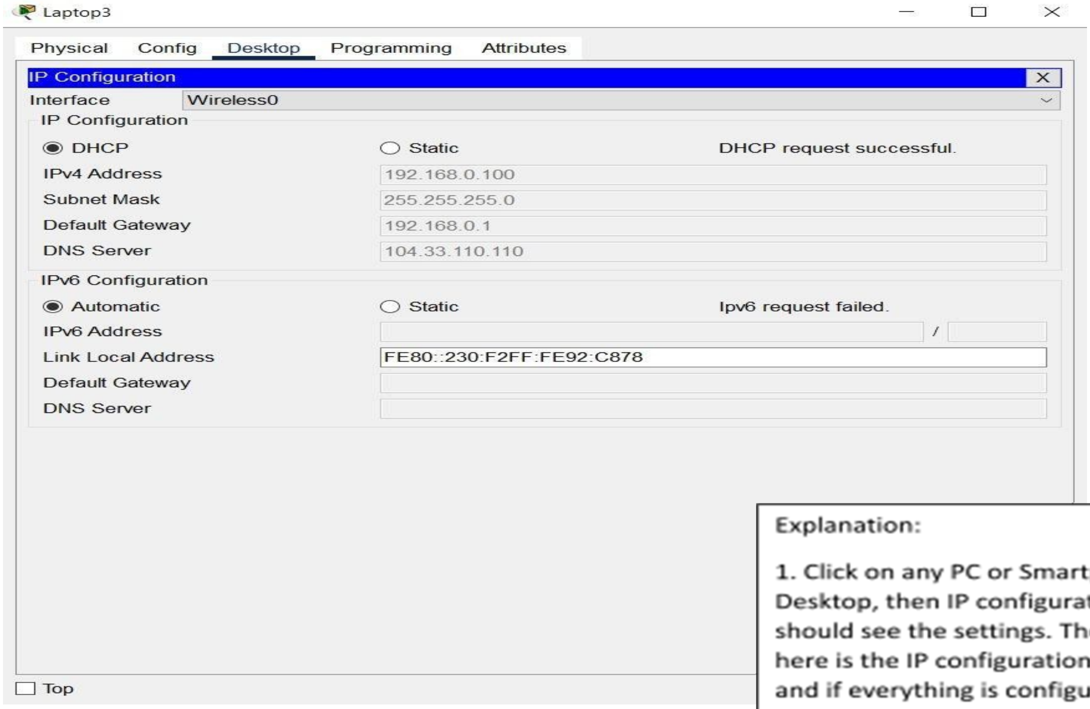
Name: Type: A Record

Address:

No.	Name	Type	Detail
0	cn.com	A Record	104.33.110.110

4) Configuring Client Devices

Configuring PCs, Laptops and Smartphones:



Interface: Wireless0

IP Configuration

● DHCP ○ Static DHCP request successful.

IPv4 Address: 192.168.0.100

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.0.1

DNS Server: 104.33.110.110

IPv6 Configuration

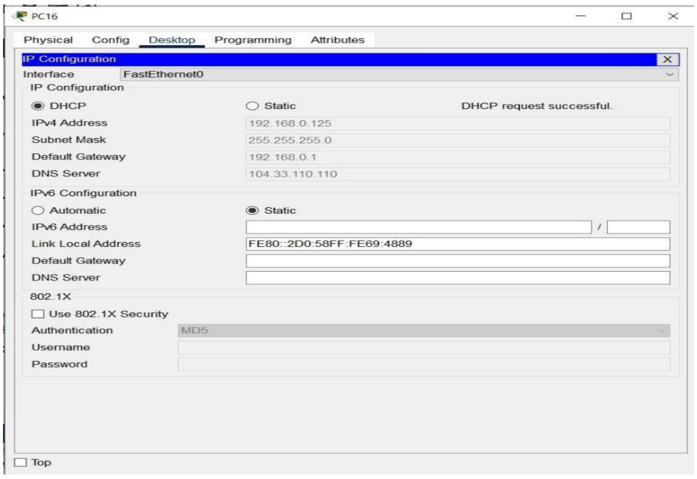
● Automatic ○ Static Ipv6 request failed.

IPv6 Address: /

Link Local Address: FE80::230:F2FF:FE92:C878

Default Gateway:

DNS Server:



Interface: FastEthernet0

IP Configuration

● DHCP ○ Static DHCP request successful.

IPv4 Address: 192.168.0.125

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.0.1

DNS Server: 104.33.110.110

IPv6 Configuration

○ Automatic ● Static

IPv6 Address: /

Link Local Address: FE80::2D0:58FF:FE69:4889

Default Gateway:

DNS Server:

802.1X

□ Use 802.1X Security

Authentication: MD5

Username:

Password:

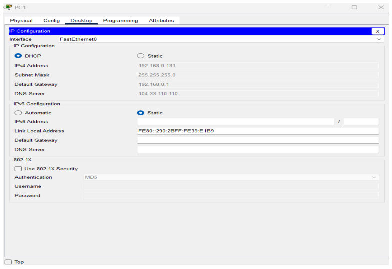
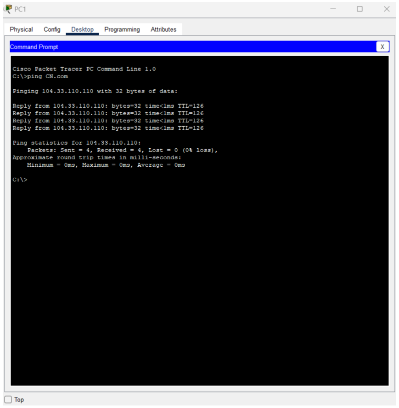
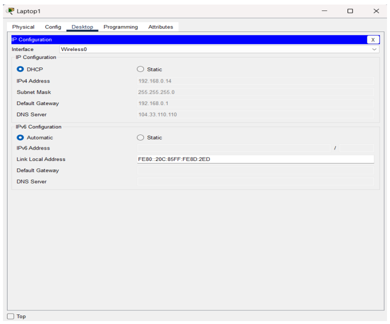
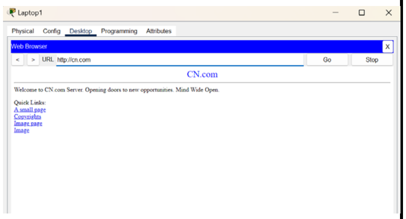
Explanation:

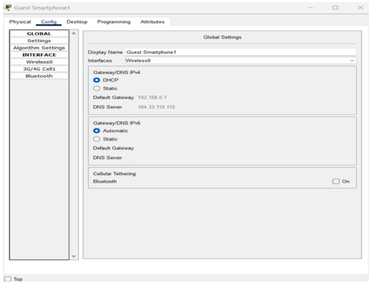
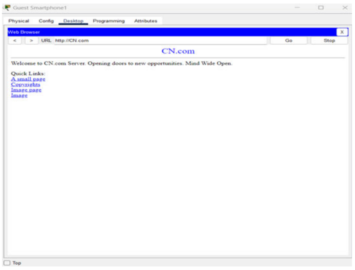
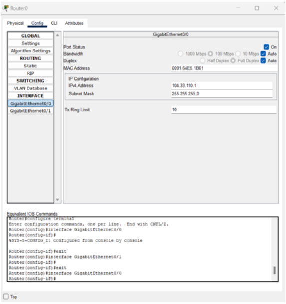
1. Click on any PC or Smartphone, go to Desktop, then IP configuration and you should see the settings. The main part here is the IP configuration, click on DHCP and if everything is configured correctly on the Wireless Router0, Router0 and CN.com, it should return a DHCP request successful

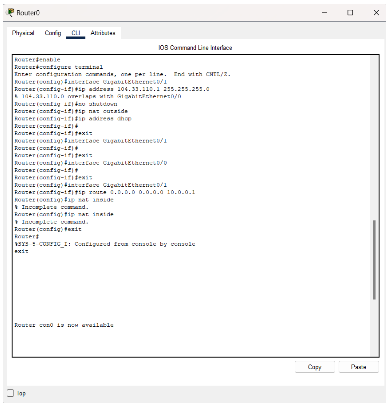
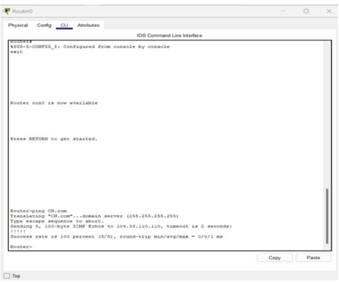
2. DHCP should automatically assign an IP Address that is within the Wireless Router0 IP range

3. Subnet Mask and Default Gateway is forwarded to the Wireless Router0. The DNS server is the IP of cn.com.

3.3. Verify Connectivity

Steps	**Explanation**	**Screenshot**
Step 1: Refresh the IPv4 settings on the PCs	We have opened the PC window and selected Desktop from the menu. Then we opened the IP Configuration window and chose DHCP instead of Static. We made sure that the computer had an IP address, Subnet Mask, and Default Gateway.	 IP Configuration Interface: FastEthernet0 IP Configuration ● DHCP ○ Static IPv4 Address: 192.168.0.131 Subnet Mask: 255.255.255.0 Default Gateway: 192.168.0.1 DNS Server: 104.33.110.110 IPv6 Configuration ○ Automatic ● Static IPv6 Address: / Link Local Address: FE80::290:2BFF:FE39:E1B9 Default Gateway: DNS Server: 802.1X □ Use 802.1X Security Authentication: MD5 Username: Password: □ Top
	In this step we tested connecting to a CN.com server Open the Command Prompt window from the Desktop menu, choose Command Prompt. Then we wrote the ping code CN.com to test it and it was working and there are no problems	 PC1 Physical Config Desktop Programming Attributes Command Prompt Cisco Packet Tracer PC Command Line 1.0 C:\>ping CN.com Pinging 104.33.110.110 with 32 bytes of data: Reply from 104.33.110.110: bytes=32 time<1ms TTL=126 Reply from 104.33.110.110: bytes=32 time<1ms TTL=126 Reply from 104.33.110.110: bytes=32 time<1ms TTL=126 Reply from 104.33.110.110: bytes=32 time<1ms TTL=126 Ping statistics for 104.33.110.110: Packets: Sent = 4, Received = 4, Lost = 0 (0% loss), Approximate round trip times in milli-seconds: Minimum = 0ms, Maximum = 0ms, Average = 0ms C:\> □ Top
Step 2: Refresh the IPv4 settings on the Laptops	We have opened the laptops window and selected Desktop from the menu. Then we opened the IP Configuration window and chose DHCP instead of Static. We made sure that the computer had an IP address, Subnet Mask, and Default Gateway	 IP Configuration Interface: Wireless0 IP Configuration ● DHCP ○ Static IPv4 Address: 192.168.0.14 Subnet Mask: 255.255.255.0 Default Gateway: 192.168.0.1 DNS Server: 104.33.110.110 IPv6 Configuration ● Automatic ○ Static IPv6 Address: / Link Local Address: FE80::20C:85FF:FE8D:2ED Default Gateway: DNS Server: □ Top
	In this step we tested connecting to a CN.com server Open the web Browser window from the Desktop menu, we type CN.com in the search bar to make sure that the site is working well	 Laptop1 Physical Config Desktop Programming Attributes Web Browser < > Go Stop URL: http://cn.com CN.com Welcome to CN.com Server. Opening doors to new opportunities. Mind Wide Open. Quick Links: A small page Copyrights Image page Image

Step 3: Refresh the IPv4 settings on the Mobile Phones	We have opened the Smartphones window and selected Config from the menu. Then we chose DHCP instead of Static. We made sure that the computer had an IP address, Subnet Mask, and Default Gateway	 Guest Smartphone1 Global Settings Display Name: Guest Smartphone1 Interfaces: Wireless0 Gateway/DNS IPv4: ● DHCP ○ Static Default Gateway: 192.168.0.1 DNS Server: 104.33.110.110 Gateway/DNS IPv6: ● Automatic ○ Static Default Gateway: DNS Server: Cellular Tethering Bluetooth □ On □ Top Physical Config Desktop Programming Attributes GLOBAL Settings Algorithm Settings INTERFACE Wireless0 3G/4G Cell1 Bluetooth
	In this step we tested connecting to a CN.com server Open the web Browser window from the Desktop menu inside the smartphone, we type CN.com in the search bar to make sure that the site is working well	 Guest Smartphone1 Web Browser URL http://CN.com CN.com Welcome to CN.com Server. Opening doors to new opportunities. Mind Wide Open. Quick Links: A small page Copyrights Image page Image □ Top Physical Config Desktop Programming Attributes < > Go Stop X
Step 4: Refresh the IPv4 settings on the Router	It seems that the router does not have an explicitly dedicated WAN interface, but only GigabitEthernet0/0 and GigabitEthernet0/1 interfaces. Any Ethernet interface can be used as a WAN interface by configuring it correctly.	 Router0 GigabitEthernet0/0 Port Status ☑ On Bandwidth ○ 1000 Mbps ○ 100 Mbps ○ 10 Mbps ☑ Auto Duplex ○ Half Duplex ○ Full Duplex ☑ Auto MAC Address: 0001.64E5.1B01 IP Configuration IPv4 Address: 104.33.110.1 Subnet Mask: 255.255.255.0 Tx Ring Limit: 10 Equivalent IOS Commands Router#configure terminal Enter configuration commands, one per line. End with CNTL/Z. Router(config)#interface GigabitEthernet0/0 Router(config-if)# %SYS-5-CONFIG_I: Configured from console by console Router(config-if)#exit Router(config)#interface GigabitEthernet0/1 Router(config-if)# Router(config-if)#exit Router(config)#interface GigabitEthernet0/0 Router(config-if)# □ Top Physical Config CLI Attributes GLOBAL Settings Algorithm Settings ROUTING Static RIP SWITCHING VLAN Database INTERFACE GigabitEthernet0/0 GigabitEthernet0/1

	In this step, configure the GigabitEthernet interface as a WAN interface Choose CLI from the router window Enter the settings mode Type the enable code configure terminal Select GigabitEthernet0/1 as external interface (WAN) Type the code interface GigabitEthernet0/0 IP address 104.33.110.1 255.255.255.0 no shutdown Set NAT on this interface as external interface Type the code ip nat outside Check the connection to the DHCP server Type the code ip address dhcp	
	Then make sure the default route ip route 0.0.0.0 0.0.0.0 10.0.0.1 make sure the GigabitEthernet0/1 interface (internal) has the ip nat inside command	
	We made sure that the CN.com works correctly and there are no problems by writing the code in the CLI interface	

```
Router#enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface GigabitEthernet0/1
Router(config-if)#ip address 104.33.110.1 255.255.255.0
% 104.33.110.0 overlaps with GigabitEthernet0/0
Router(config-if)#no shutdown
Router(config-if)#ip nat outside
Router(config-if)#ip address dhcp
Router(config-if)#
Router(config-if)#exit
Router(config)#interface GigabitEthernet0/1
Router(config-if)#
Router(config-if)#exit
Router(config)#interface GigabitEthernet0/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface GigabitEthernet0/1
Router(config-if)#ip route 0.0.0.0 0.0.0.0 10.0.0.1
Router(config)#ip nat inside
% Incomplete command.
Router(config)#ip nat inside
% Incomplete command.
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
exit




Router con0 is now available
```

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



Router con0 is now available



Press RETURN to get started.




Router>ping CN.com
Translating "CN.com"...domain server (255.255.255.255)
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 104.33.110.110, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms

Router>
```

Wireless_Router0 is configured as shown by a graphical user interface (GUI) tab that shows both Internet and LAN configurations. The LAN configuration is given an IP address of 192.168.0.1 and a subnet mask of 255.255.255.0. DHCP is also activated from IP 192.168.0.1 with a capacity to serve 200 users, thereby defining the IP range from 192.168.0.1 to 192.168.0.200. In addition, Static DNS 1 is set to 104.33.110.110, which offers domain name resolution from the external DNS server. The Internet section indicates the wireless router to be connected to the external network with IP 10.0.0.2, subnet mask 255.255.255.252, and gateway IP 10.0.0.1, which is the internal IP of Router0, enabling routing to external networks.

For Router0, the configuration is via the CLI (Command Line Interface). It shows a static routing command: ip route 192.168.0.0 255.255.255.0 10.0.0.2, which directs traffic for the 192.168.0.0/24 network via Wireless_Router0. NAT (Network Address Translation) is configured by tagging the internal interface with ip nat inside and the external interface with ip nat outside. An access-list is utilized to define local traffic, and ip nat inside source list translates internal IPs to a public IP. The GigabitEthernet0/1 interface is shown with IP 10.0.0.1, subnet 255.255.255.252, directly connected to the Wireless_Router0. Its default settings like bandwidth and MAC are not changed. The GigabitEthernet0/0 interface is assigned IP 104.33.110.1 with subnet 255.255.255.0, and is configured as the outside (WAN) interface with ip nat outside. It can also use DHCP according to circumstances.

For CN.com setup, the image is likely showing a server installation window with domain CN.com, and a public IP address, e.g., 104.33.110.x. DNS and web services have been installed in the server with the web server module to answer HTTP requests.

For client-side settings, the physical tab of the laptop shows WRT300N in place of the standard wireless module to support wireless networking. In the desktop tab, DHCP is chosen and it auto-configures IP settings. For PCs, the desktop interface shows DHCP-selected IP configuration; similar to the laptop, a valid IP, subnet, and gateway are retrieved from Wireless_Router0. Smartphones are placed in the config tab, showing wireless interface configurations with DHCP enabled and auto-assigned IP details.

In connectivity confirmation, PCs are shown via Command Prompt successfully pinging CN.com, where responses are shown and no packet loss. Laptops and smartphones use web browsers, where the typing of CN.com in the address bar successfully loads the page, confirming Internet connection. Finally, in Router CLI, the WAN parameters would be configured by using commands like interface GigabitEthernet0/0, ip address 104.33.110.1 255.255.255.0, and ip nat outside. When DHCP is being used, IP assignment will be dynamic. Command ip route 0.0.0.0 0.0.0.0 10.0.0.1 ensures default routing, and another ping to CN.com confirms the entire network's access to the internet.

4. Challenges

Throughout the process of choosing the best network design and server and router configuration for this project, we were faced with a chain of problems. Most challenging was choosing an adequate router type to meet the needs of the network due to the need to reconcile cost and performance. We needed to revise numerous drafts before developing a plan that satisfied project requirements without being too complex and inefficient, so network topology design was yet another demanding activity.

Configuring the server to facilitate smooth connectivity and correct interactions with other networked devices was another challenge. It took a lot of research, debugging, and effort to resolve them, and eventually, we created a basic but fully operational network layout in Cisco Packet Tracer. It provided us with valuable problem-solving experience and highlighted the importance of flexibility and being adaptable in network design.

5. Conclusions

This network design activity enforced our learning on network design, both theory and practical work. Through establishing the devices and maintaining good connections for different endpoints, we ensure meeting the needs of the business. This task examined our ability in critical thinking as well as collaborating to settle and optimize the network. Through practical use with Cisco Packet

Tracer, we have been adequately positioned to confront network-related future challenges and helped with the ideal tools to meet demands in the corporate world.

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