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## Project 1

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## FACULTY OF INFORMATION TECHNOLOGY ITDTA4-14

### Project 1

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## Table of Contents

<b>Deliverable 1 .....</b>	<b>3</b>
<b>Introduction .....</b>	<b>3</b>
a. <b>Symmetric and Asymmetric Cipher Types: Strengths and Weaknesses.....</b>	<b>3</b>
Symmetric Ciphers .....	3
Asymmetric Ciphers .....	3
Application in Scenario.....	4
b. <b>Hybrid Approach: Balancing Security and Efficiency.....</b>	<b>5</b>
Proposed Solution: Hybrid Cryptographic System .....	5
c. <b>Encryption Standards: SSL/TLS for Secure Communication.....</b>	<b>6</b>
SSL/TLS Overview .....	6
Application in the Scenario .....	6
d. <b>Ensuring Integrity with Hash Algorithms.....</b>	<b>7</b>
SHA-2 and SHA-3 .....	7
e. <b>Digital Signature Algorithms: Efficiency and Security.....</b>	<b>8</b>
<b>Conclusion .....</b>	<b>9</b>
<b>Bibliography .....</b>	<b>10</b>
<b>Deliverable 2.1 .....</b>	<b>13</b>
TASK 1: Create and cable the network.....	13
TASK 2: Design IP address plan .....	14
TASK 3: Configure IP addresses on all end devices .....	15
TASK 4: Configure wireless security .....	16
<b>Deliverable 2.2 .....</b>	<b>19</b>
TASK 5: Configure VTP on all switches .....	19
TASK 6: Create VLANs.....	20
TASK 7: Assign ports to VLANs on all switches.....	22
TASK 8: Connect VLANs together.....	24
TASK 9: Configure router interfaces on all routers .....	28
TASK 10: Configure dynamic routing .....	31
<b>Deliverable 3 .....</b>	<b>34</b>
Question 3.1.....	34
Question 3.2.....	96
Question 3.3.....	97
Question 3.4.....	102
Final Network Topology .....	103

# Deliverable 1

## Introduction

Digital transformations are occurring rapidly in our modern era. Governments need to ensure the confidentiality, integrity, and authenticity of sensitive communications (Hossain *et al.*, 2024). Geopolitical tensions and cyber espionage are continuously evolving, and cryptographic techniques are becoming more critical for the protection of national interests (Kose, 2021). This report evaluates various cryptographic techniques. This report focuses on cipher types, encryption standards, hash algorithms, and digital signatures. This report will also propose a robust solution for securing high-level diplomatic communication and exchanges. The objective is to develop a system that can resist interception, ensure authenticity, and maintain public trust.

### a. Symmetric and Asymmetric Cipher Types: Strengths and Weaknesses

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#### Symmetric Ciphers

Symmetric ciphers use a single key, the secret key, for both encryption and decryption (Abdelgader, 2022). Common examples of symmetric ciphers include Advanced Encryption Standard (AES), Data Encryption Standard (DES), and Triple DES (TDES or 3DES). The main strengths of symmetric ciphers are that they are fast and efficient for encrypting large data amounts, and that they have low computational overhead (Maihankali & Eze, 2021). This makes symmetric ciphers especially suitable for real-time applications. On the other hand, the main weaknesses of symmetric ciphers are that they lack scalability for multi-party communications, and that their key distribution have major risks, making the secure sharing of the secret key difficult.

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#### Asymmetric Ciphers

Asymmetric ciphers use multiple keys for encryption and decryption. During transmission, the sender uses the public key to encrypt the plain text, while receiver decrypts the cipher text using the private key (Sankhyan *et al.*, 2024). Elliptic Curve Cryptography (ECC), Rivest-Shamir-Adleman (RSA), and Digital Signature Algorithm (DSA). The main strengths of asymmetric ciphers are that they can securely distribute keys and that they provide digital signatures and non-repudiation. On the other hand, the main weaknesses of asymmetric ciphers are that they are much slower than symmetric ciphers, and that they are a lot more computationally expensive for large data encryption than symmetric ciphers (Santoso *et al.*, 2018).

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## Application in Scenario

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In the context of sensitive government communications like the exchange between high-ranking officials, asymmetric encryption, like RSA or ECC, would be the best encryption method to use. It would be ideal for establishing secure communication channels. It will allow each party to share public keys openly and keep their private keys secret (Fatima *et al.*, 2022). This will ensure that only the appropriate recipients can decrypt the message.

However, once a connection is authenticated and a secure session key has been exchanged using asymmetric encryption, symmetric encryption, like AES-256, can be employed to encrypt the large bulks of the message data. Symmetric encryption would be more effective in this case, because it is faster and more efficient than asymmetric encryption, especially with large amounts of classified information (Zhang, 2021).

Combining these two cipher types would create a robust framework by helping to cover each cipher type's weaknesses. Symmetric encryption would cover asymmetric encryption's weaknesses by handling fast and secure message transmission. On the other hand, asymmetric encryption would cover symmetric encryption's weaknesses by securing the key exchanges and identity verification. This robust framework would help protect the government's communications against interception, tampering, and unauthorised access.

## b. Hybrid Approach: Balancing Security and Efficiency

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### Proposed Solution: Hybrid Cryptographic System

To keep a balance between security and efficiency, a hybrid cryptographic system would need to be implemented. Implementing this system would include four major steps. These steps would include the following:

**Key Exchange using Asymmetric Encryption:** Asymmetric encryption like RSA or ECC can be used to securely exchange a session key. This would ensure that only the appropriate recipient can decrypt the session key, enabling trust and confidentiality at the outset (Kumar *et al.*, 2021).

**Secure Session Establishment:** A secure communication channel can be established once the symmetric session key is safely exchanged. At this step, both parties would be able to use the shared key to begin secure data transmission without the performance overhead of asymmetric encryption (Patil and Bansode, 2020).

**Data Encryption Using Symmetric Cipher:** A symmetric cipher like AES-256 can be used to encrypt all sensitive communication data. Using a symmetric cypher would provide fast and efficient encryption and decryption, making it especially effective for large amounts of confidential diplomatic data (William *et al.*, 2022).

**Message Authentication and Integrity Check:** A hash function like Secure Hash Algorithm (SHA-2 or SHA-3) can be applied to messages to generate unique message digests. These digests would need to be designed using a digital signature like ECDSA (Ghosh *et al.*, 2024). This would provide strong authentication and integrity to ensure messages haven't been altered during sending.

There are several benefits that come with implementing the hybrid cryptographic system. Firstly, this system would combine the speed of symmetric encryption with the secure key distribution of asymmetric encryption, allowing these two encryption methods to cover each other's weaknesses. Secondly, this system would ensure confidentiality, integrity, and non-repudiation (Mohamed *et al.*, 2020). Lastly, this system would be widely used in secure communication protocols like Transport Layer Security (TLS).

### c. Encryption Standards: SSL/TLS for Secure Communication

Secure Sockets Layer (SSL) and its successor, Transport Layer Security (TLS), are both cryptographic protocols. These protocols are designed to establish communication channels that are encrypted and secure from untrusted networks such as the Internet (Felix, 2024). TLS are currently the modern standard, and it enforces four key protocols: the Handshake, ChangeCipherSpec, Record, and Alert protocol. The Handshake protocol establishes a secure connection by negotiating cryptographic parameters, authenticating parties, and exchanging keys. The ChangeCipherSpec protocol encrypts subsequent messages using the new agreed-upon cipher suite and keys. The Record protocol encapsulates, encrypts, and transmits data between parties, ensuring confidentiality and integrity. Lastly, the Alert protocol sends warning and error messages, like connection closures or security failures, during TLS sessions (Wakoli, 2024).

The TLS has several key features that makes it very effective at securing communication channels. Firstly, TLS uses strong encryption algorithms like AES or ChaCha20 to protect data confidentiality during transmission. This ensures that sensitive or classified content cannot be obtained by unauthorised parties (Serrano *et al.*, 2022). Secondly, TLS verifies identities of communicating parties by relying on digital certificates issued by trusted Certificate Authorities, ensuring proper authentication. This prevents man-in-the-middle (MITM) attacks, impersonation, and eavesdropping. Thirdly, TLS ensures data integrity by employing message authentication codes (MACs) like HMAC. This helps verify that transmitted data has not been modified or tampered with during sending (Heinz *et al.*, 2020). Fourthly, modern versions of TLS, like TLS 1.3, support perfect forward secrecy (PFS) to ensure that past communications stay secure, even if long-term keys are compromised. Lastly, after the handshake in the asymmetric encryption process, TLS uses symmetric encryption for faster performance and higher throughput data exchange. This would make symmetric encryption especially ideal for communication in real time.

In the case of diplomatic and national security communications, TLS 1.3, the latest and most secure version, can be used with mutual authentication. This will safeguard these communications over the internet against MITM attacks. Moreover, this help maintain faster and more efficient data exchange during transmission.

## d. Ensuring Integrity with Hash Algorithms

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### SHA-2 and SHA-3

Hashing is a cryptographic process that changes any size of input data into a fixed-length string of characters, called a hash value or digest. In the process of hashing, the output is completely unique to the input. This means that even the smallest change in the original data will create a completely different hash (Pittalia, 2019). Moreover, hashing is also important for detecting tampering since it compares hash values. There are two main hash algorithms, Secure Hash Algorithm 2 and 3 (SHA-2 and SHA-3).

The SHA-2 was developed by the United States National Security Agency (NSA), and includes it SHA-224, SHA-256, SHA-384, and SHA-512. SHA-2 is known for its strong resistance to collisions and wide adoption in digital signatures, file integrity, and SSL/TLS. SHA-2 is widely used and supported by most systems (Pham *et al.*, 2022). It is still considered secure but is nearing performance limitations for newer architectures.

The SHA-3 is the newest version of the SHA family, and it includes SHA3-224, SHA3-256, SHA3-384, and SHA3-512. It was designed based on the Keccak algorithm, to provide a different internal structure from SHA-2 and to address the weaknesses of SHA-2. It provides additional resistance against advanced cryptographic attacks and maintains similar output lengths (Ghoshal *et al.*, 2020). Moreover, it has additional resistance to collision, pre-image, and second pre-image attacks.

In the context of diplomatic and national security communications, hashing can ensure that these communications remain unaltered during transmission. Before a message gets sent, a hash value will be created and attached to the message, using SHA-2 or SHA-3. Once the recipient receives the message, the hash from the received message will be recalculated to compare it to the original data. If the values of the original message match, the data integrity will be verified. This will confirm that the message was not corrupted or tampered with during transit, even if was intercepted.

## e. Digital Signature Algorithms: Efficiency and Security

Digital signature algorithms are cryptographic methods used to authenticate the integrity and origin of digital messages or documents. A digital signature algorithm allows a sender to create a unique digital signature using their private key. This digital signature can then be verified by the receiver using their corresponding public key. Digital signature algorithms ensure three key security properties: authenticity, integrity, and non-repudiation (Yudistira, 2024). Examples of these algorithms include RSA, DSA, and ECDSA, and they are commonly used in secure systems like financial transactions, emails, software distribution, and government communications.

**Rivest-Shamir-Adleman (RSA):** RSA is commonly used digital signature algorithm that relies on the mathematical difficulty of factoring large integers, usually large key sizes of 2048 or more bits (Alhassan *et al.*, 2022). RSA provides strong security but has a much slower computation in key generation and signing.

**Digital Signature Algorithm (DSA):** The DSA was designed by the U.S. government based on discrete logarithms. Its main strength is that has faster signature generation, but its biggest flaw is that it has slower verification (Saepulrohman & Ismangil, 2021). This makes DSA especially applicable for signing-heavy systems that need less verification.

**Elliptic Curve Digital Signature Algorithm (ECDSA):** ECDSA is a modern alternative to RSA and DSA. ECDSA offers the same security but with much smaller key sizes, giving it faster performance and reduced resource usage (Genç & Afacan, 2021). This makes ECDSA ideal for mobile and high-security environments. Moreover, it is more efficient and lightweight than RSA and DSA, making it more ideal for resource-constrained environments.

**Edwards-curve Digital Signature Algorithm (EdDSA):** EdDSA is a newer, high-speed, and strongly secure algorithm suited for more modern applications. The three main strengths that EdDSA (especially Ed25519) offers above all the other algorithms, is faster signing and verification, stronger resistance to side-channel attacks, and more robust security (Jayabalasamy & Koppu, 2022).

In the context of diplomatic and national security communications, ECDSA would be the most suitable. It provides very strong security and with smaller key sizes like 256-bit. It has faster signing and verification than the other algorithms. It has strong resistance to advanced cryptographic attacks and greater resource efficiency (Kavin & Ganapathy, 2021). Moreover, with a secure elliptic curve like P-256, it provides a robust, future-proof, and efficient digital signature solution.

## Conclusion

Protecting sensitive government communications requires more than just basic encryption. A multi-layered, hybrid cryptographic system would be needed. This system would need to combine the speed of symmetric encryption and the secure key exchange of asymmetric encryption. It would also need to include hashing for the verification of data integrity and digital signatures for authenticity. Including SSL/TLS protocols would enhance the security of network communications further. When all these technologies are combined with best practices, national security can be protected more effectively against current and future cyber threats.

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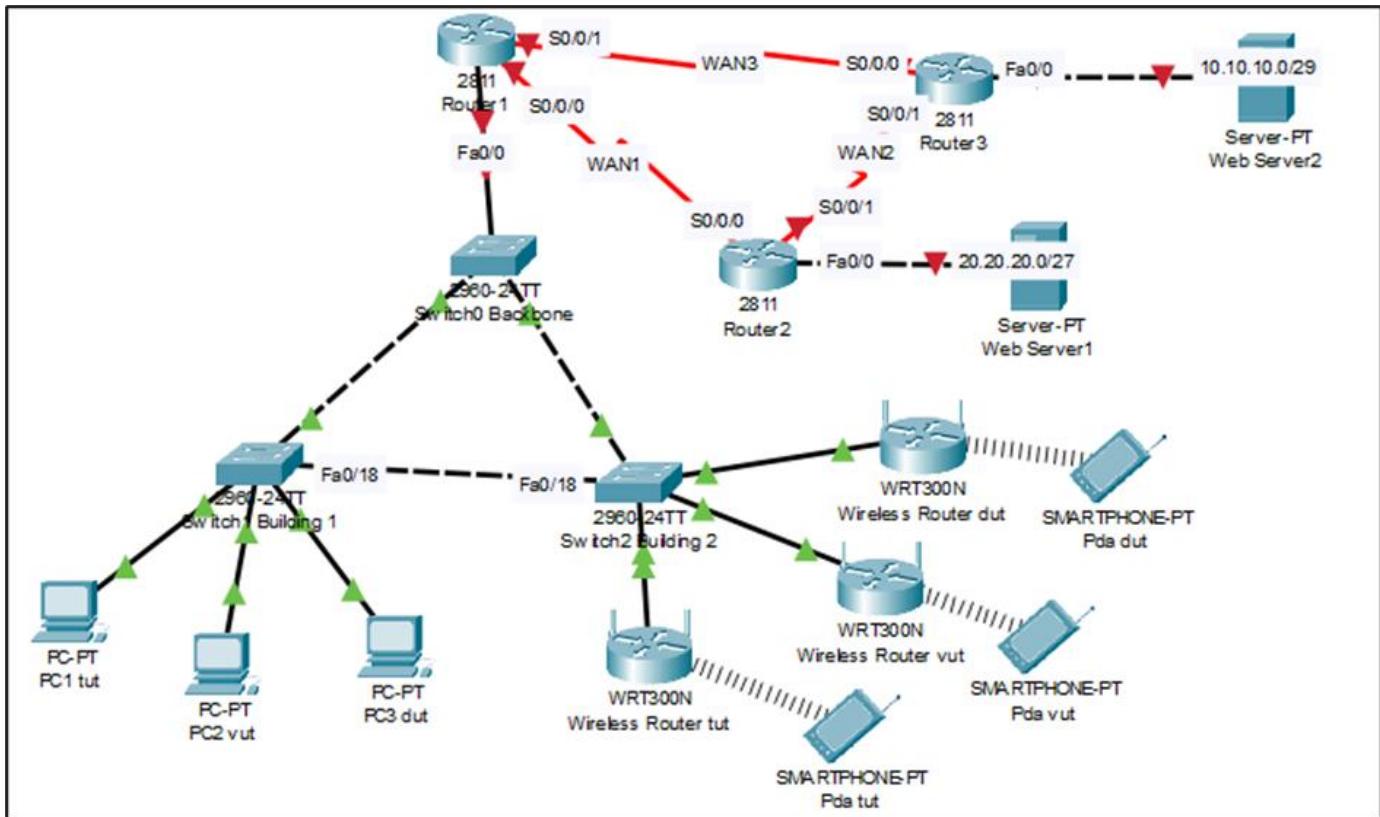
William, P., Choubey, A., Chhabra, G.S., Bhattacharya, R., Vengatesan, K. and Choubey, S., 2022, March. Assessment of hybrid cryptographic algorithm for secure sharing of textual and pictorial content. In *2022 International conference on electronics and renewable systems (ICEARS)* (pp. 918-922). IEEE.

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# Deliverable 2.1

## TASK 1: Create and cable the network



## TASK 2: Design IP address plan

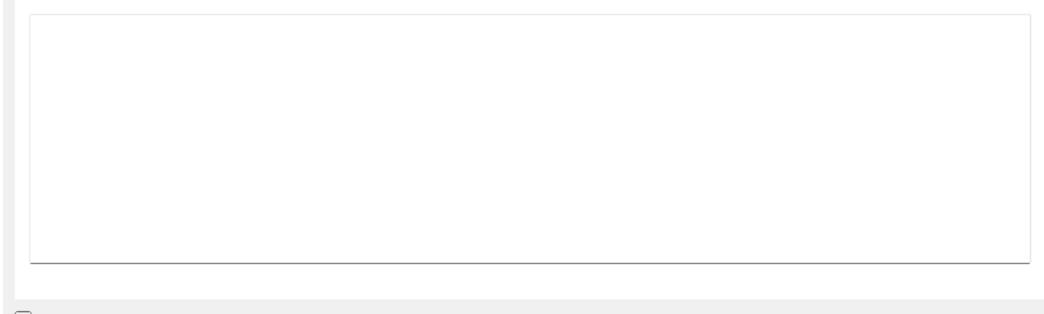
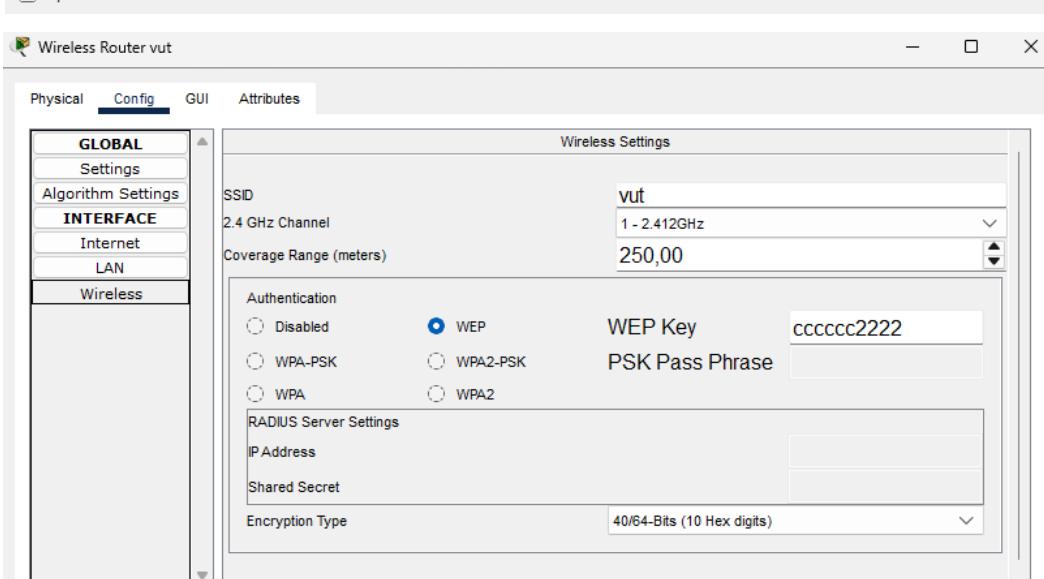
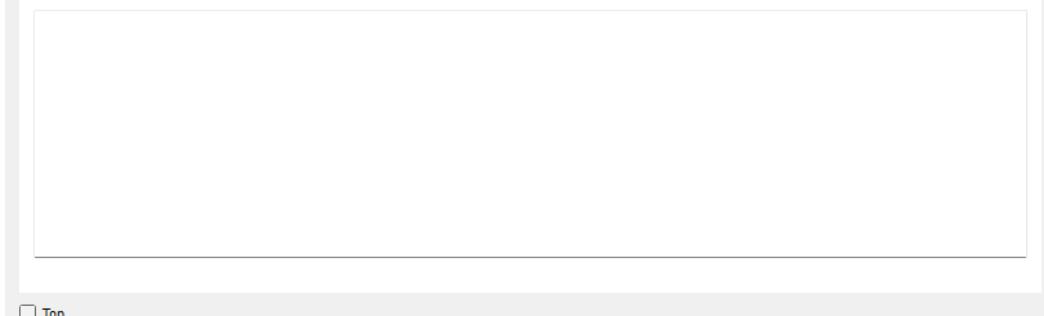
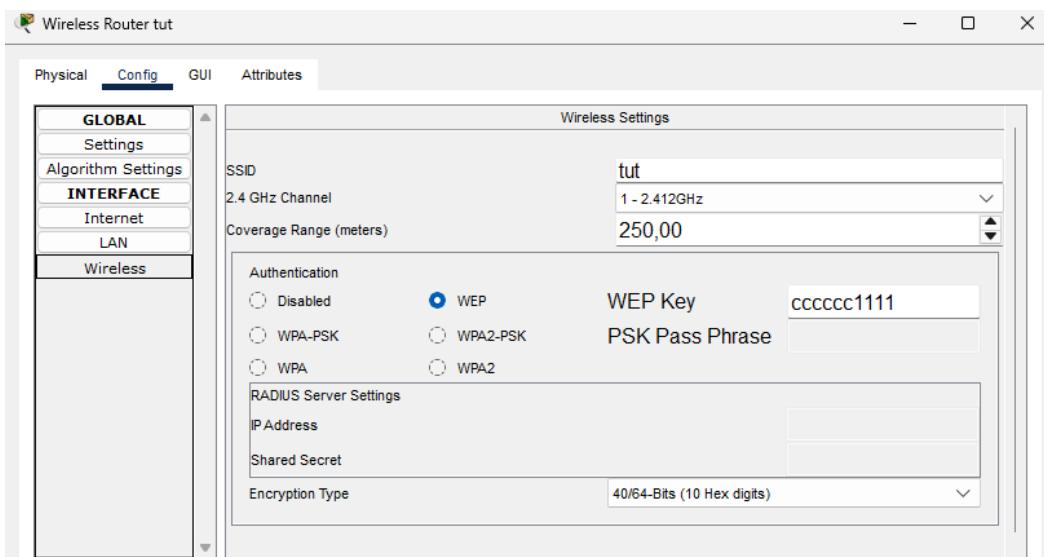
Network	Required Hosts	Next Power of 2	Subnet Mask	Hosts Available
VLAN 10 (TUT)	200	256	/24 (255.255.255.0)	254
VLAN 20 (TUT)	100	128	/25 (255.255.255.128)	126
VLAN 30 (TUT)	250	256	/24 (255.255.255.0)	254
WAN1	2	4	/30 (255.255.255.252)	2
WAN2	2	4	/30 (255.255.255.252)	2
WAN3	2	4	/30 (255.255.255.252)	2

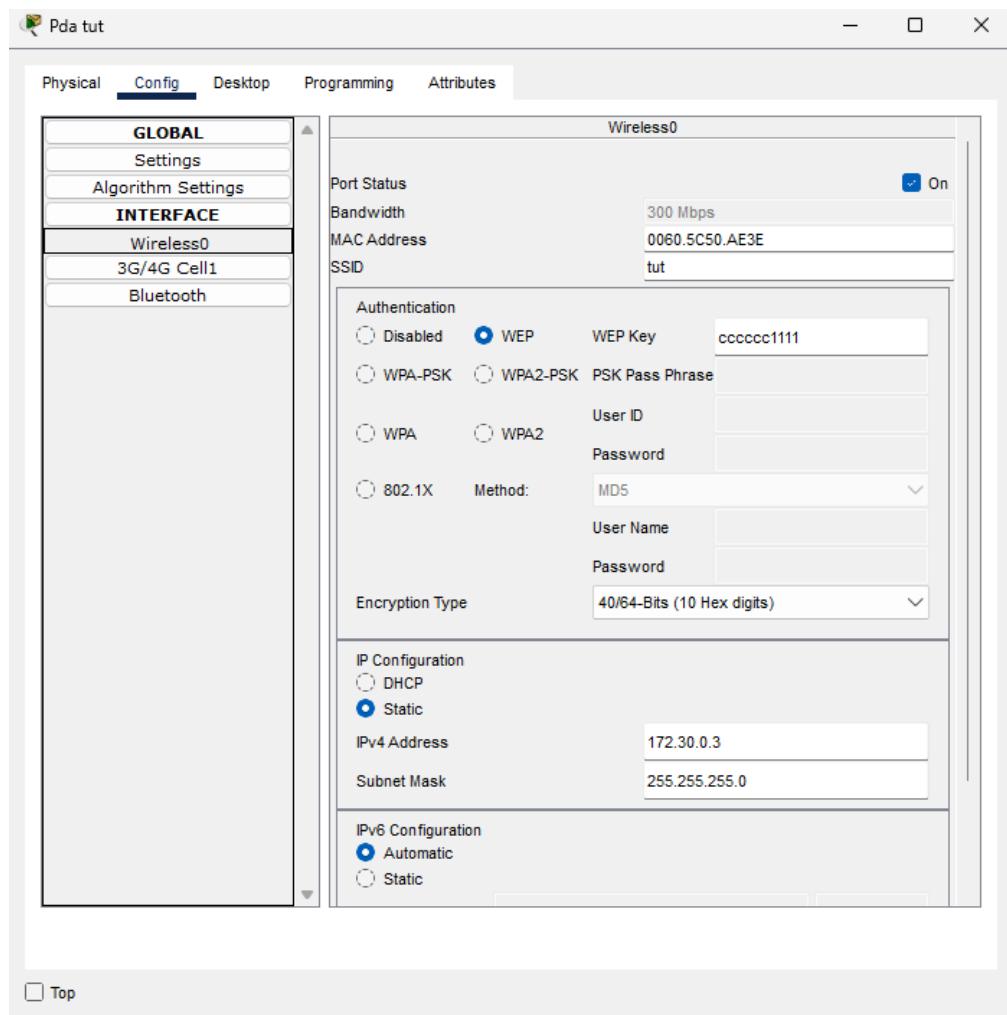
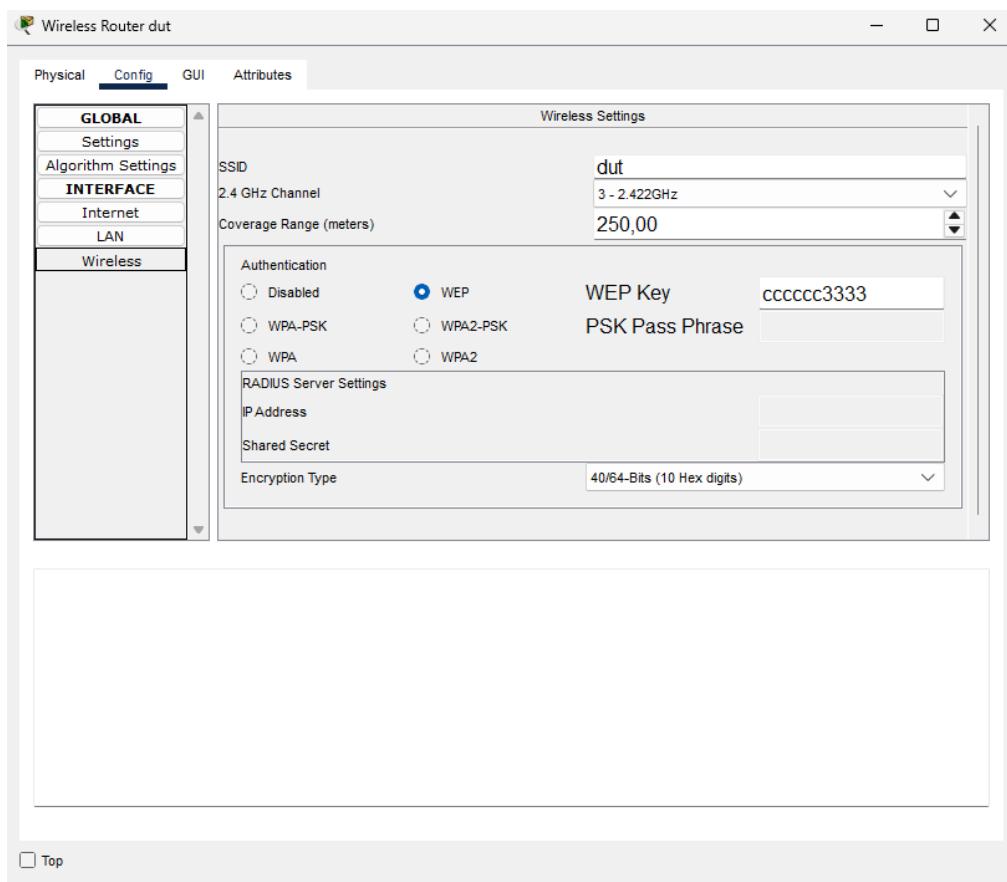
Network	Subnet address	First usable address	Last usable address	Subnet mask
VLAN 10 (TUT)	172.30.0.1/24	172.30.0.1	172.30.0.254	255.255.255.0
VLAN 20 (TUT)	172.30.1.1/25	172.30.1.1	172.30.1.126	255.255.255.128
VLAN 30 (TUT)	172.30.2.1/24	172.30.2.1	172.30.2.254	255.255.255.0
WAN1	172.30.3.0/30	172.30.3.1	172.30.3.2	255.255.255.252
WAN2	172.30.3.4/30	172.30.3.5	172.30.3.6	255.255.255.252
WAN3	172.30.3.8/30	172.30.3.9	172.30.3.10	255.255.255.252

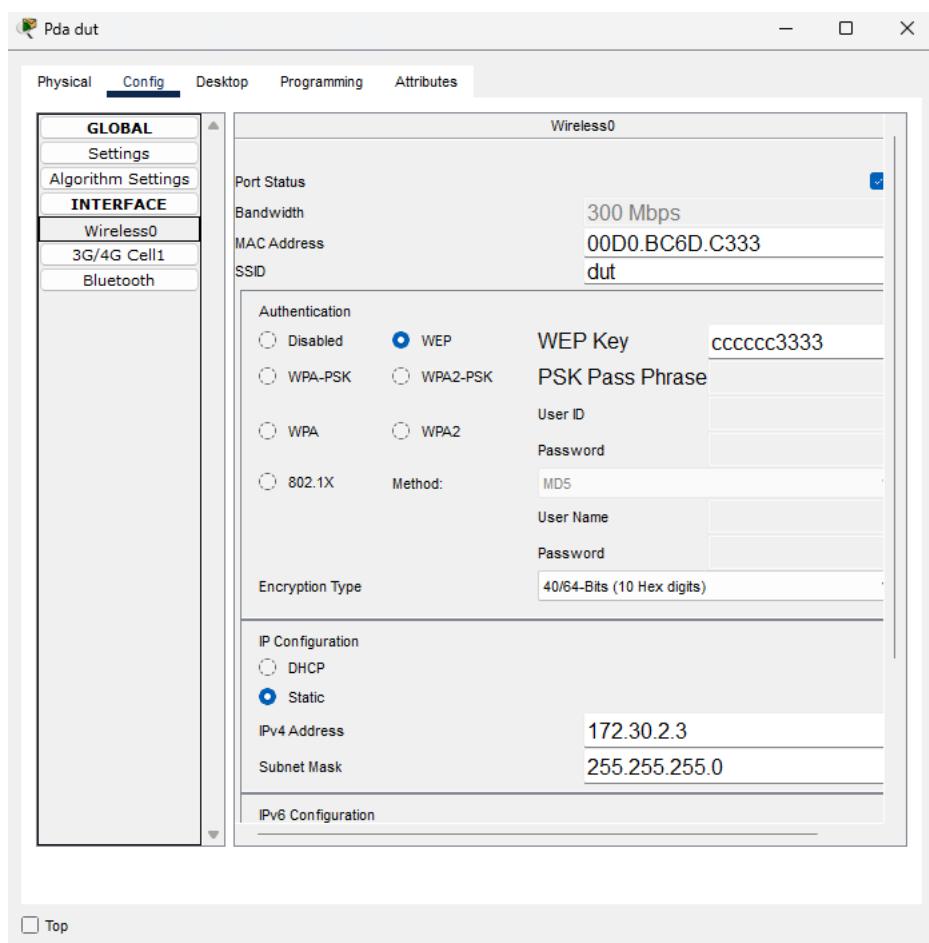
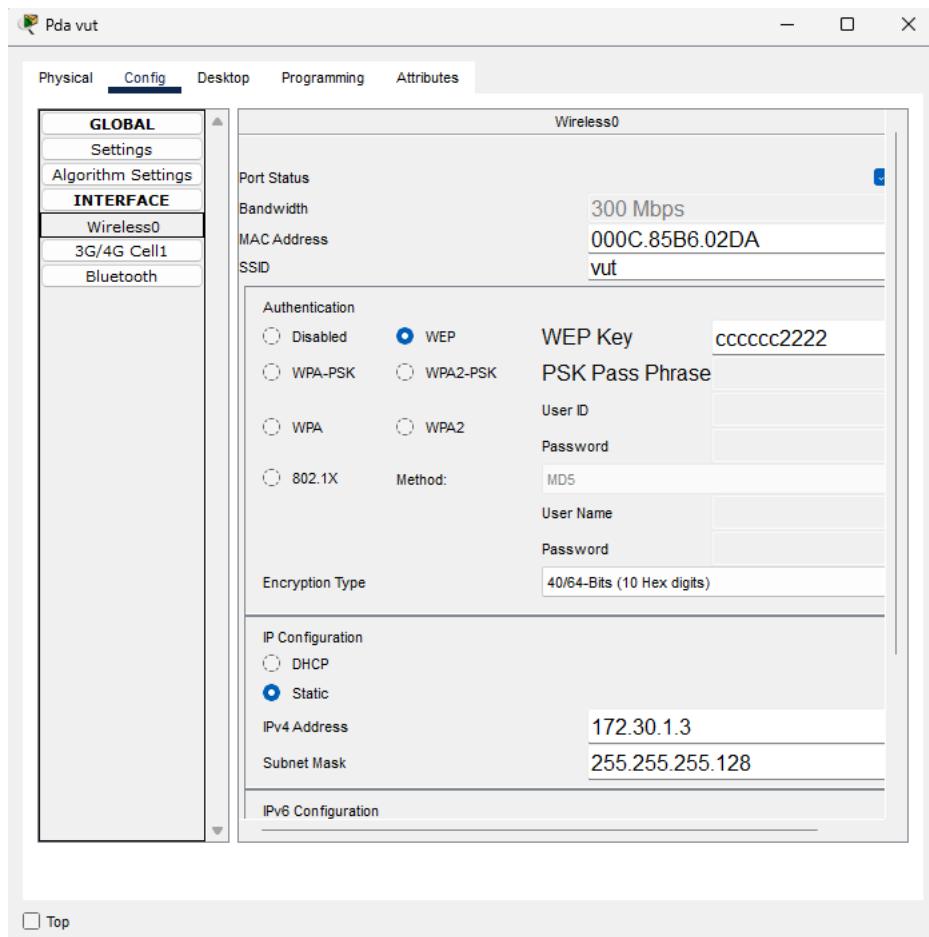
### TASK 3: Configure IP addresses on all end devices

DEVICE	INTERFACE	IP ADDRESS	SUBNET MASK	DEFAULT GATEWAY
Router1	Fa0/0.10	172.30.0.1	255.255.255.0	N/A
	Fa0/0.20	172.30.1.1	255.255.255.128	N/A
	Fa0/0.30	172.30.2.1	255.255.255.0	N/A
	S0/0/0	172.30.3.1	255.255.255.252	N/A
	S0/0/1	172.30.3.9	255.255.255.252	N/A
Router2	Fa0/0	20.20.20.1	255.255.255.224	N/A
	S0/0/0	172.30.3.2	255.255.255.252	N/A
	S0/0/1	172.30.3.5	255.255.255.252	N/A
Router3	Fa0/0	10.10.10.1	255.255.255.248	N/A
	S0/0/0	172.30.3.10	255.255.255.252	N/A
	S0/0/1	172.30.3.6	255.255.255.252	N/A
Wireless Router Tut	NIC	172.30.0.254	255.255.255.0	172.30.0.1
Wireless Router Vut	NIC	172.30.1.126	255.255.255.128	172.30.1.1
Wireless Router Dut	NIC	172.30.2.254	255.255.255.0	172.30.2.1
PC1 (tut)	NIC	172.30.0.2	255.255.255.0	172.30.0.1
PC2 (vut)	NIC	172.30.1.2	255.255.255.128	172.30.1.1
PC3 (dut)	NIC	172.30.2.2	255.255.255.0	172.30.2.1
PDA (tut)	NIC	172.30.0.3	255.255.255.0	172.30.0.1
PDA (vut)	NIC	172.30.1.3	255.255.255.128	172.30.1.1
PDA (dut)	NIC	172.30.2.3	255.255.255.0	172.30.2.1
Web Server 1	NIC	20.20.20.2	255.255.255.224	20.20.20.1
Web Server 2	NIC	10.10.10.2	255.255.255.248	10.10.10.1

## TASK 4: Configure wireless security







# Deliverable 2.2

## TASK 5: Configure VTP on all switches

### Switch0 Backbone

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vtp mode server
Device mode already VTP SERVER.
Switch(config)#vtp domain cob
Changing VTP domain name from NULL to cob
Switch(config)#vtp password cob311t
Setting device VLAN database password to cob311t
Switch(config)#

```

### Switch1 Building1

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vtp mode client
Setting device to VTP CLIENT mode.
Switch(config)#vtp domain cob
Changing VTP domain name from NULL to cob
Switch(config)#vtp password cob311t
Setting device VLAN database password to cob311t
Switch(config)#

```

### Switch2 Building2

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vtp mode client
Setting device to VTP CLIENT mode.
Switch(config)#vtp domain cob
Changing VTP domain name from NULL to cob
Switch(config)#vtp password cob311t
Setting device VLAN database password to cob311t
Switch(config)#

```

## TASK 6: Create VLANs

Switch0 Backbone

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Switch>configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#name tut
Switch(config-vlan)#exit
Switch(config)#vlan 20
Switch(config-vlan)#name vut
Switch(config-vlan)#exit
Switch(config)#vlan 30
Switch(config-vlan)#name dut
Switch(config-vlan)#exit
Switch(config)#vlan 99
Switch(config-vlan)#name management
Switch(config-vlan)#exit
Switch(config)#exit
Switch#
$SYS-5-CONFIG_I: Configured from console by console
show vlan brief
```

VLAN Name	Status	Ports
1 default	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/6, Fa0/7, Fa0/8 Fa0/9, Fa0/10, Fa0/11, Fa0/12 Fa0/13, Fa0/14, Fa0/15, Fa0/16 Fa0/17, Fa0/18, Fa0/19, Fa0/20 Fa0/21, Fa0/22, Fa0/23, Fa0/24 Gig0/1, Gig0/2
10 tut	active	
20 vut	active	
30 dut	active	
99 management	active	
1002 fddi-default	active	
1003 token-ring-default	active	
1004 fddinet-default	active	
1005 trnet-default	active	

Copy Paste

Top

Switch1 Building1

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Press RETURN to get started.
```

```
Switch>enable
Switch#show vlan brief
```

VLAN Name	Status	Ports
1 default	active	Fa0/6, Fa0/7, Fa0/8, Fa0/9 Fa0/10, Fa0/11, Fa0/12, Fa0/13 Fa0/14, Fa0/15, Fa0/16, Fa0/17 Fa0/18, Fa0/19, Fa0/20, Fa0/21 Fa0/22, Fa0/23, Fa0/24, Gig0/1 Gig0/2
10 tut	active	
20 vut	active	
30 dut	active	
99 management	active	
1002 fddi-default	active	
1003 token-ring-default	active	
1004 fddinet-default	active	
1005 trnet-default	active	

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Top

Switch2 Building2

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Press RETURN to get started.

Switch>enable
Switch#show vlan brief

VLAN Name          Status    Ports
---- --
1    default        active    Fa0/6, Fa0/7, Fa0/8, Fa0/9
                           Fa0/10, Fa0/11, Fa0/12, Fa0/13
                           Fa0/14, Fa0/15, Fa0/16, Fa0/17
                           Fa0/18, Fa0/19, Fa0/20, Fa0/21
                           Fa0/22, Fa0/23, Fa0/24, Gig0/1
                           Gig0/2
10   tut            active
20   vut            active
30   dut            active
99   management     active
1002 fddi-default  active
1003 token-ring-default  active
1004 fddinet-default  active
1005 trnet-default  active
Switch#
```

Top

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## TASK 7: Assign ports to VLANs on all switches

**Switch0 Backbone**

Physical Config **CLI** Attributes

IOS Command Line Interface

```

Switch(config-if-range)#switchport access vlan 30
Switch(config-if-range)#exit
Switch(config)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (10),
with Switch FastEthernet0/1 (1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/2 (10),
with Switch FastEthernet0/1 (1).
interface range fa0/16 - 20
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 99
Switch(config-if-range)#exit
Switch(config)#
%SYS-5-CONFIG_I: Configured from console by console
show vlan brief

VLAN Name          Status      Ports
----- 
1    default        active     Fa0/21, Fa0/22, Fa0/23, Fa0/24
                               Gig0/1, Gig0/2
10   tut            active     Fa0/1, Fa0/2, Fa0/3, Fa0/4
                               Fa0/5
20   vut            active     Fa0/6, Fa0/7, Fa0/8, Fa0/9
                               Fa0/10
30   dut            active     Fa0/11, Fa0/12, Fa0/13, Fa0/14
                               Fa0/15
99   management     active     Fa0/16, Fa0/17, Fa0/18, Fa0/19
                               Fa0/20
1002 fddi-default  active
1003 token-ring-default  active
1004 fddinet-default  active
1005 trnet-default   active
Switch#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (10),
with Switch FastEthernet0/1 (1).

```

Top

**Switch1 Building1**

Physical Config **CLI** Attributes

IOS Command Line Interface

```

access vlan 20
Switch(config-if-range)#exit
Switch(config)#
interface range fa0/11 - 15
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 30
Switch(config-if-range)#exit
Switch(config)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/2 (10),
with Switch FastEthernet0/2 (1).
interface range fa0/16 - 20
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 99
Switch(config-if-range)#exit
Switch(config)#
%SYS-5-CONFIG_I: Configured from console by console
show vlan brief

VLAN Name          Status      Ports
----- 
1    default        active     Fa0/21, Fa0/22, Fa0/23, Fa0/24
                               Gig0/1, Gig0/2
10   tut            active     Fa0/1, Fa0/2, Fa0/3, Fa0/4
                               Fa0/5
20   vut            active     Fa0/6, Fa0/7, Fa0/8, Fa0/9
                               Fa0/10
30   dut            active     Fa0/11, Fa0/12, Fa0/13, Fa0/14
                               Fa0/15
99   management     active     Fa0/16, Fa0/17, Fa0/18, Fa0/19
                               Fa0/20
1002 fddi-default  active
1003 token-ring-default  active
1004 fddinet-default  active
1005 trnet-default   active
Switch#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/2 (10),
with Switch FastEthernet0/2 (1)

```

Top

Switch2 Building2

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Switch fastEthernet0/2 (1U).
access vlan 10
Switch(config-if-range)#exit
Switch(config)#interface range fa0/6 - 10
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 20
Switch(config-if-range)#exit
Switch(config)#interface range fa0/11 - 15
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 30
Switch(config-if-range)#exit
Switch(config)#interface range fa0/16 - 20
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 99
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
show vlan brief
```

VLAN	Name	Status	Ports
1	default	active	Fa0/21, Fa0/22, Fa0/23, Fa0/24 Gig0/1, Gig0/2
10	tut	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5
20	vut	active	Fa0/6, Fa0/7, Fa0/8, Fa0/9 Fa0/10
30	dut	active	Fa0/11, Fa0/12, Fa0/13, Fa0/14 Fa0/15
99	management	active	Fa0/16, Fa0/17, Fa0/18, Fa0/19 Fa0/20
1002	fdmi-default	active	
1003	token-ring-default	active	
1004	fdmnet-default	active	
1005	trnet-default	active	

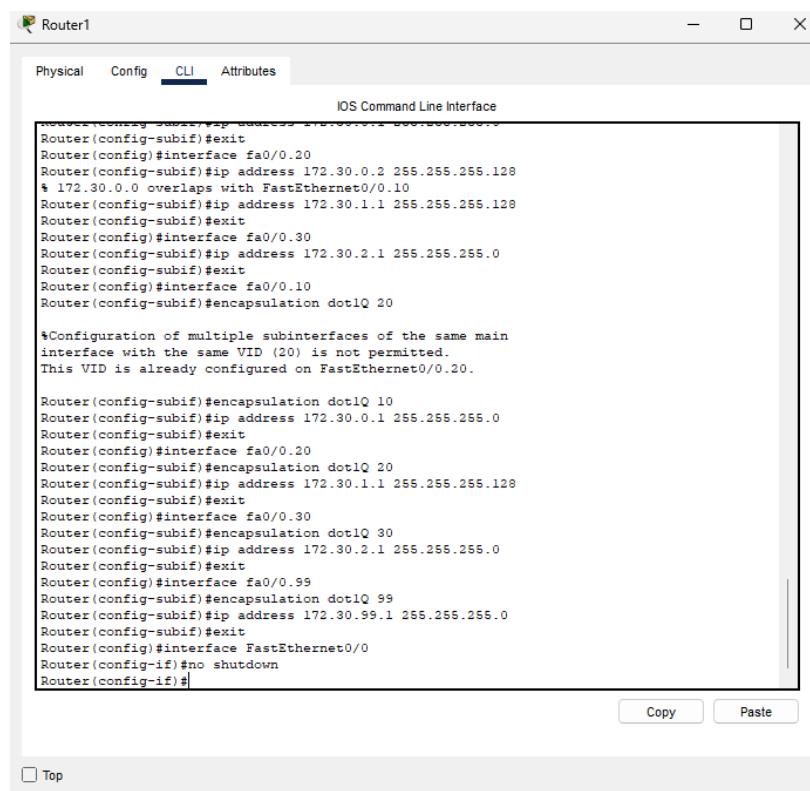
Switch#

Top

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## TASK 8: Connect VLANs together

Configure the subinterfaces on Router1:



The screenshot shows the Router1 CLI interface. The user has configured multiple subinterfaces on interface fa0/0. The configuration includes setting IP addresses for subinterfaces 10, 20, 30, and 99, and enabling IEEE 802.1Q encapsulation. An error message is displayed indicating that a VID (20) cannot be assigned to a subinterface if it is already present on the main interface.

```
Router(config-subif)#exit
Router(config)#interface fa0/0.20
Router(config-subif)#ip address 172.30.0.2 255.255.255.128
% 172.30.0.0 overlaps with FastEthernet0/0.10
Router(config-subif)#ip address 172.30.1.1 255.255.255.128
Router(config-subif)#exit
Router(config)#interface fa0/0.30
Router(config-subif)#ip address 172.30.2.1 255.255.255.0
Router(config-subif)#exit
Router(config)#interface fa0/0.10
Router(config-subif)#encapsulation dot1Q 20
Router(config-subif)#
*Configuration of multiple subinterfaces of the same main
interface with the same VID (20) is not permitted.
This VID is already configured on FastEthernet0/0.20.

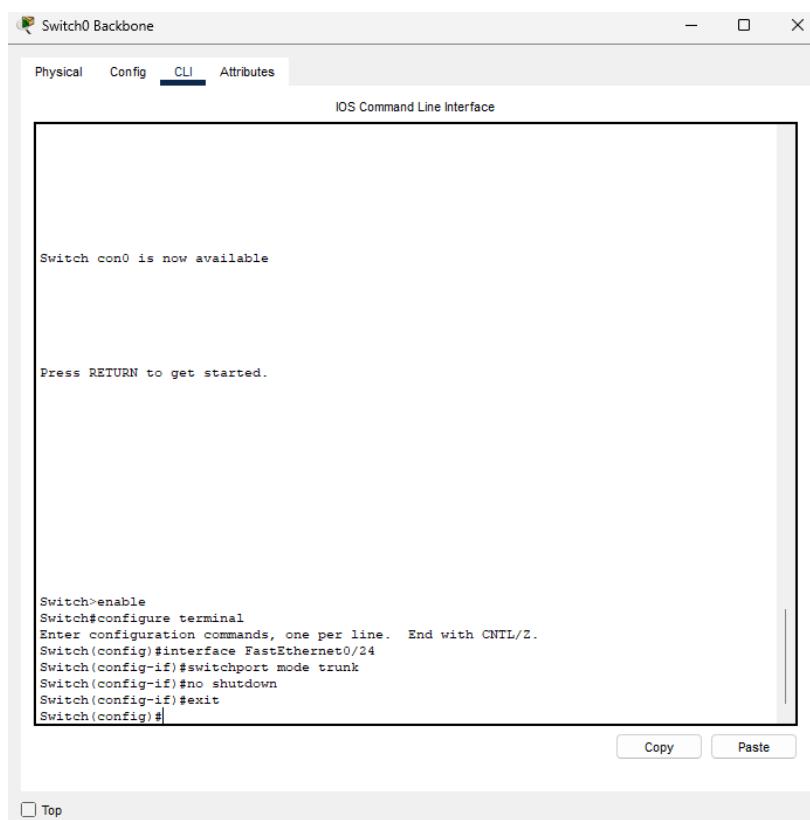
Router(config-subif)#encapsulation dot1Q 10
Router(config-subif)#ip address 172.30.0.1 255.255.255.0
Router(config-subif)#exit
Router(config)#interface fa0/0.20
Router(config-subif)#encapsulation dot1Q 20
Router(config-subif)#ip address 172.30.1.1 255.255.255.128
Router(config-subif)#exit
Router(config)#interface fa0/0.30
Router(config-subif)#encapsulation dot1Q 30
Router(config-subif)#ip address 172.30.2.1 255.255.255.0
Router(config-subif)#exit
Router(config-subif)#interface fa0/0.99
Router(config-subif)#encapsulation dot1Q 99
Router(config-subif)#ip address 172.30.99.1 255.255.255.0
Router(config-subif)#exit
Router(config)#interface FastEthernet0/0
Router(config-if)#no shutdown
Router(config-if)#

```

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Top

Set the trunk mode on Switch0 Backbone:



The screenshot shows the Switch0 Backbone CLI interface. The user is configuring a trunk port on interface con0. The configuration includes enabling the terminal and setting the port mode to trunk. A message indicates that the connection is now available.

```
Switch con0 is now available

Press RETURN to get started.

Switch>enable
Switch>configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface FastEthernet0/24
Switch(config-if)#switchport mode trunk
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#

```

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Top

## Add static routes for Router1:

Router>enable  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#interface FastEthernet0/0  
Router(config-if)#  
Router(config-if)#exit  
Router(config)#interface FastEthernet0/0  
Router(config-if)#exit  
Router(config)#interface Serial0/0/0  
Router(config-if)#  
% Ambiguous command: "i"  
Router(config-if)#exit  
Router(config)#interface FastEthernet0/0  
Router(config-if)#  
Router(config-if)#exit  
Router(config)#interface Serial0/0/0  
Router(config-if)#exit  
Router(config)#ip route 20.20.20.0 255.255.255.224 172.30.3.2  
Router(config)#end  
Router#  
%SYS-5-CONFIG\_I: Configured from console by console  
write memory  
Building configuration...  
[OK]  
Router#exit

Router con0 is now available

Top

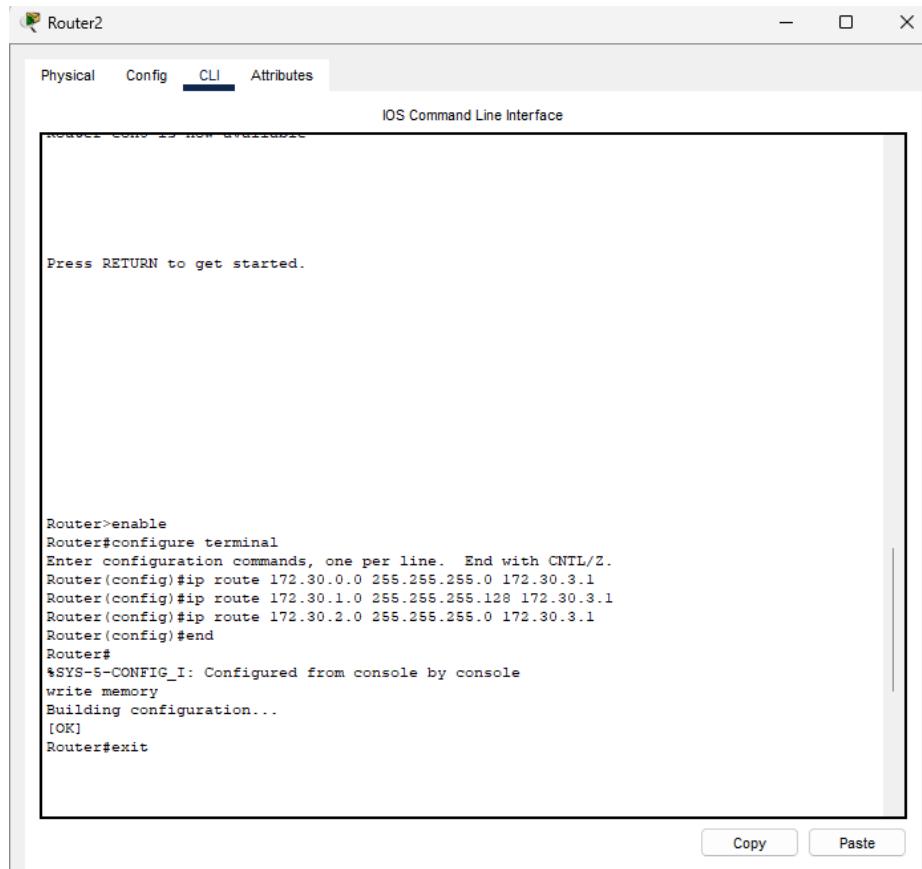
Press RETURN to get started.

Router>enable  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#ip route 10.10.10.0 255.255.255.248 172.30.3.10  
Router(config)#end  
Router#  
%SYS-5-CONFIG\_I: Configured from console by console  
write memory  
Building configuration...  
[OK]  
Router#exit

Router con0 is now available

Top

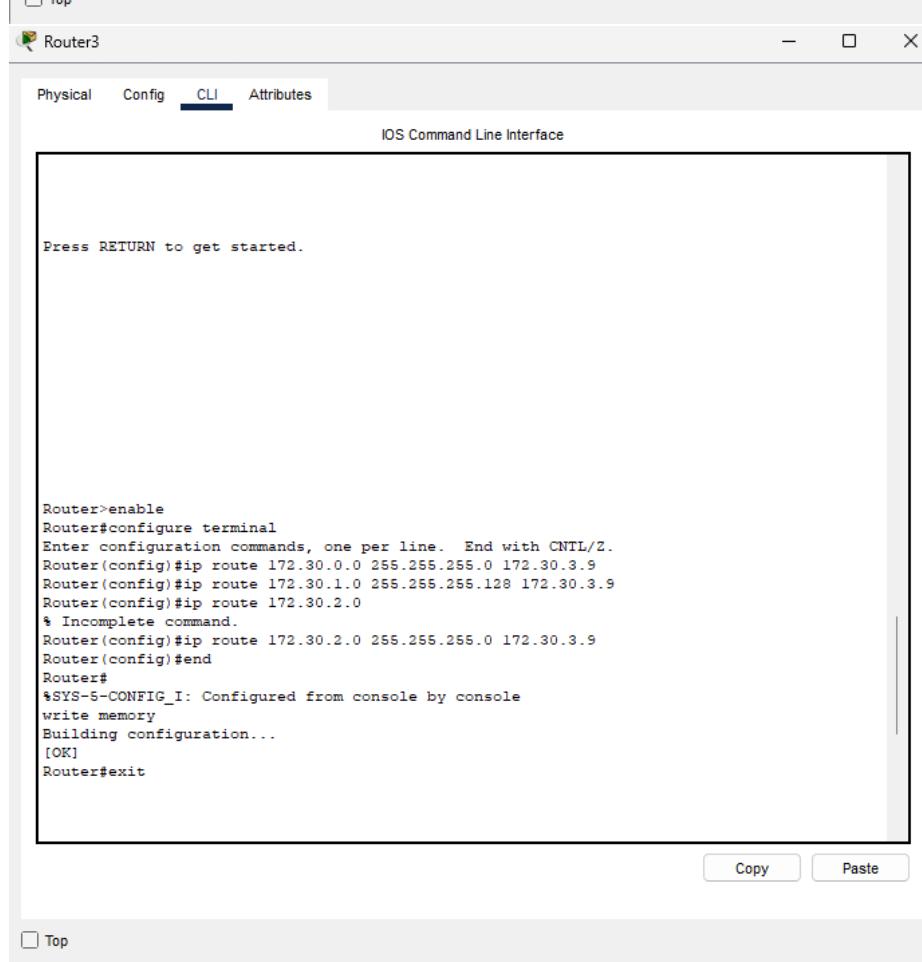
## Add static routes for Router2 and Router3:



Router>enable  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#ip route 172.30.0.0 255.255.255.0 172.30.3.1  
Router(config)#ip route 172.30.1.0 255.255.255.128 172.30.3.1  
Router(config)#ip route 172.30.2.0 255.255.255.0 172.30.3.1  
Router(config)#end  
Router#  
%SYS-5-CONFIG\_I: Configured from console by console  
write memory  
Building configuration...  
[OK]  
Router#exit

Top

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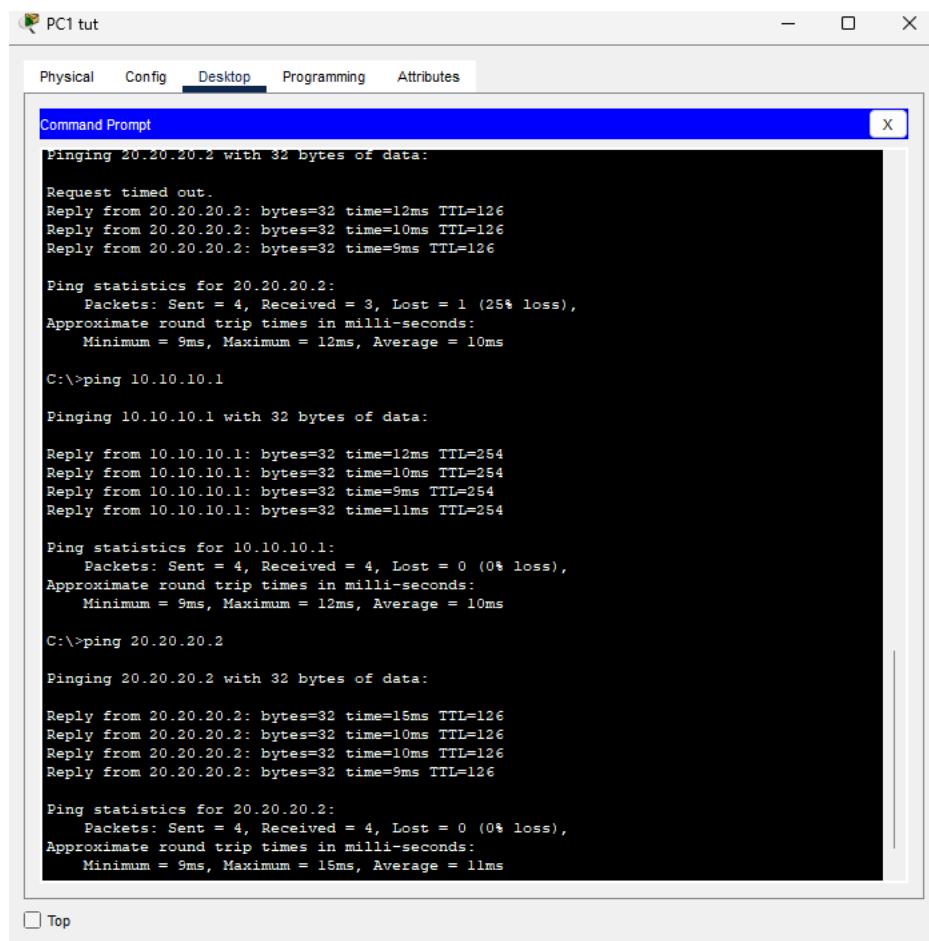


Router>enable  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#ip route 172.30.0.0 255.255.255.0 172.30.3.9  
Router(config)#ip route 172.30.1.0 255.255.255.128 172.30.3.9  
Router(config)#ip route 172.30.2.0  
% Incomplete command.  
Router(config)#ip route 172.30.2.0 255.255.255.0 172.30.3.9  
Router(config)#end  
Router#  
%SYS-5-CONFIG\_I: Configured from console by console  
write memory  
Building configuration...  
[OK]  
Router#exit

Top

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## Test the connection of the Web Servers using the ping command:



The screenshot shows a Windows Command Prompt window titled "Command Prompt". The window is part of a software interface with tabs for "Physical", "Config", "Desktop", "Programming", and "Attributes". The "Desktop" tab is selected. The Command Prompt window displays the following output:

```
Pinging 20.20.20.2 with 32 bytes of data:  
Request timed out.  
Reply from 20.20.20.2: bytes=32 time=12ms TTL=126  
Reply from 20.20.20.2: bytes=32 time=10ms TTL=126  
Reply from 20.20.20.2: bytes=32 time=9ms TTL=126  
  
Ping statistics for 20.20.20.2:  
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
Approximate round trip times in milli-seconds:  
    Minimum = 9ms, Maximum = 12ms, Average = 10ms  
  
C:\>ping 10.10.10.1  
  
Pinging 10.10.10.1 with 32 bytes of data:  
  
Reply from 10.10.10.1: bytes=32 time=12ms TTL=254  
Reply from 10.10.10.1: bytes=32 time=10ms TTL=254  
Reply from 10.10.10.1: bytes=32 time=9ms TTL=254  
Reply from 10.10.10.1: bytes=32 time=11ms TTL=254  
  
Ping statistics for 10.10.10.1:  
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
Approximate round trip times in milli-seconds:  
    Minimum = 9ms, Maximum = 12ms, Average = 10ms  
  
C:\>ping 20.20.20.2  
  
Pinging 20.20.20.2 with 32 bytes of data:  
  
Reply from 20.20.20.2: bytes=32 time=15ms TTL=126  
Reply from 20.20.20.2: bytes=32 time=10ms TTL=126  
Reply from 20.20.20.2: bytes=32 time=10ms TTL=126  
Reply from 20.20.20.2: bytes=32 time=9ms TTL=126  
  
Ping statistics for 20.20.20.2:  
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
Approximate round trip times in milli-seconds:  
    Minimum = 9ms, Maximum = 15ms, Average = 11ms
```

## TASK 9: Configure router interfaces on all routers

Router1 configuration:

Router#show controllers serial 0/0/0  
Interface Serial0/0/0  
Hardware is PowerQUICC MPC860  
DCE V.3S, clock rate 2000000  
idb at 0x81081AC4, driver data structure at 0x81084AC0  
SCC Registers:  
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x0  
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00  
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E  
Interrupt Registers:  
Config [CICR]=0x00367F80, Pending [CIPR]=0x0000C000  
Mask [CIMR]=0x0002000000, In-srv [CISR]=0x00000000  
Command register [CR]=0x580  
Port A [PADIR]=0x1030, [PAPAR]=0xFFFF  
[PAODR]=0x0010, [PADAT]=0xCBEF  
Port B [PBDIR]=0x09C0E, [PBPAR]=0x0800E  
[PBODR]=0x000000, [PBDAT]=0x3FFFD  
Port C [PCDIR]=0x00C, [PCPAR]=0x200  
[PCSO]=0xC20, [PCDAT]=0xDF2, [PCINT]=0x00F  
Receive Ring  
rmd(68012830): status 9000 length 60C address 3B6DAC4  
rmd(68012838): status B000 length 60C address 3B6D444  
Transmit Ring  
Router#interface Serial0/0/0  
^  
\* Invalid input detected at '^' marker.  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#interface Serial0/0/0  
Router(config-if)#ip address 172.30.3.1 255.255.255.252  
Router(config-if)#clock rate 64000  
Router(config-if)#no shutdown  
Router(config-if)#exit  
Router(config)#exit  
Router#

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%SYS-5-CONFIG\_I: Configured from console by console  
show controllers serial 0/0/1  
Interface Serial0/0/1  
Hardware is PowerQUICC MPC860  
DCE V.3S, clock rate 2000000  
idb at 0x81081AC4, driver data structure at 0x81084AC0  
SCC Registers:  
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x0  
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00  
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E  
Interrupt Registers:  
Config [CICR]=0x00367F80, Pending [CIPR]=0x0000C000  
Mask [CIMR]=0x0002000000, In-srv [CISR]=0x00000000  
Command register [CR]=0x580  
Port A [PADIR]=0x1030, [PAPAR]=0xFFFF  
[PAODR]=0x0010, [PADAT]=0xCBEF  
Port B [PBDIR]=0x09C0E, [PBPAR]=0x0800E  
[PBODR]=0x000000, [PBDAT]=0x3FFFD  
Port C [PCDIR]=0x00C, [PCPAR]=0x200  
[PCSO]=0xC20, [PCDAT]=0xDF2, [PCINT]=0x00F  
Receive Ring  
rmd(68012830): status 9000 length 60C address 3B6DAC4  
rmd(68012838): status B000 length 60C address 3B6D444  
Transmit Ring  
Router#configure terminal  
^  
\* Invalid input detected at '^' marker.  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#interface Serial 0/0/1  
Router(config-if)#ip address 172.30.3.9 255.255.255.252  
Router(config-if)#clock rate 64000  
Router(config-if)#no shutdown  
Router(config-if)#

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## Router2 configuration:

Router>enable  
Router#show controllers serial 0/0/0  
Interface Serial0/0/0  
Hardware is PowerQUICC MPC860  
DTE V.35 TX and RX clocks detected  
idb at 0x81081AC4, driver data structure at 0x81084AC0  
SCC Registers:  
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x8  
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00  
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E  
Interrupt Registers:  
Config [CICR]=0x00367F80, Pending [CIPR]=0x0000C000  
Mask [CIMR]=0x00200000, In-srv [CISR]=0x00000000  
Command register [CRJ]=0x580  
Port A [PDIR]=0x1030, [PAPAR]=0xFFFFF  
[PAODR]=0x0010, [PADAT]=0xCBFF  
Port B [PBDIR]=0x09C0F, [PBPAR]=0x0800E  
[PBODR]=0x00000, [PBDAT]=0x3FFFFD  
Port C [PCDIR]=0x00C, [PCPAR]=0x200  
[PCSO]=0xC20, [PCDAT]=0xDEF2, [PCINT]=0x00F  
Receive Ring  
rmd(68012830): status 9000 length 60C address 3B6DAC4  
rmd(68012838): status B000 length 60C address 3B6D444  
Transmit Ring  
  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#interface FastEthernet0/0  
Router(config-if)#ip address 20.20.20.1 255.255.255.224  
Router(config-if)#no shutdown  
Router(config-if)#exit  
Router(config)#interface Serial0/0/0  
Router(config-if)#ip address 172.30.3.2 255.255.255.252  
Router(config-if)#no shutdown  
Router(config-if)#exit

Router(config-if)#ip address 172.30.3.5 255.255.255.252  
Router(config-if)#no shutdown  
Router(config-if)#exit  
Router(config)#exit  
Router#  
%SYS-5-CONFIG\_I: Configured from console by console  
show controllers serial 0/0/1  
Interface Serial0/0/1  
Hardware is PowerQUICC MPC860  
DCE V.35, clock rate 2000000  
idb at 0x81081AC4, driver data structure at 0x81084AC0  
SCC Registers:  
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x8  
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00  
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E  
Interrupt Registers:  
Config [CICR]=0x00367F80, Pending [CIPR]=0x0000C000  
Mask [CIMR]=0x00200000, In-srv [CISR]=0x00000000  
Command register [CRJ]=0x580  
Port A [PDIR]=0x1030, [PAPAR]=0xFFFFF  
[PAODR]=0x0010, [PADAT]=0xCBFF  
Port B [PBDIR]=0x09C0F, [PBPAR]=0x0800E  
[PBODR]=0x00000, [PBDAT]=0x3FFFFD  
Port C [PCDIR]=0x00C, [PCPAR]=0x200  
[PCSO]=0xC20, [PCDAT]=0xDEF2, [PCINT]=0x00F  
Receive Ring  
rmd(68012830): status 9000 length 60C address 3B6DAC4  
rmd(68012838): status B000 length 60C address 3B6D444  
Transmit Ring  
  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#interface Serial0/0/1  
Router(config-if)#ip address 172.30.3.5 255.255.255.252  
Router(config-if)#clock rate 64000  
Router(config-if)#no shutdown  
Router(config-if)#[/p]

## Router3 configuration:

Router>enable  
Router#show controllers serial 0/0/0  
Interface Serial0/0/0  
Hardware is PowerQUICC MPC860  
DTE V.35 TX and RX clocks detected  
idb at 0x81081AC4, driver data structure at 0x81084AC0  
SCC Registers:  
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x8  
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00  
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E  
Interrupt Registers:  
Config [CICR]=0x00367F80, Pending [CIPR]=0x00000000  
Mask [CIMR]=0x00200000, In-srv [CISR]=0x00000000  
Command register [CRJ]=0x580  
Port A [PADIR]=0x1030, [PAPAR]=0xFFFF  
[PAODR]=0x0010, [PADAT]=0xCBFF  
Port B [PBDIR]=0x09C0F, [PBPAR]=0x0800E  
[PBODR]=0x00000, [PBDAT]=0x3FFFFD  
Port C [PCDIR]=0x00C, [PCPAR]=0x200  
[PCSO]=0xC20, [PCDAT]=0xDF2, [PCINT]=0x00F  
Receive Ring  
rmd(68012830): status 9000 length 60C address 3B6DAC4  
rmd(68012838): status B000 length 60C address 3B6D444  
Transmit Ring  
  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#interface FastEthernet0/0  
Router(config-if)#ip address 10.10.10.1 255.255.255.248  
Router(config-if)#no shutdown  
Router(config-if)#exit  
Router(config)#interface Serial0/0/0  
Router(config-if)#ip address 172.30.3.6 255.255.255.252  
% 172.30.3.4 overlaps with Serial0/0/1  
Router(config-if)#ip address 172.30.3.10 255.255.255.252  
Router(config-if)#no shutdown

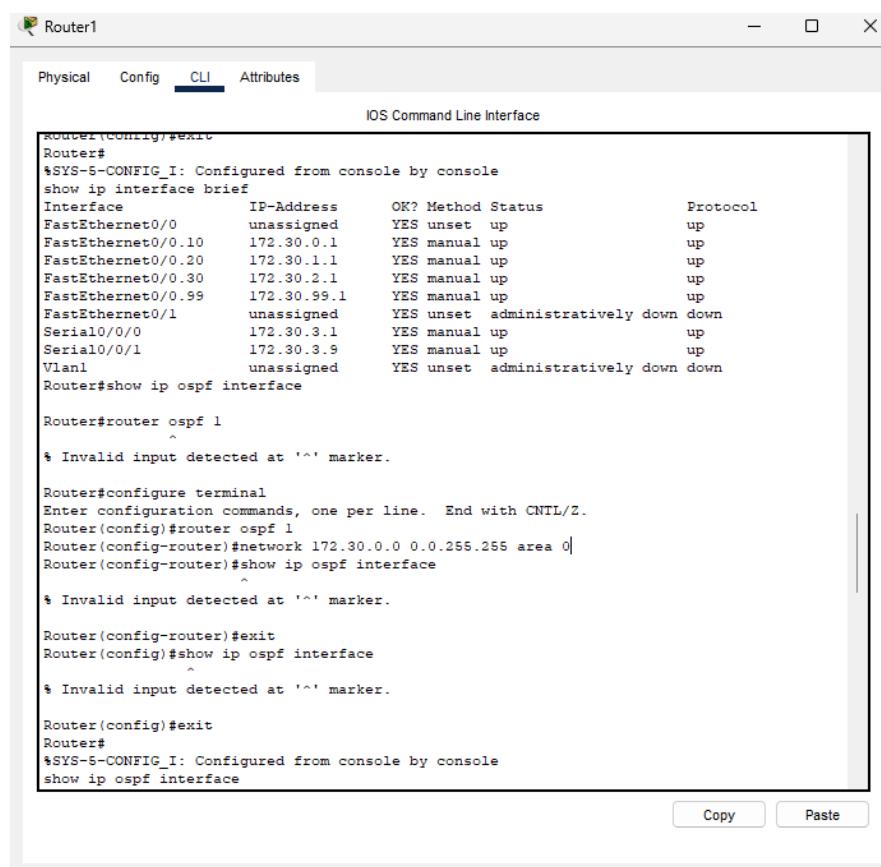
Top

\* 172.30.3.4 overlaps with Serial0/0/1  
Router(config-if)#ip address 172.30.3.10 255.255.255.252  
Router(config-if)#no shutdown  
Router(config-if)#exit  
Router(config)#exit  
Router#  
%SYS-5-CONFIG\_I: Configured from console by console  
show controllers serial 0/0/1  
Interface Serial0/0/1  
Hardware is PowerQUICC MPC860  
DTE V.35 TX and RX clocks detected  
idb at 0x81081AC4, driver data structure at 0x81084AC0  
SCC Registers:  
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x8  
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00  
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E  
Interrupt Registers:  
Config [CICR]=0x00367F80, Pending [CIPR]=0x00000000  
Mask [CIMR]=0x00200000, In-srv [CISR]=0x00000000  
Command register [CRJ]=0x580  
Port A [PADIR]=0x1030, [PAPAR]=0xFFFF  
[PAODR]=0x0010, [PADAT]=0xCBFF  
Port B [PBDIR]=0x09C0F, [PBPAR]=0x0800E  
[PBODR]=0x00000, [PBDAT]=0x3FFFFD  
Port C [PCDIR]=0x00C, [PCPAR]=0x200  
[PCSO]=0xC20, [PCDAT]=0xDF2, [PCINT]=0x00F  
Receive Ring  
rmd(68012830): status 9000 length 60C address 3B6DAC4  
rmd(68012838): status B000 length 60C address 3B6D444  
Transmit Ring  
  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#interface Serial0/0/1  
Router(config-if)#ip address 172.30.3.6 255.255.255.252  
Router(config-if)#no shutdown  
Router(config-if)#[

Top

## TASK 10: Configure dynamic routing

Router1 configuration:



The screenshot shows the Router1 CLI interface. The user has navigated through several configuration modes, including router configuration, OSPF configuration, and network configuration, before finally exiting back to the main Router# prompt. The output displays the current IP interface table and the configuration of OSPF area 0.

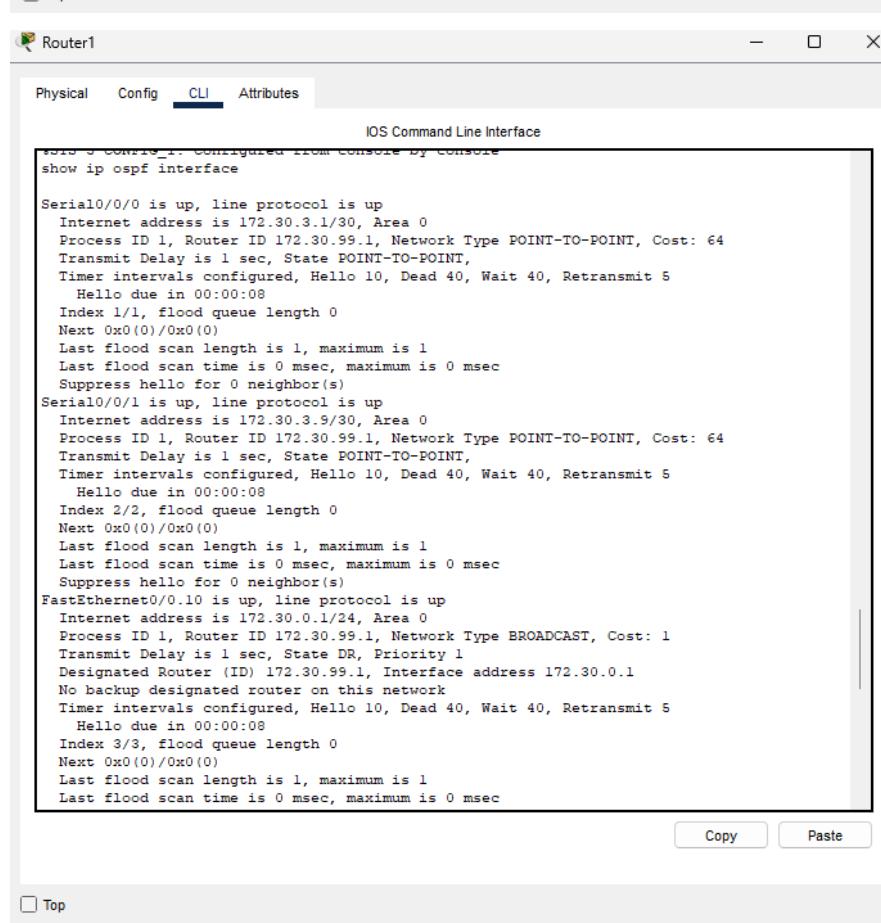
```
Router#exit
Router#
*SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
FastEthernet0/0     unassigned     YES unset up           up
FastEthernet0/0.10  172.30.0.1    YES manual up        up
FastEthernet0/0.20  172.30.1.1    YES manual up        up
FastEthernet0/0.30  172.30.2.1    YES manual up        up
FastEthernet0/0.99  172.30.99.1   YES manual up       up
FastEthernet0/1     unassigned    YES unset administratively down down
Serial0/0/0         172.30.3.1    YES manual up        up
Serial0/0/1         172.30.3.9    YES manual up        up
Vlan1              unassigned    YES unset administratively down down
Router#show ip ospf interface
Router#router ospf 1
^
* Invalid input detected at '^' marker.

Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 172.30.0.0 0.0.255.255 area 0
Router(config-router)#show ip ospf interface
^
* Invalid input detected at '^' marker.

Router(config-router)#exit
Router(config)#show ip ospf interface
^
* Invalid input detected at '^' marker.

Router(config)#exit
Router#
*SYS-5-CONFIG_I: Configured from console by console
show ip ospf interface
```

Top



The screenshot shows the Router1 CLI interface. The user has entered the show ip ospf interface command to view detailed information for each OSPF interface. The output includes details such as line protocol status, internet address, process ID, router ID, network type, cost, transmit delay, timer intervals, and hello/dead/hold times.

```
*SYS-5-CONFIG_I: Configured from console by console
show ip ospf interface
Serial0/0/0 is up, line protocol is up
  Internet address is 172.30.3.1/30, Area 0
  Process ID 1, Router ID 172.30.99.1, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT,
  Timer intervals configured, Hello 10, Dead 40, Retransmit 5
    Hello due in 00:00:08
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Suppress hello for 0 neighbor(s)
Serial0/0/1 is up, line protocol is up
  Internet address is 172.30.3.9/30, Area 0
  Process ID 1, Router ID 172.30.99.1, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT,
  Timer intervals configured, Hello 10, Dead 40, Retransmit 5
    Hello due in 00:00:08
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Suppress hello for 0 neighbor(s)
FastEthernet0/0.10 is up, line protocol is up
  Internet address is 172.30.0.1/24, Area 0
  Process ID 1, Router ID 172.30.99.1, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 172.30.99.1, Interface address 172.30.0.1
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Retransmit 5
    Hello due in 00:00:08
  Index 3/3, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
```

Top

## Router2 configuration:

Router>enable  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#router ospf 1  
Router(config-router)#network 172.30.3.0 0.0.0.3 area 0  
Router(config-router)#network 172.  
04:41:58: %OSPF-5-ADJCHG: Process 1, Nbr 172.30.99.1 on Serial0/0/0 from LOADING to FULL,  
Loading Done  
30.10.0 0.0.0.255 area 0  
Router(config-router)#network 172.30.11.0 0.0.0.255 area 0  
Router(config-router)#exit  
Router(config)#write memory  
^  
\* Invalid input detected at '^' marker.  
Router(config)#exit  
Router#  
\*SYS-5-CONFIG\_I: Configured from console by console  
writememory  
Translating "writememory"...domain server (255.255.255.255)  
\* Unknown command or computer name, or unable to find computer address  
Router#write memory  
Building configuration...  
[OK]  
Router#show ip ospf interface  
  
FastEthernet0/0 is up, line protocol is up  
Internet address is 20.20.20.1/27, Area 0  
Process ID 1, Router ID 172.30.3.5, Network Type BROADCAST, Cost: 1  
Transmit Delay is 1 sec, State DR, Priority 1  
Designated Router (ID) 172.30.3.5, Interface address 20.20.20.1  
No backup designated router on this network  
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5  
Hello due in 00:00:04  
Index 1/1, flood queue length 0  
Next 0x0(0)/0x0(0)

Copy Paste

Router#Top  
Router#  
Physical Config CLI Attributes  
IOS Command Line Interface  
  
writememory  
Translating "writememory"...domain server (255.255.255.255)  
\* Unknown command or computer name, or unable to find computer address  
  
Router#write memory  
Building configuration...  
[OK]  
Router#show ip ospf interface  
  
FastEthernet0/0 is up, line protocol is up  
Internet address is 20.20.20.1/27, Area 0  
Process ID 1, Router ID 172.30.3.5, Network Type BROADCAST, Cost: 1  
Transmit Delay is 1 sec, State DR, Priority 1  
Designated Router (ID) 172.30.3.5, Interface address 20.20.20.1  
No backup designated router on this network  
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5  
Hello due in 00:00:04  
Index 1/1, flood queue length 0  
Next 0x0(0)/0x0(0)  
Last flood scan length is 1, maximum is 1  
Last flood scan time is 0 msec, maximum is 0 msec  
Neighbor Count is 0, Adjacent neighbor count is 0  
Suppress hello for 0 neighbor(s)  
Serial0/0/0 is up, line protocol is up  
Internet address is 172.30.3.2/30, Area 0  
Process ID 1, Router ID 172.30.3.5, Network Type POINT-TO-POINT, Cost: 64  
Transmit Delay is 1 sec, State POINT-TO-POINT,  
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5  
Hello due in 00:00:04  
Index 2/2, flood queue length 0  
Next 0x0(0)/0x0(0)  
Last flood scan length is 1, maximum is 1  
Last flood scan time is 0 msec, maximum is 0 msec  
Neighbor Count is 1, Adjacent neighbor count is 1  
Adjacent with neighbor 172.30.99.1  
Suppress hello for 0 neighbor(s)  
Router#

Copy Paste

Router#Top

## Router3 configuration:

Router>enable  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#router ospf 1  
Router(config-router)#network 172.30.3.8 0.0.0.3 area 0  
Router(config-router)#  
04:48:48: %OSPF-5-ADJCHG: Process 1, Nbr 172.30.99.1 on Serial0/0/0 from LOADING to FULL,  
Loading Done  
network 172.30.12.0 0.0.0.255 area 0  
Router(config-router)#network 172.30.13.0 0.0.0.255 area 0  
Router(config-router)#exit  
Router(config)#exit  
Router#  
%SYS-5-CONFIG\_I: Configured from console by console  
write memory  
Building configuration...  
[OK]  
Router#show ip ospf interface  
  
FastEthernet0/0 is up, line protocol is up  
  Internet address is 10.10.10.1/29, Area 0  
  Process ID 1, Router ID 172.30.3.10, Network Type BROADCAST, Cost: 1  
  Transmit Delay is 1 sec, State DR, Priority 1  
  Designated Router (ID) 172.30.3.10, Interface address 10.10.10.1  
  No backup designated router on this network  
  Timer intervals configured, Hello 10, Dead 40, Retransmit 5  
    Hello due in 00:00:02  
  Index 1/1, flood queue length 0  
  Next 0x0(0)/0x0(0)  
  Last flood scan length is 1, maximum is 1  
  Last flood scan time is 0 msec, maximum is 0 msec  
  Neighbor Count is 0, Adjacent neighbor count is 0  
  Suppress hello for 0 neighbor(s)  
Serial0/0/0 is up, line protocol is up  
  Internet address is 172.30.3.10/30, Area 0  
  Process ID 1, Router ID 172.30.3.10, Network Type POINT-TO-POINT, Cost: 64

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Top

Router(config) Router#exit  
Router#  
%SYS-5-CONFIG\_I: Configured from console by console  
write memory  
Building configuration...  
[OK]  
Router#show ip ospf interface  
  
FastEthernet0/0 is up, line protocol is up  
  Internet address is 10.10.10.1/29, Area 0  
  Process ID 1, Router ID 172.30.3.10, Network Type BROADCAST, Cost: 1  
  Transmit Delay is 1 sec, State DR, Priority 1  
  Designated Router (ID) 172.30.3.10, Interface address 10.10.10.1  
  No backup designated router on this network  
  Timer intervals configured, Hello 10, Dead 40, Retransmit 5  
    Hello due in 00:00:02  
  Index 1/1, flood queue length 0  
  Next 0x0(0)/0x0(0)  
  Last flood scan length is 1, maximum is 1  
  Last flood scan time is 0 msec, maximum is 0 msec  
  Neighbor Count is 0, Adjacent neighbor count is 0  
  Suppress hello for 0 neighbor(s)  
Serial0/0/0 is up, line protocol is up  
  Internet address is 172.30.3.10/30, Area 0  
  Process ID 1, Router ID 172.30.3.10, Network Type POINT-TO-POINT, Cost: 64  
  Transmit Delay is 1 sec, State POINT-TO-POINT,  
  Timer intervals configured, Hello 10, Dead 40, Retransmit 5  
    Hello due in 00:00:03  
  Index 2/2, flood queue length 0  
  Next 0x0(0)/0x0(0)  
  Last flood scan length is 1, maximum is 1  
  Last flood scan time is 0 msec, maximum is 0 msec  
  Neighbor Count is 1 , Adjacent neighbor count is 1  
    Adjacent with neighbor 172.30.99.1  
  Suppress hello for 0 neighbor(s)  
Router#

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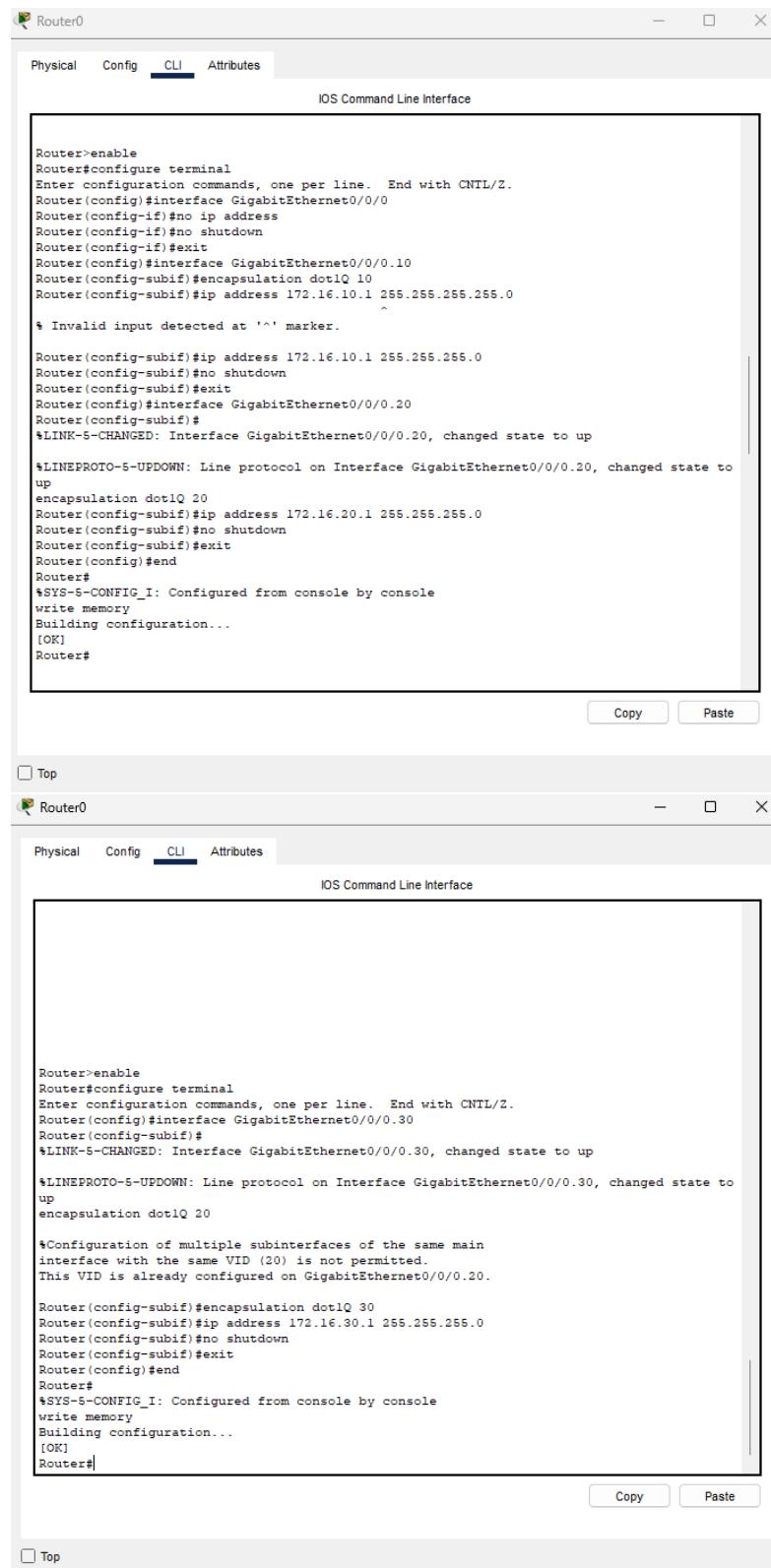
Top

# Deliverable 3

## Question 3.1

### Step 1: Setup and configure the Core Router and Core Switch

Core Router configuration: Add a GigabitEthernet IP address for inter-VLAN routing



The image displays two side-by-side screenshots of the Cisco IOS Command Line Interface (CLI) running on a device named 'Router0'. Both screenshots show the configuration mode (Config tab selected) and the command-line input area.

**Screenshot 1 (Top):**

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0
Router(config-if)#no ip address
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#interface GigabitEthernet0/0/0.10
Router(config-subif)#encapsulation dot1Q 10
Router(config-subif)#ip address 172.16.10.1 255.255.255.0
Router(config-subif)#
* Invalid input detected at '^' marker.

Router(config-subif)#ip address 172.16.10.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#interface GigabitEthernet0/0/0.20
Router(config-subif)#
*LINK-5-CHANGED: Interface GigabitEthernet0/0/0.20, changed state to up

*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0.20, changed state to up
encapsulation dot1Q 20
Router(config-subif)#ip address 172.16.20.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#end
Router#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router#
```

**Screenshot 2 (Bottom):**

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/30
Router(config-subif)#
*LINK-5-CHANGED: Interface GigabitEthernet0/0/30, changed state to up

*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/30, changed state to up
encapsulation dot1Q 20

*Configuration of multiple subinterfaces of the same main
interface with the same VID (20) is not permitted.
This VID is already configured on GigabitEthernet0/0/0.20.

Router(config-subif)#encapsulation dot1Q 30
Router(config-subif)#ip address 172.16.30.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#end
Router#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router#
```

 Router0

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Press RETURN to get started.

Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0.40
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/0.40, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0.40, changed state to up
encapsulation dot1Q 40
Router(config-subif)#ip address 172.16.40.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router#
```

Top

 Router0

Physical Config **CLI** Attributes

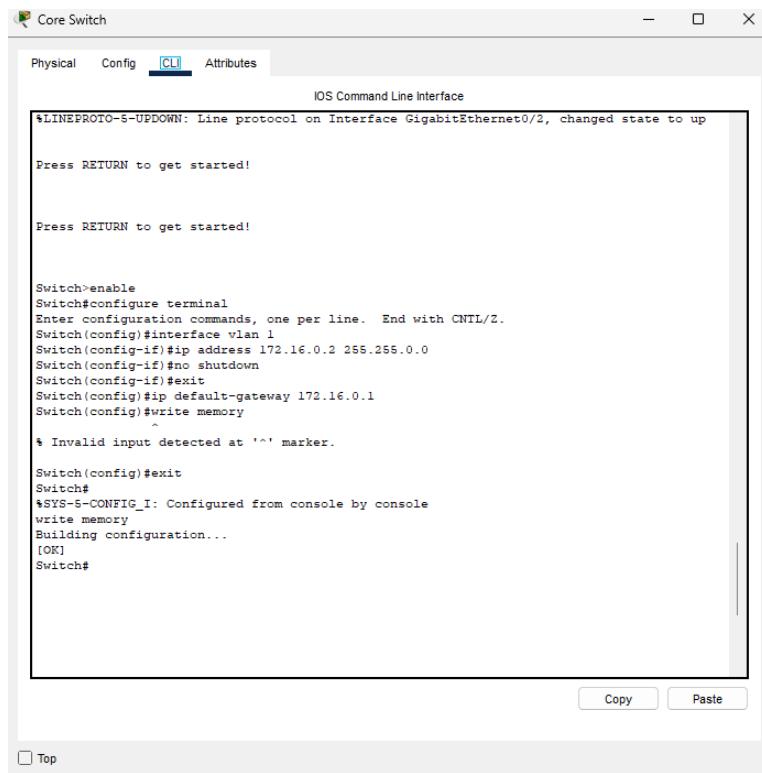
IOS Command Line Interface

```
Press RETURN to get started.

Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0.50
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/0.50, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0.50, changed state to up
encapsulation dot1Q 50
Router(config-subif)#ip address 172.16.50.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router#
```

Top

## Core Switch configuration: Assign an IP address to VLAN1 and set the Default Gateway



The screenshot shows a Windows Command Line Interface window titled "Core Switch". The tab bar at the top has three tabs: "Physical", "Config", and "CLI", with "CLI" being the active tab. Below the tabs is a sub-header "IOS Command Line Interface". The main area of the window contains the following text:

```
*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up
Press RETURN to get started!
Press RETURN to get started!

Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)#interface vlan 1
switch(config-if)#ip address 172.16.0.2 255.255.0.0
switch(config-if)#no shutdown
switch(config-if)#exit
switch(config)#ip default-gateway 172.16.0.1
switch(config)#write memory
^
* Invalid input detected at '^' marker.

Switch(config)#exit
switch#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

At the bottom right of the window, there are two buttons: "Copy" and "Paste". At the bottom left, there is a checkbox labeled "Top".

## Step 2: Distribution Switch, Access Switches, Servers, and PCs Setup and Configuration (Finance Department)

Distribution Switch configuration: Add a VLAN, assign ports to VLAN 10, and set the trunk link to the Core Switch and Access Switches

The screenshot shows the Cisco Distribution Switch CLI interface. The tab bar at the top has 'Physical', 'Config' (which is selected), and 'Attributes'. Below the tabs is the text 'IOS Command Line Interface'. The main area contains the following configuration commands:

```
Switch>
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/5 (10),
with Switch GigabitEthernet0/1 (1).
enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (10),
with Switch GigabitEthernet0/1 (1).
vlan
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/4 (10),
with Switch GigabitEthernet0/1 (1).
10
Switch(config-vlan)#name FINANCE
Switch(config-vlan)#exit
Switch(config)#interface
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/6 (10),
with Switch GigabitEthernet0/1 (1).
GigabitEthernet0/2
Switch(config-if)#switc
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/5 (10),
with Switch GigabitEthernet0/1 (1).
port mode access
Switch(config-if)#switchport access vlan 10
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (10),
with Switch GigabitEthernet0/1 (1).

Switch(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/4 (10),
with Switch GigabitEthernet0/1 (1).
exit
Switch(config)#interface FastEthernet0/1
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/6 (10),
with Switch GigabitEthernet0/1 (1).

Switch(config-if)#switchport mode access

```

At the bottom right of the command window are 'Copy' and 'Paste' buttons. Below the command window is a toolbar with a 'Top' button.

The screenshot shows the Cisco Distribution Switch CLI interface. The tab bar at the top has 'Physical', 'Config' (which is selected), and 'Attributes'. Below the tabs is the text 'IOS Command Line Interface'. The main area contains the following configuration commands:

```
Switch(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/5 (10),
with Switch GigabitEthernet0/1 (1).

Switch(config)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (10),
with Switch GigabitEthernet0/1 (1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/4 (10),
with Switch GigabitEthernet0/1 (1).
interface FastEthernet0/2
Switch(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/6 (10),
with Switch GigabitEthernet0/1 (1).
switchport mode access
Switch(config-if)#switchport access vlan 10
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/5 (10),
with Switch GigabitEthernet0/1 (1).

Switch(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (10),
with Switch GigabitEthernet0/1 (1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/4 (10),
with Switch GigabitEthernet0/1 (1).
ge FastEthernet
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/6 (10),
with Switch GigabitEthernet0/1 (1).
0/3 - 6
Switch(config-if-range)#switchport mode trunk
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/6 (10),
with Switch GigabitEthernet0/1 (1).
```

At the bottom right of the command window are 'Copy' and 'Paste' buttons. Below the command window is a toolbar with a 'Top' button.

Distribution Switch

Physical Config **CLI** Attributes

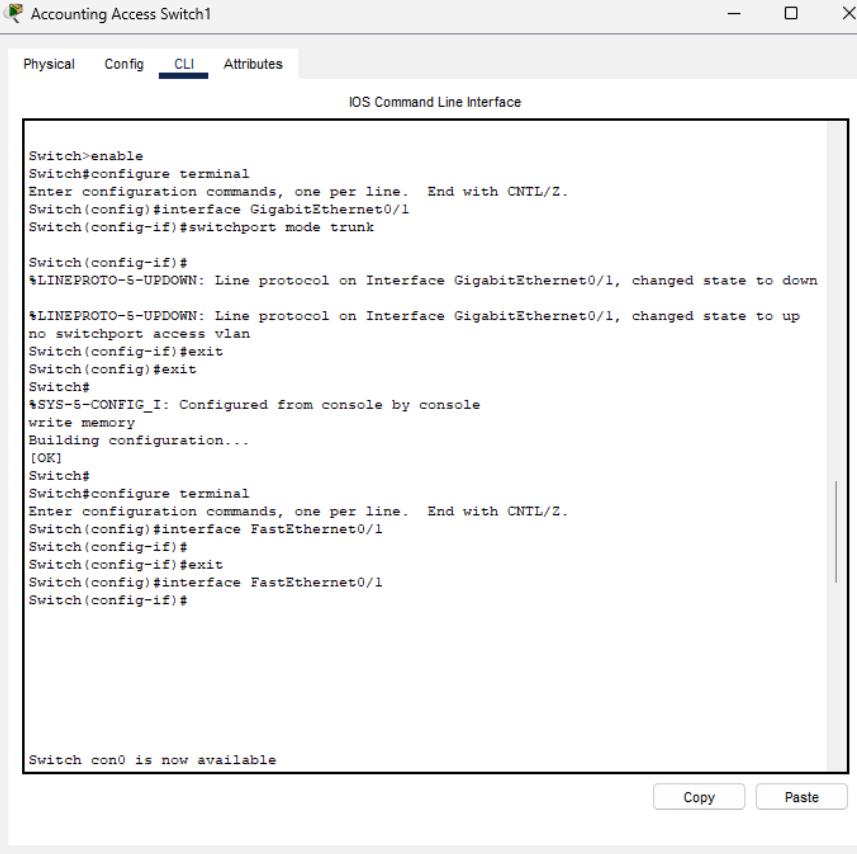
IOS Command Line Interface

```
Switch(config-if-range)#  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to down  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to down  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to up  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to down  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to down  
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to up  
exit  
Switch(config)#interface GigabitEthernet0/1  
Switch(config-if)#switchport mode trunk  
Switch(config-if)#exit  
Switch(config)#end  
Switch#  
%SYS-5-CONFIG_I: Configured from console by console  
write memory  
Building configuration...  
[OK]  
Switch#
```

Top

Copy Paste

## Accounting Access Switch1 and Switch2 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs

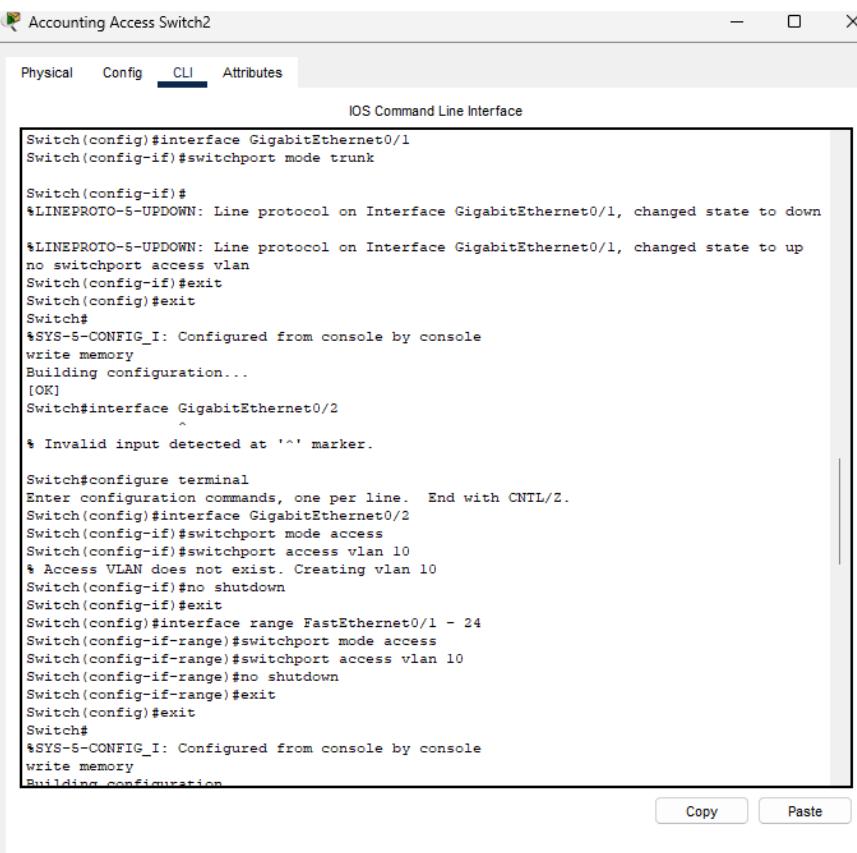


```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk

Switch(config-if)#
*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down
*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface FastEthernet0/1
Switch(config-if)#
Switch(config-if)#exit
Switch(config)#interface FastEthernet0/1
Switch(config-if)#

Switch con0 is now available
```

Top

```
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk

Switch(config-if)#
*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down
*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#interface GigabitEthernet0/2
^
* Invalid input detected at '^' marker.

Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 10
* Access VLAN does not exist. Creating vlan 10
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config-if-range)#
Switch(config-if-range)#interface range FastEthernet0/1 - 24
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 10
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
```

Top

Finance Access Switch1 and Switch2 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/1 (1),
with Switch FastEthernet0/3 (10).
Ethernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/1 (1),
with Switch FastEthernet0/3 (10).
switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface range FastEthernet0/1 - 24
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport acc
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/1 (1),
with Switch FastEthernet0/3 (10).
ess vlan 10
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
```

Top

Copy      Paste

## Server configuration: Assign IP addresses to the Accounting, Billing, and Payroll Server

The image displays two screenshots of a server configuration interface for the Accounting Server. Both screenshots show the 'Config' tab selected.

**Screenshot 1: Global Settings**

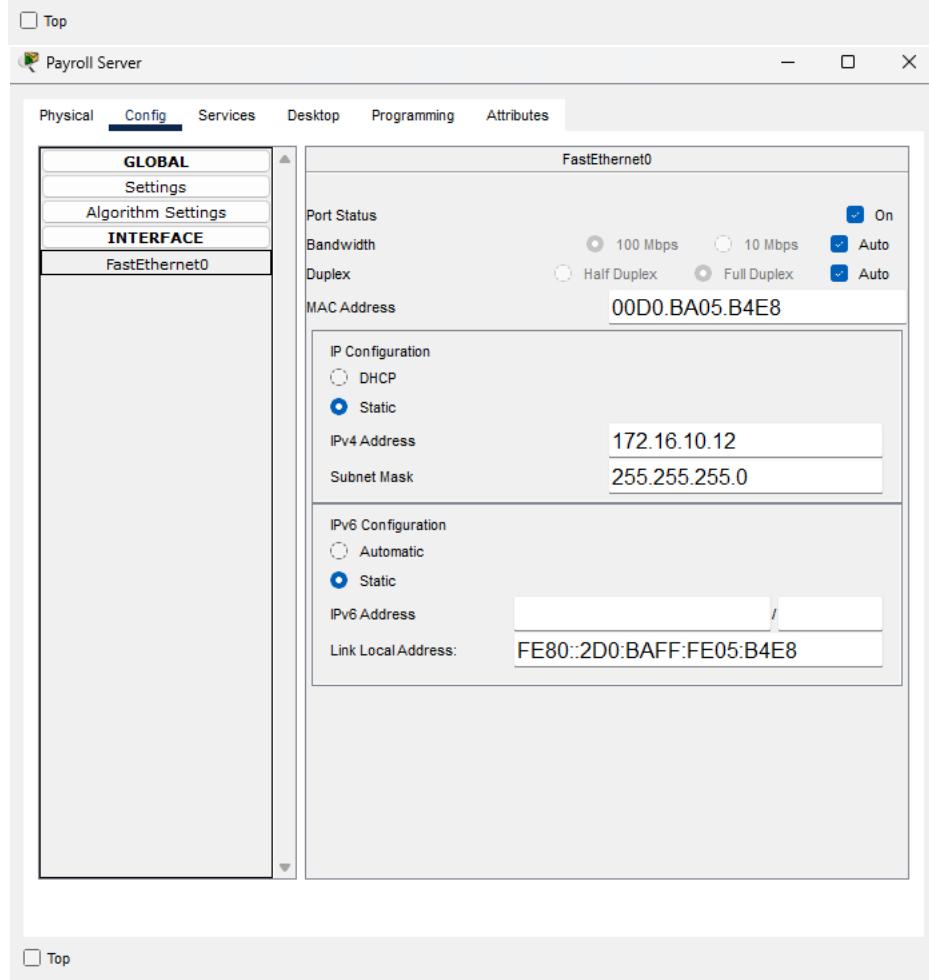
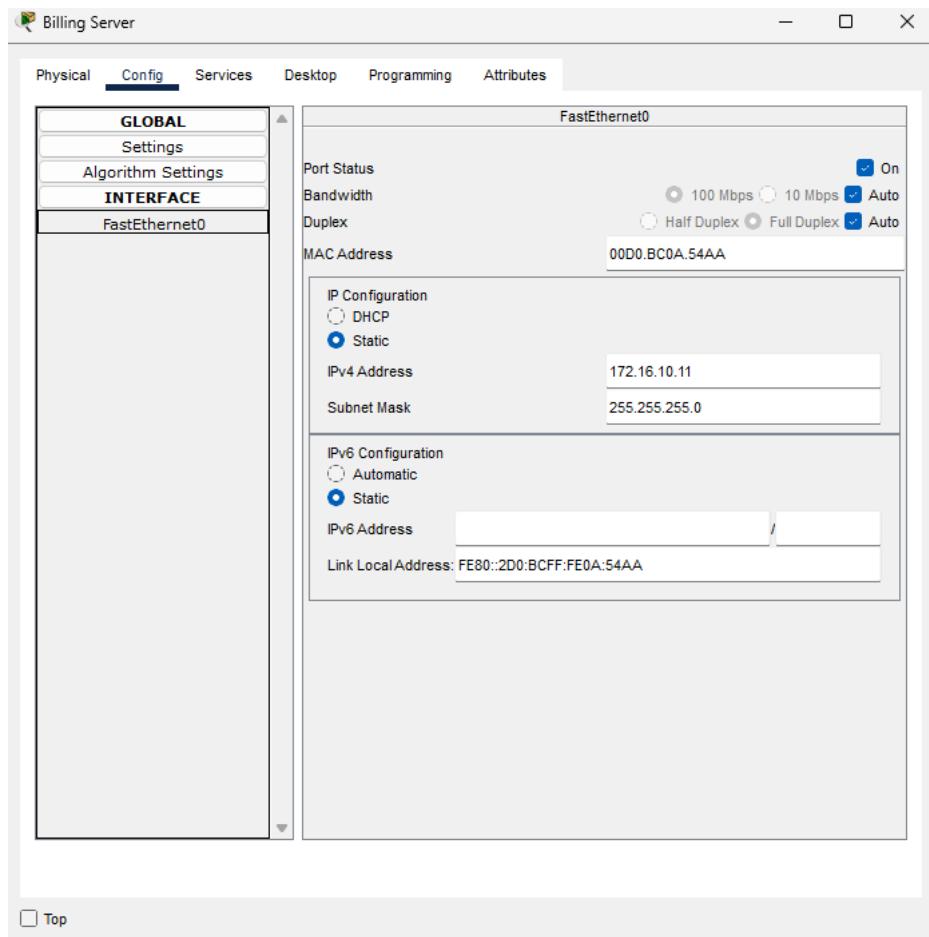
The left sidebar shows navigation categories: Physical, Config, Services, Desktop, Programming, Attributes, GLOBAL, Settings, Algorithm Settings, INTERFACE, and FastEthernet0. The right panel displays 'Global Settings' for the Accounting Server. It includes fields for 'Display Name' (Accounting Server), 'Gateway/DNS IPv4' (set to Static with Default Gateway 172.16.10.1), and 'Gateway/DNS IPv6' (set to Static).

Display Name	Accounting Server
Gateway/DNS IPv4	<input type="radio"/> DHCP <input checked="" type="radio"/> Static Default Gateway: 172.16.10.1
Gateway/DNS IPv6	<input type="radio"/> Automatic <input checked="" type="radio"/> Static Default Gateway: [empty] DNS Server: [empty]

**Screenshot 2: Interface Configuration**

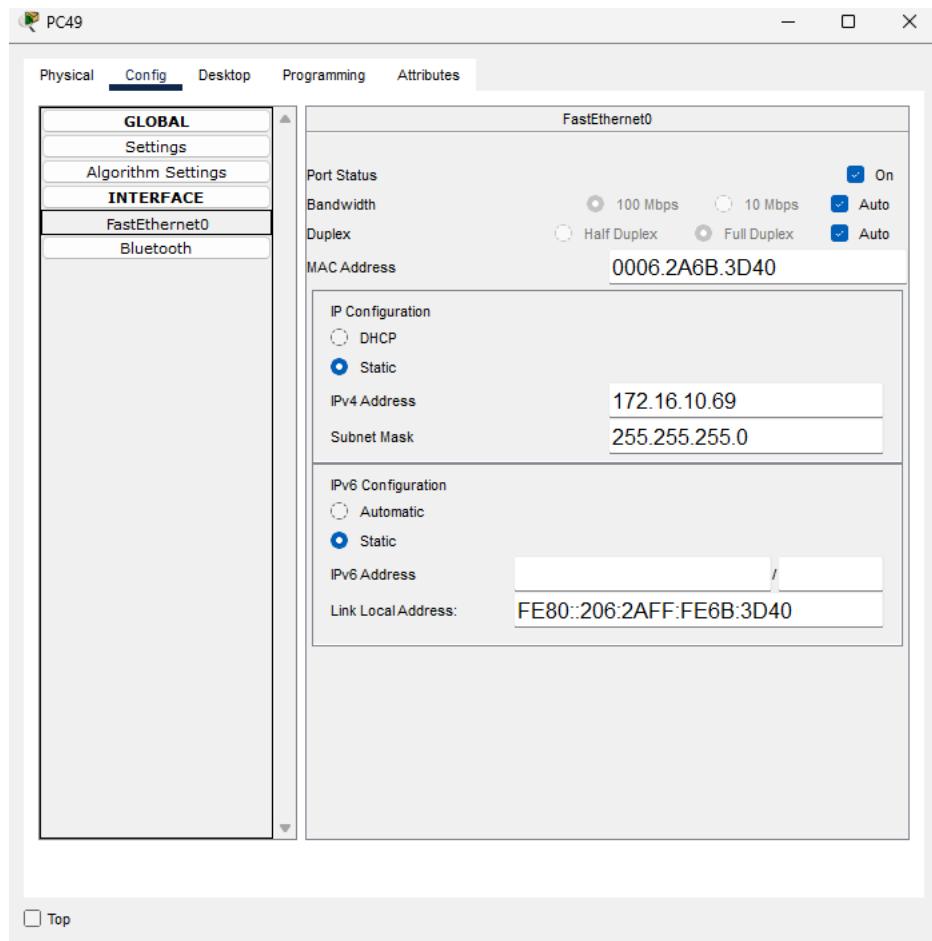
The left sidebar shows the same navigation categories. The right panel displays 'FastEthernet0' settings. It includes fields for 'Port Status' (On), 'Bandwidth' (100 Mbps), 'Duplex' (Full Duplex), and 'MAC Address' (0090.2B91.4846). The 'IP Configuration' section shows 'Static' assigned with 'IPv4 Address' (172.16.10.10) and 'Subnet Mask' (255.255.255.0). The 'IPv6 Configuration' section shows 'Static' assigned with 'IPv6 Address' (FE80::2B91:4846) and 'Link Local Address' (FE80::2B91:4846).

Port Status	On
Bandwidth	100 Mbps
Duplex	Half Duplex
MAC Address	0090.2B91.4846
IP Configuration	<input type="radio"/> DHCP <input checked="" type="radio"/> Static IPv4 Address: 172.16.10.10 Subnet Mask: 255.255.255.0
IPv6 Configuration	<input type="radio"/> Automatic <input checked="" type="radio"/> Static IPv6 Address: FE80::2B91:4846 Link Local Address: FE80::2B91:4846



## PC configurations: Assign IP addresses for 50 Accountant PCs (172.16.10.20 – 69)

The image displays two screenshots of a network configuration software interface for a device named PC0. The top screenshot shows the 'Config' tab selected, specifically the 'GLOBAL' section. It includes fields for 'Display Name' (PC0), 'Interfaces' (FastEthernet0), and 'Gateway/DNS IPv4' settings (Default Gateway: 172.16.10.1). The bottom screenshot shows the 'Config' tab selected, specifically the 'FastEthernet0' section. It includes fields for 'Port Status' (On), 'Bandwidth' (100 Mbps), 'Duplex' (Half Duplex), 'MAC Address' (00D0.582C.E1B7), and 'IP Configuration' (Static, IPv4 Address: 172.16.10.20, Subnet Mask: 255.255.255.0). Both screenshots also show a sidebar with options like Physical, Config, Desktop, Programming, and Attributes.



## PC configurations: Assign IP addresses for 30 Finance Analyst PCs (172.16.10.70 – 99)

**PC50**

Physical Config Desktop Programming Attributes

**GLOBAL**  
Settings  
Algorithm Settings  
**INTERFACE**  
FastEthernet0  
Bluetooth

**FastEthernet0**

Port Status: On  
Bandwidth: 100 Mbps  
Duplex: Half Duplex

MAC Address: 0060.2F63.B937

IP Configuration:  
Static (selected)  
IPv4 Address: 172.16.10.70  
Subnet Mask: 255.255.255.0

IPv6 Configuration:  
Static (selected)  
IPv6 Address: FE80::260:2FFF:FE63:B937  
Link Local Address: FE80::260:2FFF:FE63:B937

Top

**PC79**

Physical Config Desktop Programming Attributes

**GLOBAL**  
Settings  
Algorithm Settings  
**INTERFACE**  
FastEthernet0  
Bluetooth

**FastEthernet0**

Port Status: On  
Bandwidth: 100 Mbps  
Duplex: Full Duplex

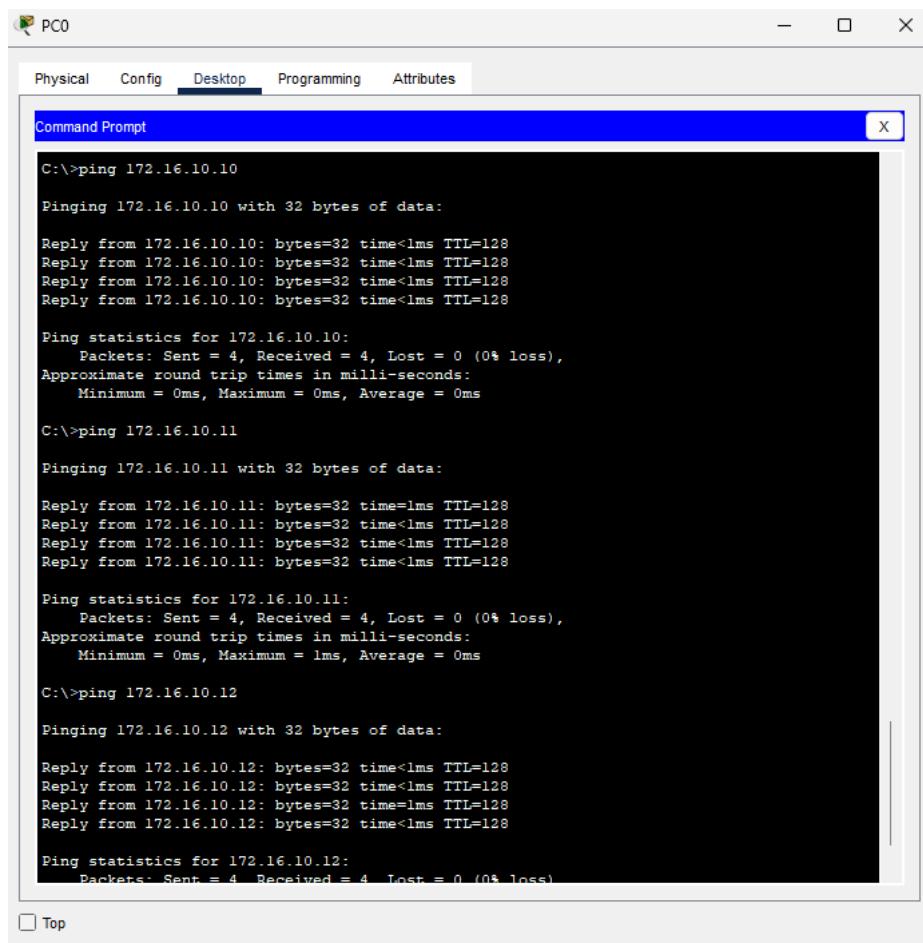
MAC Address: 0060.47E1.1ED8

IP Configuration:  
Static (selected)  
IPv4 Address: 172.16.10.99  
Subnet Mask: 255.255.255.0

IPv6 Configuration:  
Static (selected)  
IPv6 Address: FE80::260:47FF:FE61:1ED8  
Link Local Address: FE80::260:47FF:FE61:1ED8

Top

## Test connections: Ping the servers from the PCs



PC0

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ping 172.16.10.10
Pinging 172.16.10.10 with 32 bytes of data:
Reply from 172.16.10.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

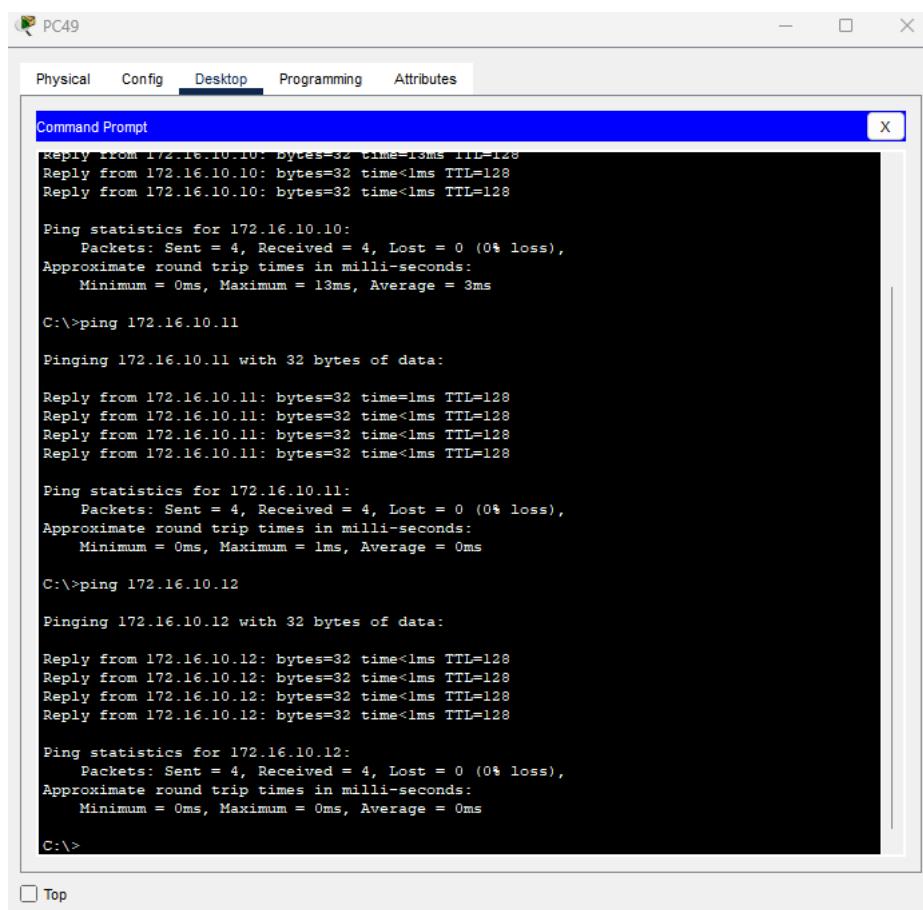
C:\>ping 172.16.10.11
Pinging 172.16.10.11 with 32 bytes of data:
Reply from 172.16.10.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.10.12
Pinging 172.16.10.12 with 32 bytes of data:
Reply from 172.16.10.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss)
```

Top



PC49

Physical Config Desktop Programming Attributes

Command Prompt

```
Reply from 172.16.10.10: bytes=32 time=13ms TTL=128
Reply from 172.16.10.10: bytes=32 time<1ms TTL=128
Reply from 172.16.10.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 13ms, Average = 3ms

C:\>ping 172.16.10.11
Pinging 172.16.10.11 with 32 bytes of data:
Reply from 172.16.10.11: bytes=32 time=<1ms TTL=128
Reply from 172.16.10.11: bytes=32 time<1ms TTL=128
Reply from 172.16.10.11: bytes=32 time<1ms TTL=128
Reply from 172.16.10.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.10.12
Pinging 172.16.10.12 with 32 bytes of data:
Reply from 172.16.10.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Top

PC50

Physical Config Desktop Programming Attributes

Command Prompt X

```
C:\>ping 172.16.10.10
Pinging 172.16.10.10 with 32 bytes of data:
Reply from 172.16.10.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.10.11
Pinging 172.16.10.11 with 32 bytes of data:
Reply from 172.16.10.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.10.12
Pinging 172.16.10.12 with 32 bytes of data:
Reply from 172.16.10.12: bytes=32 time<1ms TTL=128
Reply from 172.16.10.12: bytes=32 time<1ms TTL=128
Reply from 172.16.10.12: bytes=32 time<1ms TTL=128
Reply from 172.16.10.12: bytes=32 time=6ms TTL=128

Ping statistics for 172.16.10.12:
    Packets: Sent = 4 Received = 4 Lost = 0 (0% loss)
```

Top

PC79

Physical Config Desktop Programming Attributes

Command Prompt X

```
Microsoft Windows [Version 10.0]
C:\>ping 172.16.10.10
Pinging 172.16.10.10 with 32 bytes of data:
Reply from 172.16.10.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.10.11
Pinging 172.16.10.11 with 32 bytes of data:
Reply from 172.16.10.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.10.12
Pinging 172.16.10.12 with 32 bytes of data:
Reply from 172.16.10.12: bytes=32 time<1ms TTL=128
Reply from 172.16.10.12: bytes=32 time<1ms TTL=128
Reply from 172.16.10.12: bytes=32 time=11ms TTL=128
Reply from 172.16.10.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.12:
    Packets: Sent = 4 Received = 4 Lost = 0 (0% loss)
```

Top

## Configure Core Router Subinterfaces for VLAN 10 and verify the configuration.

The screenshot shows the Cisco IOS Command Line Interface (CLI) running on a device named 'Router0'. The window title is 'Router0'. The tabs at the top are 'Physical', 'Config', 'CLI' (which is selected), and 'Attributes'. The main pane displays the following command session:

```
Router#ping 172.16.10.20
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.20, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)

Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0.10
Router(config-subif)#encapsulation dot1Q 10
Router(config-subif)#ip address 172.16.10.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#end
Router#
*SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface          IP-Address      OK? Method Status        Protocol
GigabitEthernet0/0/0 unassigned    YES manual up           up
GigabitEthernet0/0/0.10 172.16.10.1 YES manual up           up
GigabitEthernet0/0/0.20 172.16.20.1 YES manual up           up
GigabitEthernet0/0/0.30 172.16.30.1 YES manual up           up
GigabitEthernet0/0/0.40 172.16.40.1 YES manual up           up
GigabitEthernet0/0/0.50 172.16.50.1 YES manual up           up
GigabitEthernet0/0/1 unassigned    YES unset administratively down down
GigabitEthernet0/0/2 unassigned    YES unset administratively down down
Vlan1              unassigned    YES unset administratively down down
Router#ping 172.16.10.20
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.20, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/3/18 ms

Router#
```

At the bottom right of the CLI window are 'Copy' and 'Paste' buttons. Below the window is a small checkbox labeled 'Top'.

Test the connections of the Accountant and Financial Analyst PCs to the Default Gateway (172.16.10.1)

The screenshot shows a Microsoft Windows Command Prompt window titled 'PC0'. The tabs at the top are 'Physical', 'Config', 'Desktop' (which is selected), 'Programming', and 'Attributes'. The main pane displays the following command session:

```
Command Prompt
Reply from 172.16.10.11: bytes=32 time=1ms TTL=128
Reply from 172.16.10.11: bytes=32 time<1ms TTL=128
Reply from 172.16.10.11: bytes=32 time=1ms TTL=128
Reply from 172.16.10.11: bytes=32 time=12ms TTL=128

Ping statistics for 172.16.10.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>ping 172.16.10.12

Pinging 172.16.10.12 with 32 bytes of data:

Reply from 172.16.10.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.10.1

Pinging 172.16.10.1 with 32 bytes of data:

Reply from 172.16.10.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.16.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

## Step 3: Distribution Switch, Access Switches, Servers, and PCs Setup and Configuration (Marketing Department)

Distribution Switch configuration: Add a VLAN, assign ports to VLAN 20, and set the trunk link to the Core Switch and Access Switches

The screenshot shows the CLI interface for the Marketing Distribution Switch. The user has navigated to the configuration mode and created a new VLAN named 'MARKETING'. They then assigned specific ports to this VLAN and configured a range of ports as trunk links. The terminal window displays the command history and some log messages related to interface states.

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 20
Switch(config-vlan)#name MARKETING
Switch(config-vlan)#exit
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
Switch(config-if)#exit
Switch(config)#interface range FastEthernet0/1 - 2
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 20
Switch(config-if-range)#exit
Switch(config)#interface range FastEthernet 0/3 - 6
Switch(config-if-range)#switchport mode trunk

Switch(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to up
exit
```

Copy      Paste

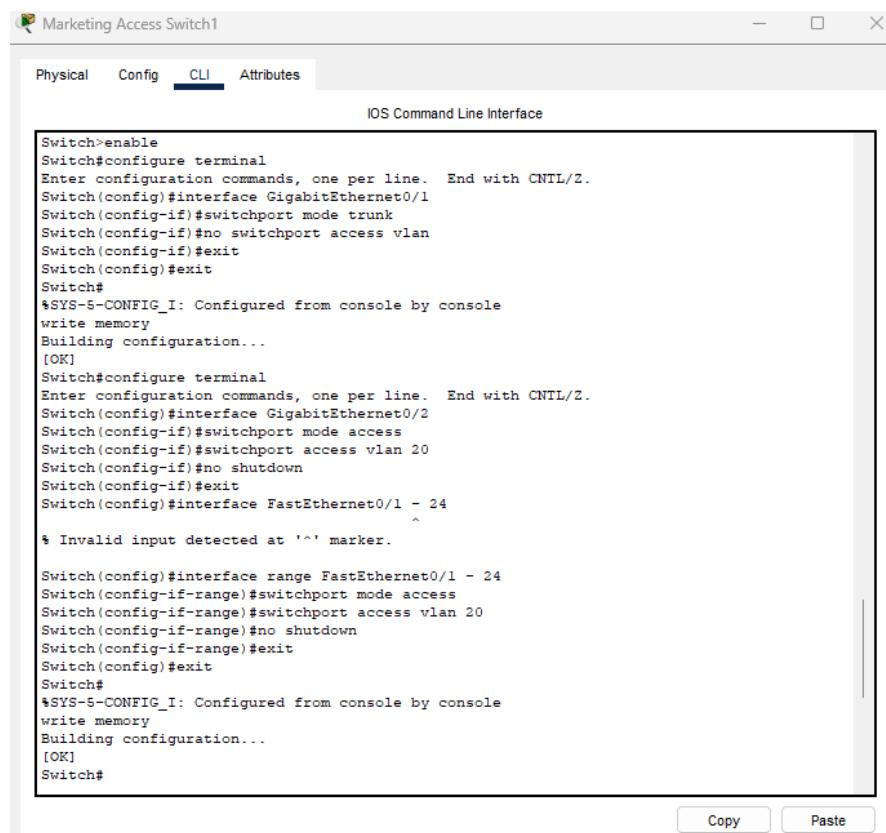
The screenshot shows the final configuration steps on the Marketing Distribution Switch. The user exits configuration mode, saves the changes, and exits the terminal session. The terminal window displays the command history and log messages indicating the successful execution of the configuration commands.

```
Switch(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to up
exit
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
exit
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

Copy      Paste

## Marketing Access Switch1, Switch2, and Switch3 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs



Marketing Access Switch1

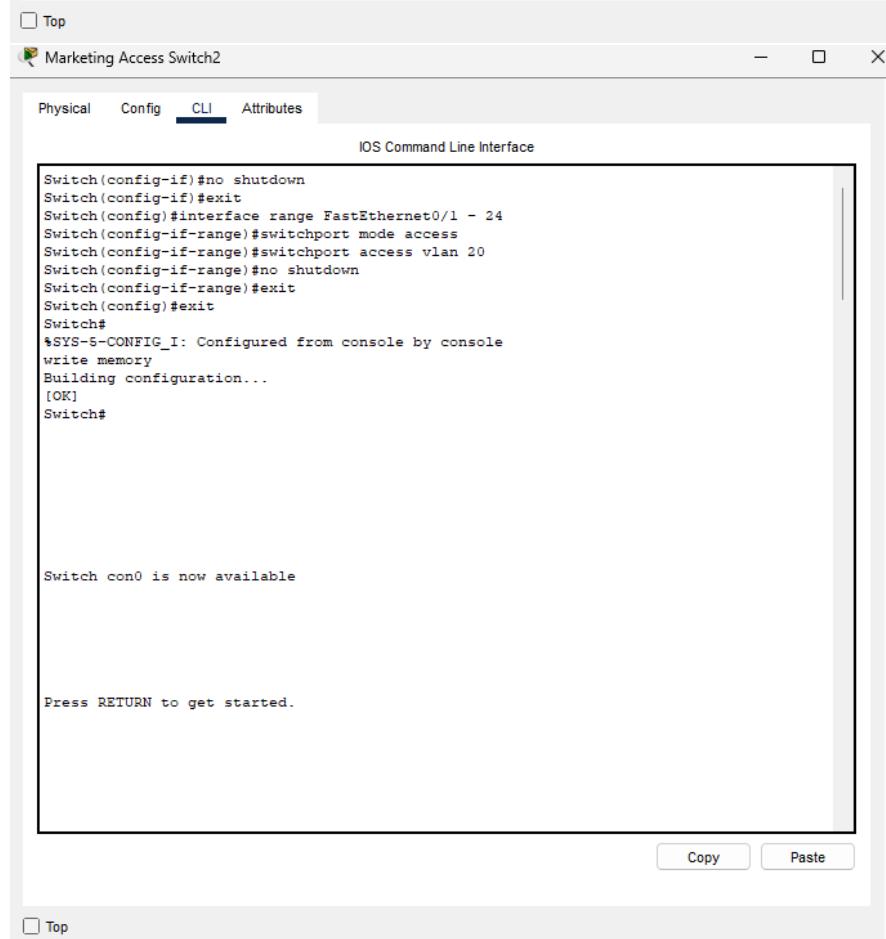
Physical Config CLI Attributes

IOS Command Line Interface

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface FastEthernet0/1 - 24
^
* Invalid input detected at '^' marker.

Switch(config)#interface range FastEthernet0/1 - 24
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 20
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

Copy Paste



Marketing Access Switch2

Physical Config CLI Attributes

IOS Command Line Interface

```
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface range FastEthernet0/1 - 24
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 20
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
Switch con0 is now available

Press RETURN to get started.
```

Copy Paste

Marketing Access Switch3

Physical Config **CLI** Attributes

IOS Command Line Interface

```

Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
% Access VLAN does not exist. Creating vlan 20
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface range FastEthernet0/1 - 9
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 20
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#

```

Top

**Copy** **Paste**

Graphic Design Access Switch1 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs

Graphic Design Access Switch1

Physical Config **CLI** Attributes

IOS Command Line Interface

```

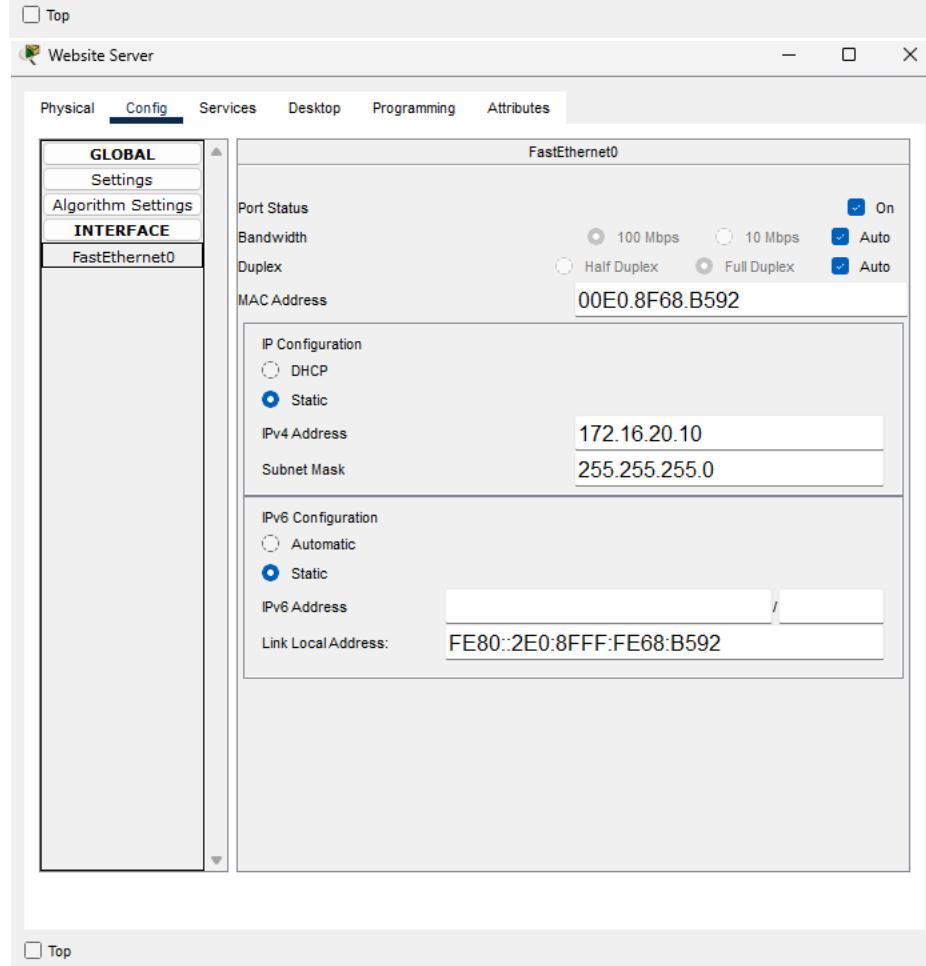
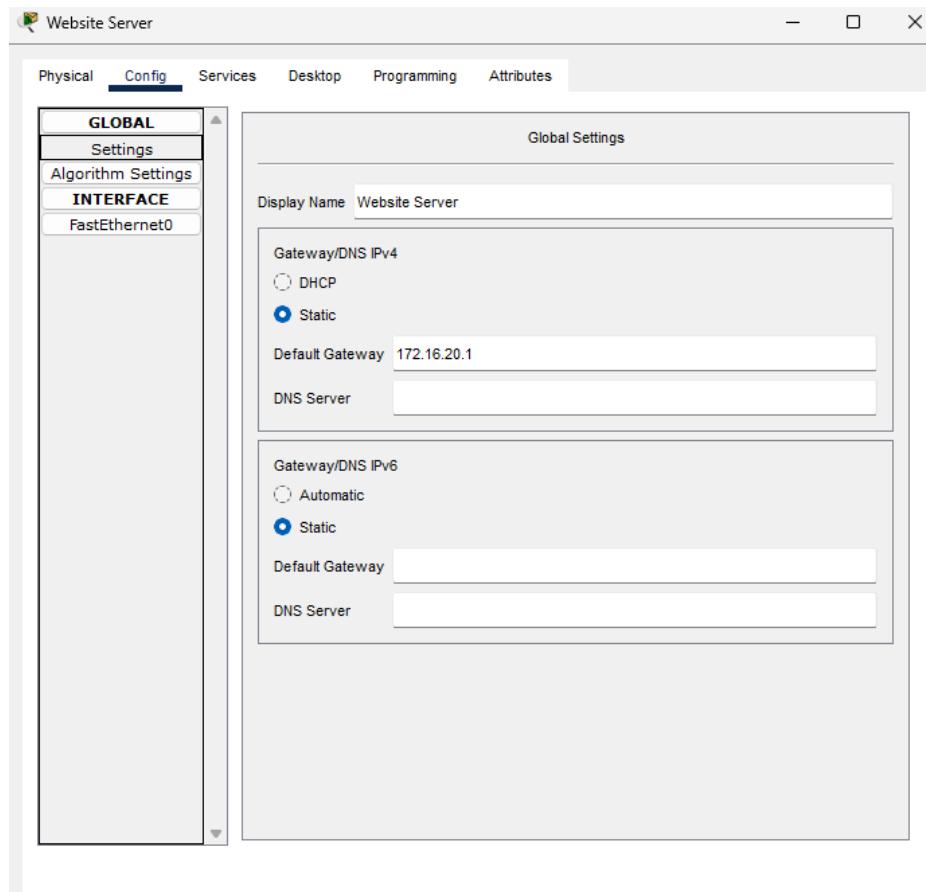
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
% Access VLAN does not exist. Creating vlan 20
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 20
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#

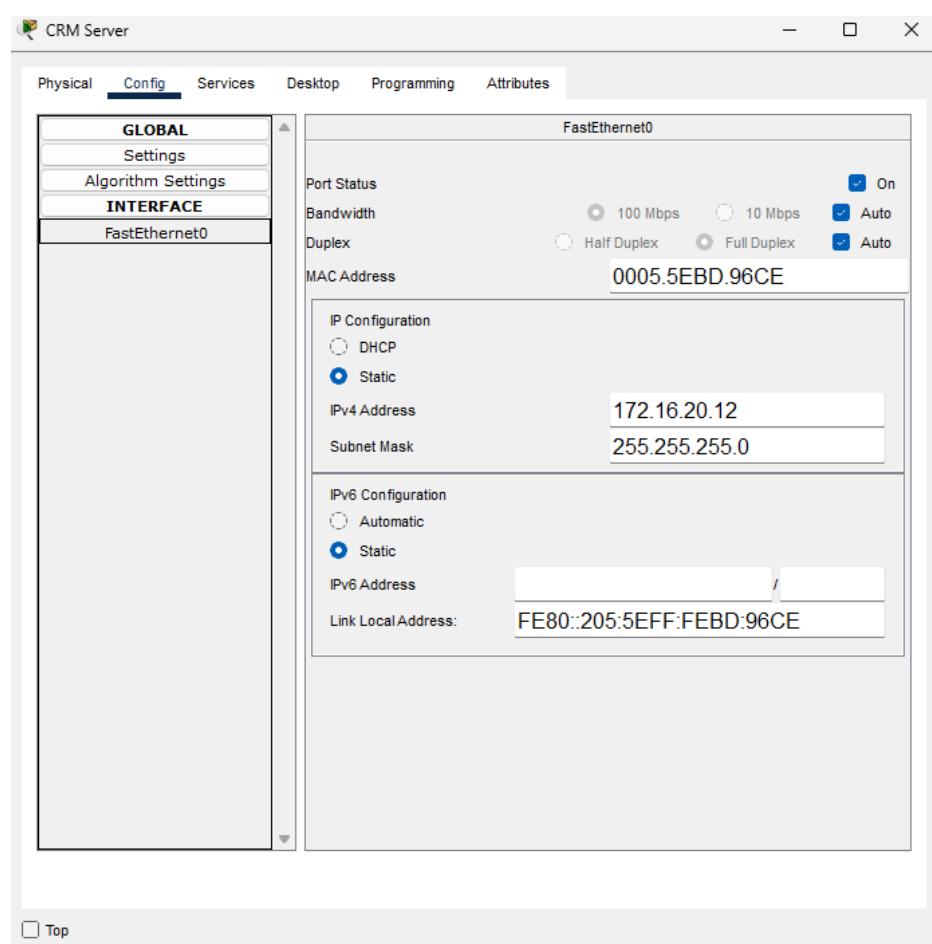
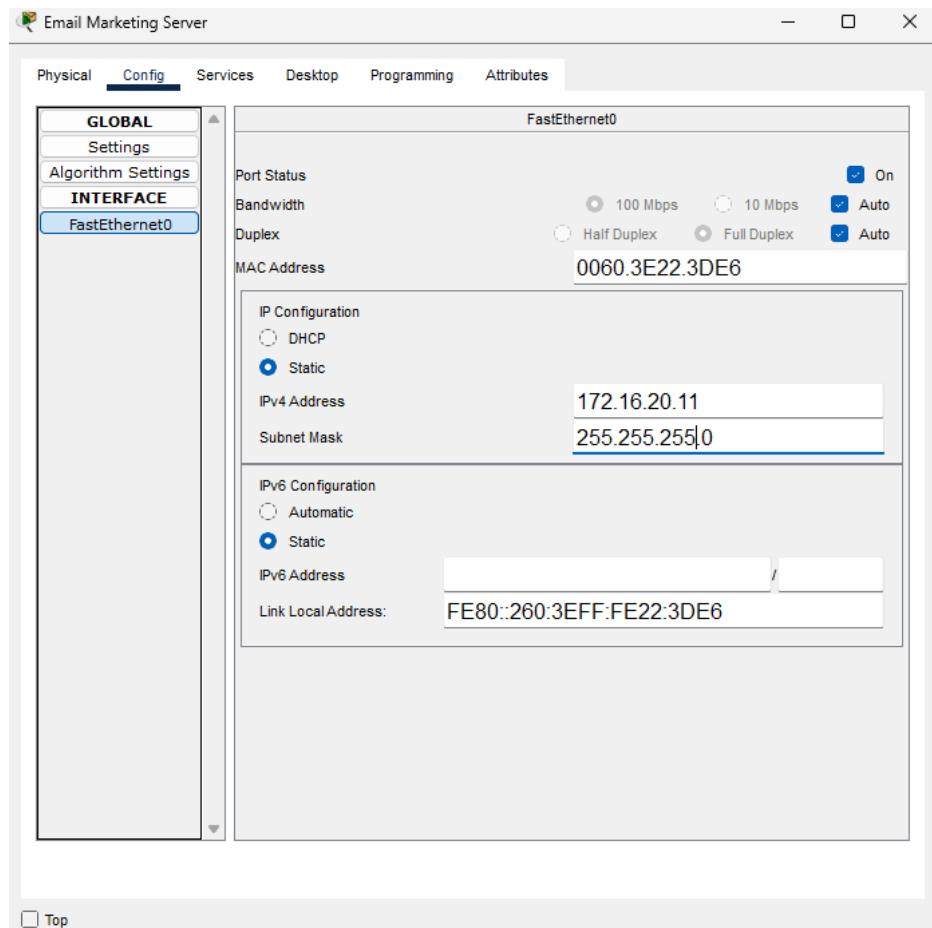
```

Top

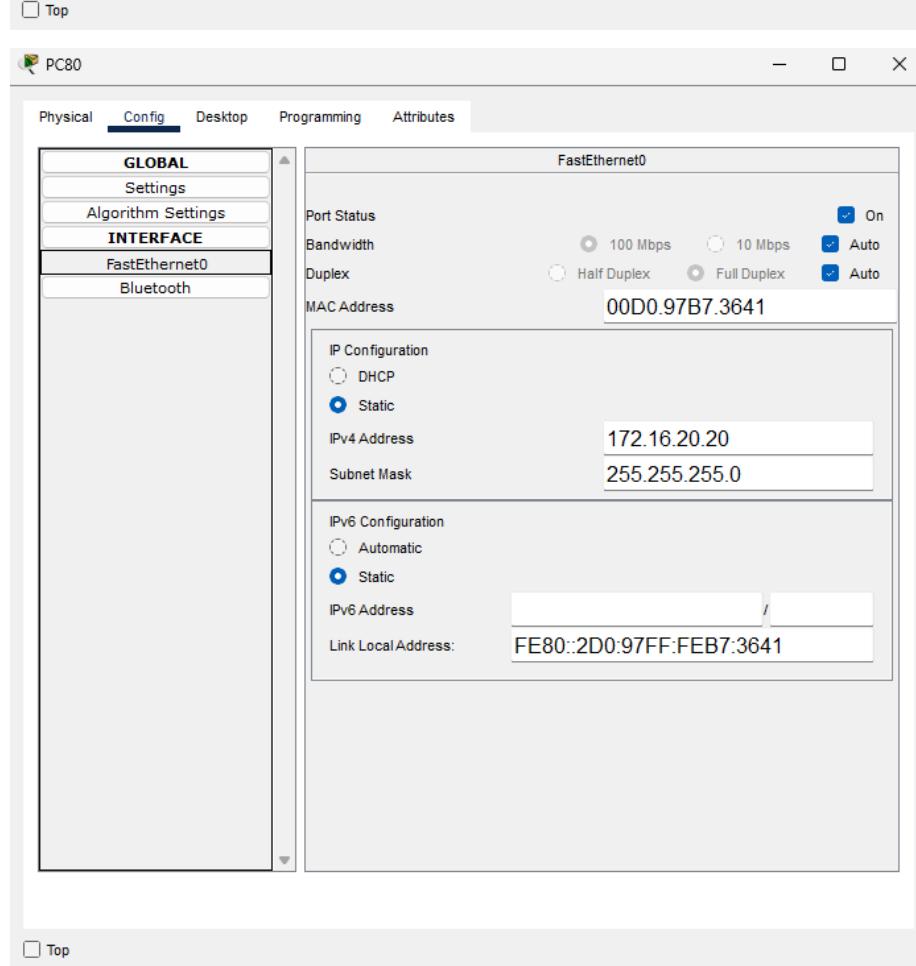
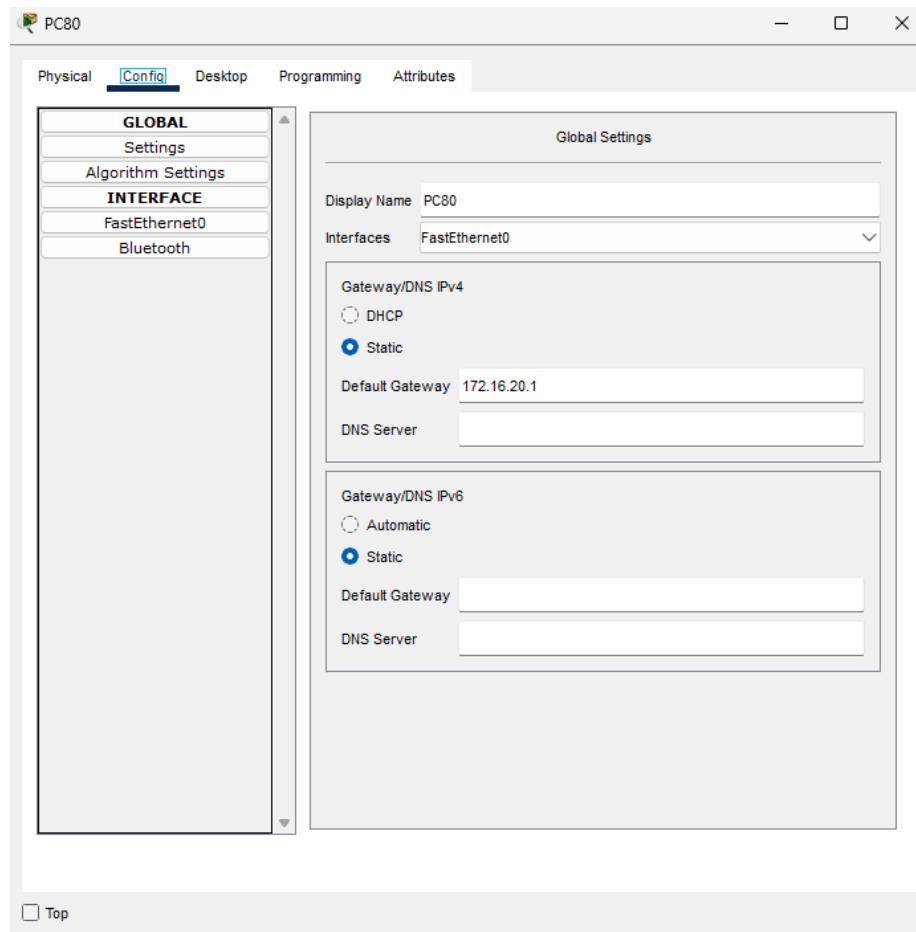
**Copy** **Paste**

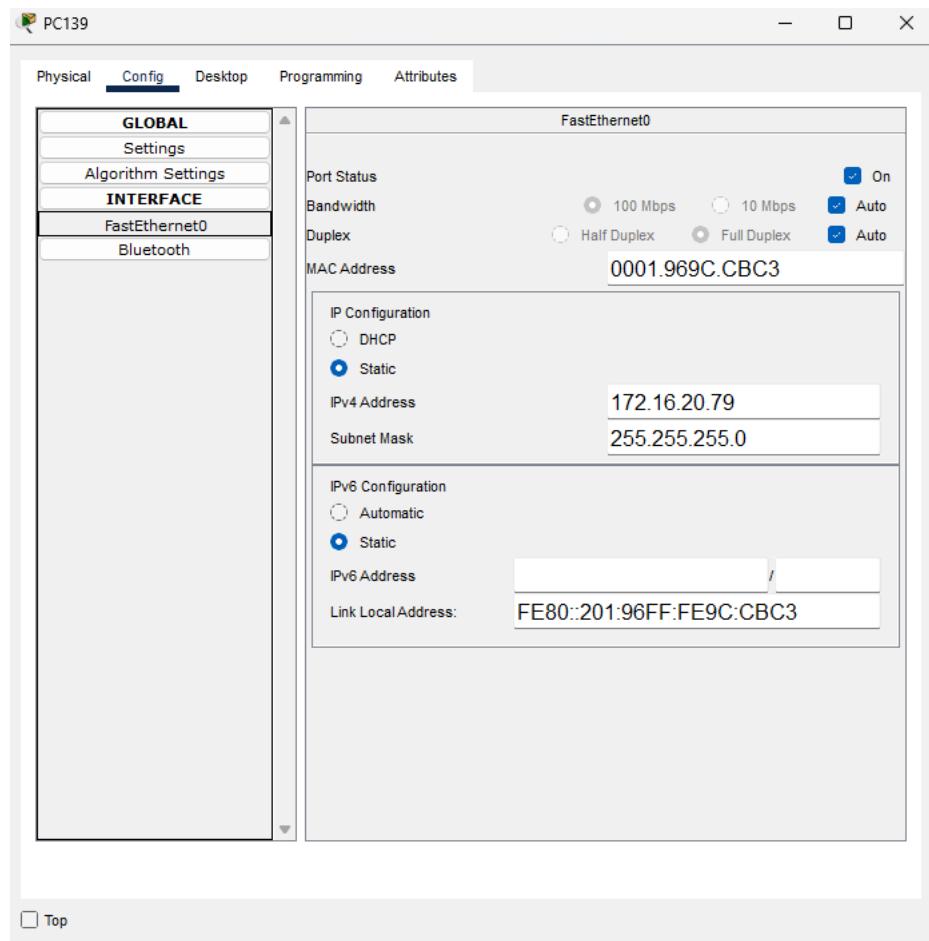
## Server configuration: Assign IP addresses to the Website, Email Marketing, and CRM Server



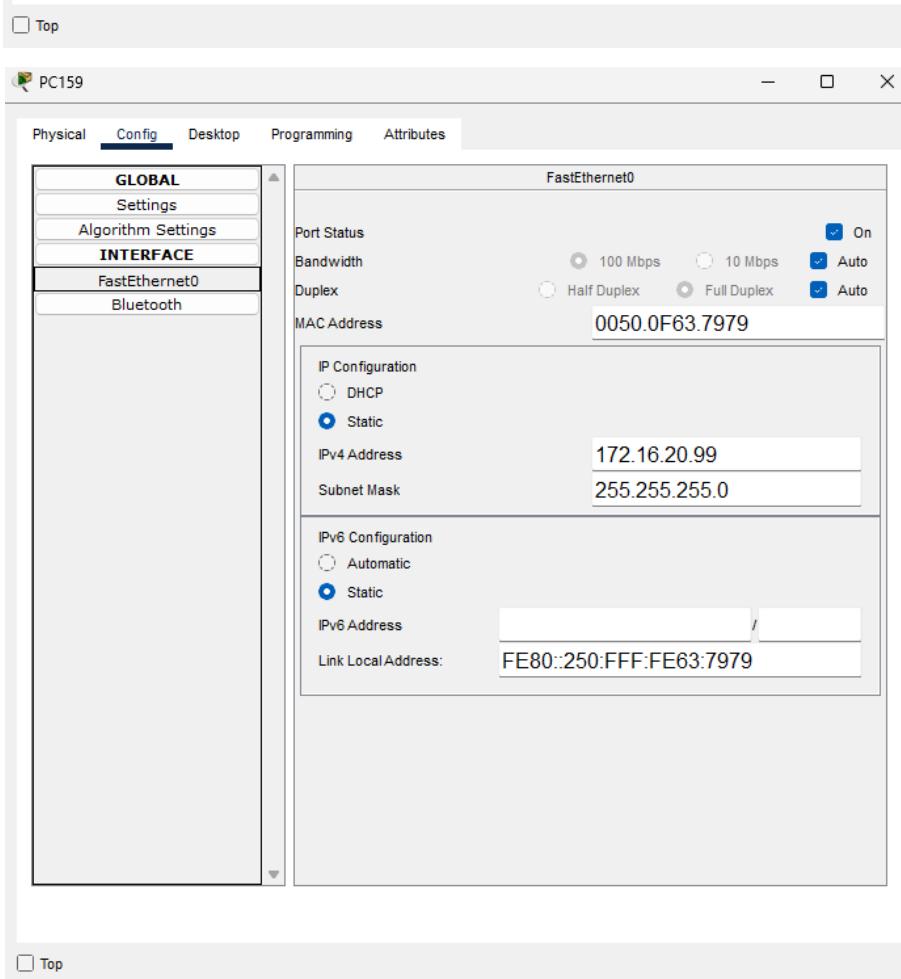
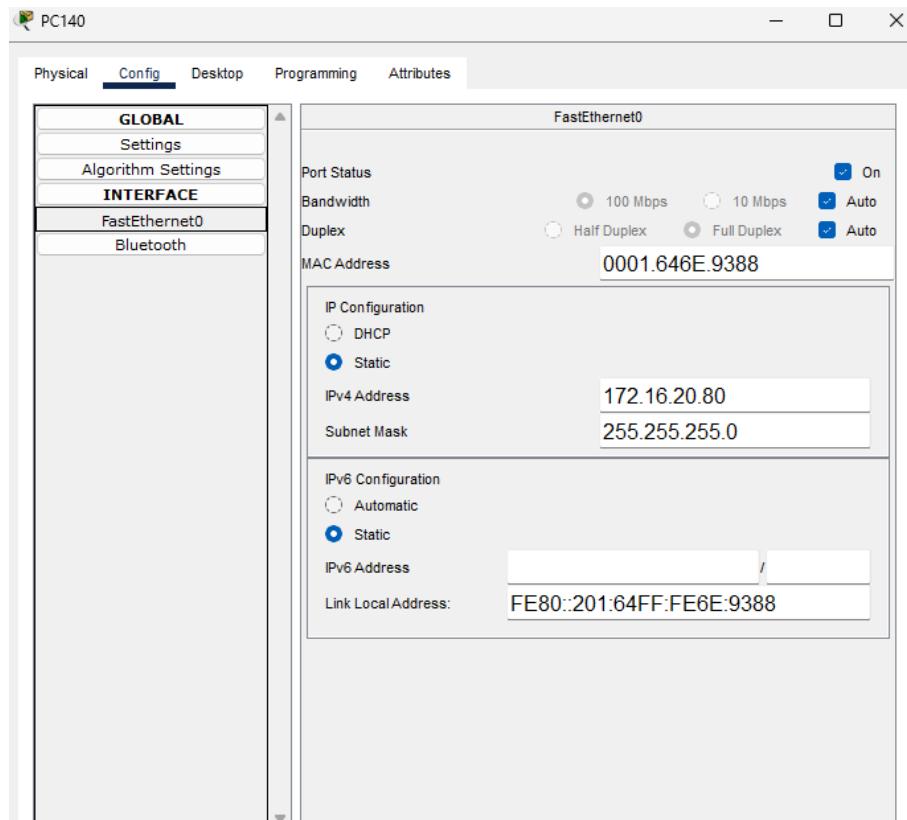


## PC configurations: Assign IP addresses for 60 Marketer PCs (172.16.20.20 – 79)

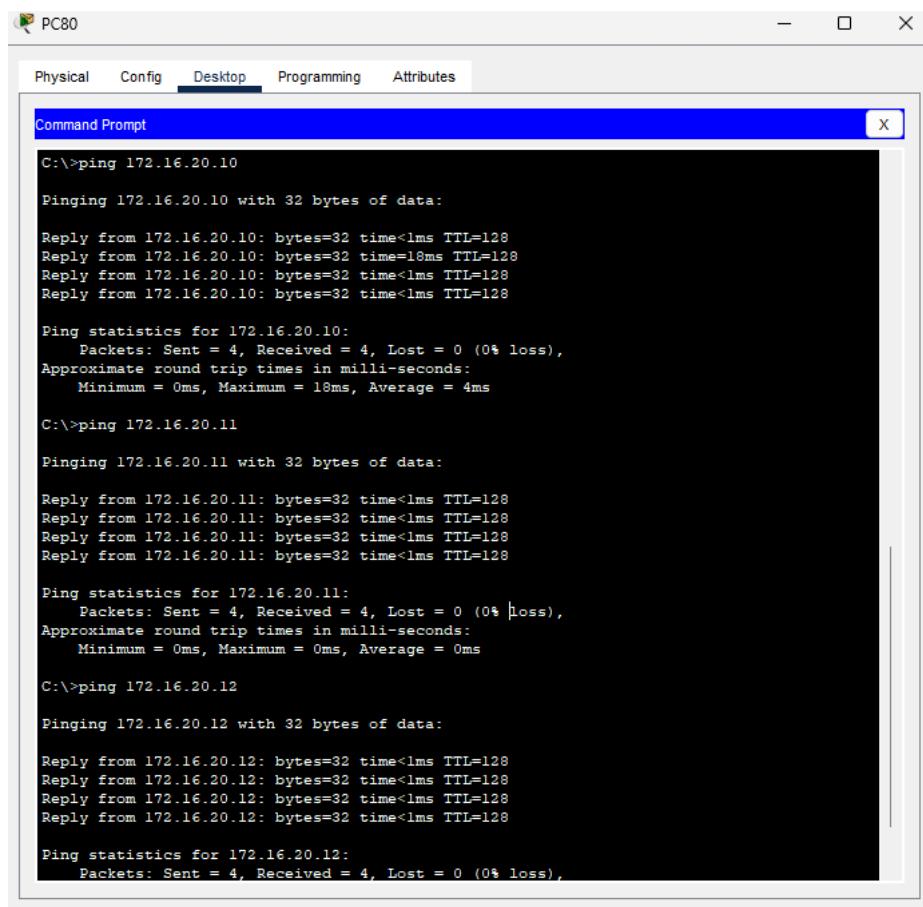




## PC configurations: Assign IP addresses for 20 Graphic Designer PCs (172.16.20.80 – 99)



## Test connections: Ping the servers from the PCs



PC80

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ping 172.16.20.10

Pinging 172.16.20.10 with 32 bytes of data:

Reply from 172.16.20.10: bytes=32 time<1ms TTL=128
Reply from 172.16.20.10: bytes=32 time=18ms TTL=128
Reply from 172.16.20.10: bytes=32 time<1ms TTL=128
Reply from 172.16.20.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 18ms, Average = 4ms

C:\>ping 172.16.20.11

Pinging 172.16.20.11 with 32 bytes of data:

Reply from 172.16.20.11: bytes=32 time<1ms TTL=128

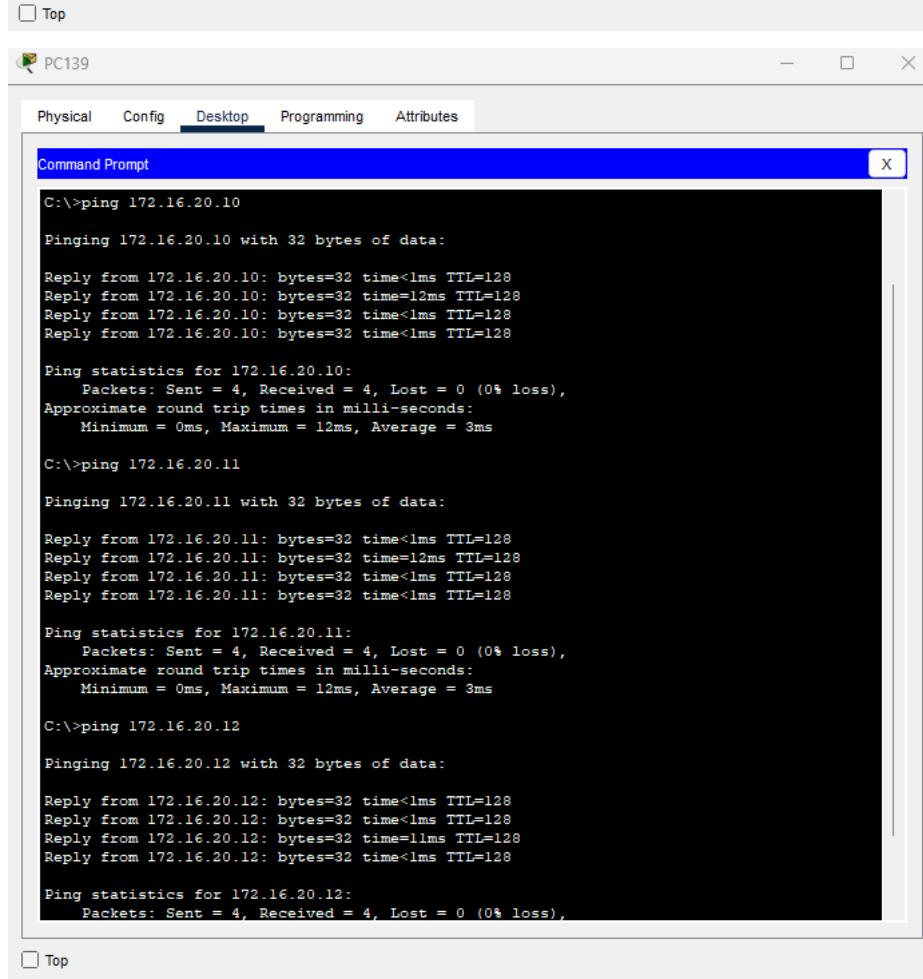
Ping statistics for 172.16.20.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.20.12

Pinging 172.16.20.12 with 32 bytes of data:

Reply from 172.16.20.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```



PC139

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ping 172.16.20.10

Pinging 172.16.20.10 with 32 bytes of data:

Reply from 172.16.20.10: bytes=32 time<1ms TTL=128
Reply from 172.16.20.10: bytes=32 time=12ms TTL=128
Reply from 172.16.20.10: bytes=32 time<1ms TTL=128
Reply from 172.16.20.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>ping 172.16.20.11

Pinging 172.16.20.11 with 32 bytes of data:

Reply from 172.16.20.11: bytes=32 time<1ms TTL=128
Reply from 172.16.20.11: bytes=32 time=12ms TTL=128
Reply from 172.16.20.11: bytes=32 time<1ms TTL=128
Reply from 172.16.20.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>ping 172.16.20.12

Pinging 172.16.20.12 with 32 bytes of data:

Reply from 172.16.20.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

PC140

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ping 172.16.20.10
Pinging 172.16.20.10 with 32 bytes of data:
Reply from 172.16.20.10: bytes=32 time<1ms TTL=128
Reply from 172.16.20.10: bytes=32 time=18ms TTL=128
Reply from 172.16.20.10: bytes=32 time<1ms TTL=128
Reply from 172.16.20.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 18ms, Average = 4ms

C:\>ping 172.16.20.11
Pinging 172.16.20.11 with 32 bytes of data:
Reply from 172.16.20.11: bytes=32 time<1ms TTL=128
Reply from 172.16.20.11: bytes=32 time=1ms TTL=128
Reply from 172.16.20.11: bytes=32 time=20ms TTL=128
Reply from 172.16.20.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 20ms, Average = 5ms

C:\>ping 172.16.20.12
Pinging 172.16.20.12 with 32 bytes of data:
Reply from 172.16.20.12: bytes=32 time<1ms TTL=128
Reply from 172.16.20.12: bytes=32 time=19ms TTL=128
Reply from 172.16.20.12: bytes=32 time=17ms TTL=128
Reply from 172.16.20.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

PC159

Physical Config Desktop Programming Attributes

Command Prompt

```
Microsoft Windows [Version 10.0.19041]
Copyright (c) 2020 Microsoft Corporation. All rights reserved.

C:\>ping 172.16.20.10
Pinging 172.16.20.10 with 32 bytes of data:
Reply from 172.16.20.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.20.11
Pinging 172.16.20.11 with 32 bytes of data:
Reply from 172.16.20.11: bytes=32 time=1ms TTL=128
Reply from 172.16.20.11: bytes=32 time=13ms TTL=128
Reply from 172.16.20.11: bytes=32 time=1ms TTL=128
Reply from 172.16.20.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 13ms, Average = 3ms

C:\>ping 172.16.20.12
Pinging 172.16.20.12 with 32 bytes of data:
Reply from 172.16.20.12: bytes=32 time=1ms TTL=128
Reply from 172.16.20.12: bytes=32 time=1ms TTL=128
Reply from 172.16.20.12: bytes=32 time<1ms TTL=128
Reply from 172.16.20.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

## Configure Core Router Subinterfaces for VLAN 20 and verify the configuration.

The screenshot shows a Windows Command Prompt window titled "Router0". The tab bar at the top has "Physical", "Config", "CLI" (which is selected), and "Attributes". The main area displays the IOS Command Line Interface (CLI) output:

```
Vlan1      unassigned    YES unset  administratively down down
Router#ping 172.16.10.20
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.20, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/3/18 ms

Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0.20
Router(config-subif)#encapsulation dot1Q 20
Router(config-subif)#ip address 172.16.20.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#end
Router#
*SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0/0  unassigned      YES manual up           up
GigabitEthernet0/0/0.10 172.16.10.1  YES manual up           up
GigabitEthernet0/0/0.20 172.16.20.1  YES manual up           up
GigabitEthernet0/0/0.30 172.16.30.1  YES manual up           up
GigabitEthernet0/0/0.40 172.16.40.1  YES manual up           up
GigabitEthernet0/0/0.50 172.16.50.1  YES manual up           up
GigabitEthernet0/0/1    unassigned      YES unset  administratively down down
GigabitEthernet0/0/2    unassigned      YES unset  administratively down down
Vlan1    unassigned      YES unset  administratively down down
Router#ping 172.16.20.20
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.20, timeout is 2 seconds:
!!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/3/11 ms
Router#
```

At the bottom right of the window are "Copy" and "Paste" buttons. Below the window is a "Top" button.

Test the connections of the Marketer and Graphic Designer PCs to the Default Gateway (172.16.20.1)

The screenshot shows a Windows Command Prompt window titled "PC80". The tab bar at the top has "Physical", "Config", "Desktop" (which is selected), "Programming", and "Attributes". A "Command Prompt" window is open in the foreground, showing the results of a ping test:

```
Reply from 172.16.20.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.20.12

Pinging 172.16.20.12 with 32 bytes of data:

Reply from 172.16.20.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.20.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.20.1

Pinging 172.16.20.1 with 32 bytes of data:

Reply from 172.16.20.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.16.20.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Below the "Command Prompt" window is a "Top" button.

## Step 4: Distribution Switch, Access Switches, Servers, and PCs Setup and Configuration (R&D Department)

Distribution Switch configuration: Add a VLAN, assign ports to VLAN 30, and set the trunk link to the Core Switch and Access Switches

The screenshot shows the 'R&D Distribution Switch' window with the 'CLI' tab selected. The terminal window displays the following IOS Command Line Interface session:

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

Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 30
Switch(config-vlan)#name R&D
Switch(config-vlan)#exit
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 30
Switch(config-if)#exit
Switch(config)#interface range FastEthernet0/1 - 2
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 30
Switch(config-if-range)#exit
Switch(config)#interface range FastEthernet0/3 - 6
Switch(config-if-range)#switchport mode trunk
Switch(config-if-range)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk

Switch(config-if)#
*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down
*LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
exit
Switch(config)#end
Switch#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

At the bottom right of the terminal window are 'Copy' and 'Paste' buttons.

The screenshot shows the 'R&D Distribution Switch' window with the 'CLI' tab selected. The terminal window displays the following message:

Switch con0 is now available

Press RETURN to get started.

At the bottom right of the terminal window are 'Copy' and 'Paste' buttons.

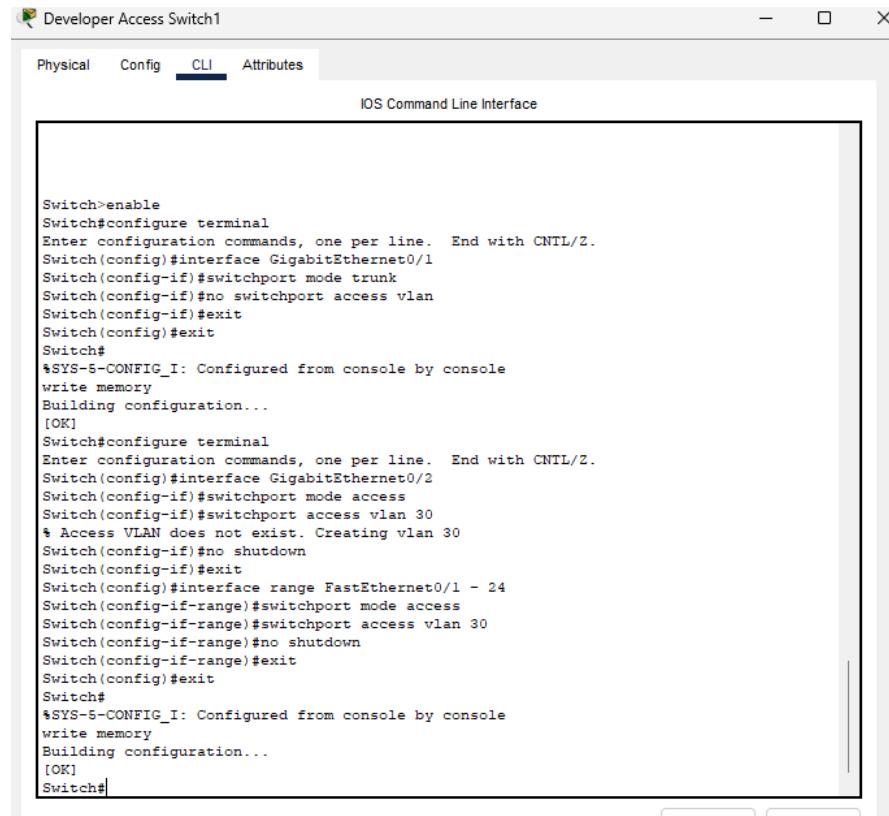
Below the terminal window, there is a message box with the text:

Switch con0 is now available

Press RETURN to get started.

\*LINK-5-CHANGED: Interface FastEthernet0/3, changed state to up
\*LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
\*LINK-5-CHANGED: Interface FastEthernet0/4, changed state to up
\*LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to up
\*LINK-5-CHANGED: Interface FastEthernet0/5, changed state to up
\*LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up

## Developer Access Switch1 and Switch2 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs

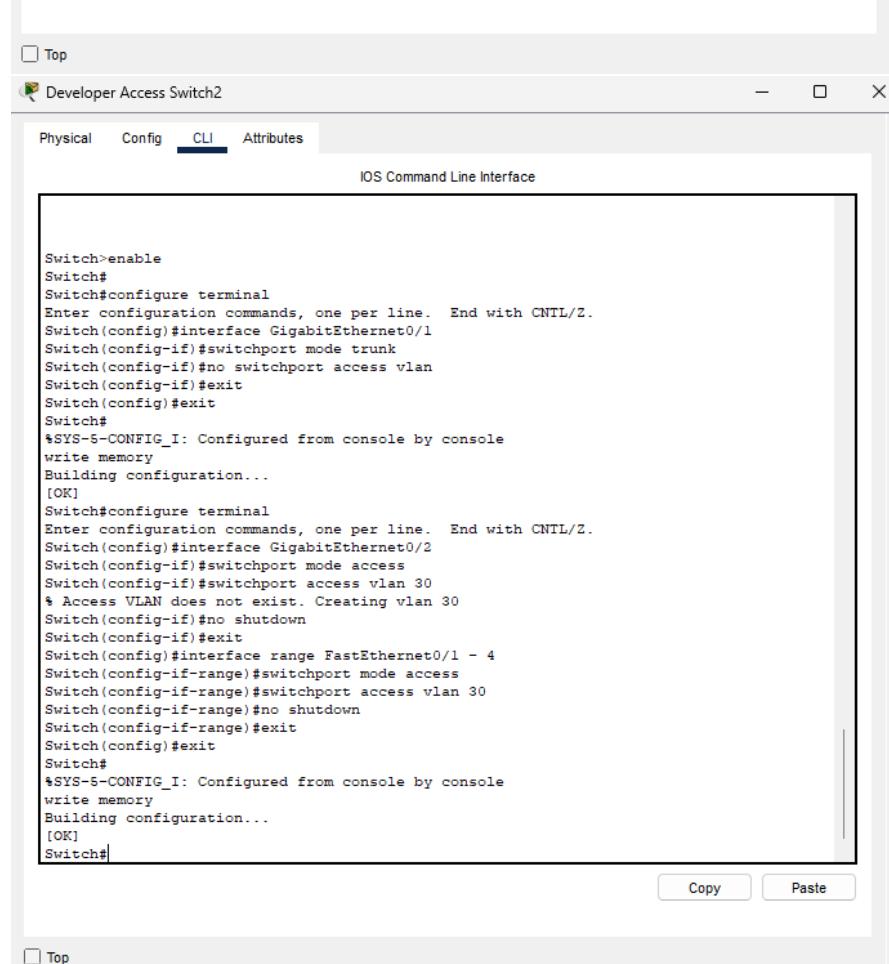


```
Developer Access Switch1
Physical Config CLI Attributes
IOS Command Line Interface

Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 30
% Access VLAN does not exist. Creating vlan 30
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config-if)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

Copy Paste

Top



```
Developer Access Switch2
Physical Config CLI Attributes
IOS Command Line Interface

Switch>enable
Switch#
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 30
% Access VLAN does not exist. Creating vlan 30
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 30
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

Copy Paste

Top

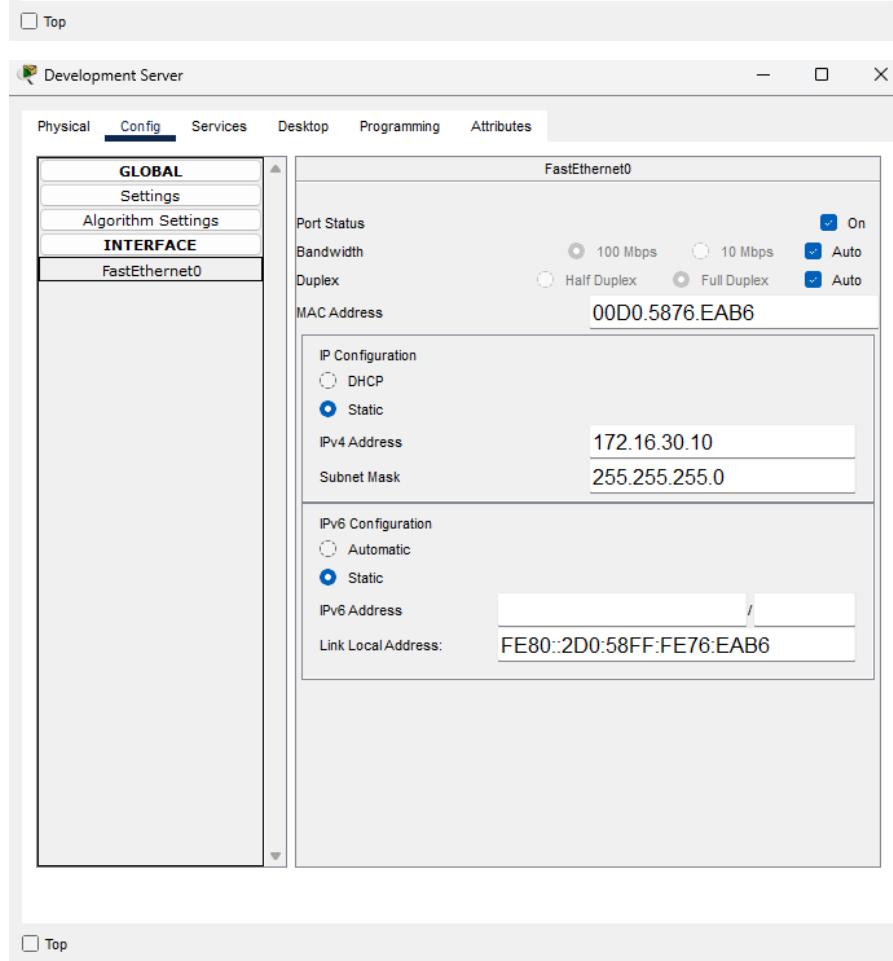
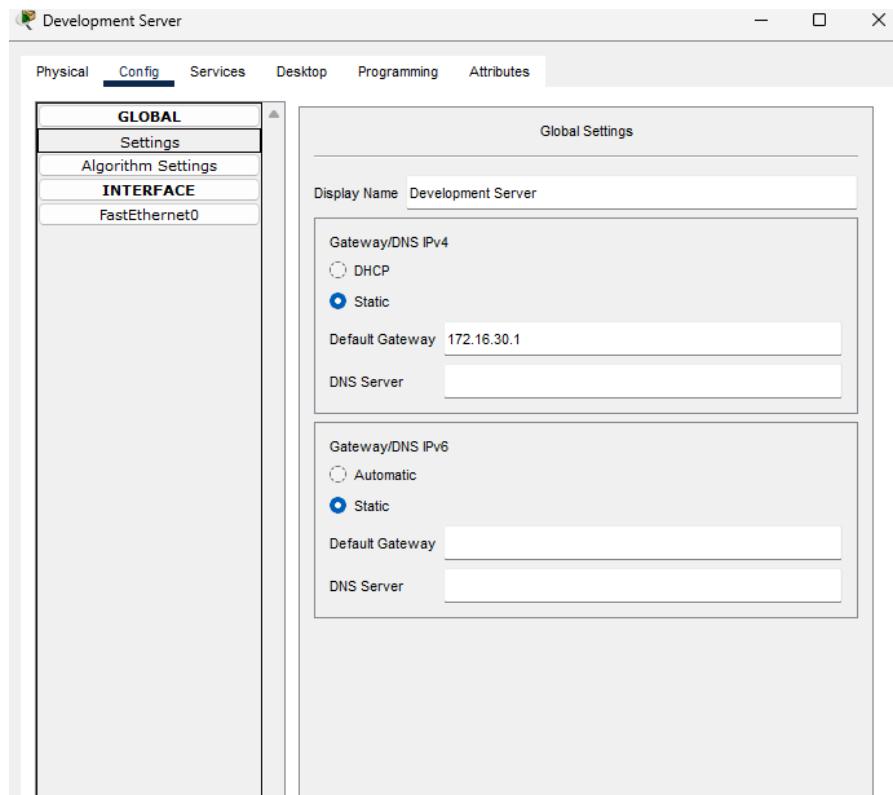
## Engineer & QA Tester Access Switch1 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs

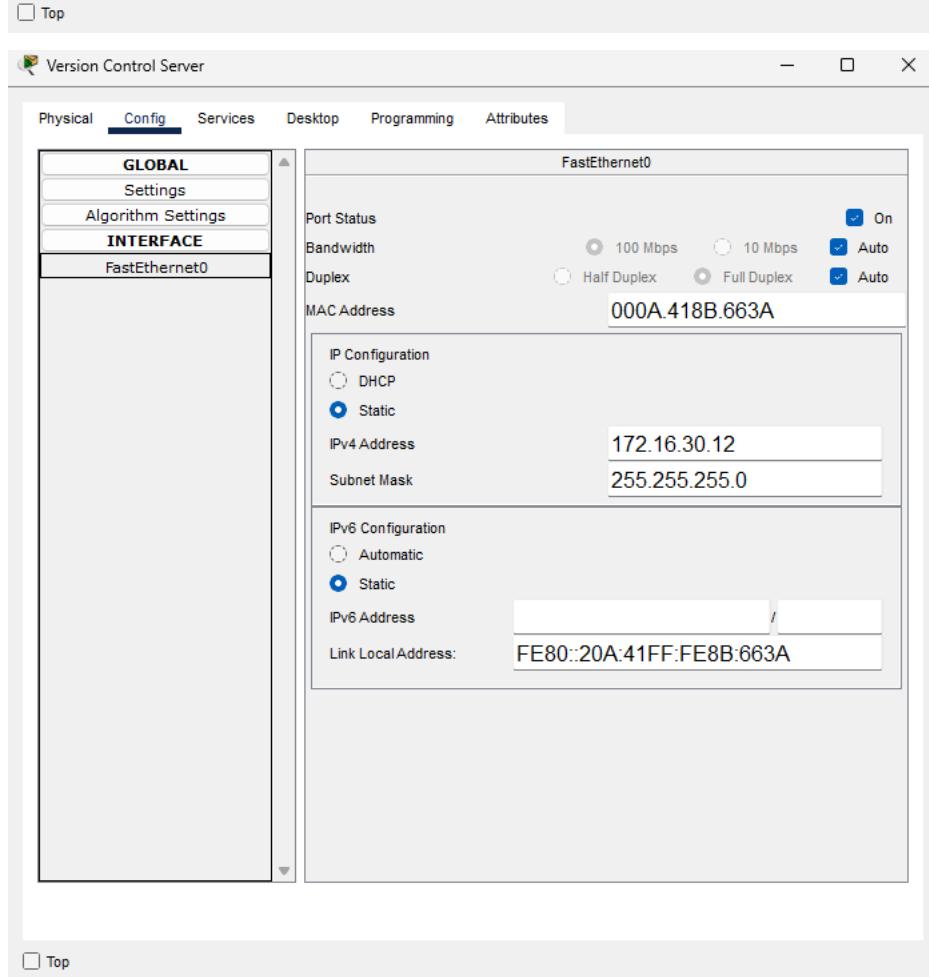
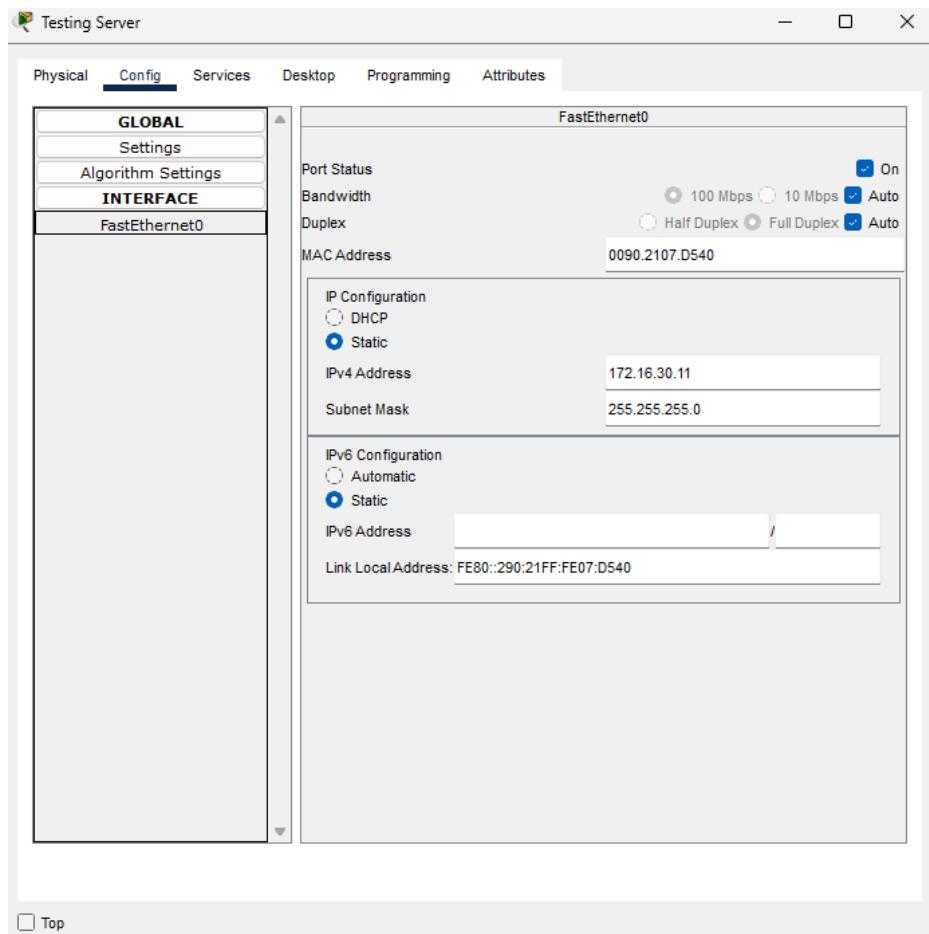
The screenshot shows a window titled "Engineer & QA Tester Access Switch1". The tab bar at the top has "Physical", "Config", "CLI" (which is selected), and "Attributes". Below the tab bar is a header "IOS Command Line Interface". The main area contains the following CLI session output:

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 30
% Access VLAN does not exist. Creating vlan 30
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config-if)#range FastEthernet0/1 - 19
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 30
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

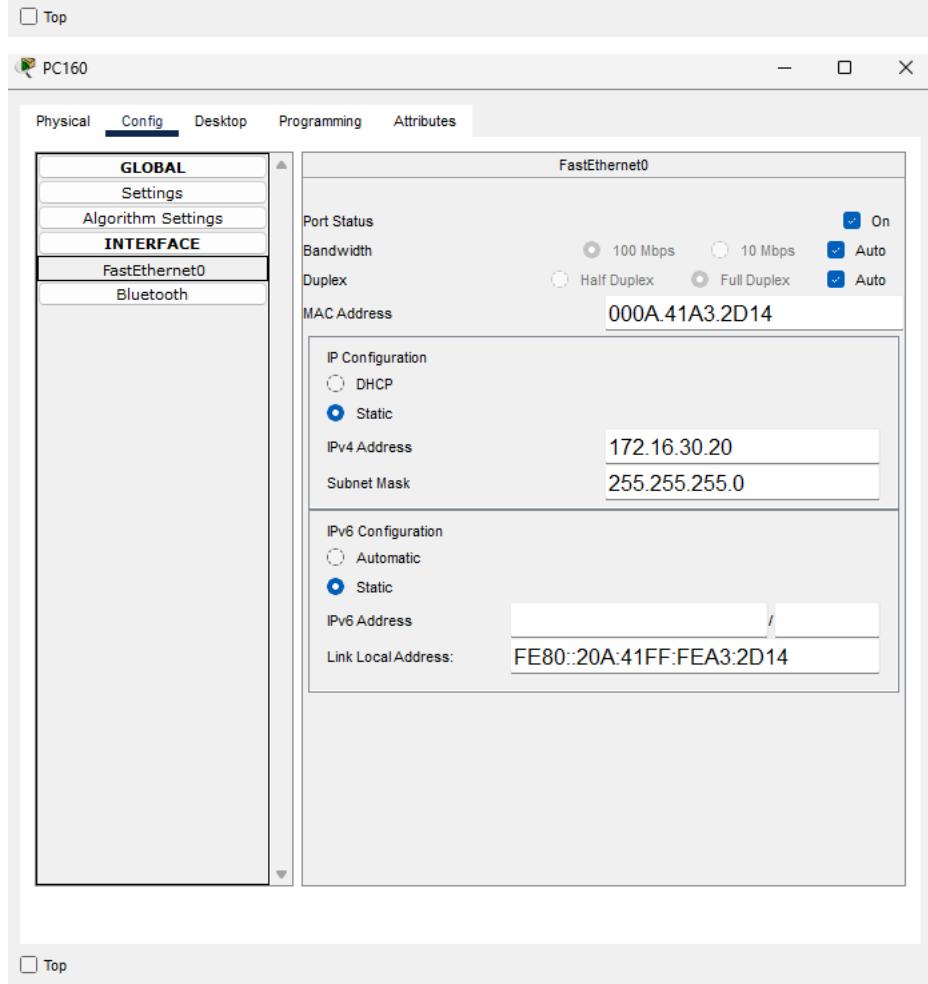
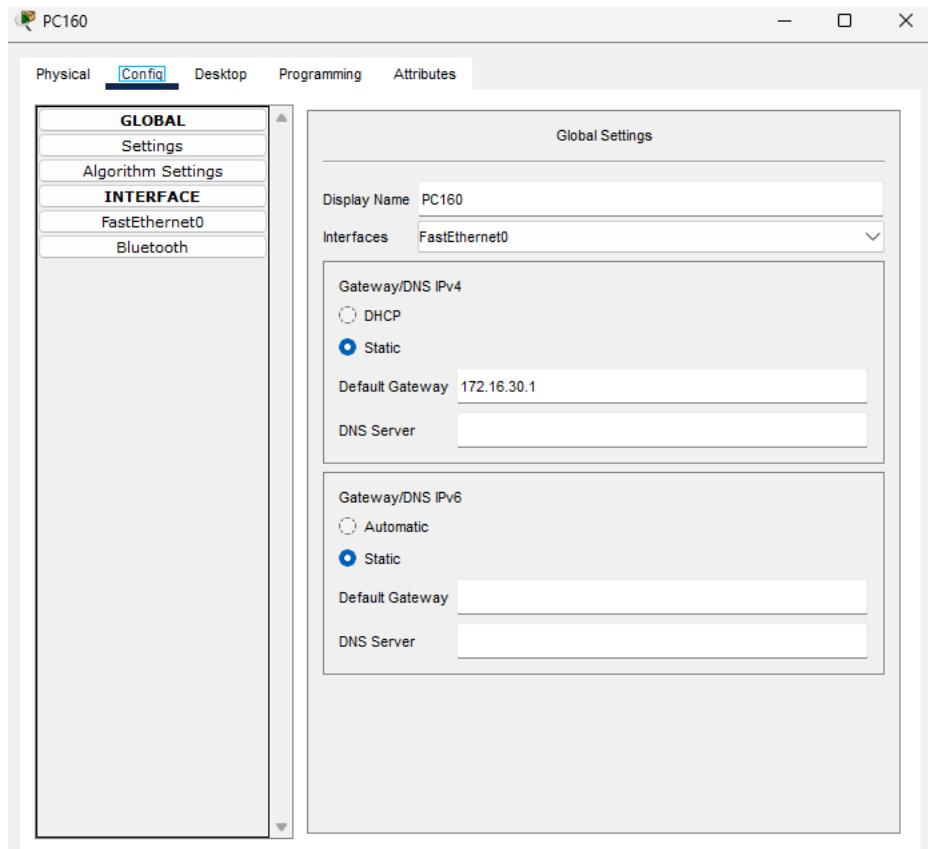
At the bottom right of the main window are "Copy" and "Paste" buttons. At the bottom left is a "Top" button.

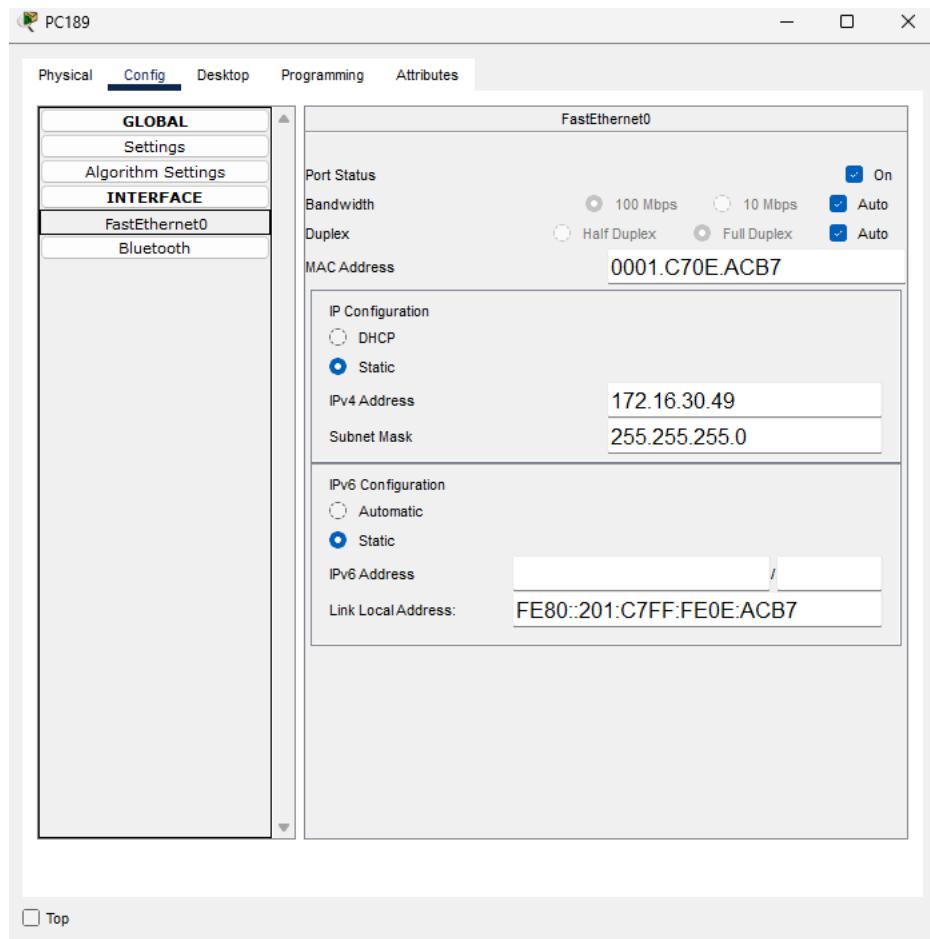
## Server configuration: Assign IP addresses to the Development, Testing, and Version Control Server



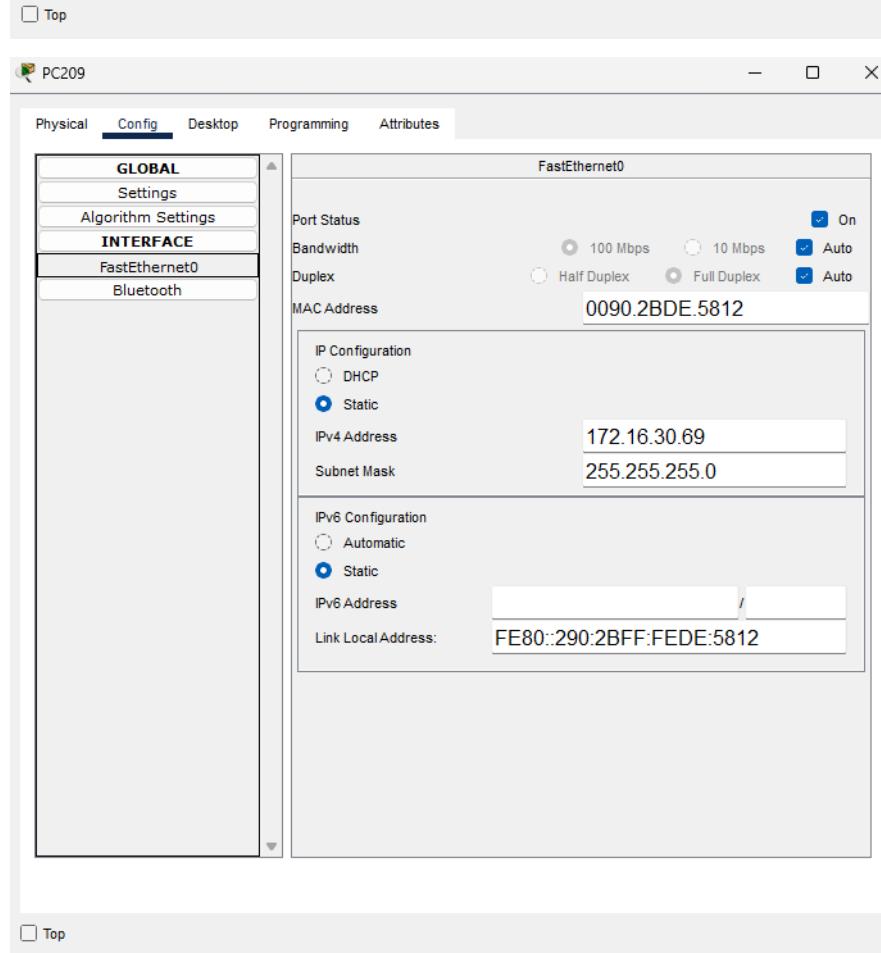
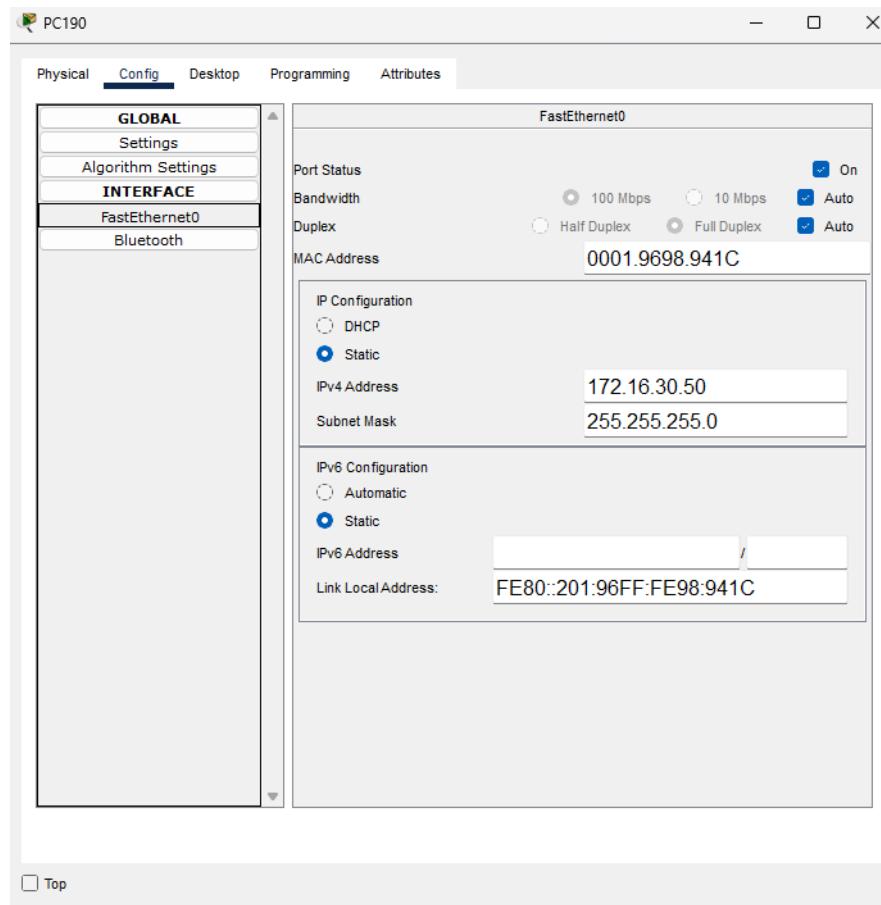


## PC configurations: Assign IP addresses for 30 Developer PCs (172.16.30.20 – 49)

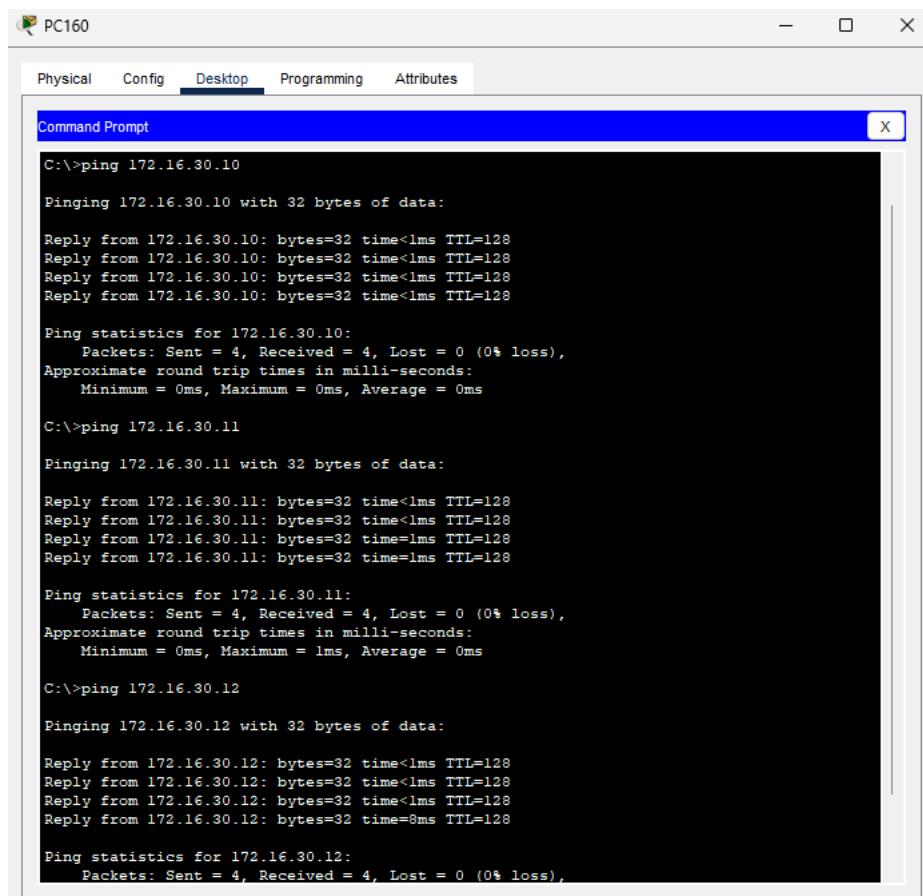




## PC configurations: Assign IP addresses for 20 Engineer and QA Tester PCs (172.16.30.50 – 69)



## Test connections: Ping the servers from the PCs



```
C:\>ping 172.16.30.10
Pinging 172.16.30.10 with 32 bytes of data:
Reply from 172.16.30.10: bytes=32 time<1ms TTL=128

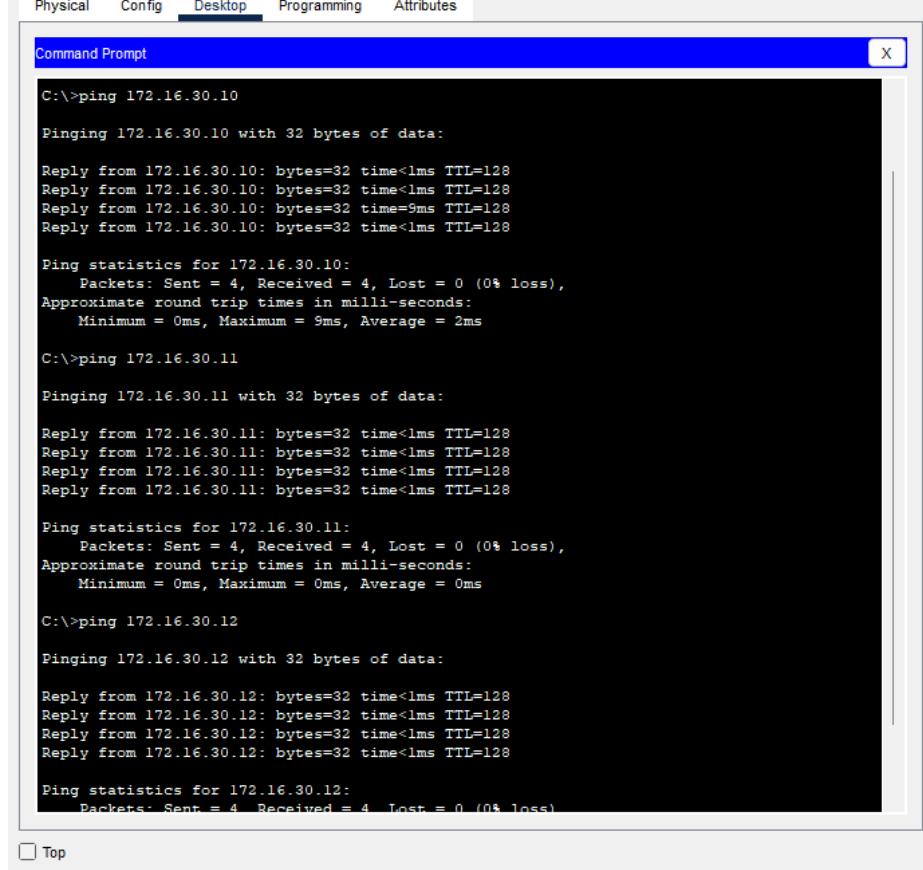
Ping statistics for 172.16.30.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.30.11
Pinging 172.16.30.11 with 32 bytes of data:
Reply from 172.16.30.11: bytes=32 time<1ms TTL=128
Reply from 172.16.30.11: bytes=32 time<1ms TTL=128
Reply from 172.16.30.11: bytes=32 time=1ms TTL=128
Reply from 172.16.30.11: bytes=32 time=1ms TTL=128

Ping statistics for 172.16.30.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.30.12
Pinging 172.16.30.12 with 32 bytes of data:
Reply from 172.16.30.12: bytes=32 time<1ms TTL=128
Reply from 172.16.30.12: bytes=32 time<1ms TTL=128
Reply from 172.16.30.12: bytes=32 time<1ms TTL=128
Reply from 172.16.30.12: bytes=32 time=8ms TTL=128

Ping statistics for 172.16.30.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```



```
C:\>ping 172.16.30.10
Pinging 172.16.30.10 with 32 bytes of data:
Reply from 172.16.30.10: bytes=32 time<1ms TTL=128
Reply from 172.16.30.10: bytes=32 time=1ms TTL=128
Reply from 172.16.30.10: bytes=32 time=9ms TTL=128
Reply from 172.16.30.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 9ms, Average = 2ms

C:\>ping 172.16.30.11
Pinging 172.16.30.11 with 32 bytes of data:
Reply from 172.16.30.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.30.12
Pinging 172.16.30.12 with 32 bytes of data:
Reply from 172.16.30.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

PC190

Physical Config Desktop Programming Attributes

Command Prompt X

```
C:\>ping 172.16.30.10
Pinging 172.16.30.10 with 32 bytes of data:
Reply from 172.16.30.10: bytes=32 time<1ms TTL=128
Reply from 172.16.30.10: bytes=32 time=8ms TTL=128
Reply from 172.16.30.10: bytes=32 time<1ms TTL=128
Reply from 172.16.30.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 8ms, Average = 2ms

C:\>ping 172.16.30.11
Pinging 172.16.30.11 with 32 bytes of data:
Reply from 172.16.30.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.30.12
Pinging 172.16.30.12 with 32 bytes of data:
Reply from 172.16.30.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

PC209

Physical Config Desktop Programming Attributes

Command Prompt X

```
Windows PowerShell 1.0 Command Line Editor
C:\>ping 172.16.30.10
Pinging 172.16.30.10 with 32 bytes of data:
Reply from 172.16.30.10: bytes=32 time=1ms TTL=128
Reply from 172.16.30.10: bytes=32 time<1ms TTL=128
Reply from 172.16.30.10: bytes=32 time<1ms TTL=128
Reply from 172.16.30.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.30.11
Pinging 172.16.30.11 with 32 bytes of data:
Reply from 172.16.30.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.30.12
Pinging 172.16.30.12 with 32 bytes of data:
Reply from 172.16.30.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

## Configure Core Router Subinterfaces for VLAN 30 and verify the configuration.

```
Vlan1      unassigned    YES unset administratively down down
Router#ping 172.16.20.20

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.20, timeout is 2 seconds:
!!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/3/11 ms

Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0.30
Router(config-subif)#encapsulation dot1Q 30
Router(config-subif)#ip address 172.16.30.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#end
Router#
*SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0/0  unassigned     YES manual up        up
GigabitEthernet0/0/1  172.16.10.1   YES manual up        up
GigabitEthernet0/0/2  172.16.20.1   YES manual up        up
GigabitEthernet0/0/3  172.16.30.1   YES manual up        up
GigabitEthernet0/0/4  172.16.40.1   YES manual up        up
GigabitEthernet0/0/5  172.16.50.1   YES manual up        up
GigabitEthernet0/0/6  unassigned     YES unset administratively down down
GigabitEthernet0/0/7  unassigned     YES unset administratively down down
Vlan1      unassigned    YES unset administratively down down
Router#ping 172.16.30.20

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.30.20, timeout is 2 seconds:
!!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/2/10 ms

Router#
```

Test the connections of the Developer, Engineer, and QA Tester PCs to the Default Gateway (172.16.30.1)

```
Reply from 172.16.30.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.11:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.30.12

Pinging 172.16.30.12 with 32 bytes of data:

Reply from 172.16.30.12: bytes=32 time<1ms TTL=128
Reply from 172.16.30.12: bytes=32 time<1ms TTL=128
Reply from 172.16.30.12: bytes=32 time=8ms TTL=128
Reply from 172.16.30.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.30.12:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 8ms, Average = 2ms

C:\>ping 172.16.30.1

Pinging 172.16.30.1 with 32 bytes of data:

Reply from 172.16.30.1: bytes=32 time=1ms TTL=255
Reply from 172.16.30.1: bytes=32 time<1ms TTL=255
Reply from 172.16.30.1: bytes=32 time<1ms TTL=255
Reply from 172.16.30.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.16.30.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

## Step 5: Distribution Switch, Access Switches, Servers, and PCs Setup and Configuration (HR Department)

Distribution Switch configuration: Add a VLAN, assign ports to VLAN 40, and set the trunk link to the Core Switch and Access Switches

HR Distribution Switch

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 40
Switch(config-vlan)#name HR
Switch(config-vlan)#exit
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 40
Switch(config-if)#exit
Switch(config)#interface range FastEthernet0/1 - 2
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 40
Switch(config-if-range)#exit
Switch(config)#interface range FastEthernet0/3 - 6
Switch(config-if-range)#switchport mode trunk
Switch(config-if-range)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
exit
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

Copy Paste

HR Distribution Switch

Physical Config **CLI** Attributes

IOS Command Line Interface

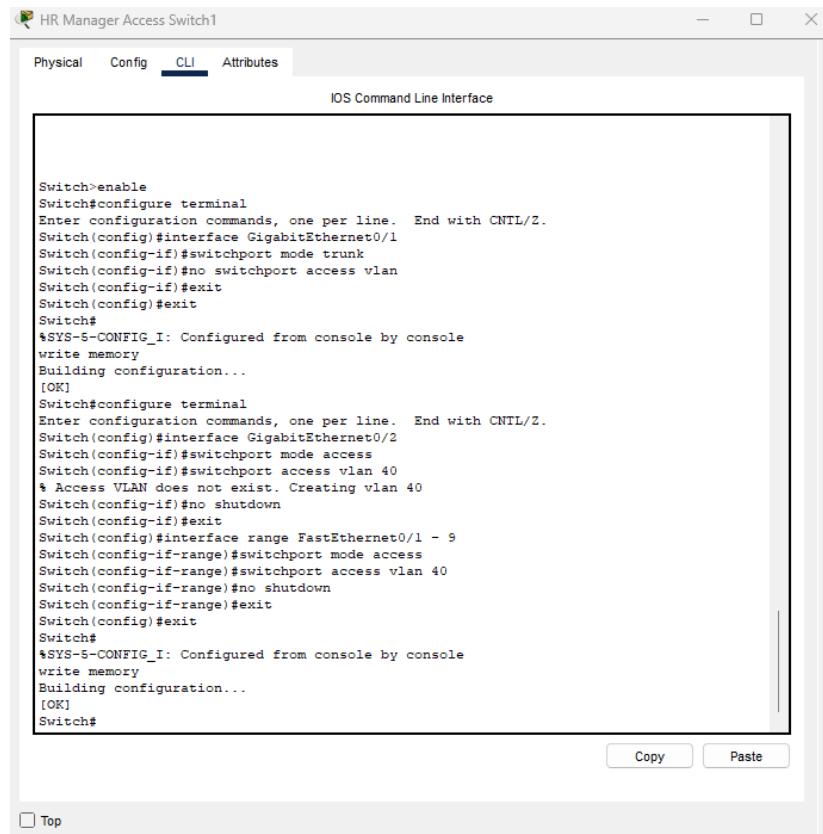
```
Switch(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up
exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
exit

Switch con0 is now available

Press RETURN to get started.
```

Copy Paste

## HR Manager Access Switch1 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs

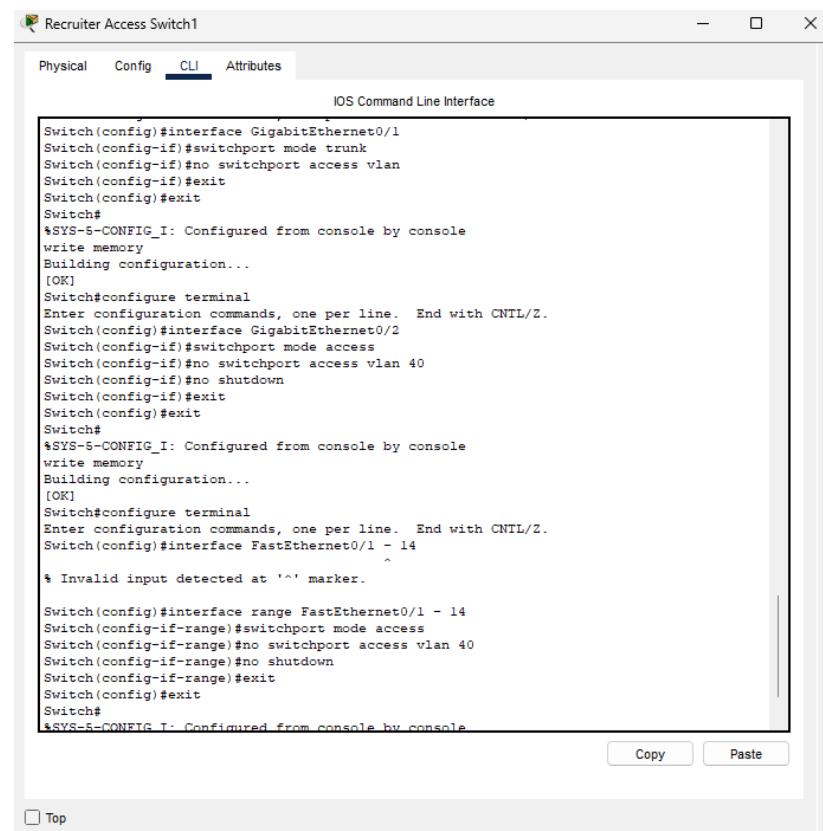


The screenshot shows the configuration interface for the HR Manager Access Switch1. The 'CLI' tab is selected. The terminal window displays the following IOS Command Line Interface session:

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 40
% Access VLAN does not exist. Creating vlan 40
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface range FastEthernet0/1 - 9
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 40
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

At the bottom of the terminal window, there are 'Copy' and 'Paste' buttons.

## Recruiter Access Switch1 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs



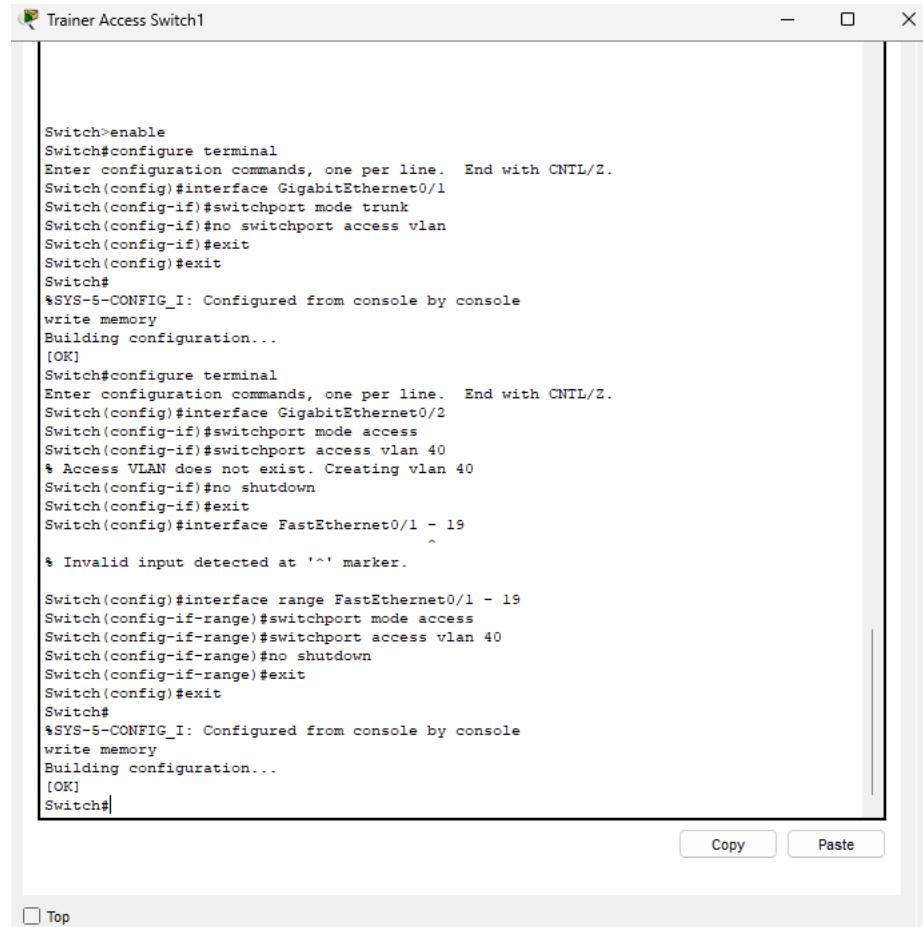
The screenshot shows the configuration interface for the Recruiter Access Switch1. The 'CLI' tab is selected. The terminal window displays the following IOS Command Line Interface session:

```
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#no switchport access vlan 40
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#exit
Switch#
*SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface FastEthernet0/1 - 14
^
* Invalid input detected at '^' marker.

Switch(config)#interface range FastEthernet0/1 - 14
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#no switchport access vlan 40
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
*SYS-5-CONFIG_I: Configured from console by console
```

At the bottom of the terminal window, there are 'Copy' and 'Paste' buttons.

Trainer Access Switch1 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs



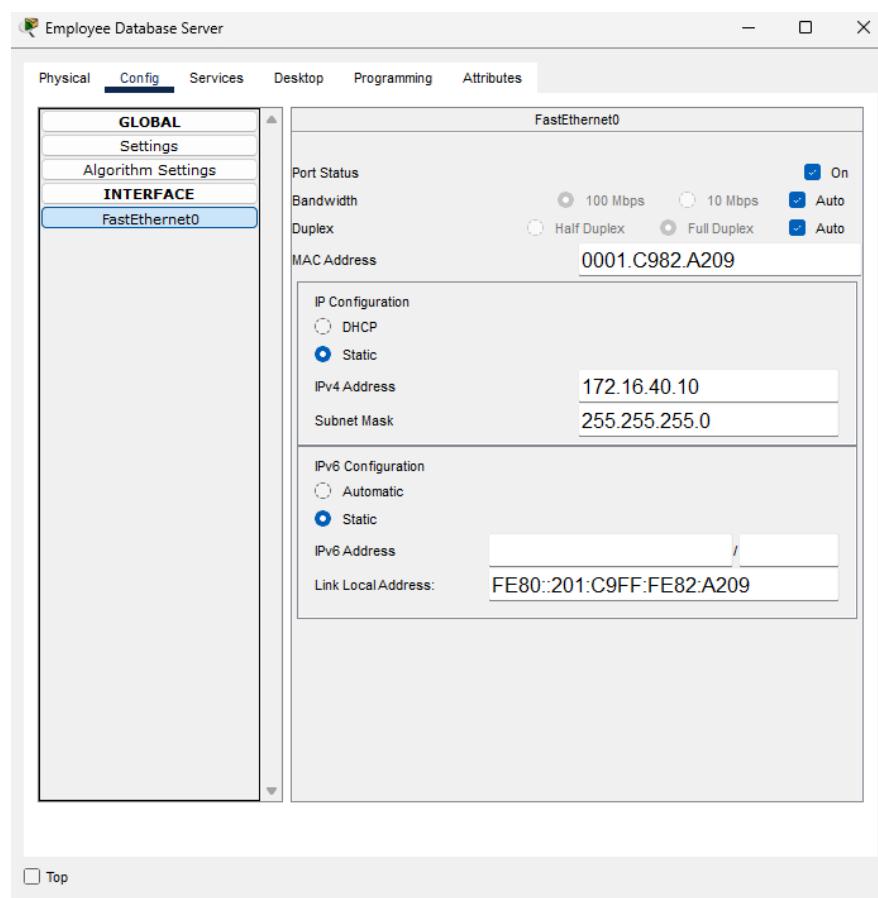
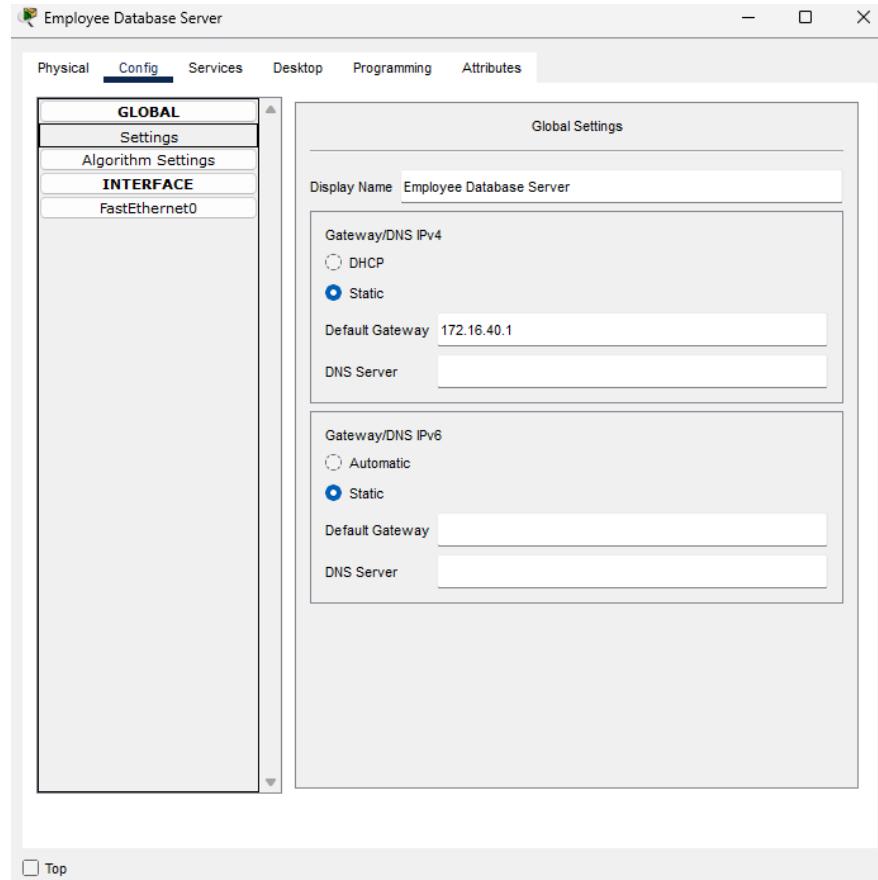
The screenshot shows a terminal window titled "Trainer Access Switch1". The window contains the following configuration commands:

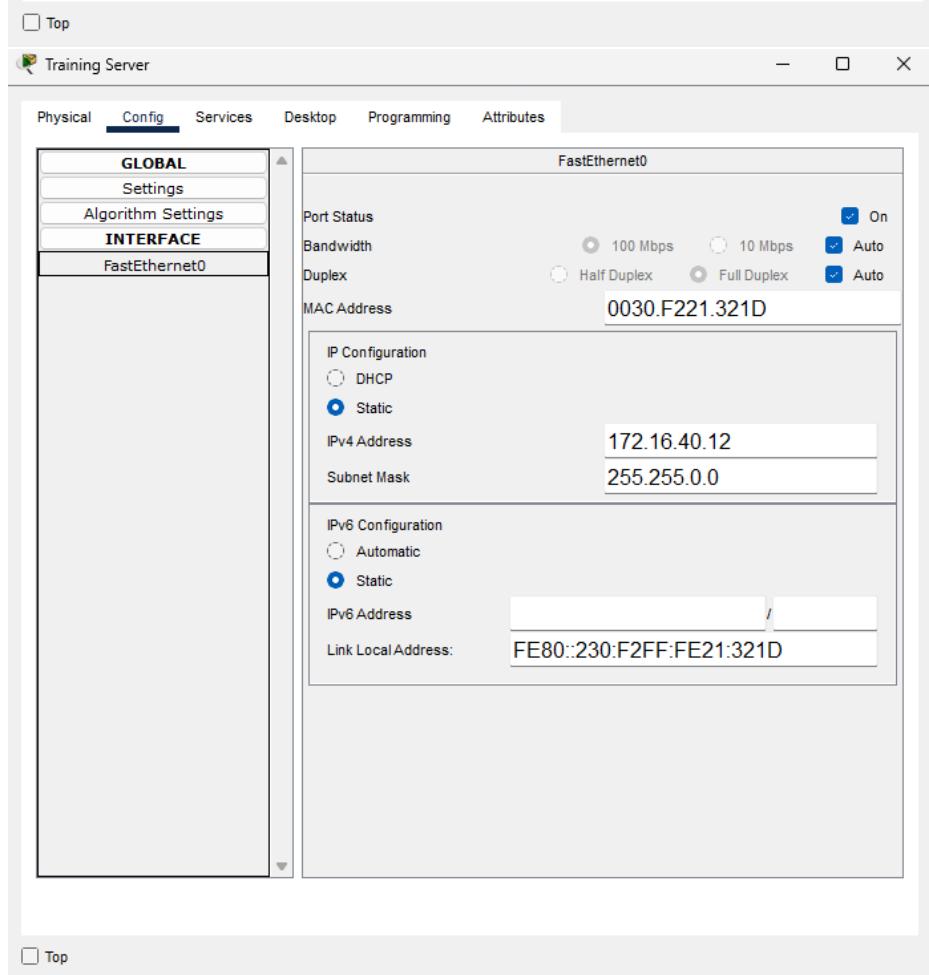
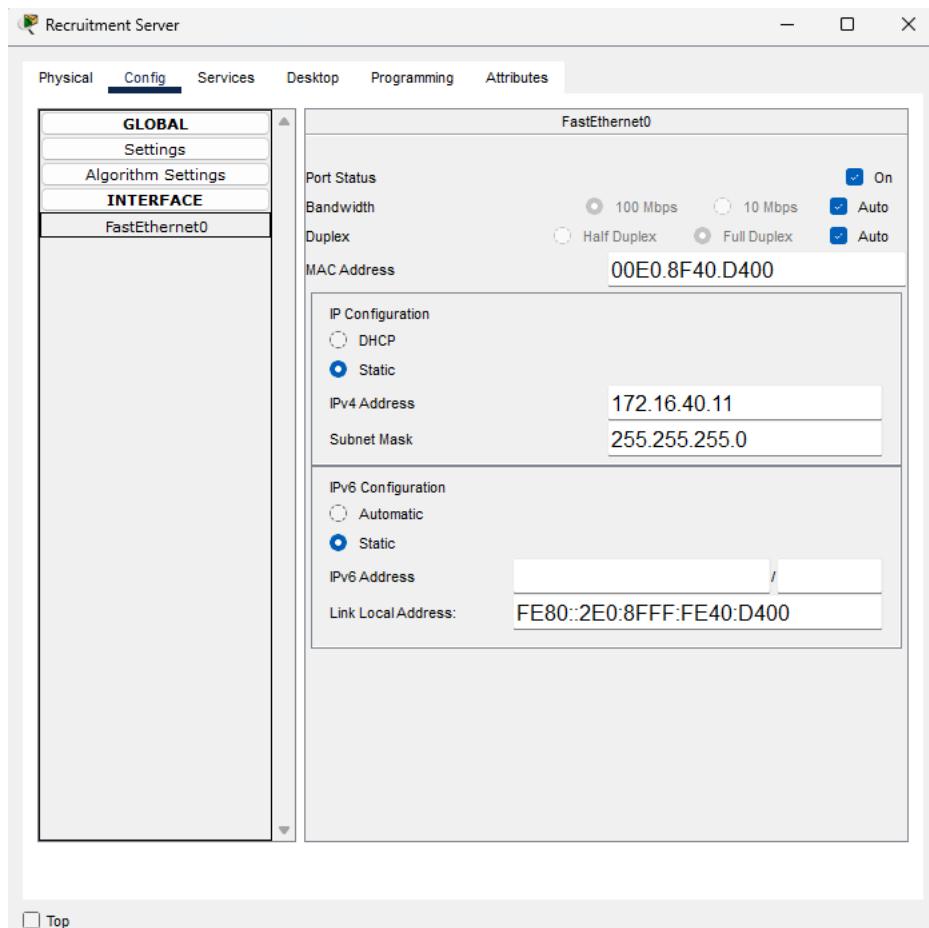
```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 40
% Access VLAN does not exist. Creating vlan 40
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#exit
Switch(config)#interface FastEthernet0/1 - 19
^
% Invalid input detected at '^' marker.

Switch(config)#interface range FastEthernet0/1 - 19
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 40
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

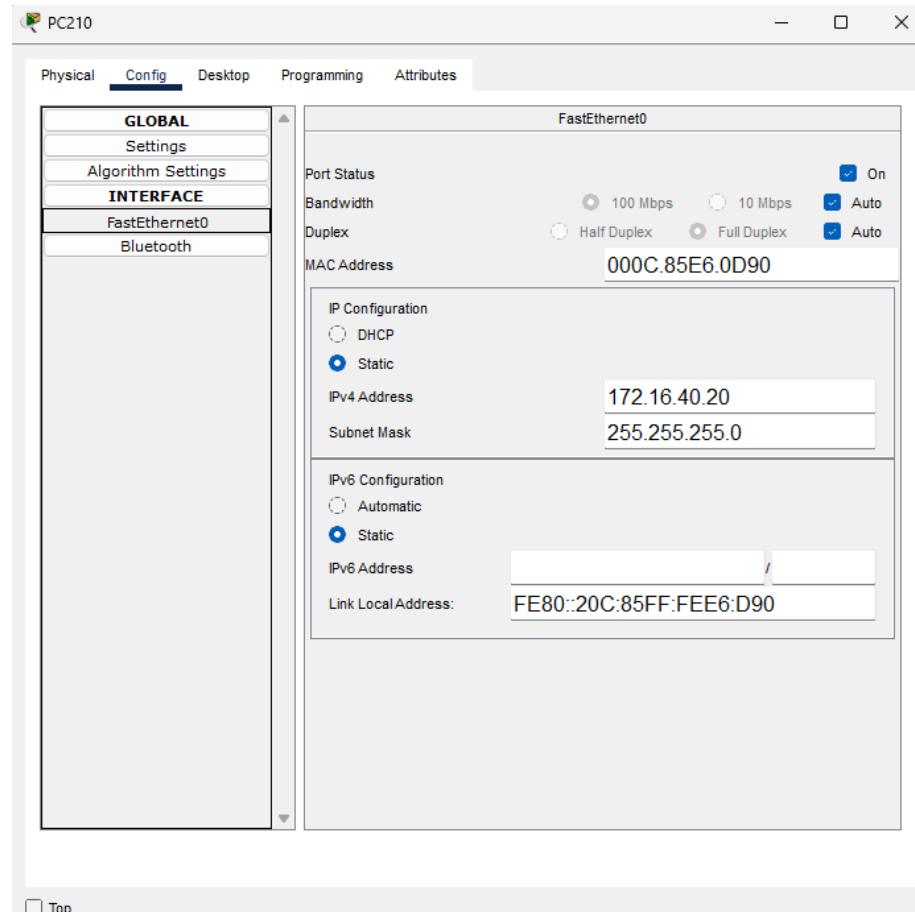
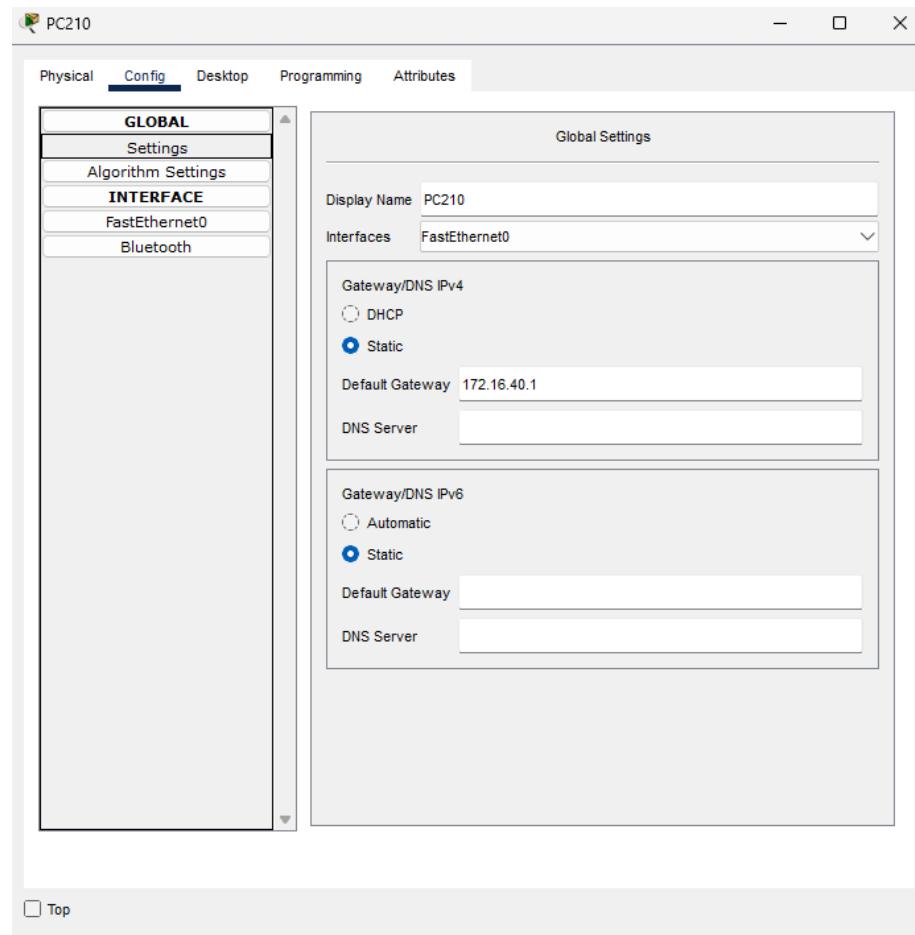
At the bottom of the window, there are "Copy" and "Paste" buttons. Below the window, there is a "Top" button.

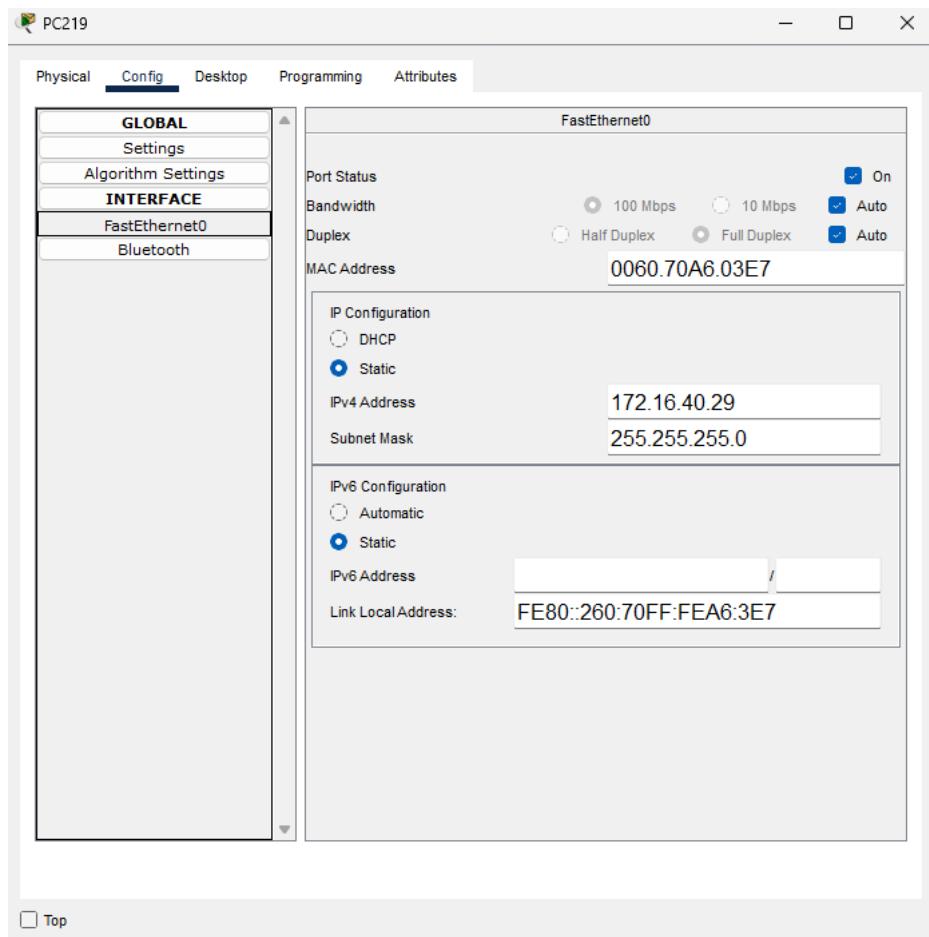
## Server configuration: Assign IP addresses to the Employee Database, Recruitment, and Training Server



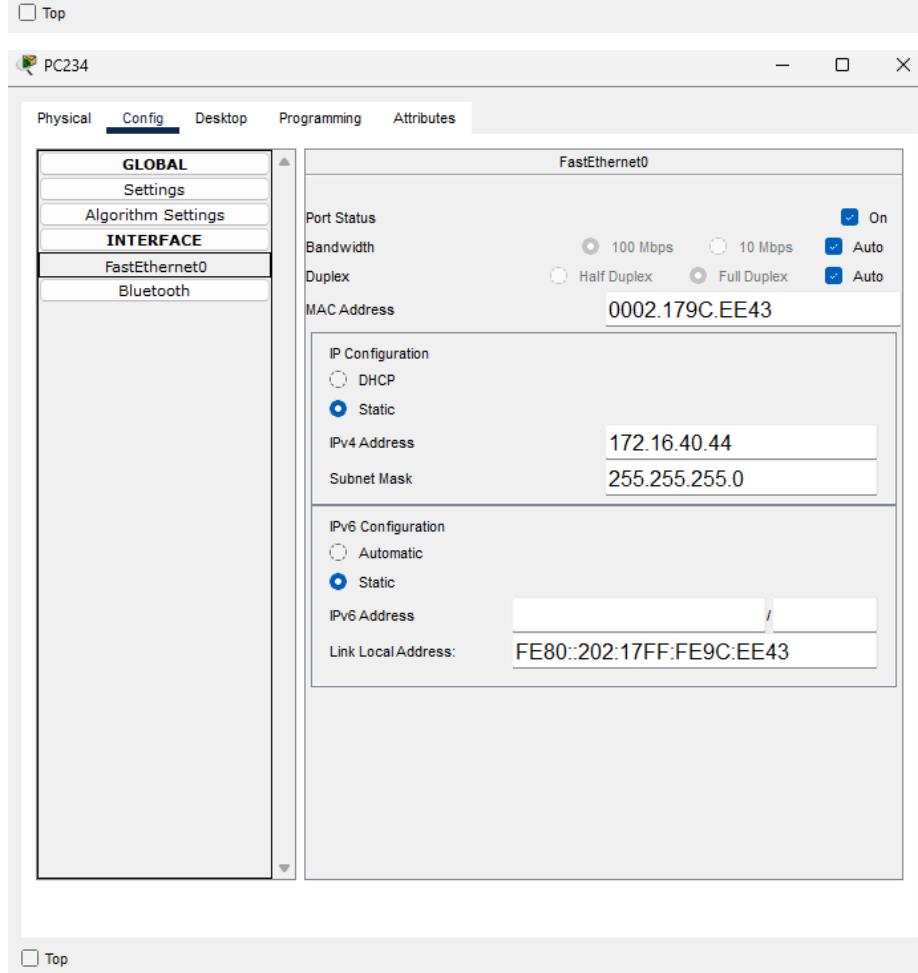
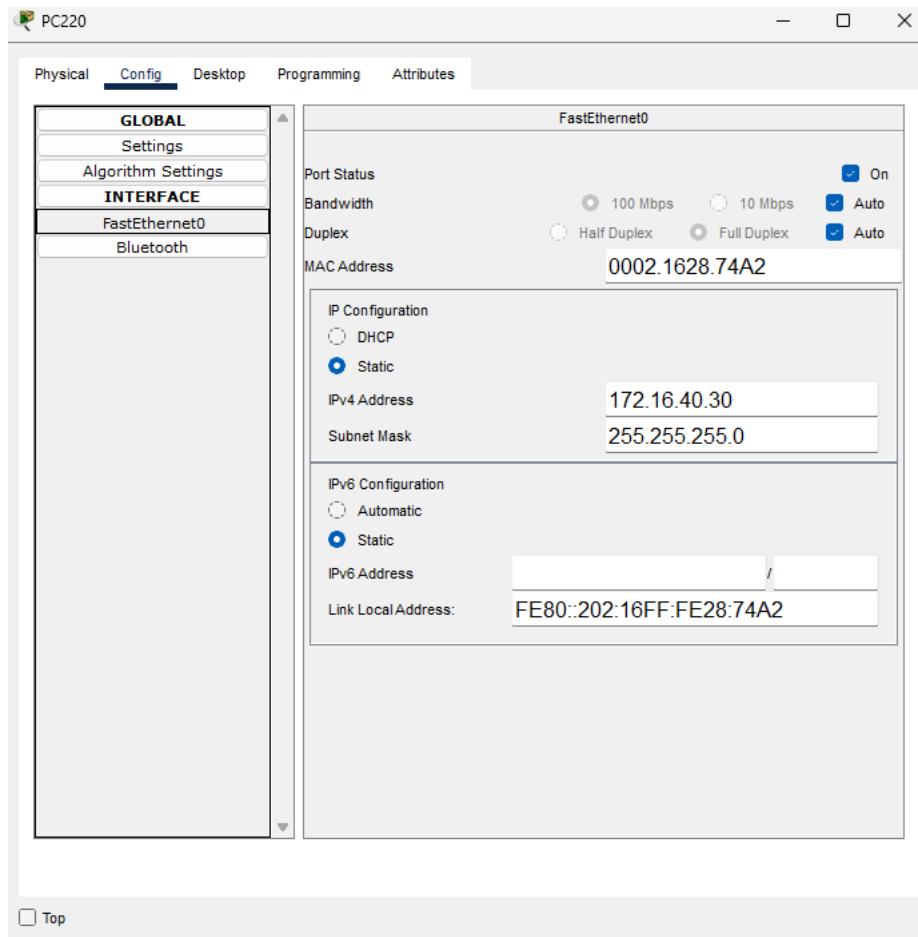


## PC configurations: Assign IP addresses for 10 HR Manager PCs (172.16.40.20 – 29)





## PC configurations: Assign IP addresses for 10 HR Manager PCs (172.16.40.30 – 44)



## PC configurations: Assign IP addresses for 10 HR Manager PCs (172.16.40.45 – 64)

The image displays two separate windows of a network configuration software, labeled PC235 and PC254.

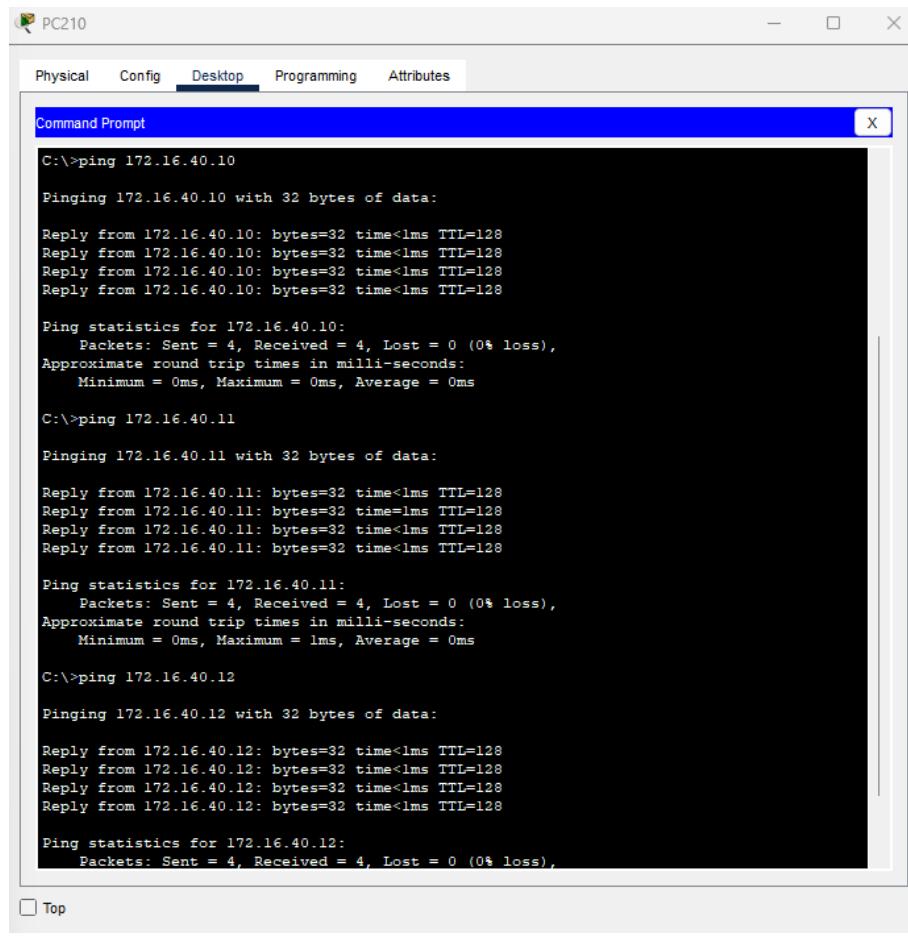
**PC235 Configuration:**

- Left Panel (GLOBAL):** Contains links for Settings, Algorithm Settings, INTERFACE, FastEthernet0, and Bluetooth.
- Right Panel (FastEthernet0):**
  - Port Status:** On (checked), 100 Mbps (radio button), Half Duplex (radio button).
  - Bandwidth:** 10 Mbps (radio button), Auto (checkbox checked).
  - Duplex:** Full Duplex (radio button), Auto (checkbox checked).
  - MAC Address:** 0003.E435.40A7
  - IP Configuration:** Static (radio button selected).
    - IPv4 Address:** 172.16.40.45
    - Subnet Mask:** 255.255.255.0
  - IPv6 Configuration:** Static (radio button selected).
    - IPv6 Address:** [Empty field]
    - Link Local Address:** FE80::203:E4FF:FE35:40A7

**PC254 Configuration:**

- Left Panel (GLOBAL):** Contains links for Settings, Algorithm Settings, INTERFACE, FastEthernet0, and Bluetooth.
- Right Panel (FastEthernet0):**
  - Port Status:** On (checked), 100 Mbps (radio button), Half Duplex (radio button).
  - Bandwidth:** 10 Mbps (radio button), Auto (checkbox checked).
  - Duplex:** Full Duplex (radio button), Auto (checkbox checked).
  - MAC Address:** 0002.16CE.0516
  - IP Configuration:** Static (radio button selected).
    - IPv4 Address:** 172.16.40.64
    - Subnet Mask:** 255.255.255.0
  - IPv6 Configuration:** Static (radio button selected).
    - IPv6 Address:** [Empty field]
    - Link Local Address:** FE80::202:16FF:FECE:516

## Test connections: Ping the servers from the PCs



```
C:\>ping 172.16.40.10
Pinging 172.16.40.10 with 32 bytes of data:
Reply from 172.16.40.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

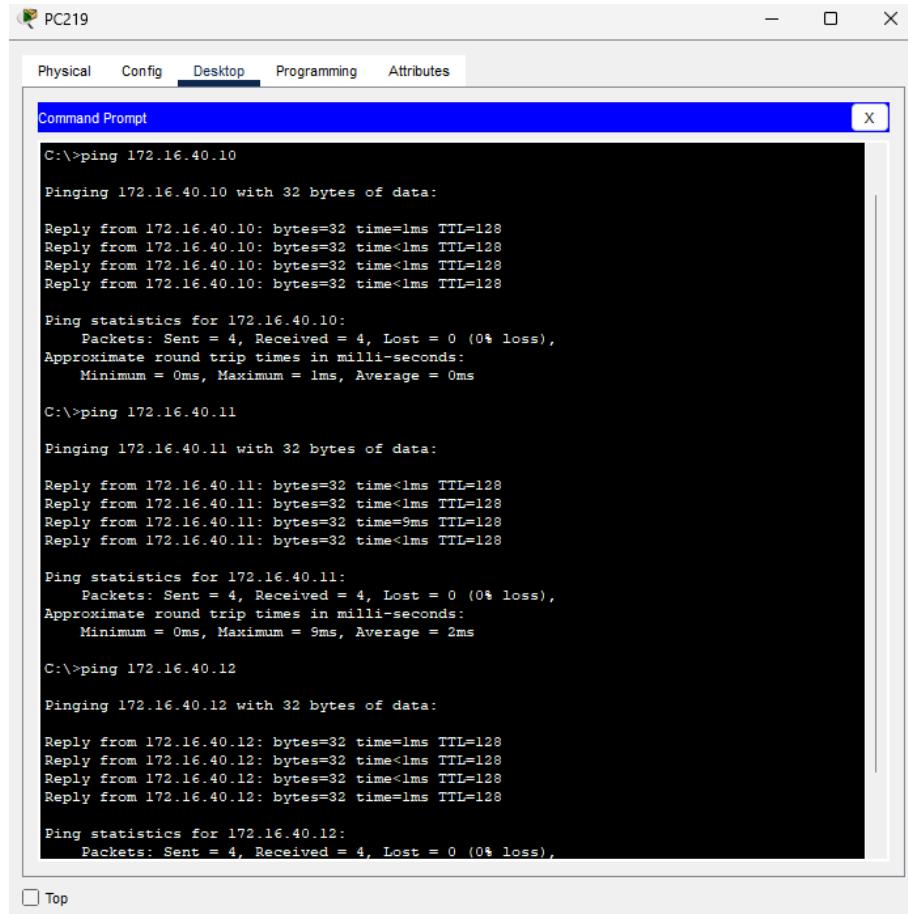
C:\>ping 172.16.40.11
Pinging 172.16.40.11 with 32 bytes of data:
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128
Reply from 172.16.40.11: bytes=32 time=1ms TTL=128
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.40.12
Pinging 172.16.40.12 with 32 bytes of data:
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top



```
C:\>ping 172.16.40.10
Pinging 172.16.40.10 with 32 bytes of data:
Reply from 172.16.40.10: bytes=32 time=1ms TTL=128
Reply from 172.16.40.10: bytes=32 time<1ms TTL=128
Reply from 172.16.40.10: bytes=32 time<1ms TTL=128
Reply from 172.16.40.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.40.11
Pinging 172.16.40.11 with 32 bytes of data:
Reply from 172.16.40.11: bytes=32 time=32ms TTL=128
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128
Reply from 172.16.40.11: bytes=32 time=9ms TTL=128
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 9ms, Average = 2ms

C:\>ping 172.16.40.12
Pinging 172.16.40.12 with 32 bytes of data:
Reply from 172.16.40.12: bytes=32 time=1ms TTL=128
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128
Reply from 172.16.40.12: bytes=32 time=1ms TTL=128

Ping statistics for 172.16.40.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

**PC220**

Physical Config Desktop Programming Attributes

**Command Prompt**

```
C:\>ping 172.16.40.10
Pinging 172.16.40.10 with 32 bytes of data:
Reply from 172.16.40.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.40.11
Pinging 172.16.40.11 with 32 bytes of data:
Reply from 172.16.40.11: bytes=32 time=<1ms TTL=128

Ping statistics for 172.16.40.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.40.12
Pinging 172.16.40.12 with 32 bytes of data:
Reply from 172.16.40.12: bytes=32 time=<1ms TTL=128

Ping statistics for 172.16.40.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

**PC234**

Physical Config Desktop Programming Attributes

**Command Prompt**

```
C:\>ping 172.16.40.10
Pinging 172.16.40.10 with 32 bytes of data:
Reply from 172.16.40.10: bytes=32 time=<1ms TTL=128

Ping statistics for 172.16.40.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.40.11
Pinging 172.16.40.11 with 32 bytes of data:
Reply from 172.16.40.11: bytes=32 time=<1ms TTL=128
Reply from 172.16.40.11: bytes=32 time=9ms TTL=128
Reply from 172.16.40.11: bytes=32 time=<1ms TTL=128
Reply from 172.16.40.11: bytes=32 time=8ms TTL=128

Ping statistics for 172.16.40.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 9ms, Average = 4ms

C:\>ping 172.16.40.12
Pinging 172.16.40.12 with 32 bytes of data:
Reply from 172.16.40.12: bytes=32 time=<1ms TTL=128

Ping statistics for 172.16.40.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

PC235

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ping 172.16.40.10
Pinging 172.16.40.10 with 32 bytes of data:
Reply from 172.16.40.10: bytes=32 time<1ms TTL=128
Reply from 172.16.40.10: bytes=32 time<1ms TTL=128
Reply from 172.16.40.10: bytes=32 time=1ms TTL=128
Reply from 172.16.40.10: bytes=32 time=1ms TTL=128

Ping statistics for 172.16.40.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.40.11
Pinging 172.16.40.11 with 32 bytes of data:
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128
Reply from 172.16.40.11: bytes=32 time=8ms TTL=128
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 8ms, Average = 2ms

C:\>ping 172.16.40.12
Pinging 172.16.40.12 with 32 bytes of data:
Reply from 172.16.40.12: bytes=32 time=1ms TTL=128
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

PC254

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ping 172.16.40.10
Pinging 172.16.40.10 with 32 bytes of data:
Reply from 172.16.40.10: bytes=32 time=1ms TTL=128
Reply from 172.16.40.10: bytes=32 time<1ms TTL=128
Reply from 172.16.40.10: bytes=32 time<1ms TTL=128
Reply from 172.16.40.10: bytes=32 time=1ms TTL=128

Ping statistics for 172.16.40.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.40.11
Pinging 172.16.40.11 with 32 bytes of data:
Reply from 172.16.40.11: bytes=32 time=1ms TTL=128
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128
Reply from 172.16.40.11: bytes=32 time=1ms TTL=128
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.40.12
Pinging 172.16.40.12 with 32 bytes of data:
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128
Reply from 172.16.40.12: bytes=32 time=11ms TTL=128
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

## Configure Core Router Subinterfaces for VLAN 40 and verify the configuration.

```
Vlan1 unassigned YES unset administratively down down
Router#ping 172.16.30.20
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.30.20, timeout is 2 seconds:
!!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/2/10 ms

Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0.40
Router(config-subif)#encapsulation dot1Q 40
Router(config-subif)#ip address 172.16.40.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0/0 unassigned    YES manual up        up
GigabitEthernet0/0/0.10172.16.10.1 YES manual up        up
GigabitEthernet0/0/0.20172.16.20.1 YES manual up        up
GigabitEthernet0/0/0.30172.16.30.1 YES manual up        up
GigabitEthernet0/0/0.40172.16.40.1 YES manual up        up
GigabitEthernet0/0/0.50172.16.50.1 YES manual up        up
GigabitEthernet0/0/1 unassigned    YES unset administratively down down
GigabitEthernet0/0/2 unassigned    YES unset administratively down down
Vlan1 unassigned    YES unset administratively down down
Router#ping 172.16.40.20
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.40.20, timeout is 2 seconds:
!!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms

Router#
```

Top

Test the connections of the HR Manager, Recruiter, and Trainer PCs to the Default Gateway (172.16.40.1)

```
Reply from 172.16.40.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.40.12

Pinging 172.16.40.12 with 32 bytes of data:

Reply from 172.16.40.12: bytes=32 time=2ms TTL=128
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128
Reply from 172.16.40.12: bytes=32 time=0ms TTL=128
Reply from 172.16.40.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.40.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 8ms, Average = 2ms

C:\>ping 172.16.40.1

Pinging 172.16.40.1 with 32 bytes of data:

Reply from 172.16.40.1: bytes=32 time<1ms TTL=255
Reply from 172.16.40.1: bytes=32 time=9ms TTL=255
Reply from 172.16.40.1: bytes=32 time<1ms TTL=255
Reply from 172.16.40.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.16.40.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 9ms, Average = 2ms

C:\>
```

Top

## Step 6: Distribution Switch, Access Switches, Servers, and PCs Setup and Configuration (Customer Service Department)

Distribution Switch configuration: Add a VLAN, assign ports to VLAN 40, and set the trunk link to the Core Switch and Access Switches

Customer Service Distribution Switch

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vian 50
Switch(config-vlan)#name CUSTOMER SERVICE
^
% Invalid input detected at '^' marker.

Switch(config-vlan)#name CUSTOMER_SERVICE
Switch(config-vlan)#exit
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 50
Switch(config-if)#exit
Switch(config)#interface range FastEthernet0/1 - 2
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 50
Switch(config-if-range)#exit
Switch(config)#interface range FastEthernet0/3 - 6
Switch(config-if-range)#switchport mode trunk

Switch(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up
```

Copy Paste

Customer Service Distribution Switch

Physical Config **CLI** Attributes

IOS Command Line Interface

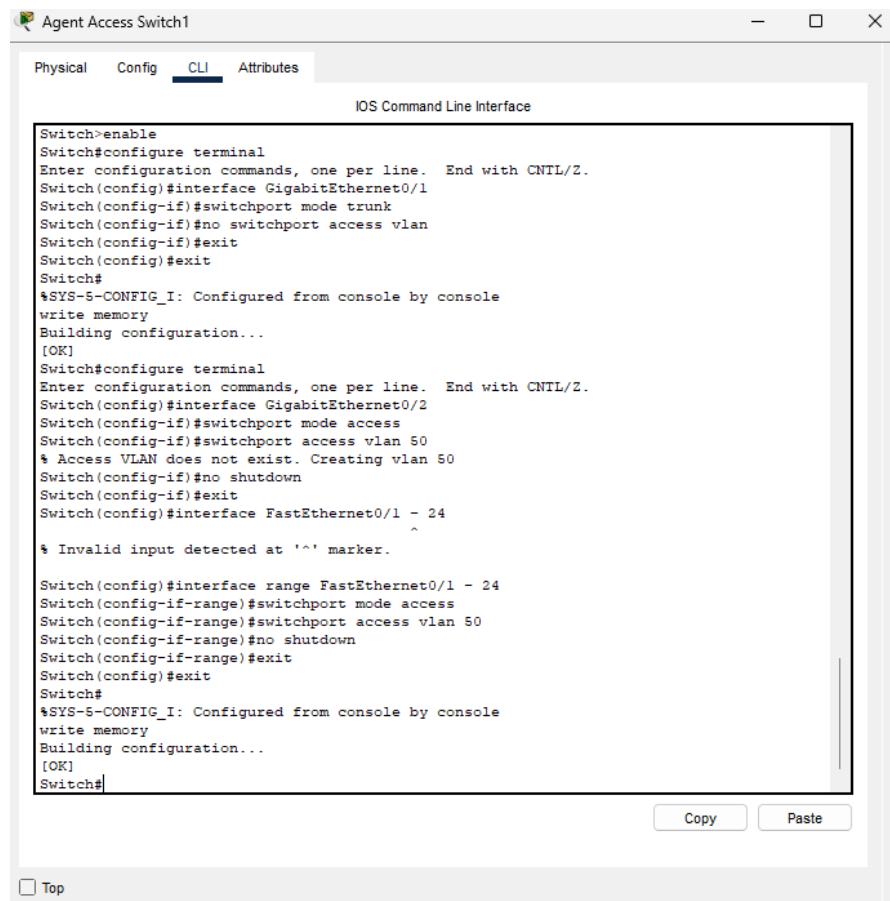
```
Switch(config-if-range)#switchport mode trunk

Switch(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to up
interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
exit
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

Copy Paste

## Agent Access Switch1, Switch2, Switch3, and Switch4 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs



Agent Access Switch1

Physical Config **CLI** Attributes

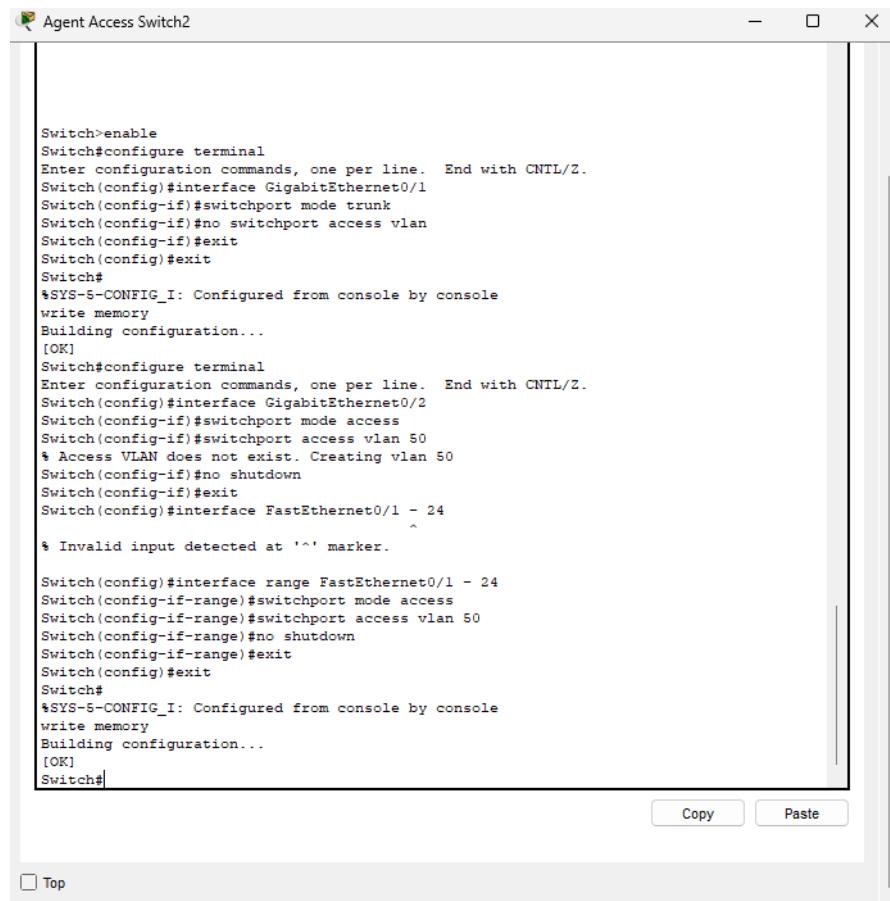
IOS Command Line Interface

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 50
% Access VLAN does not exist. Creating vlan 50
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface FastEthernet0/1 - 24
^
% Invalid input detected at '^' marker.

Switch(config)#interface range FastEthernet0/1 - 24
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 50
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

Top

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Agent Access Switch2

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 50
% Access VLAN does not exist. Creating vlan 50
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface FastEthernet0/1 - 24
^
% Invalid input detected at '^' marker.

Switch(config)#interface range FastEthernet0/1 - 24
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 50
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

Top

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Agent Access Switch3

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 50
% Access VLAN does not exist. Creating vlan 50
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

Top

Copy Paste

Agent Access Switch4

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#no switchport access vlan
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 50
% Access VLAN does not exist. Creating vlan 50
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
```

Top

Copy Paste

## Supervisor Access Switch1 configuration: Set the trunk link to the Distribution Switch and assign the access ports for the PCs

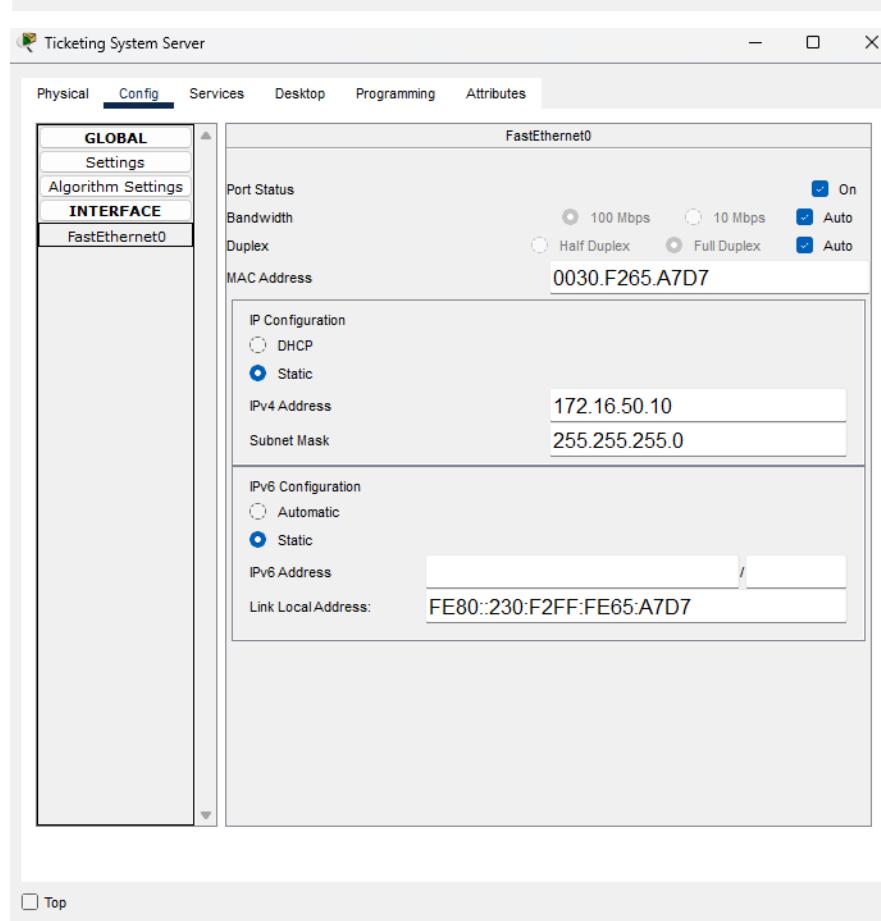
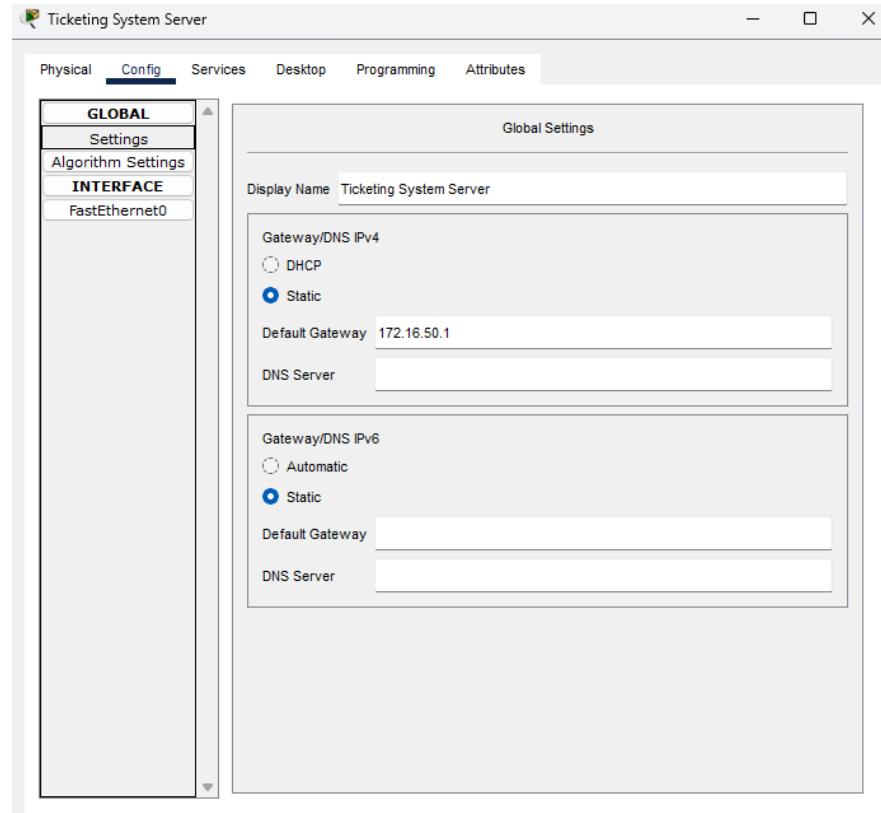
The screenshot shows the Supervisor Access Switch1 configuration interface. The tab 'CLI' is selected. The command-line interface (CLI) window displays the following configuration commands:

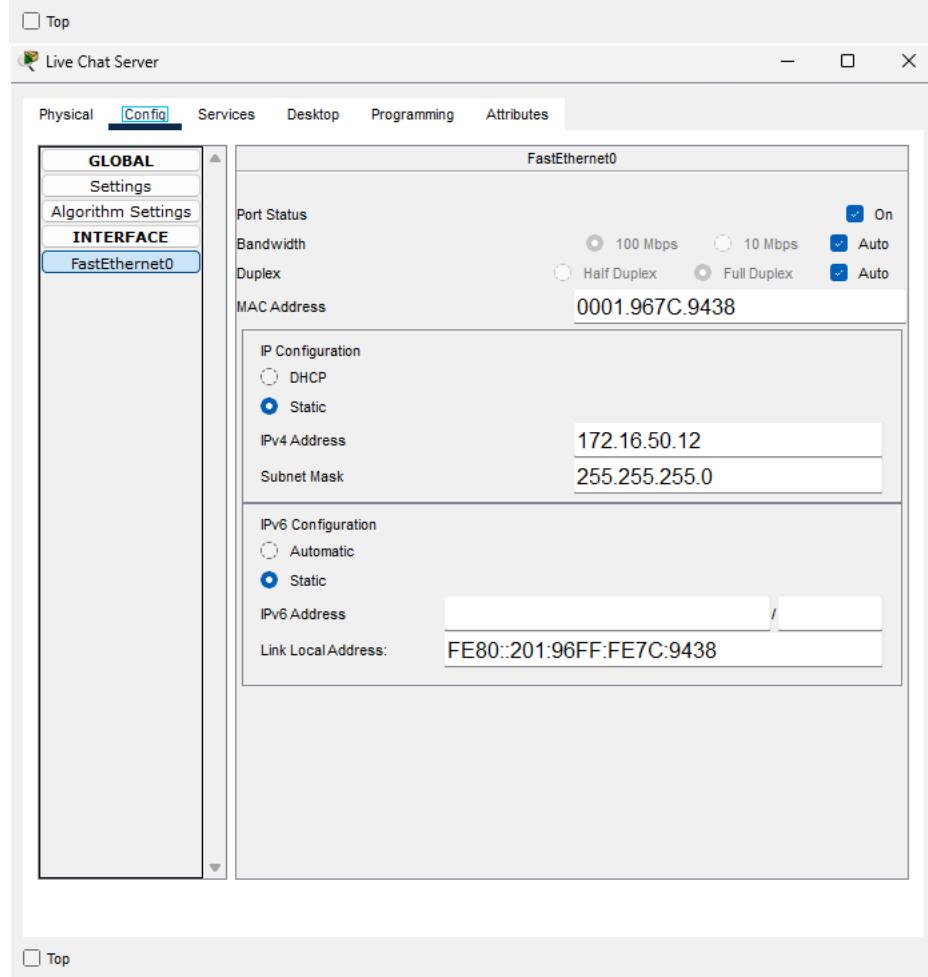
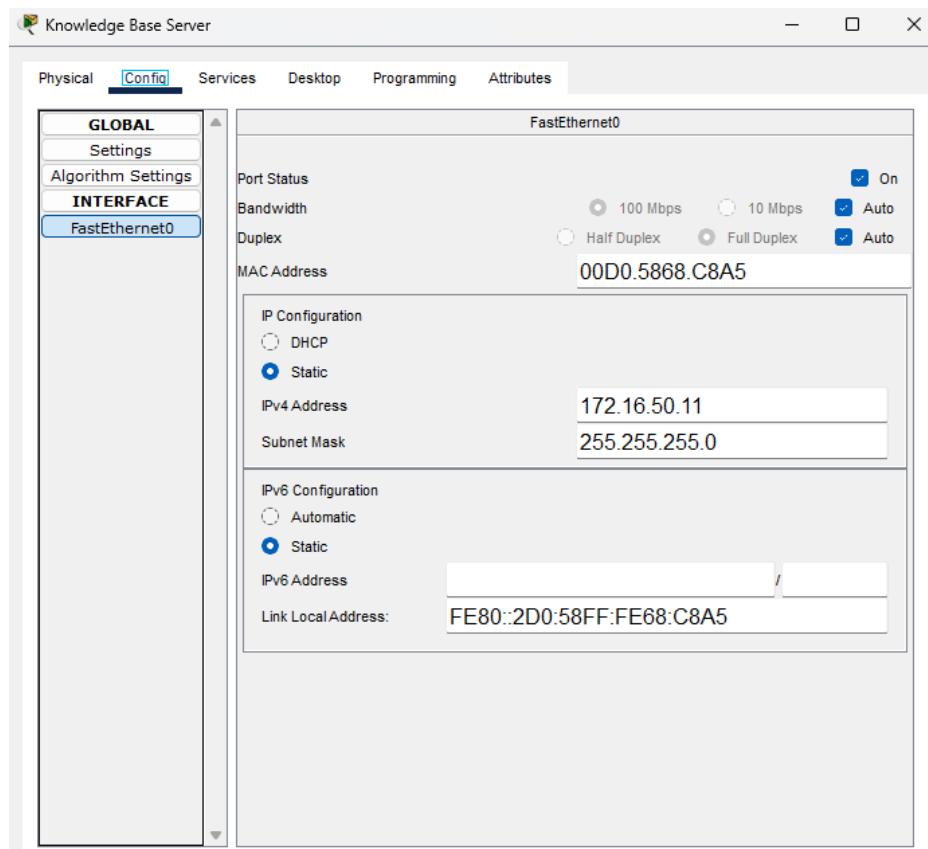
```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
no switchport access vlan
Switch(config-if)#exit
Switch(config)#
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface GigabitEthernet0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 50
% Access VLAN does not exist. Creating vlan 50
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface range FastEthernet0/1 - 14
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 50
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Switch#
```

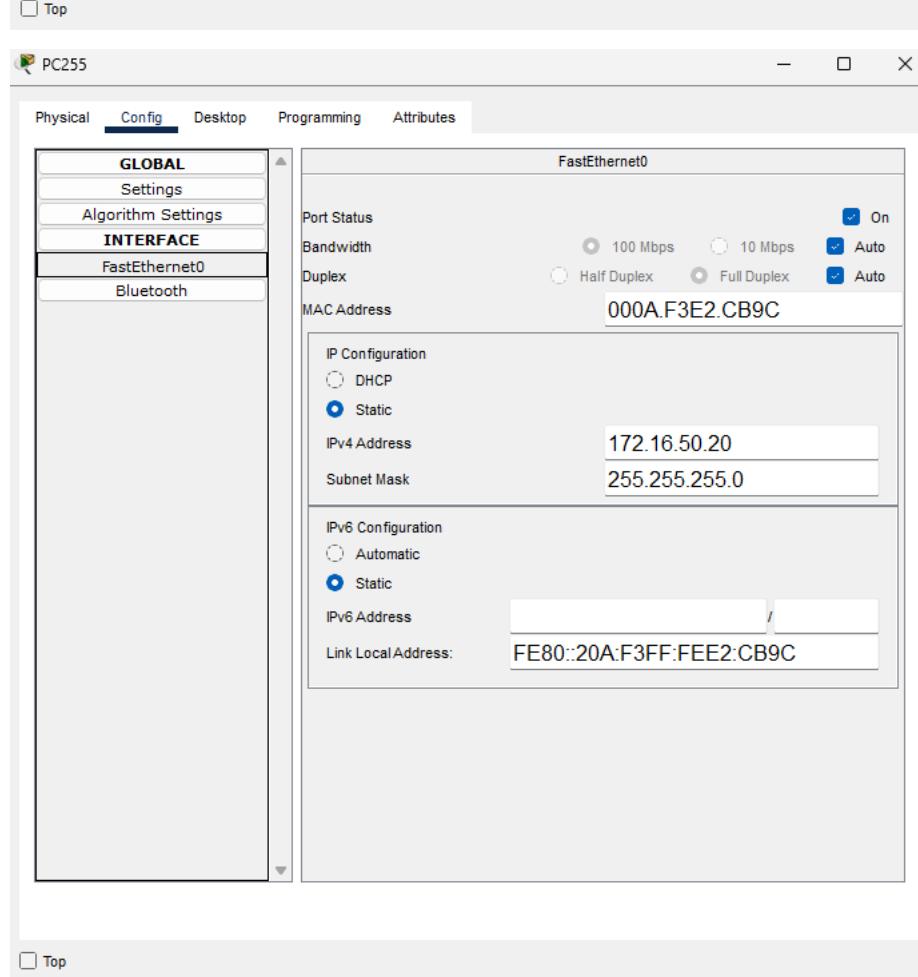
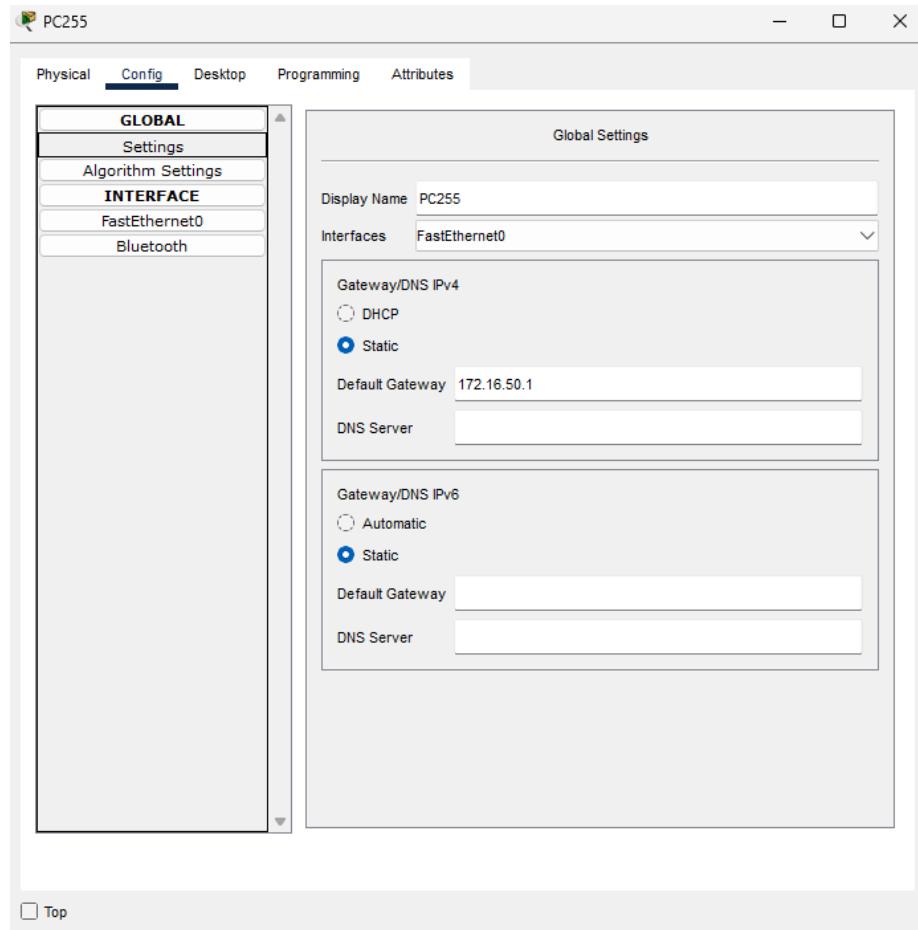
At the bottom right of the CLI window are 'Copy' and 'Paste' buttons. Below the window is a 'Top' button.

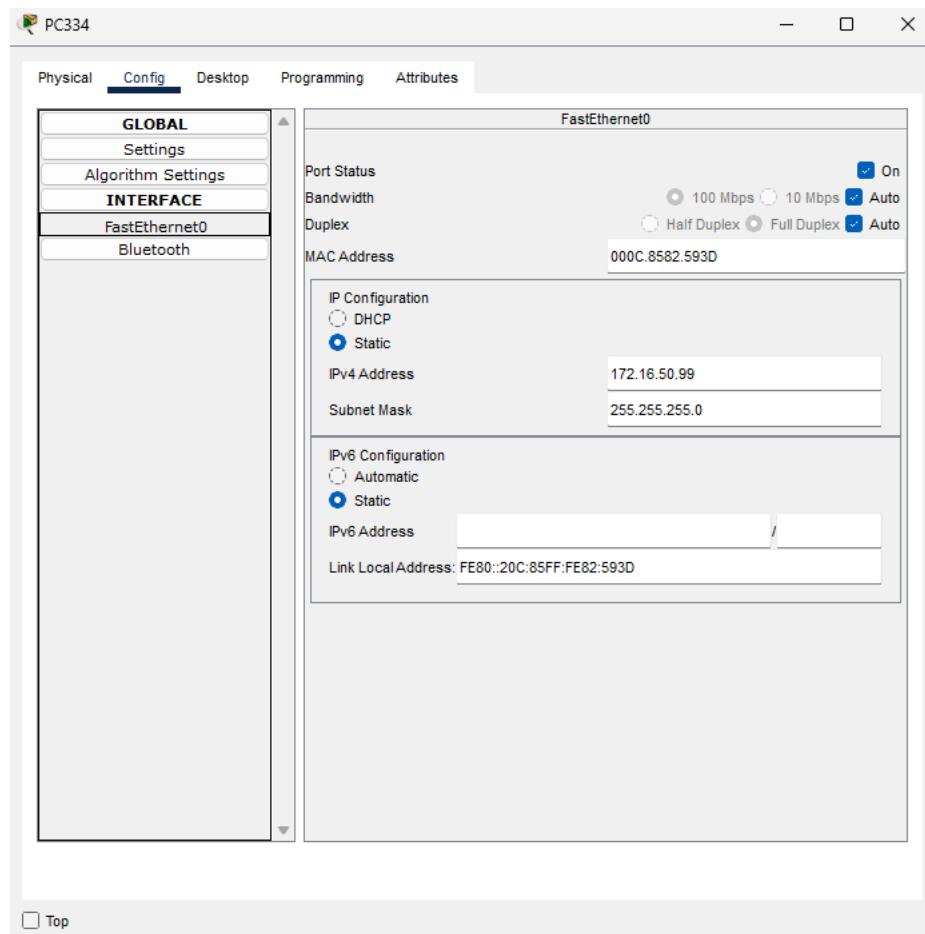
## Server configuration: Assign IP addresses to the Ticketing System, Knowledge Base, and Live Chat Server



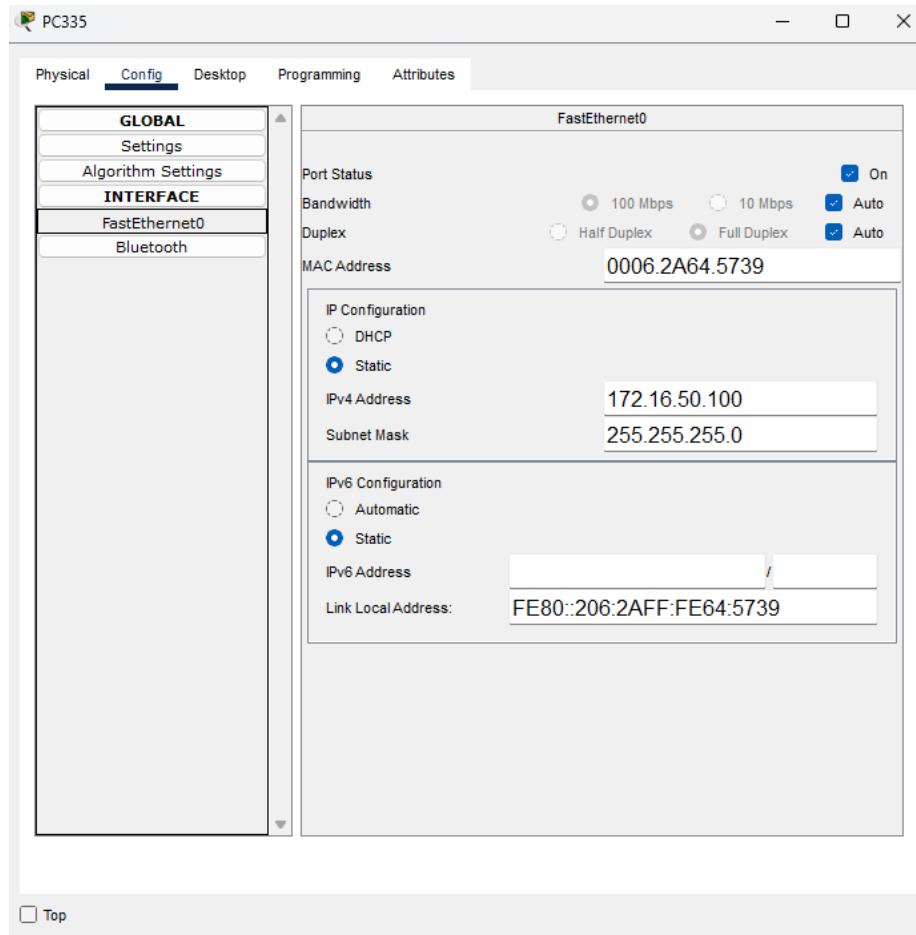


## PC configurations: Assign IP addresses for 80 Agent PCs (172.16.50.20 – 99)

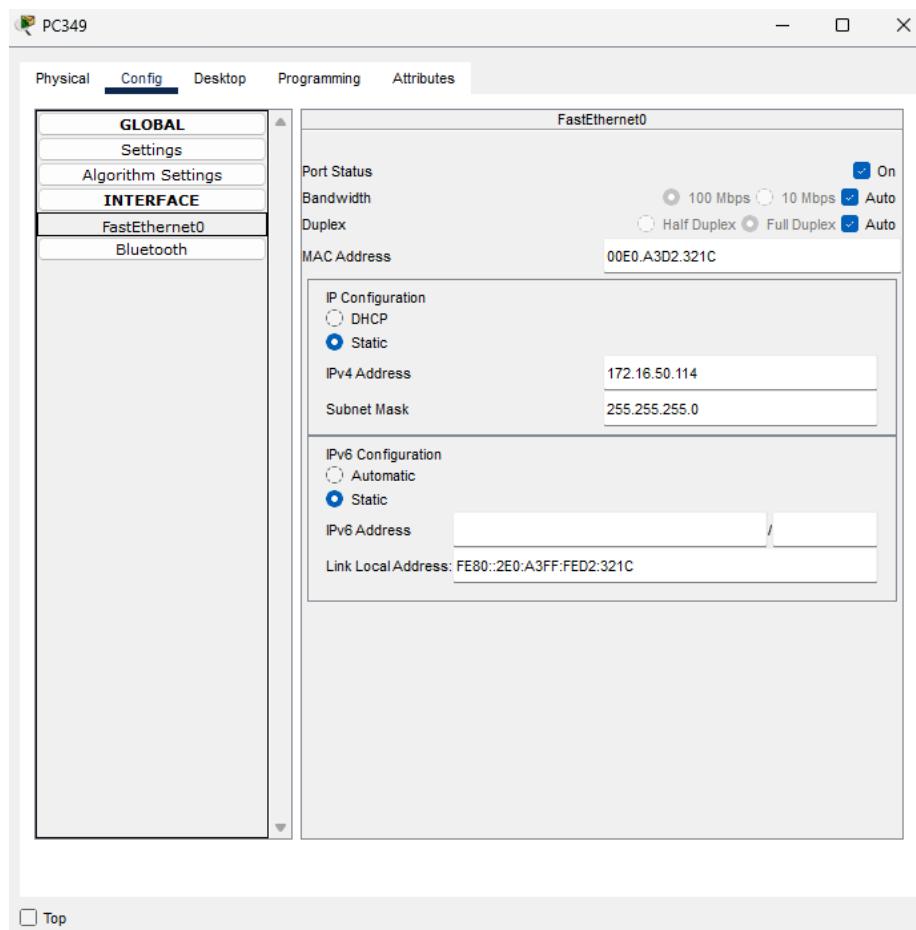




## PC configurations: Assign IP addresses for 15 Supervisor PCs (172.16.50.100 – 114)



Top



Top

## Test connections: Ping the servers from the PCs

PC255

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ping 172.16.50.10
Pinging 172.16.50.10 with 32 bytes of data:
|
Reply from 172.16.50.10: bytes=32 time=lms TTL=128
Reply from 172.16.50.10: bytes=32 time=lms TTL=128
Reply from 172.16.50.10: bytes=32 time<lms TTL=128
Reply from 172.16.50.10: bytes=32 time<lms TTL=128

Ping statistics for 172.16.50.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.50.11
Pinging 172.16.50.11 with 32 bytes of data:

Reply from 172.16.50.11: bytes=32 time=lms TTL=128
Reply from 172.16.50.11: bytes=32 time<lms TTL=128
Reply from 172.16.50.11: bytes=32 time=lms TTL=128
Reply from 172.16.50.11: bytes=32 time=lms TTL=128

Ping statistics for 172.16.50.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.50.12
Pinging 172.16.50.12 with 32 bytes of data:

Reply from 172.16.50.12: bytes=32 time<lms TTL=128

Ping statistics for 172.16.50.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

PC334

Physical Config Desktop Programming Attributes

Command Prompt

```
Microsoft Windows [Version 10.0.19041]
C:\>ping 172.16.50.10
Pinging 172.16.50.10 with 32 bytes of data:
|
Reply from 172.16.50.10: bytes=32 time=lms TTL=128
Reply from 172.16.50.10: bytes=32 time=lms TTL=128
Reply from 172.16.50.10: bytes=32 time<lms TTL=128
Reply from 172.16.50.10: bytes=32 time<lms TTL=128

Ping statistics for 172.16.50.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.50.11
Pinging 172.16.50.11 with 32 bytes of data:

Reply from 172.16.50.11: bytes=32 time=lms TTL=128
Reply from 172.16.50.11: bytes=32 time<lms TTL=128
Reply from 172.16.50.11: bytes=32 time=lms TTL=128
Reply from 172.16.50.11: bytes=32 time=lms TTL=128

Ping statistics for 172.16.50.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.50.12
Pinging 172.16.50.12 with 32 bytes of data:

Reply from 172.16.50.12: bytes=32 time<lms TTL=128
Reply from 172.16.50.12: bytes=32 time=lms TTL=128
Reply from 172.16.50.12: bytes=32 time<lms TTL=128
Reply from 172.16.50.12: bytes=32 time=lms TTL=128

Ping statistics for 172.16.50.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

PC335

Physical Config Desktop Programming Attributes

Command Prompt X

```
C:\>ping 172.16.50.10
Pinging 172.16.50.10 with 32 bytes of data:
Reply from 172.16.50.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.50.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.50.11
Pinging 172.16.50.11 with 32 bytes of data:
Reply from 172.16.50.11: bytes=32 time<1ms TTL=128
Reply from 172.16.50.11: bytes=32 time<1ms TTL=128
Reply from 172.16.50.11: bytes=32 time=12ms TTL=128
Reply from 172.16.50.11: bytes=32 time=12ms TTL=128

Ping statistics for 172.16.50.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 6ms

C:\>ping 172.16.50.12
Pinging 172.16.50.12 with 32 bytes of data:
Reply from 172.16.50.12: bytes=32 time<1ms TTL=128
Reply from 172.16.50.12: bytes=32 time=1ms TTL=128
Reply from 172.16.50.12: bytes=32 time<1ms TTL=128
Reply from 172.16.50.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.50.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

PC349

Physical Config Desktop Programming Attributes

Command Prompt X

```
C:\>ping 172.16.50.10
Pinging 172.16.50.10 with 32 bytes of data:
Reply from 172.16.50.10: bytes=32 time<1ms TTL=128
Reply from 172.16.50.10: bytes=32 time<1ms TTL=128
Reply from 172.16.50.10: bytes=32 time=1ms TTL=128
Reply from 172.16.50.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.50.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.16.50.11
Pinging 172.16.50.11 with 32 bytes of data:
Reply from 172.16.50.11: bytes=32 time=1ms TTL=128
Reply from 172.16.50.11: bytes=32 time<1ms TTL=128
Reply from 172.16.50.11: bytes=32 time<1ms TTL=128
Reply from 172.16.50.11: bytes=32 time=12ms TTL=128

Ping statistics for 172.16.50.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>ping 172.16.50.12
Pinging 172.16.50.12 with 32 bytes of data:
Reply from 172.16.50.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.50.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

Top

## Configure Core Router Subinterfaces for VLAN 50 and verify the configuration.

The screenshot shows the Router0 CLI interface. The tabs at the top are Physical, Config, CLI (selected), and Attributes. The main window displays the following text:

```
Vlan1 unassigned YES unset administratively down down
Router#ping 172.16.40.20
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.40.20, timeout is 2 seconds:
!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms

Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface GigabitEthernet0/0/0.50
Router(config-subif)#encapsulation dot1Q 50
Router(config-subif)#ip address 172.16.50.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface          IP-Address      OK? Method Status       Protocol
GigabitEthernet0/0/0  unassigned    YES manual up        up
GigabitEthernet0/0/0.10172.16.10.1  YES manual up        up
GigabitEthernet0/0/0.20172.16.20.1  YES manual up        up
GigabitEthernet0/0/0.30172.16.30.1  YES manual up        up
GigabitEthernet0/0/0.40172.16.40.1  YES manual up        up
GigabitEthernet0/0/0.50172.16.50.1  YES manual up        up
GigabitEthernet0/0/1  unassigned    YES unset administratively down down
GigabitEthernet0/0/2  unassigned    YES unset administratively down down
Vlan1              unassigned    YES unset administratively down down
Router#ping 172.16.50.20
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.50.20, timeout is 2 seconds:
!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms
Router#
```

At the bottom right of the window are 'Copy' and 'Paste' buttons. Below the window is a 'Top' button.

Test the connections of the Agent and Supervisor PCs to the Default Gateway (172.16.50.1)

The screenshot shows the PC255 Command Prompt window. The tabs at the top are Physical, Config, Desktop (selected), Programming, and Attributes. The main window displays the following text:

```
Reply from 172.16.50.11: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.50.11:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.50.12

Pinging 172.16.50.12 with 32 bytes of data:

Reply from 172.16.50.12: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.50.12:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.50.1

Pinging 172.16.50.1 with 32 bytes of data:

Reply from 172.16.50.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.16.50.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Below the window is a 'Top' button.

## Question 3.2

NET.COM can implement five key security measures to safeguard their sensitive data and network infrastructure against evolving cyber threats and vulnerabilities. They include the following:

**Firewall Implementation (Perimeter and Host-based):** Implementing well-configured firewalls can help NET.COM prevent unauthorised access and block malicious IPs. This makes firewalls effective for filtering incoming and outgoing traffic based on the network's security rules. Firewalls only have one major weakness: they cannot detect threats inside the network.

**Intrusion Detection and Prevention Systems (IDS/ IPS):** IDS/IPS systems are designed to watch traffic and identify suspicious activity. Once suspicious activity is detected, these systems take automated action to prevent breaches. They will enhance NET.COM's visibility into threats as well as help them prevent their known vulnerabilities to be exploited. Two major weaknesses of these systems are that they can indicate false positives and that they need constant updates.

**VLAN Segmentation and Access Control:** VLANs are designed to limit broadcast traffic and isolate sensitive departments like NET.COM's Finance and HR departments. Implementing VLANs will help NET.COM to prevent attackers from moving laterally and accessing sensitive information and resources. This will improve their overall internal security.

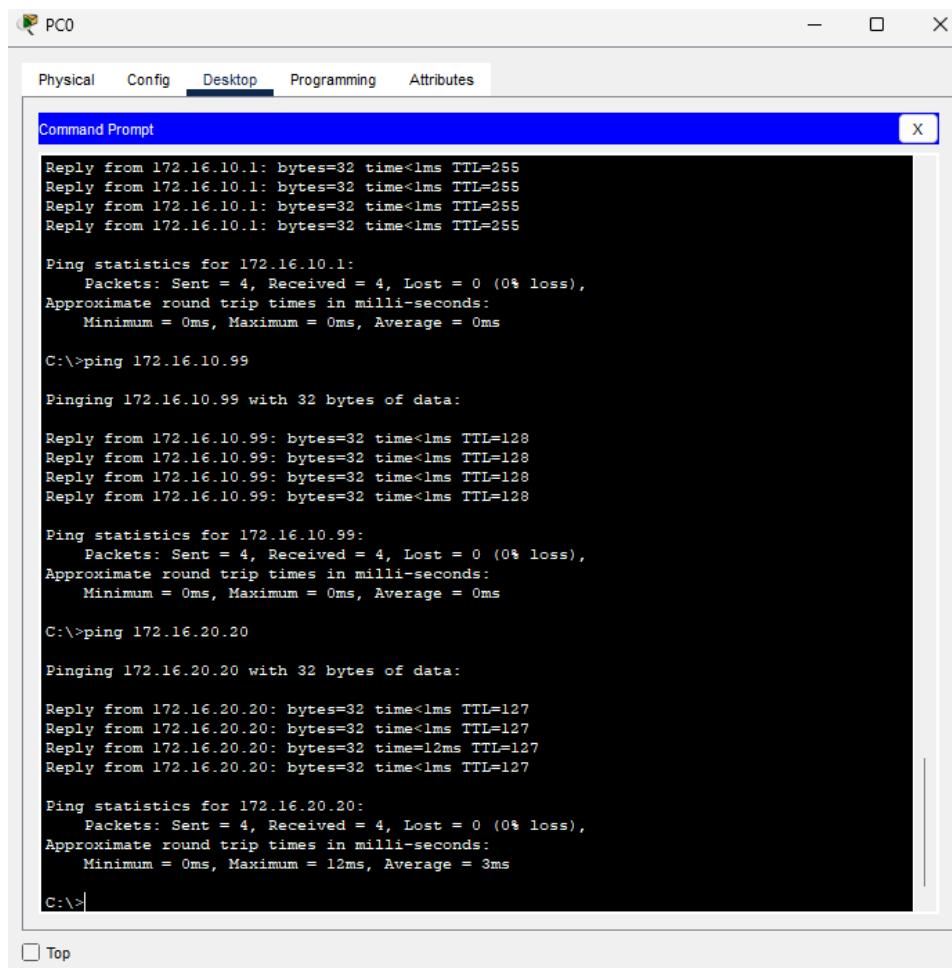
**Authentication and Encryption:** Strong encryption and multi-factor authentication (MFA) can be used in combination to protect data in transit and access credentials. Encryption will help NET.COM prevent eavesdrops, and MFA will help them minimise the risk of stolen credentials. Examples can include WPA3, VPNs, and HTTPS. It should be noted however that when encryption and MFA are improperly configurated, they can leave gaps with vulnerabilities in the network. Virtual private networks (VPNs) can be implemented to secure remote access to the network.

**Frequent Patches and Security Updates:** Regularly patching and updating NET.COM's network can help them prevent exploitations of their known vulnerabilities and close security holes. Moreover, automated patch management tools can be implemented to improve the reliability of their security patches and updates. Legacy systems will still face security risks, regardless of the implementation of these regular security updates.

## Question 3.3

### 1. Ping Test (ICMP Echo Requests):

- **Within the Same Department:** The ping command can be used in Command Prompt from one device to another device in the same VLAN. For example, PC0 can ping the IP address of PC79 (ping 172.16.10.99). If replies are received, local VLAN connectivity is confirmed.
- **Across Different Departments:** The ping command can be used in Command Prompt from one device in a VLAN to another device in a different VLAN. For example, PC0 in VLAN 10 can ping the IP address of PC80 in VLAN 20 (ping 172.16.20.20). If replies are received, it will confirm that inter-VLAN routing is working via the router-on-a-stick setup.



The screenshot shows a Windows Command Prompt window titled "Command Prompt". The window is part of a software interface with tabs for Physical, Config, Desktop, Programming, and Attributes. The Desktop tab is selected. The Command Prompt window displays the following output:

```
Reply from 172.16.10.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.16.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.10.99

Pinging 172.16.10.99 with 32 bytes of data:

Reply from 172.16.10.99: bytes=32 time<1ms TTL=128

Ping statistics for 172.16.10.99:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.20.20

Pinging 172.16.20.20 with 32 bytes of data:

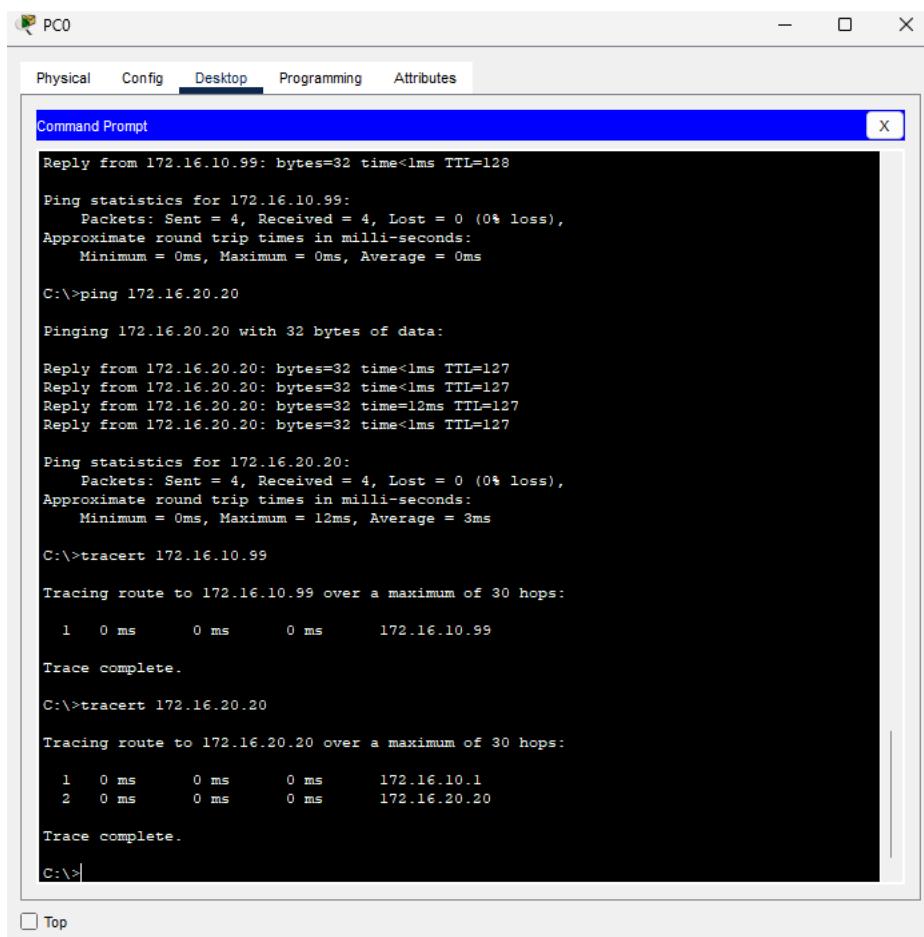
Reply from 172.16.20.20: bytes=32 time<1ms TTL=127
Reply from 172.16.20.20: bytes=32 time<1ms TTL=127
Reply from 172.16.20.20: bytes=32 time=12ms TTL=127
Reply from 172.16.20.20: bytes=32 time<1ms TTL=127

Ping statistics for 172.16.20.20:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>
```

## 2. Traceroute Command:

- **Within the Same Department:** The **tracert** command can be used in Command Prompt from one device to another in the same VLAN. For example, PC0 can trace the route to the IP address of PC79 (**tracert 172.16.10.99**). If the message “Trace complete” is received, local VLAN connectivity is confirmed.
- **Across Different Departments:** The **tracert** command can be used in Command Prompt from one device in a VLAN to another device in a different VLAN. For example, PC0 in VLAN 10 can trace the route to the IP address of PC80 in VLAN 20 (**tracert 172.16.20.20**). If the message “Trace complete” is received, it will confirm that inter-VLAN routing is working via the router-on-a-stick setup.



The screenshot shows a Windows Command Prompt window titled "Command Prompt". The window is part of a larger application interface with tabs for "Physical", "Config", "Desktop", "Programming", and "Attributes". The "Desktop" tab is currently selected. The Command Prompt window displays the following output:

```
Reply from 172.16.10.99: bytes=32 time<1ms TTL=128
Ping statistics for 172.16.10.99:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.20.20

Pinging 172.16.20.20 with 32 bytes of data:

Reply from 172.16.20.20: bytes=32 time<1ms TTL=127
Reply from 172.16.20.20: bytes=32 time<1ms TTL=127
Reply from 172.16.20.20: bytes=32 time=12ms TTL=127
Reply from 172.16.20.20: bytes=32 time<1ms TTL=127

Ping statistics for 172.16.20.20:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>tracert 172.16.10.99

Tracing route to 172.16.10.99 over a maximum of 30 hops:
  1  0 ms      0 ms      0 ms      172.16.10.99
Trace complete.

C:\>tracert 172.16.20.20

Tracing route to 172.16.20.20 over a maximum of 30 hops:
  1  0 ms      0 ms      0 ms      172.16.10.1
  2  0 ms      0 ms      0 ms      172.16.20.20
Trace complete.

C:\>
```

A "Top" button is visible at the bottom left of the Command Prompt window.

### 3. Verify ARP and MAC Tables:

- Verify on the Core Router:** The `show ip arp` command can be used at the IOS Command Line Interface of the Core Router to display the Address Resolution Protocol (ARP) table. This maps IP addresses to their corresponding MAC (hardware) addresses for devices that the router has communicated with.

The screenshot shows the Cisco IOS Command Line Interface (CLI) for a router named 'Router'. The window title is 'Router0'. The tabs at the top are 'Physical', 'Config', 'CLI' (which is selected), and 'Attributes'. The main text area displays the output of the `show ip arp` command. The output shows the ARP table with columns: Protocol, Address, Age (min), Hardware Addr, Type, and Interface. The table lists several entries for different IP addresses and their corresponding MAC addresses and interfaces.

```
Router>enable
Router#show ip arp
Protocol Address      Age (min) Hardware Addr   Type   Interface
Internet 172.16.10.20    160 00D0.582C.E1B7  ARPA   GigabitEthernet0/0/0.10
Internet 172.16.20.20    113 00D0.97B7.3E41  ARPA   GigabitEthernet0/0/0.20
Internet 172.16.30.20    109 000A.41A3.2D14  ARPA   GigabitEthernet0/0/0.30
Internet 172.16.40.20    107 000C.B8E6.0D90  ARPA   GigabitEthernet0/0/0.40
Internet 172.16.50.20    105 000A.F3E2.CB9C  ARPA   GigabitEthernet0/0/0.50
Router#
```

- Verify on Switches:** The `show mac address-table` command can be used at the IOS Command Line Interface of the Core Switch, a Distribution Switch, or an Access Switch to ensure the MAC addresses of devices are being learned correctly.

The screenshot shows the Cisco IOS Command Line Interface (CLI) for a switch named 'Core Switch'. The window title is 'Core Switch'. The tabs at the top are 'Physical', 'Config', 'CLI' (selected), and 'Attributes'. The main text area displays the output of the `show mac address-table` command. The output shows the MAC address table with columns: Vlan, Mac Address, Type, and Ports. The table lists numerous entries for different MAC addresses and their associated ports and VLANs.

```
Switch>enable
Switch#show mac address-table
Mac Address Table
-----
Vlan  Mac Address      Type      Ports
---  -----
1    0000.0ca4.2b19  DYNAMIC   Fa0/2
1    0000.0cd7.8b01  DYNAMIC   Giog0/1
1    0002.4a6d.2e19  DYNAMIC   Fa0/4
1    000a.418c.7619  DYNAMIC   Fa0/3
1    000c.cf87.3519  DYNAMIC   Fa0/1
1    0060.7093.3019  DYNAMIC   Giog0/2
10   0000.0cd7.8b01  DYNAMIC   Giog0/1
10   0060.7093.3019  DYNAMIC   Giog0/2
20   0000.0cd7.8b01  DYNAMIC   Giog0/1
20   000c.cf87.3519  DYNAMIC   Fa0/1
30   0000.0ca4.2b19  DYNAMIC   Fa0/2
30   0000.0cd7.8b01  DYNAMIC   Giog0/1
40   0000.0cd7.8b01  DYNAMIC   Giog0/1
40   000a.418c.7619  DYNAMIC   Fa0/3
50   0000.0cd7.8b01  DYNAMIC   Giog0/1
50   0002.4a6d.2e19  DYNAMIC   Fa0/4
Switch#
```

Finance Distribution Switch

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Switch>enable
Switch#show mac address-table
  Mac Address Table
-----
Vlan   Mac Address      Type      Ports
----  -----
  1    0002.16eb.b51a  DYNAMIC   Gig0/1
  1    000d.bdc6.1319  DYNAMIC   Fa0/5
  1    00d0.ba5d.b119  DYNAMIC   Fa0/4
  1    00d0.ff75.c119  DYNAMIC   Fa0/6
  1    00e0.f991.5919  DYNAMIC   Fa0/3
  10   00d0.ba5d.b119  DYNAMIC   Fa0/4
Switch#
```

Switch con0 is now available

Press RETURN to get started.

Top

Accounting Access Switch1

Physical Config **CLI** Attributes

IOS Command Line Interface

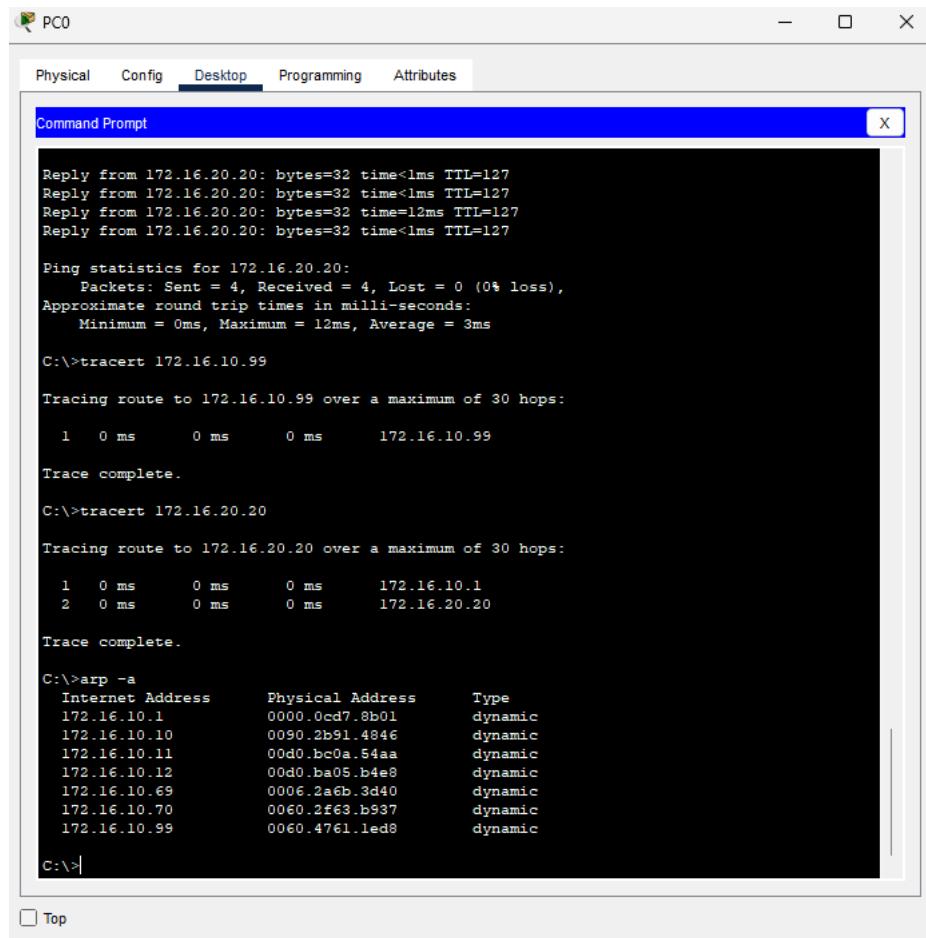
```
Switch>enable
Switch#show mac address-table
  Mac Address Table
-----
Vlan   Mac Address      Type      Ports
----  -----
  1    0060.7093.3003  DYNAMIC   Gig0/1
  10   0060.7093.3003  DYNAMIC   Gig0/1
Switch#
```

Switch con0 is now available

Press RETURN to get started.

Top

- **Verify on PCs:** The arp -a command can be used in Command Prompt on a PC to confirm that the correct IP-to-MAC mappings exist. This will indicate local layer 2 connectivity.



```

PC0

Physical Config Desktop Programming Attributes

Command Prompt

Reply from 172.16.20.20: bytes=32 time<1ms TTL=127
Reply from 172.16.20.20: bytes=32 time<1ms TTL=127
Reply from 172.16.20.20: bytes=32 time=12ms TTL=127
Reply from 172.16.20.20: bytes=32 time<1ms TTL=127

Ping statistics for 172.16.20.20:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>tracert 172.16.10.99

Tracing route to 172.16.10.99 over a maximum of 30 hops:
  1  0 ms      0 ms      0 ms      172.16.10.99
Trace complete.

C:\>tracert 172.16.20.20

Tracing route to 172.16.20.20 over a maximum of 30 hops:
  1  0 ms      0 ms      0 ms      172.16.10.1
  2  0 ms      0 ms      0 ms      172.16.20.20
Trace complete.

C:\>arp -a
   Internet Address        Physical Address          Type
   172.16.10.1              0000.0cd7.8b01      dynamic
   172.16.10.10             0090.2b91.4846      dynamic
   172.16.10.11             00d0.bc0a.54aa      dynamic
   172.16.10.12             00d0.ba05.b4e8      dynamic
   172.16.10.69             0006.2a6b.3d40      dynamic
   172.16.10.70             0060.2f63.b937      dynamic
   172.16.10.99             0060.4761.led8      dynamic

C:\>

```

These three methods will help verify whether connectivity exists at both Layer 2, where the VLANs are, and Layer 3 across the VLANs. They will enable network administrators to isolate and troubleshoot issues more effectively and with ease.

## Question 3.4

To facilitate shared resource access like shared servers, printers, or applications, among different departments while ensuring security, efficiency, and scalability, the following analysis can be conducted. This analysis will outline a structured approach.

Firstly, network segmentation can be executed with VLANs. This is also called logical separation. With this step, each department is placed in its own VLAN to isolate broadcast domains and enhance overall security of the network. In this case, VLAN 10 is assigned to the Finance department, VLAN 20 to Marketing, VLAN 30 to R&D, VLAN 40 to HR, and VLAN 50 to the Customer Service department.

Secondly, inter-VLAN routing can be performed via Router-on-a-Stick. This means that a router or Layer 3 switch is configured with sub-interfaces to route traffic between departments. This will allow communication between the VLANs. Moreover, this will keep the departments isolated while still allowing them to share their services to each other securely.

Thirdly, shared servers can be deployed in a separate VLAN or DMZ like VLAN 99, that will be reachable by all departments through firewall rules and controlled routing. This will bring three main advantages to the network: Access permissions will be easier to manage, control and monitoring will be improved, and redundant resources will be reduced.

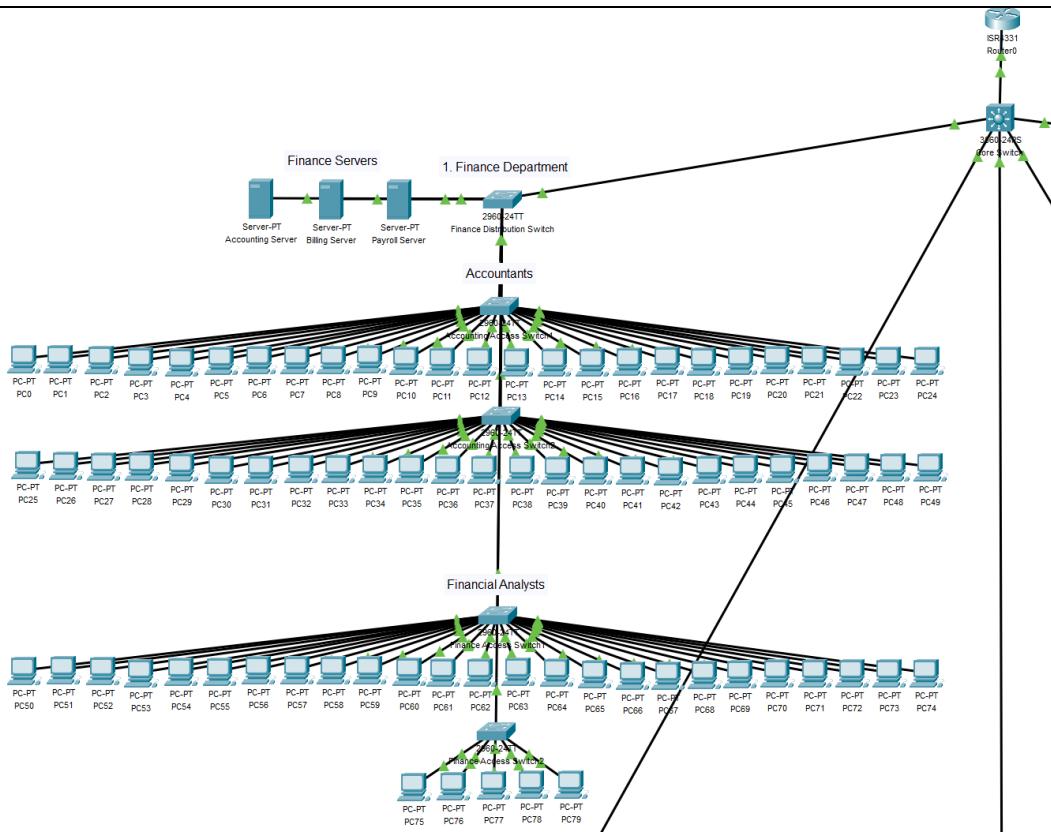
Fourthly, Access Control Lists (ACLs) and Firewalls can be implemented. Implementing ACLs on the core router or layer 3 switch will allow them to permit and deny traffic between VLAMs. This will also allow all other VLANs to access the server VLAN. Moreover, it will allow them to deny unnecessary inter-departmental communication to reduce the attack surface.

Lastly, DNS and DHCP can be used for dynamic access. The DHCP will assign IPs automatically to clients in each VLAN, while the DNS will allow devices to resolve the names of shared resources. Together these two will ensure access without manual IP entry.

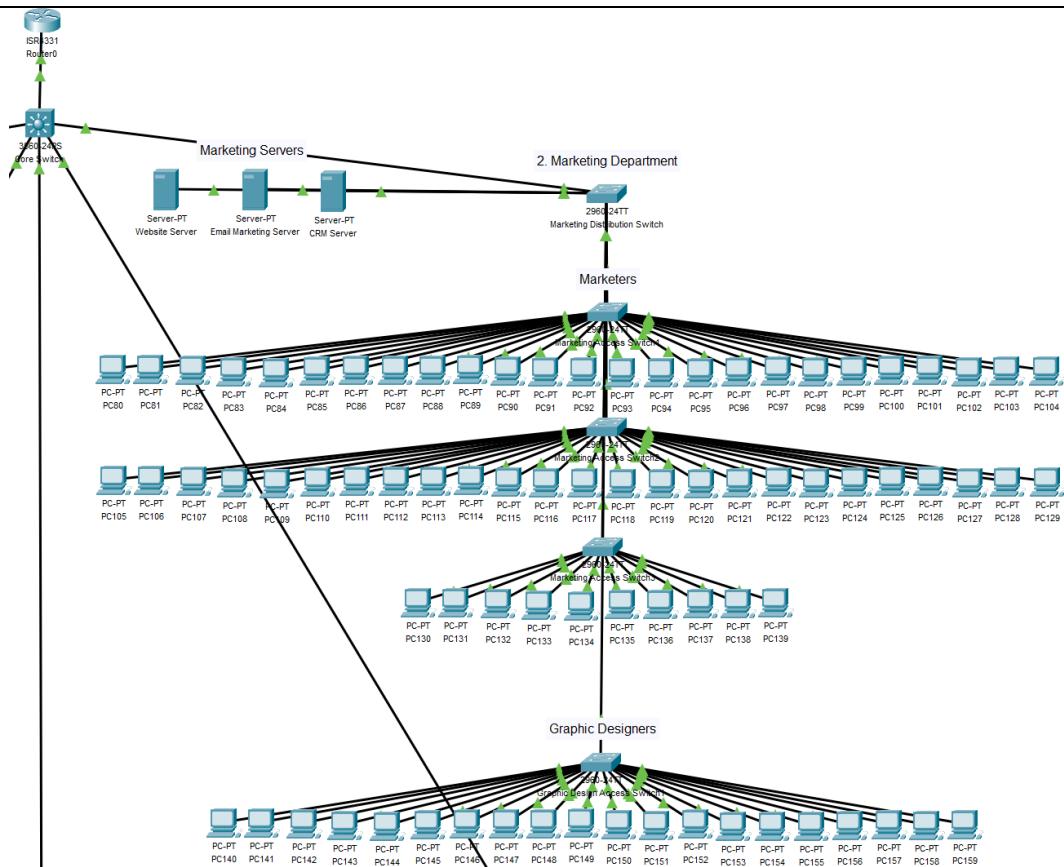
Combining these steps into a single design will help NET.COM ensure that their resources are securely and efficiently shared among departments. This design will also maintain scalability, isolation, and control.

# Final Network Topology

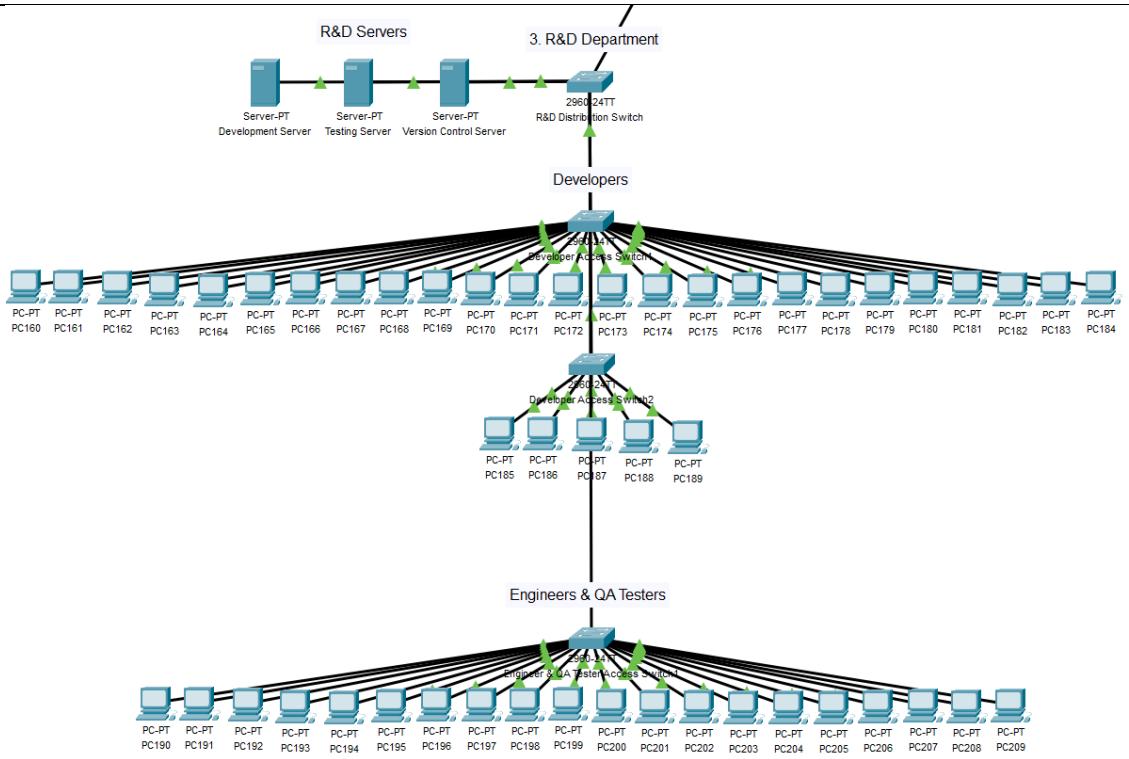
## 1. Finance Department



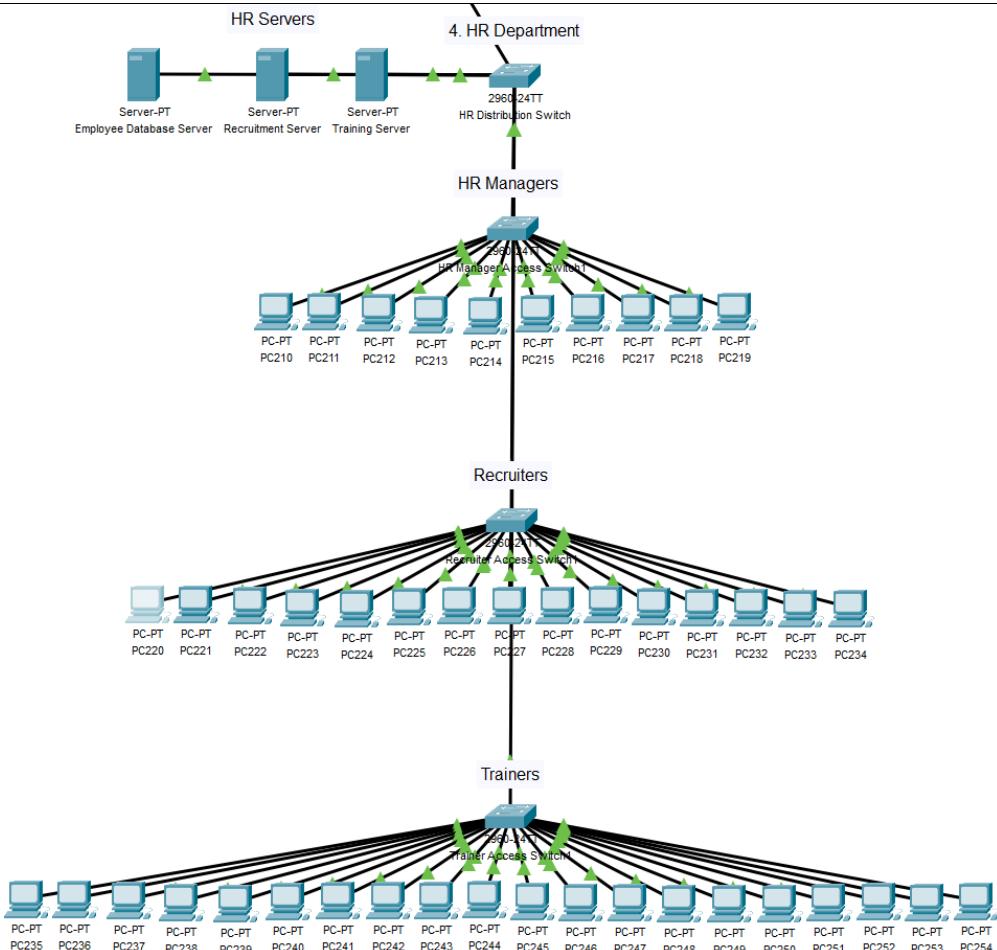
## 2. Marketing Department



### 3. R&D Department



### 4. HR Department



## 5. HR Department

