Week 4 Assignment 1

Course: Cloud and Network Security - C1-2026

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Week four Assignment one:

Class exercise: VLANs and Secure Switch Configuration

Contents

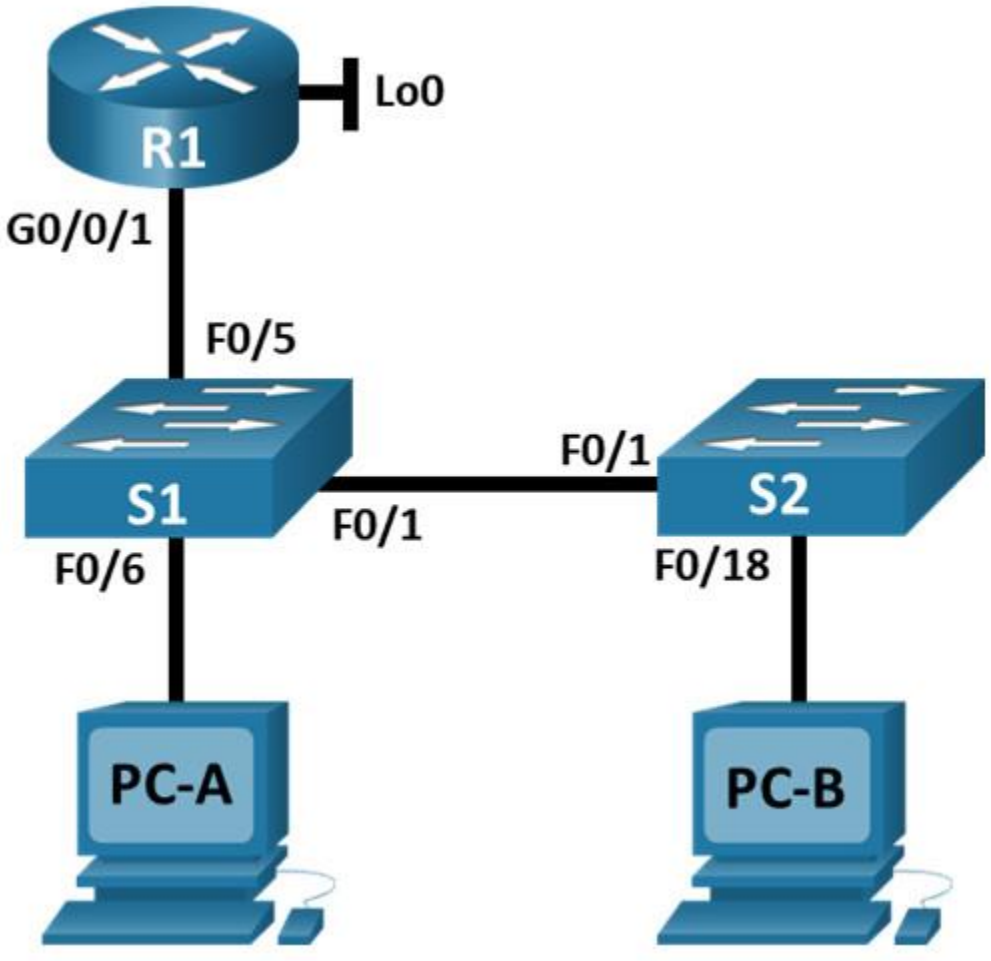
Introduction

In this comprehensive lab, VLANs and Secure Switch Configuration, we focus on hardening Layer 2 network infrastructure by reviewing and implementing essential security features. The primary objective is to transform a basic network topology consisting of a router, switches, and workstations into a secure, segmented environment.

Throughout this exercise, we will move beyond initial device initialization to advanced configuration tasks. This includes the creation and management of VLANs to segment traffic, specifically establishing distinct Management, Native, and "Parking Lot" VLANs to organize and isolate network resources. A significant portion of this lab is dedicated to implementing robust

switch security measures. We will configure 802.1Q trunking, secure access ports using Port Security features like sticky MAC addresses, and defend against common network attacks by deploying DHCP Snooping, PortFast, and BPDU Guard. By the end of this session, the network will be configured not just for connectivity, but for resilience against unauthorized access and Layer 2 vulnerabilities.

Topology



Addressing Table

Device	Interface / VLAN	IP Address	Subnet Mask
R1	G0/0/1	192.168.10.1	255.255.255.0
	Loopback 0	10.10.1.1	255.255.255.0

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Device	Interface / VLAN	IP Address	Subnet Mask
S1	**VLAN 10**	**192.168.10.201**	**255.255.255.0**
S2	**VLAN 10**	**192.168.10.202**	**255.255.255.0**
PC – A	**NIC**	**DHCP**	**255.255.255.0**
PC – B	**NIC**	**DHCP**	**255.255.255.0**

Objectives

Part 1: Configure the Network Devices.

- Cable the network.
- Configure R1.
- Configure and verify basic switch settings.

Part 2: Configure VLANs on Switches.

- Configure VLAN 10.
- Configure the SVI for VLAN 10.
- Configure VLAN 333 with the name Native on S1 and S2.
- Configure VLAN 999 with the name ParkingLot on S1 and S2.

Part 3: Configure Switch Security.

- Implement 802.1Q trunking.
- Configure access ports.
- Secure and disable unused switchports.
- Document and implement port security features.
- Implement DHCP snooping security.
- Implement PortFast and BPDU guard.

- Verify end-to-end-connectivity.

Background / Scenario

This is a comprehensive lab to review previously covered Layer 2 security features.

Note: The routers used with CCNA hands-on labs are Cisco 4221 with Cisco IOS XE Release 16.9.3 (universalk9 image). The switches used in the labs are Cisco Catalyst 2960s with Cisco IOS Release 15.0(2) (lanbasek9 image). Other routers, switches, and Cisco IOS versions can be used.

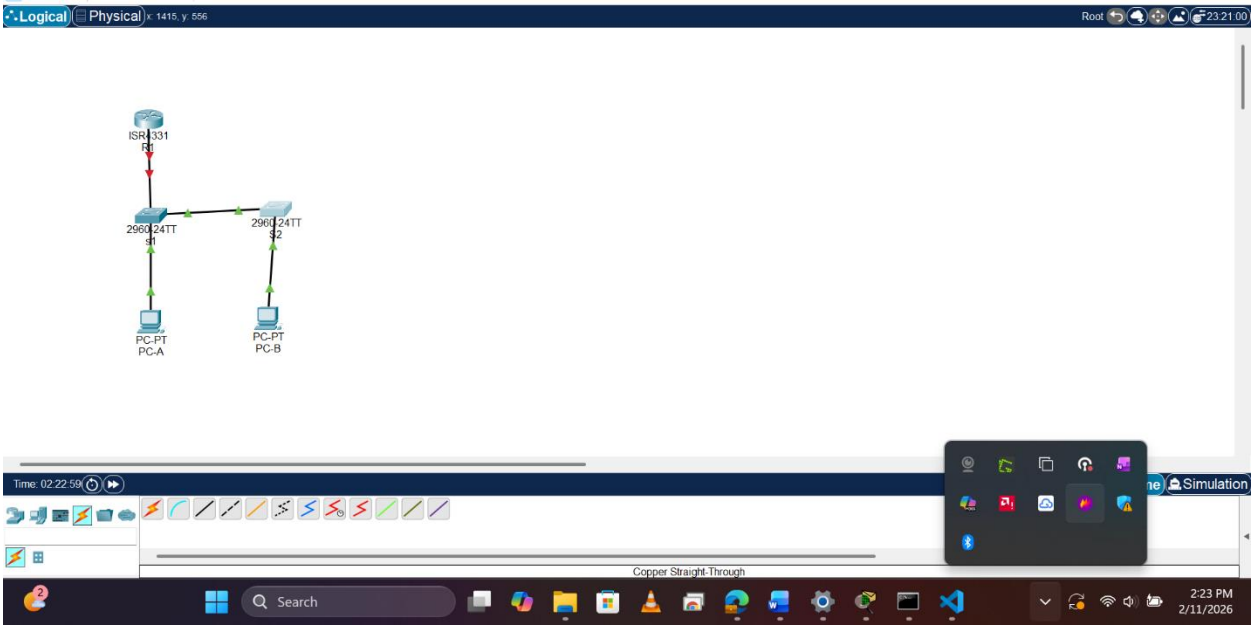
Note: Make sure that the switches have been erased and have no startup configurations. If you are unsure, contact your instructor.

Instructions

Part 1: Configure the Network Devices.

Step 1: Cable the network.

a. Cable the network as shown in the topology.



b. Initialize the devices.

Step 2: Configure R1.

a. Load the following configuration script on R1.

enable

configure terminal

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```
hostname R1
no ip domain lookup
ip dhcp excluded-address 192.168.10.1 192.168.10.9
ip dhcp excluded-address 192.168.10.201 192.168.10.202
!
ip dhcp pool Students
 network 192.168.10.0 255.255.255.0
 default-router 192.168.10.1
 domain-name CCNA2.Lab-11.6.1
!
interface Loopback0
 ip address 10.10.1.1 255.255.255.0
!
interface GigabitEthernet0/0/1
 description Link to S1 Port 5
 ip dhcp relay information trusted
 ip address 192.168.10.1 255.255.255.0
 no shutdown
!
line con 0
 logging synchronous
 exec-timeout 0 0
```

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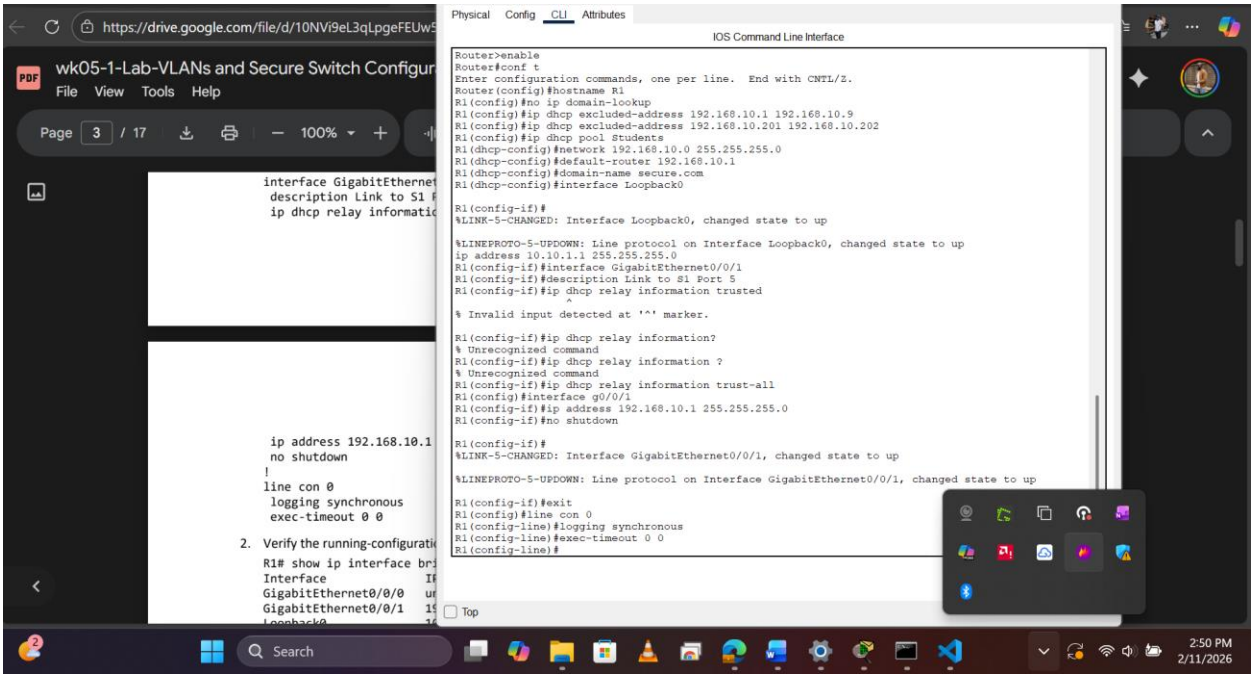

b. Verify the running-configuration on R1 using the following command:

R1# **show ip interface brief**

Interface	IP-Address	OK?	Method	Status	Protocol
GigabitEthernet0/0/0	unassigned	YES	unset	down	down
GigabitEthernet0/0/1	192.168.10.1	YES	manual	up	up
Loopback0	10.10.1.1	YES	manual	up	up

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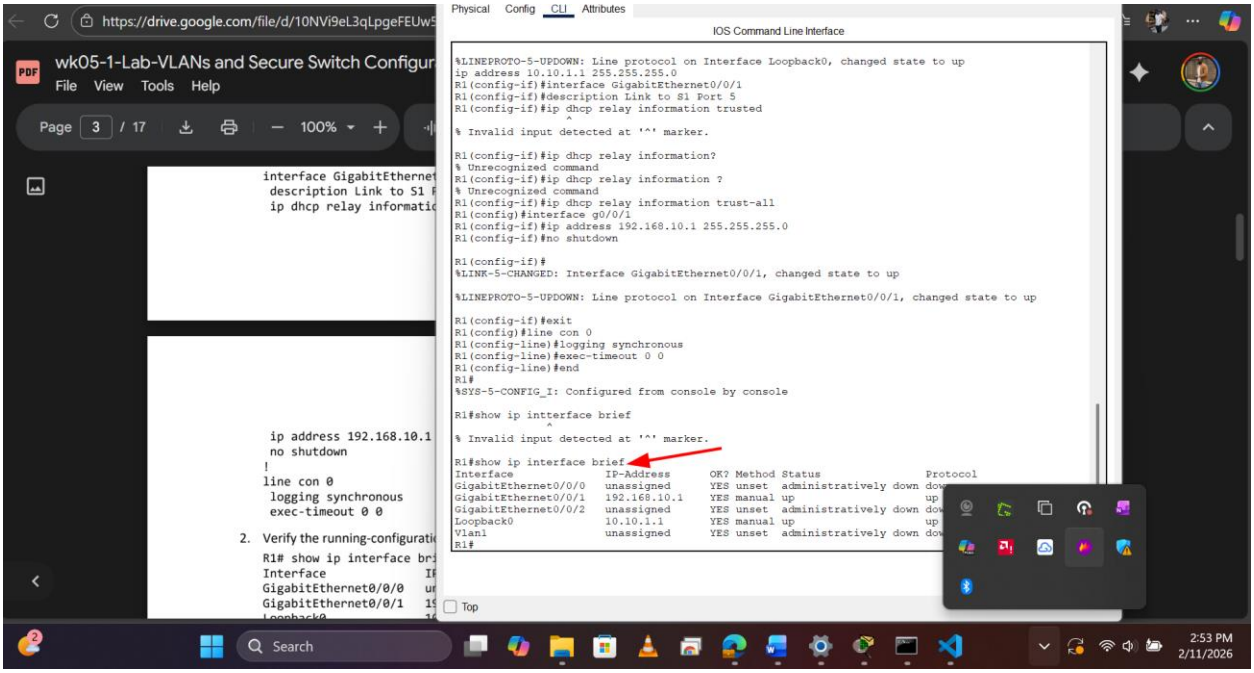
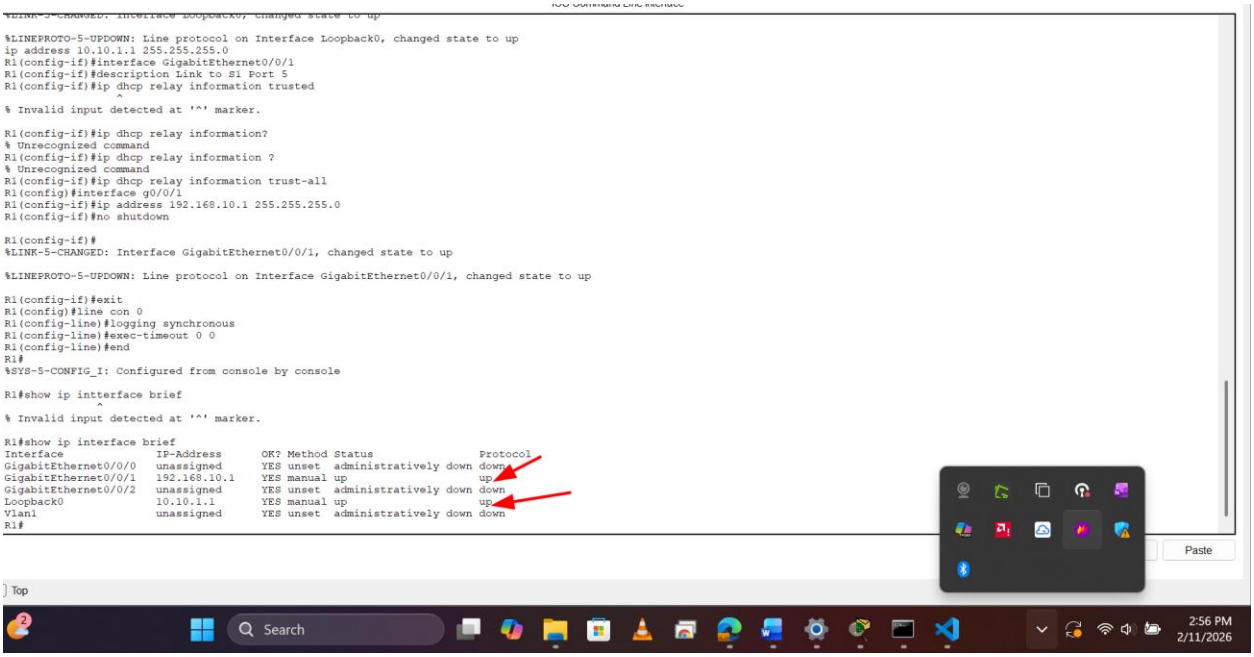


c. Verify IP addressing and interfaces are in an up / up state (troubleshoot as necessary).



Step 3: Configure and verify basic switch settings.

a. Configure the hostname for switches S1 and S2.

Switch# config t

Switch(config)# hostname S1

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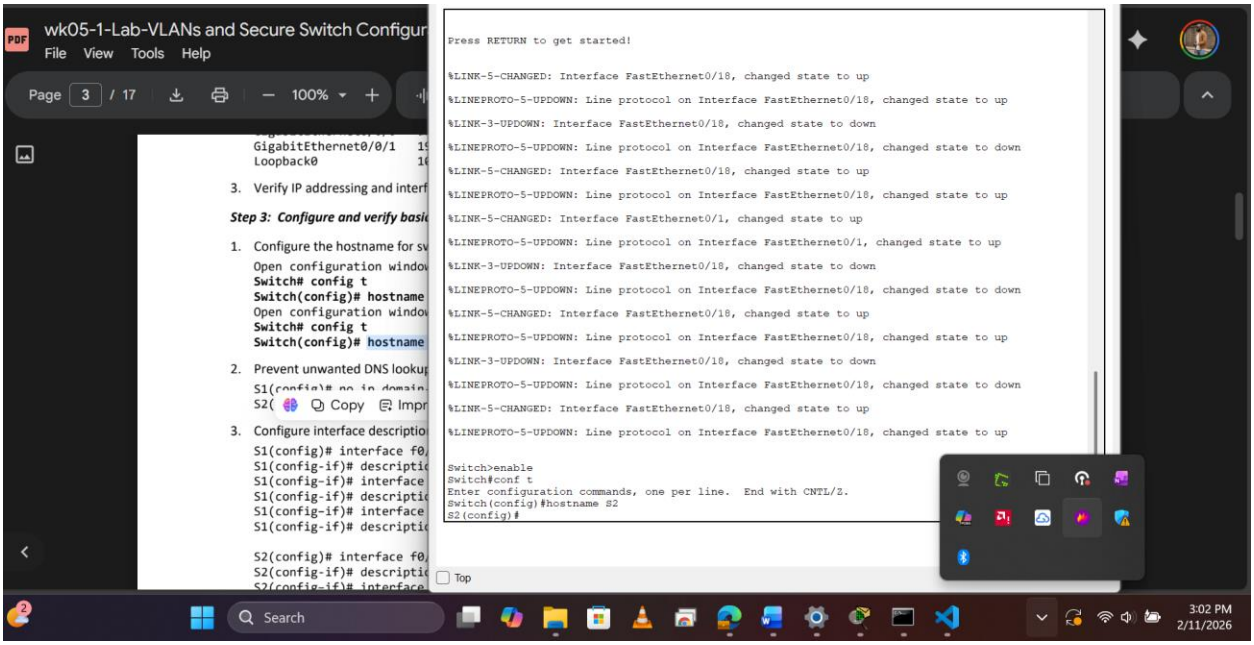
Switch# config t

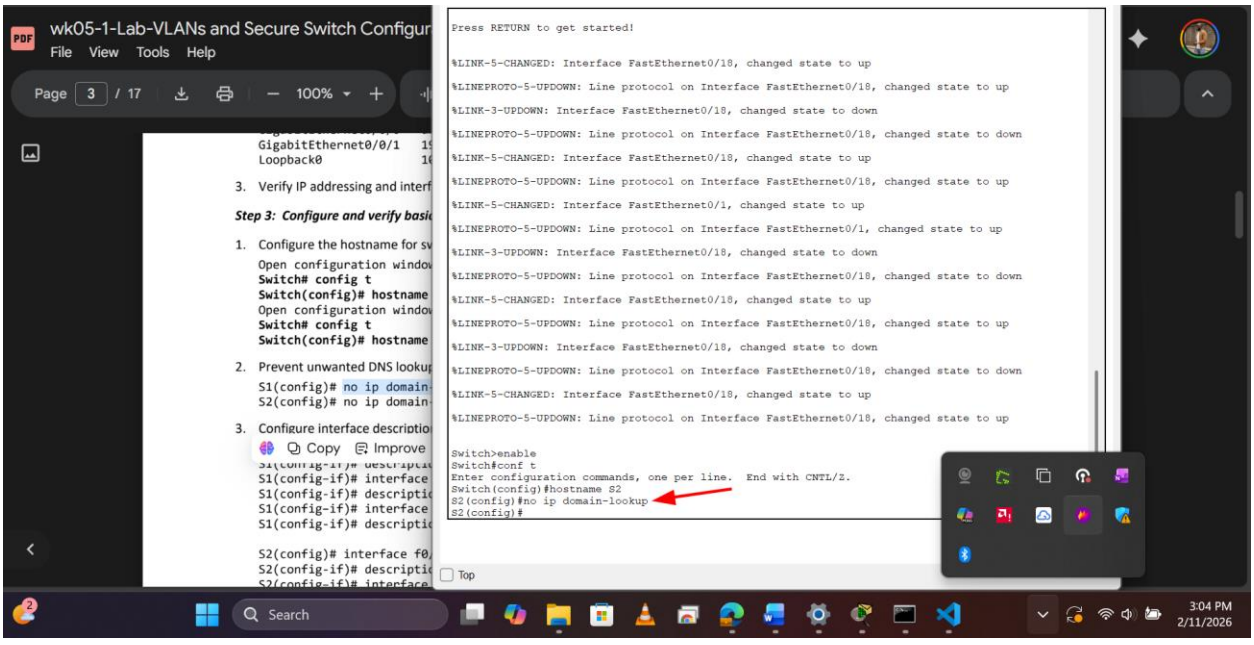
Switch(config)# hostname S2



b. Prevent unwanted DNS lookups on both switches.

S1(config)# no ip domain-lookup

S2(config)# no ip domain-lookup



c. Configure interface descriptions for the ports that are in use in S1 and S2.

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S1(config)# interface f0/1

S1(config-if)# description Link to S2

S1(config-if)# interface f0/5

S1(config-if)# description Link to R1

S1(config-if)# interface f0/6

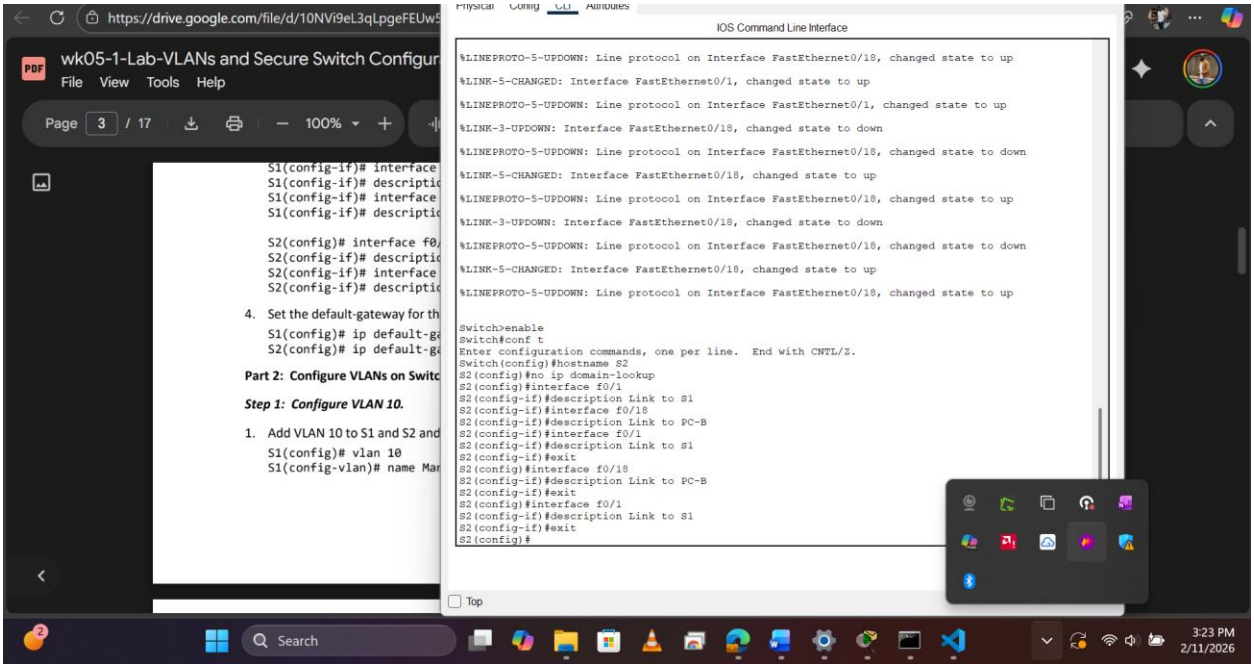
S1(config-if)# description Link to PC-A

S2(config)# interface f0/1

S2(config-if)# description Link to S1

S2(config-if)# interface f0/18

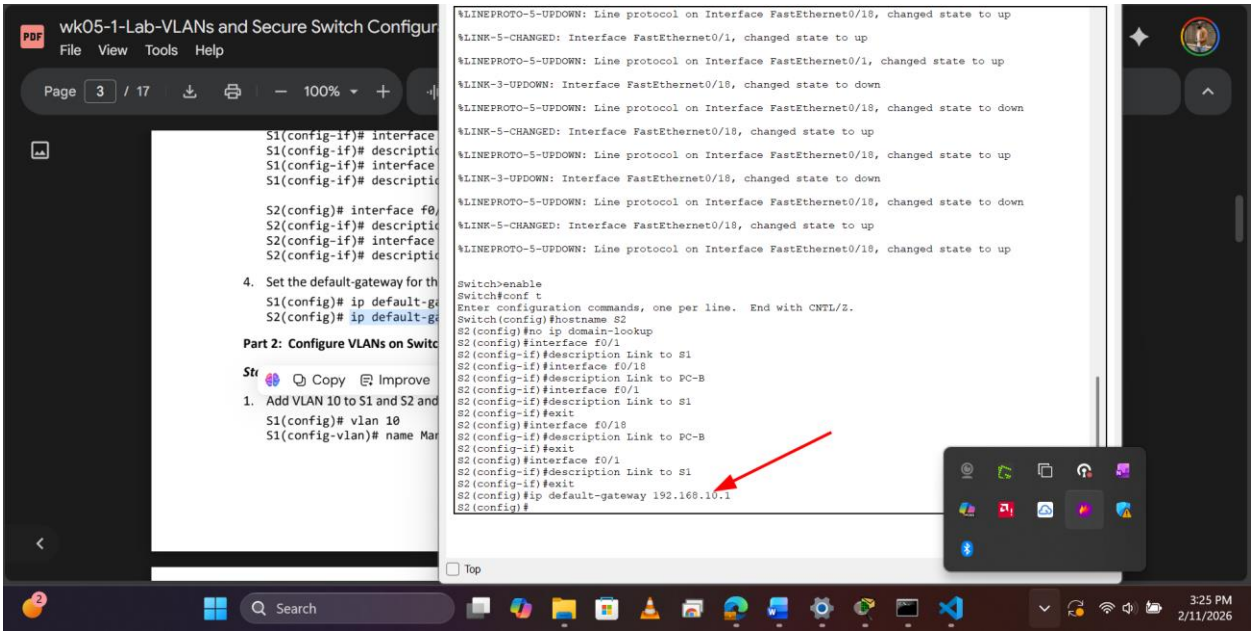
S2(config-if)# description Link to PC-B



d. Set the default-gateway for the Management VLAN to 192.168.10.1 on both switches.

S1(config)# ip default-gateway 192.168.10.1

S2(config)# ip default-gateway 192.168.10.1



Part 2: Configure VLANs on Switches.

Step 1: Configure VLAN 10.

Add VLAN 10 to S1 and S2 and name the VLAN **Management.**

S1(config)# vlan 10

S1(config-vlan)# name Management

S2(config)# vlan 10

S2(config-vlan)# name Management

Step 2: Configure the SVI for VLAN 10.

Configure the IP address according to the Addressing Table for SVI for VLAN 10 on S1 and S2. Enable the SVI interfaces and provide a description for the interface.

S1(config)# interface vlan 10

S1(config-if)# ip address 192.168.10.201 255.255.255.0

S1(config-if)# description Management SVI

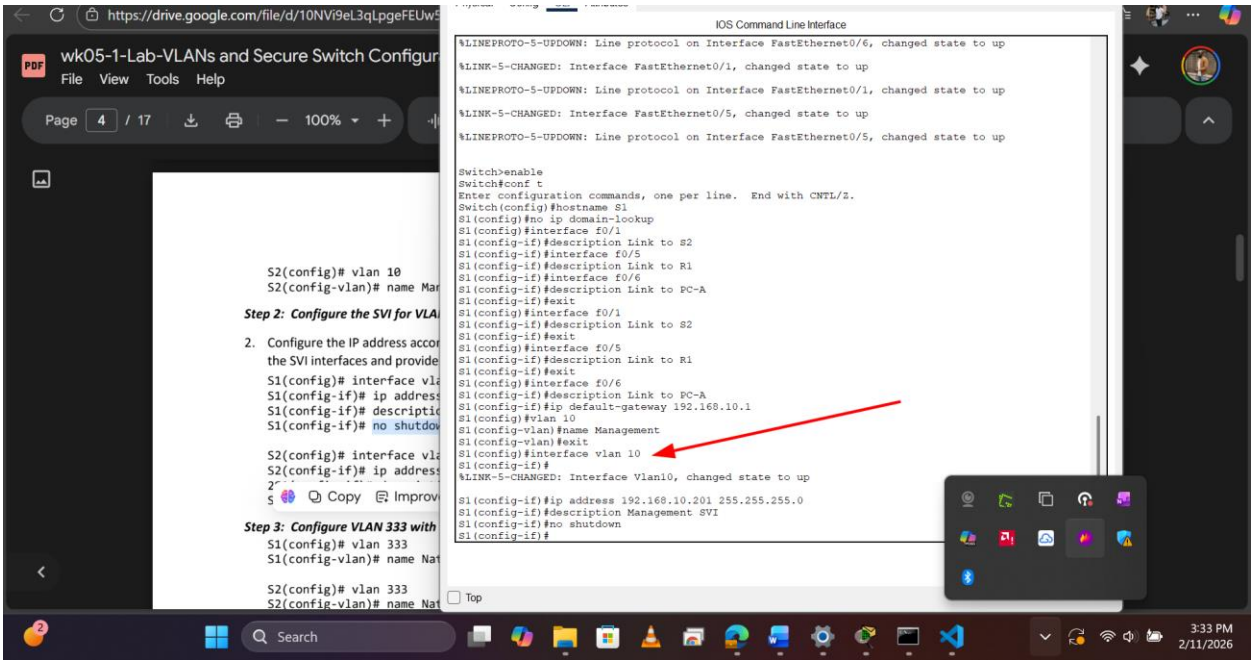
S1(config-if)# no shutdown

S2(config)# interface vlan 10

S2(config-if)# ip address 192.168.10.202 255.255.255.0

S2(config-if)# description Management SVI

S2(config-if)# no shutdown



Step 3: Configure VLAN 333 with the name Native on S1 and S2.

S1(config)# vlan 333

S1(config-vlan)# name Native

S2(config)# vlan 333

S2(config-vlan)# name Native

Step 4: Configure VLAN 999 with the name ParkingLot on S1 and S2.

S1(config-vlan)# vlan 999

S1(config-vlan)# name ParkingLot

S2(config-vlan)# vlan 999

S2(config-vlan)# name ParkingLot

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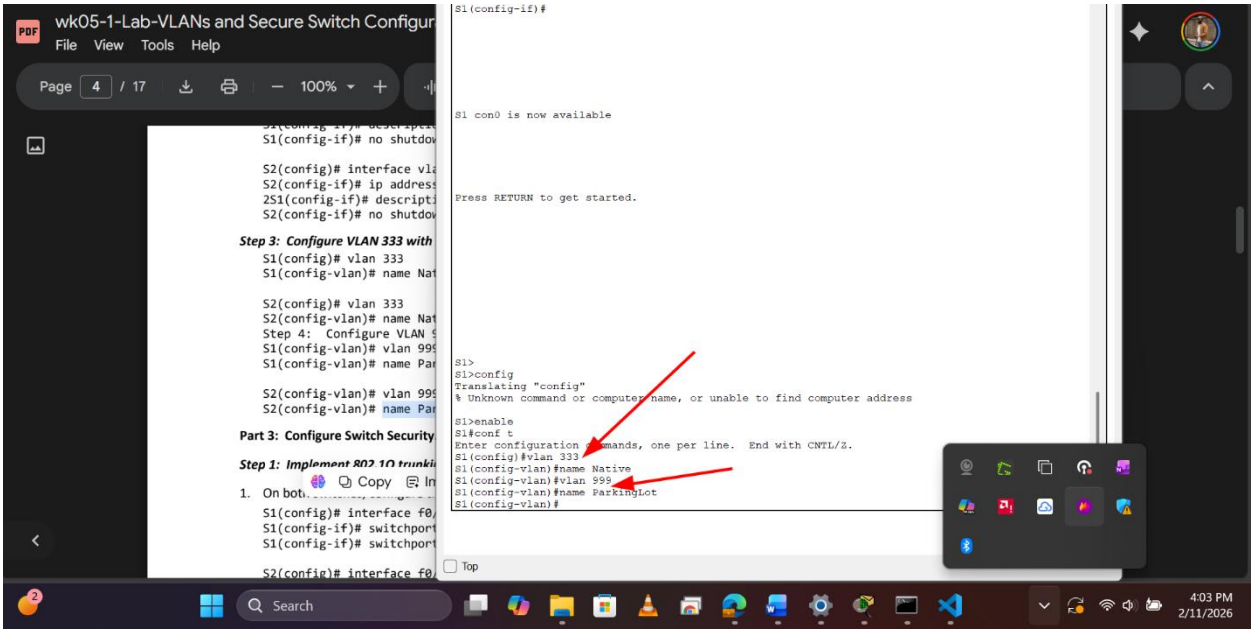

Part 3: Configure Switch Security.

Step 1: Implement 802.1Q trunking.

a. On both switches, configure trunking on F0/1 to use VLAN 333 as the native VLAN.

S1(config)# interface f0/1

S1(config-if)# switchport mode trunk

S1(config-if)# switchport trunk native vlan 333

S2(config)# interface f0/1

S2(config-if)# switchport mode trunk

S2(config-if)# switchport trunk native vlan 333

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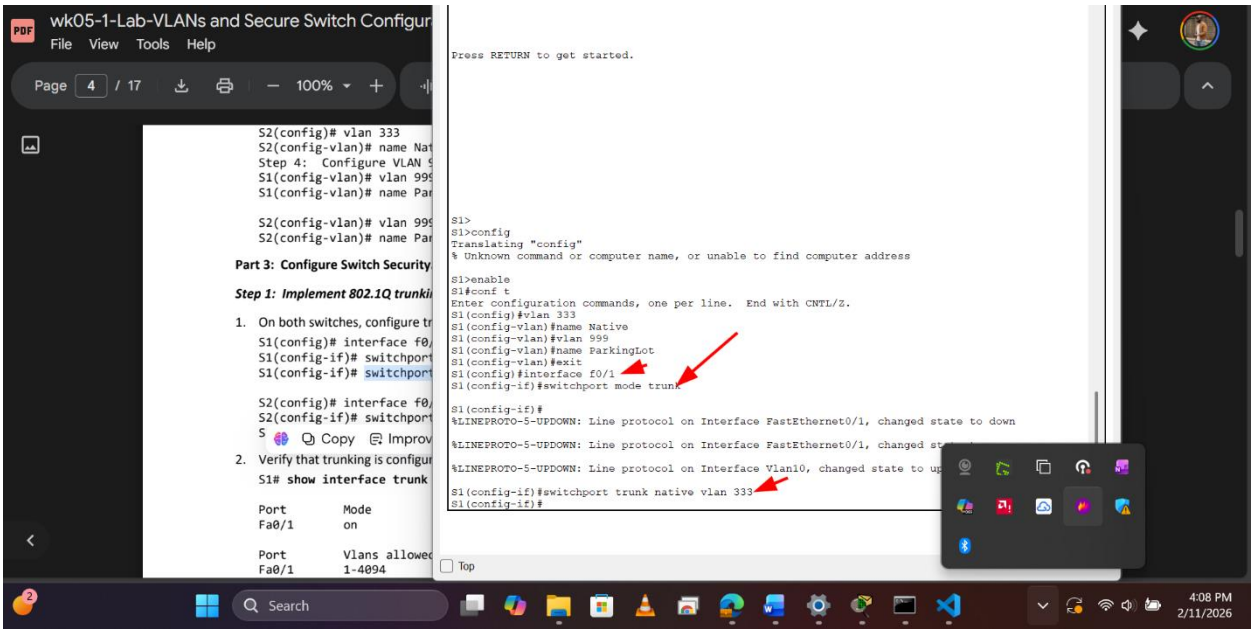

b. Verify that trunking is configured on both switches.

S1# **show interface trunk**

Port	Mode	Encapsulation	Status	Native vlan
Fa0/1	on	802.1q	trunking	333

Port	Vlans allowed on trunk
Fa0/1	1-4094

Port	Vlans allowed and active in management domain
Fa0/1	1,10,333,999

Port	Vlans in spanning tree forwarding state and not pruned
Fa0/1	1,10,333,999

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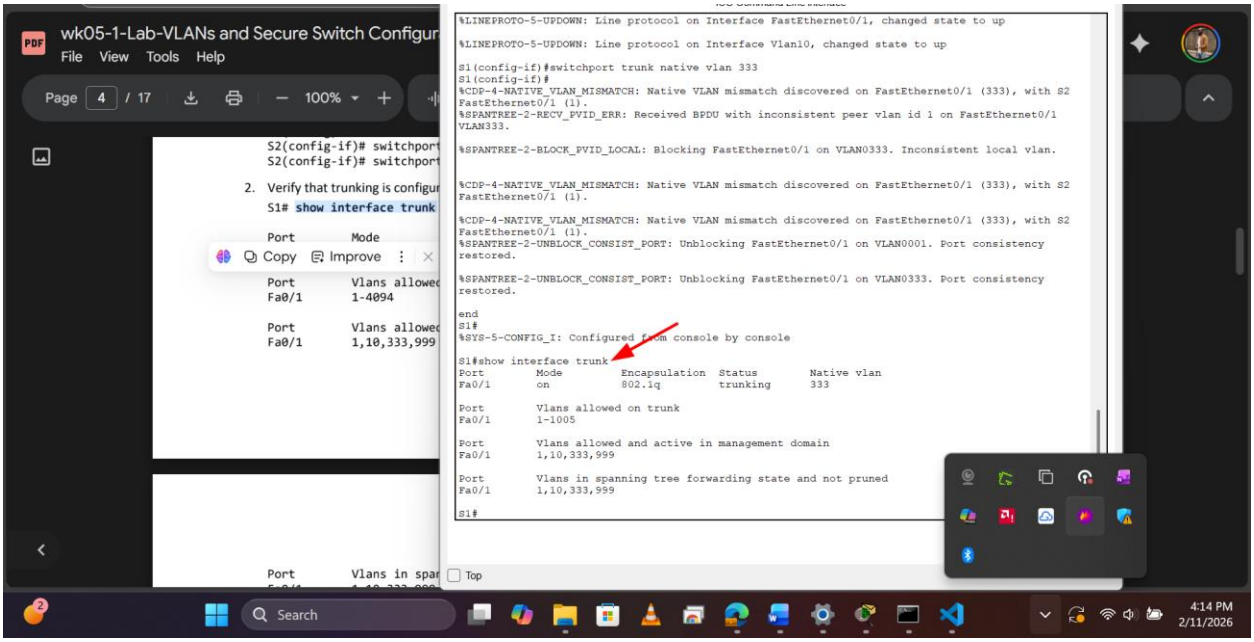

S2# **show interface trunk**

Port	Mode	Encapsulation	Status	Native vlan
Fa0/1	on	802.1q	trunking	333

Port	Vlans allowed on trunk
Fa0/1	1-4094

Port	Vlans allowed and active in management domain
Fa0/1	1,10,333,999

Port	Vlans in spanning tree forwarding state and not pruned
Fa0/1	1,10,333,999

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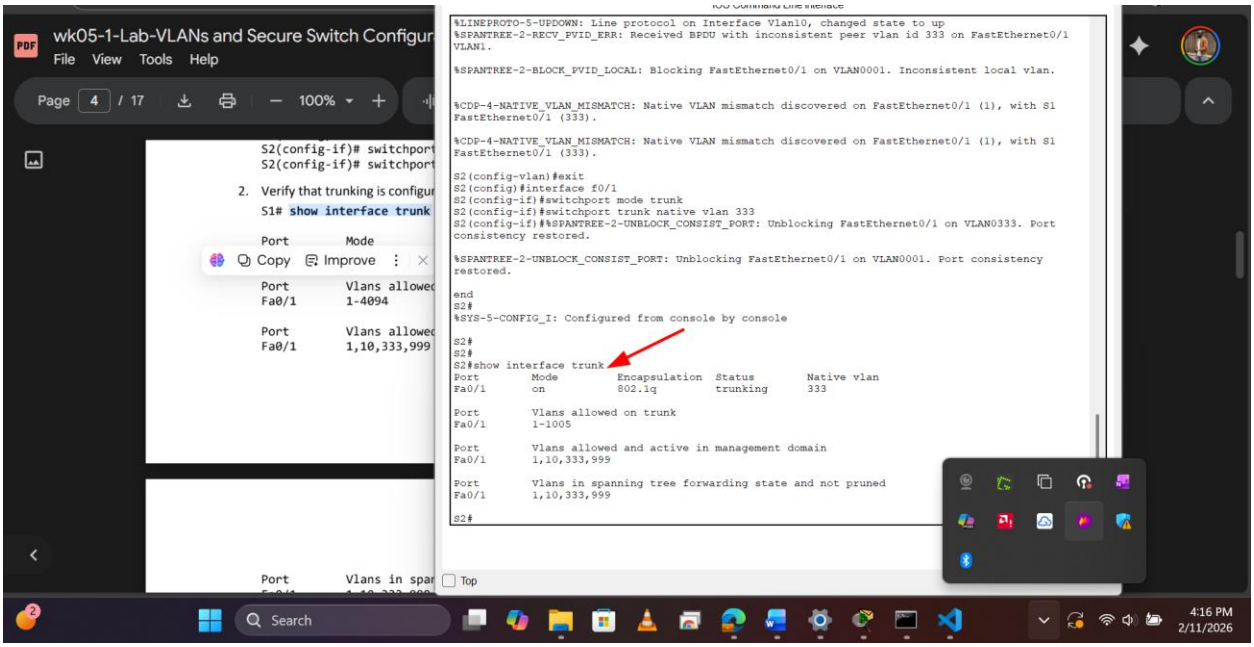


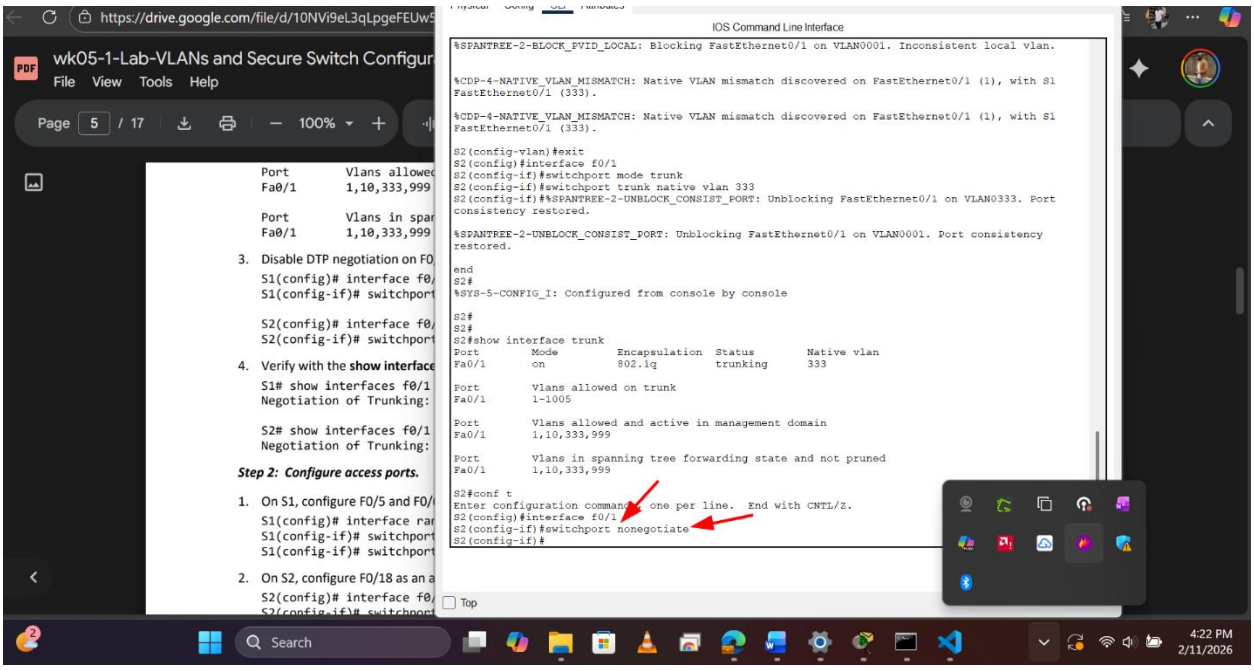
c. Disable DTP negotiation on F0/1 on S1 and S2.

S1(config)# interface f0/1

S1(config-if)# switchport nonegotiate

S2(config)# interface f0/1

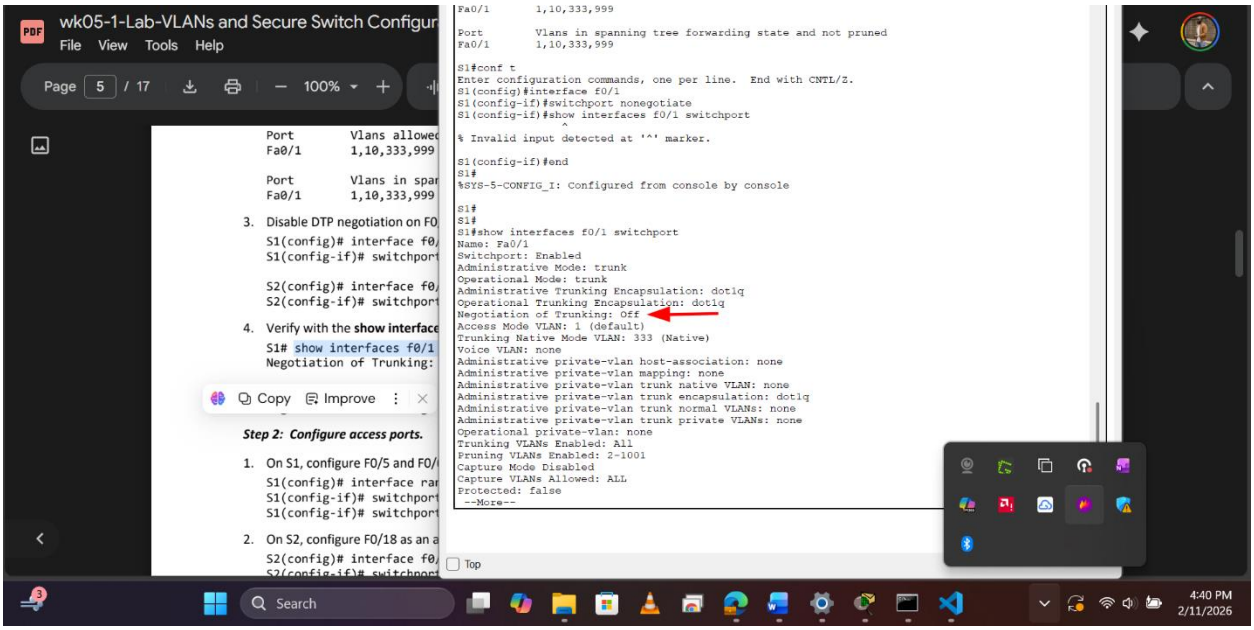
S2(config-if)# switchport nonegotiate



d. Verify with the **show interfaces** command.

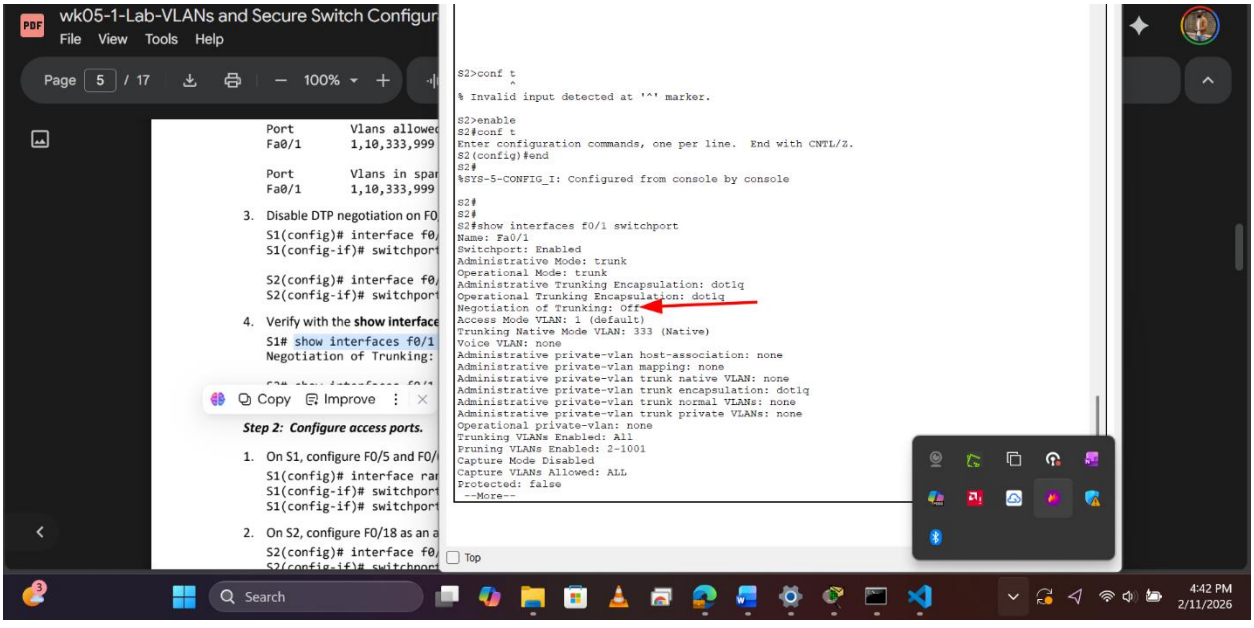
S1# **show interfaces f0/1 switchport | include Negotiation**

Negotiation of Trunking: Off



S2# **show interfaces f0/1 switchport | include Negotiation**

Negotiation of Trunking: Off



Step 2: Configure access ports.

a. On S1, configure F0/5 and F0/6 as access ports that are associated with VLAN 10.

S1(config)# interface range f0/5-6

S1(config-if)# switchport mode access

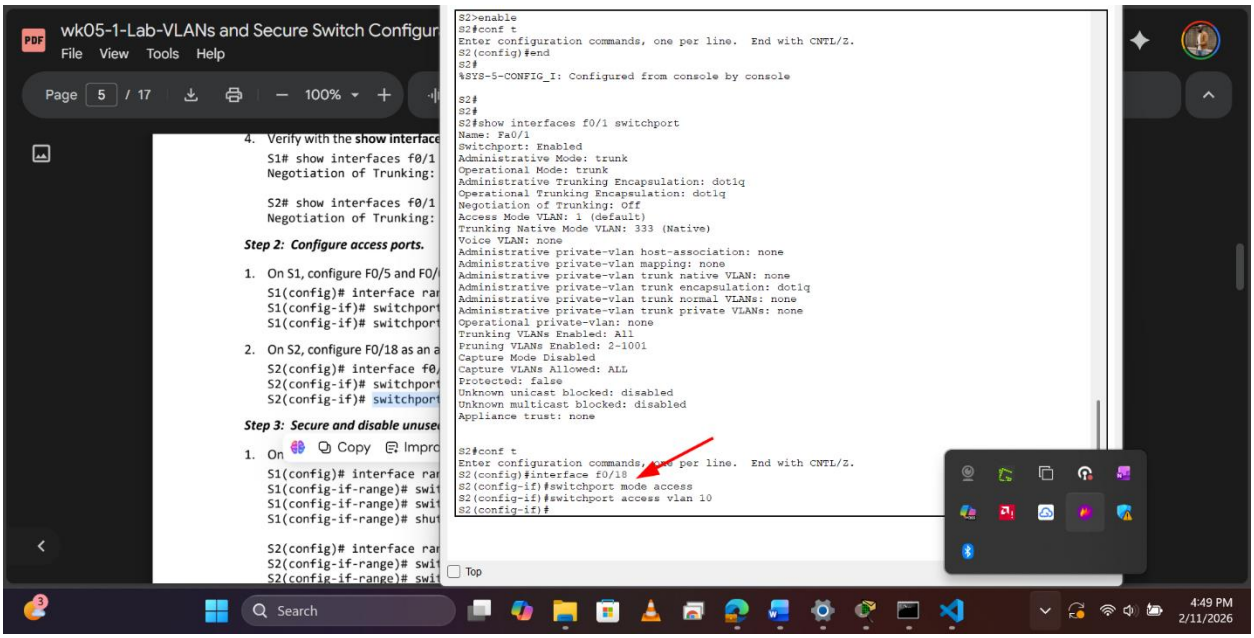
S1(config-if)# switchport access vlan 10

b. On S2, configure F0/18 as an access port that is associated with VLAN 10.

S2(config)# interface f0/18

S2(config-if)# switchport mode access

S2(config-if)# switchport access vlan 10



Step 3: Secure and disable unused switchports.

a. On S1 and S2, move the unused ports from VLAN 1 to VLAN 999 and disable the unused ports.

S1(config)# interface range f0/2-4 , f0/7-24, g0/1-2

S1(config-if-range)# switchport mode access

S1(config-if-range)# switchport access vlan 999

S1(config-if-range)# shutdown

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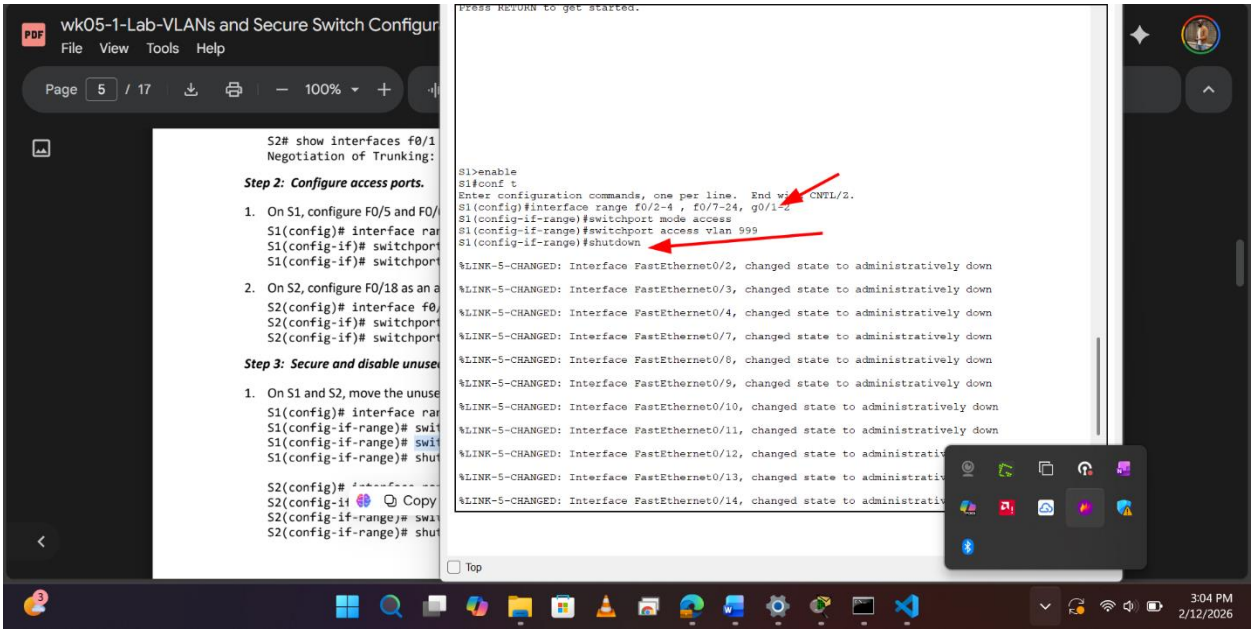
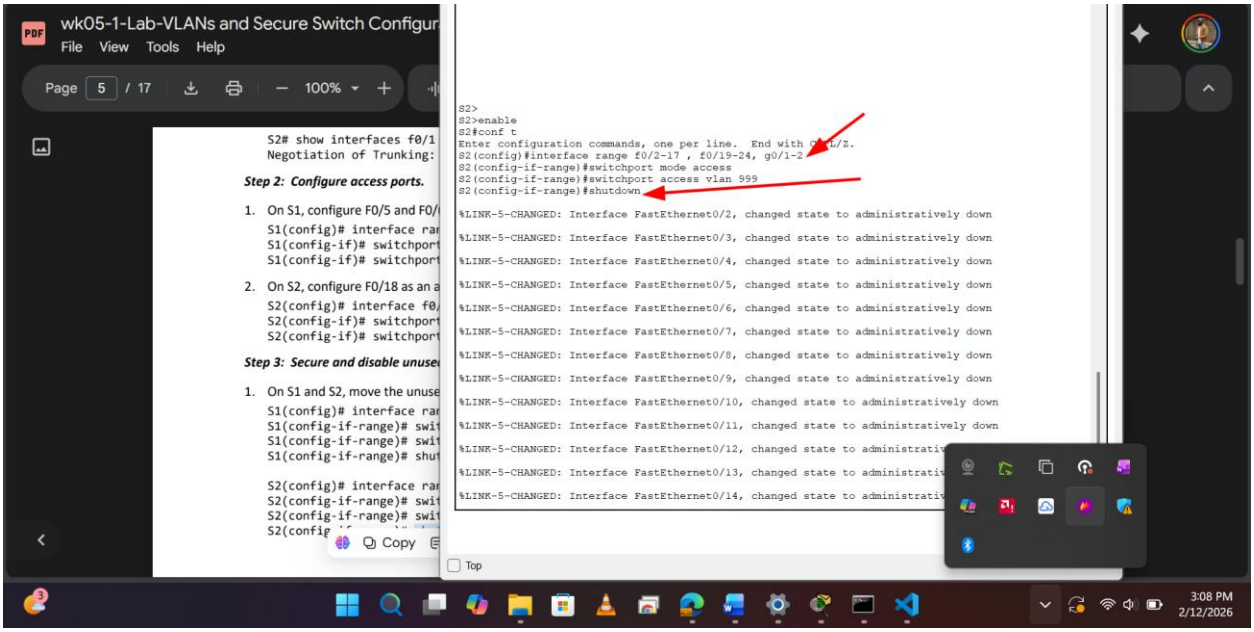


S2(config)# interface range f0/2-17 , f0/19-24, g0/1-2

S2(config-if-range)# switchport mode access

S2(config-if-range)# switchport access vlan 999

S2(config-if-range)# shutdown



b. Verify that unused ports are disabled and associated with VLAN 999 by issuing the **show** command.

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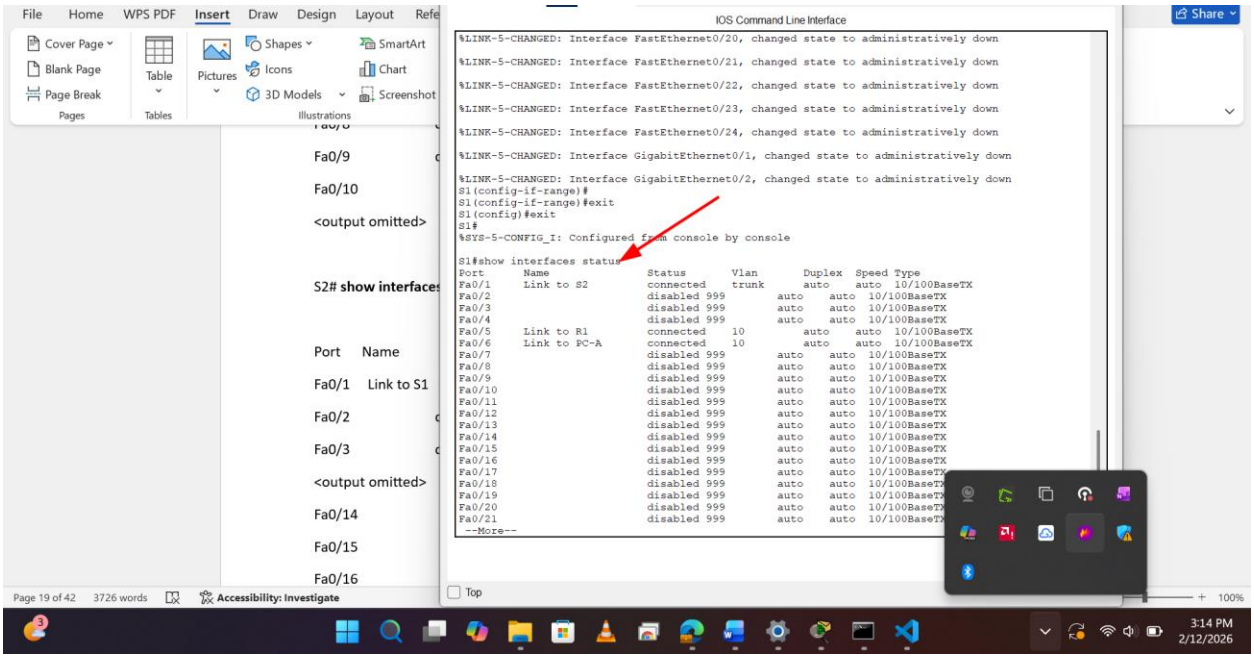
S1# **show interfaces status**

Port	Name	Status	Vlan	Duplex	Speed	Type
Fa0/1	Link to S2	connected	trunk	a-full	a-100	10/100BaseTX
Fa0/2		disabled	999	auto	auto	10/100BaseTX
Fa0/3		disabled	999	auto	auto	10/100BaseTX
Fa0/4		disabled	999	auto	auto	10/100BaseTX
Fa0/5	Link to R1	connected	10	a-full	a-100	10/100BaseTX
Fa0/6	Link to PC-A	connected	10	a-full	a-100	10/100BaseTX
Fa0/7		disabled	999	auto	auto	10/100BaseTX
Fa0/8		disabled	999	auto	auto	10/100BaseTX
Fa0/9		disabled	999	auto	auto	10/100BaseTX
Fa0/10		disabled	999	auto	auto	10/100BaseTX

<output omitted>



S2# **show interfaces status**

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Port	Name	Status	Vlan	Duplex	Speed	Type
Fa0/1	Link to S1	connected	trunk	a-full	a-100	10/100BaseTX
Fa0/2		disabled	999	auto	auto	10/100BaseTX
Fa0/3		disabled	999	auto	auto	10/100BaseTX
<output omitted>						
Fa0/14		disabled	999	auto	auto	10/100BaseTX
Fa0/15		disabled	999	auto	auto	10/100BaseTX
Fa0/16		disabled	999	auto	auto	10/100BaseTX
Fa0/17		disabled	999	auto	auto	10/100BaseTX
Fa0/18	Link to PC-B	connected	10	a-full	a-100	10/100BaseTX
Fa0/19		disabled	999	auto	auto	10/100BaseTX
Fa0/20		disabled	999	auto	auto	10/100BaseTX
Fa0/21		disabled	999	auto	auto	10/100BaseTX
Fa0/22		disabled	999	auto	auto	10/100BaseTX
Fa0/23		disabled	999	auto	auto	10/100BaseTX
Fa0/24		disabled	999	auto	auto	10/100BaseTX
Gi0/1		disabled	999	auto	auto	10/100/1000BaseTX
Gi0/2		disabled	999	auto	auto	10/100/1000BaseTX

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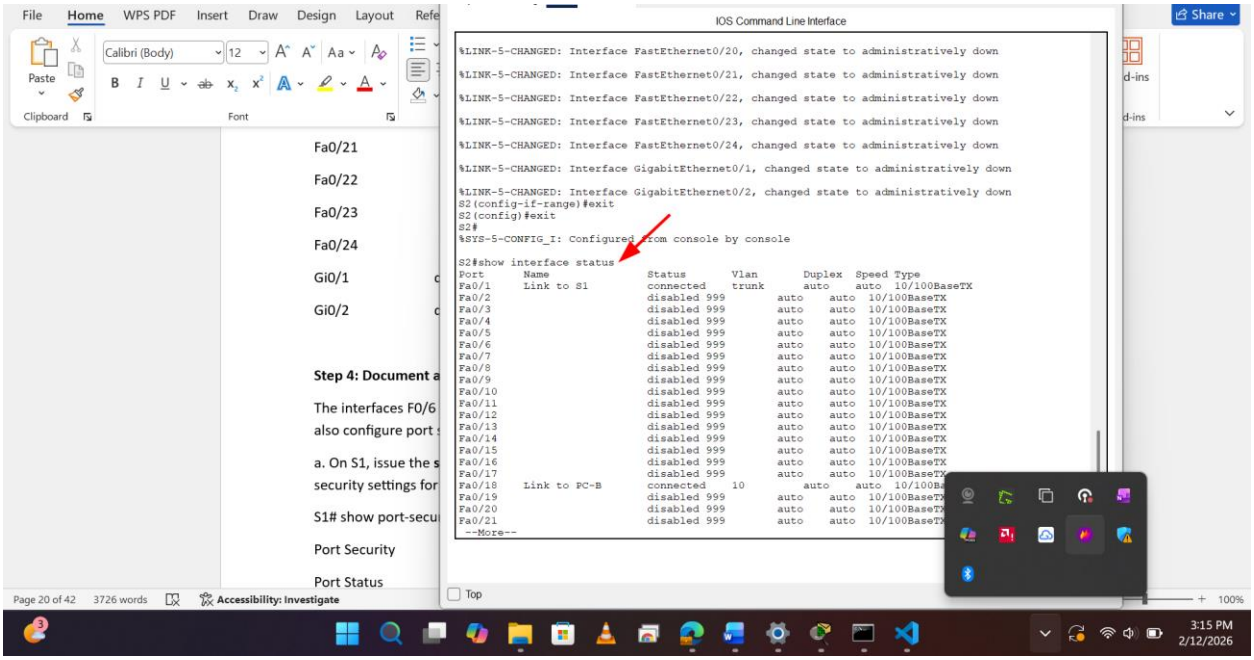
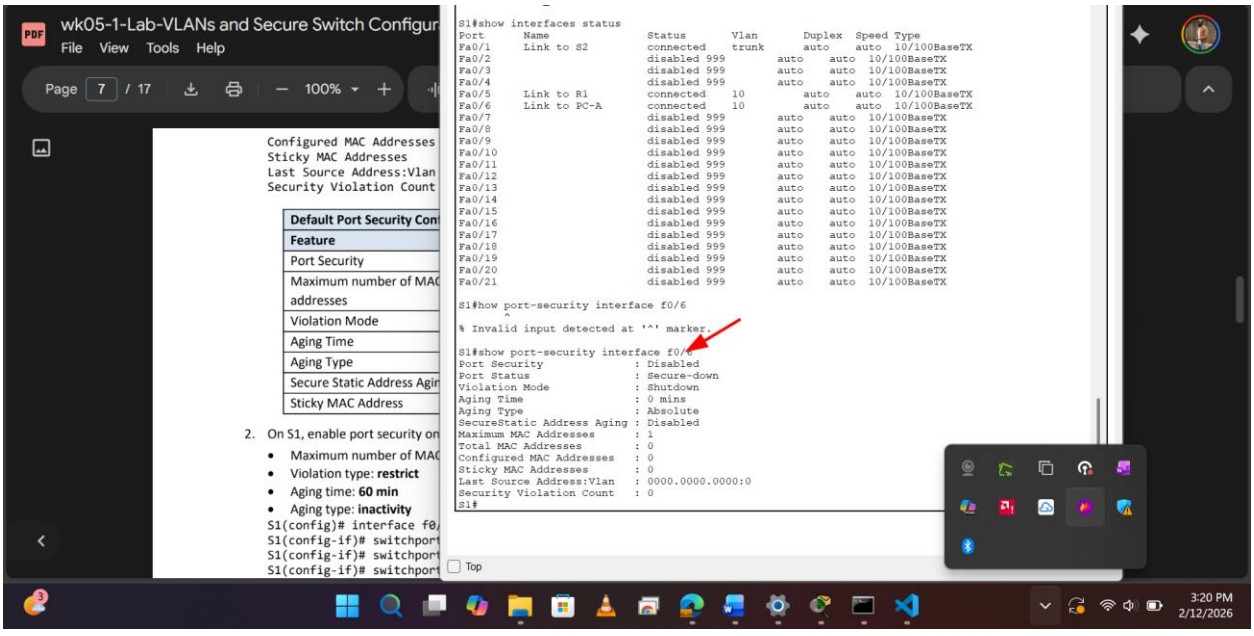


Step 4: Document and implement port security features.

The interfaces F0/6 on S1 and F0/18 on S2 are configured as access ports. In this step, you will also configure port security on these two access ports.

a. On S1, issue the **show port-security interface f0/6** command to display the default port security settings for interface F0/6. Record your answers in the table below.



S1# show port-security interface f0/6

Port Security : Disabled

Port Status : Secure-down

Violation Mode : Shutdown

Aging Time : 0 mins

Aging Type : Absolute

SecureStatic Address Aging : Disabled

Maximum MAC Addresses : 1

Total MAC Addresses : 0

Configured MAC Addresses : 0

Sticky MAC Addresses : 0

Last Source Address:Vlan : 0000.0000.0000:0

Security Violation Count : 0

Default Port Security Configuration	
Feature	**Default Setting**
Port Security	Disabled
Maximum number of MAC addresses	1
Violation Mode	Shutdown
Aging Time	0 mins
Aging Type	Absolute
Secure Static Address Aging	Disabled
Sticky MAC Address	0

b. On S1, enable port security on F0/6 with the following settings:

- Maximum number of MAC addresses: **3**

- Violation type: **restrict**
- Aging time: **60 min**
- Aging type: **inactivity**

S1(config)# interface f0/6

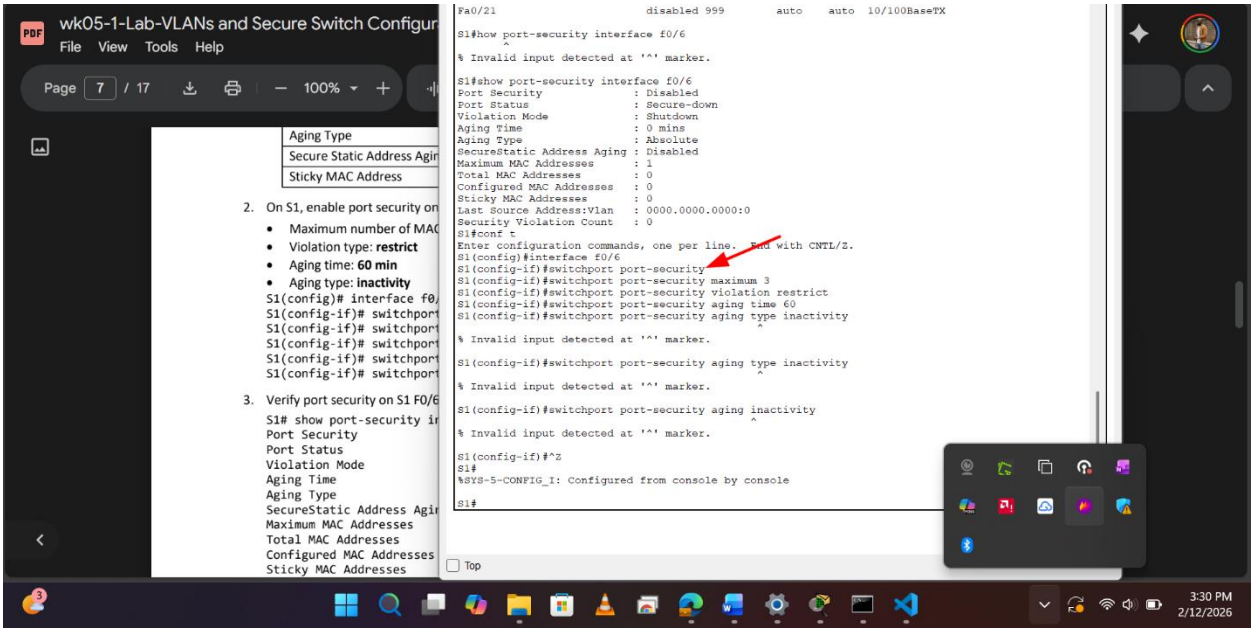
S1(config-if)# switchport port-security

S1(config-if)# switchport port-security maximum 3

S1(config-if)# switchport port-security violation restrict

S1(config-if)# switchport port-security aging time 60

S1(config-if)# switchport port-security aging type inactivity



c. Verify port security on S1 F0/6.

S1# **show port-security interface f0/6**

Port Security : Enabled

Port Status : Secure-up

Violation Mode : Restrict

Aging Time : 60 mins

Aging Type : Inactivity

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SecureStatic Address Aging : Disabled

Maximum MAC Addresses : 3

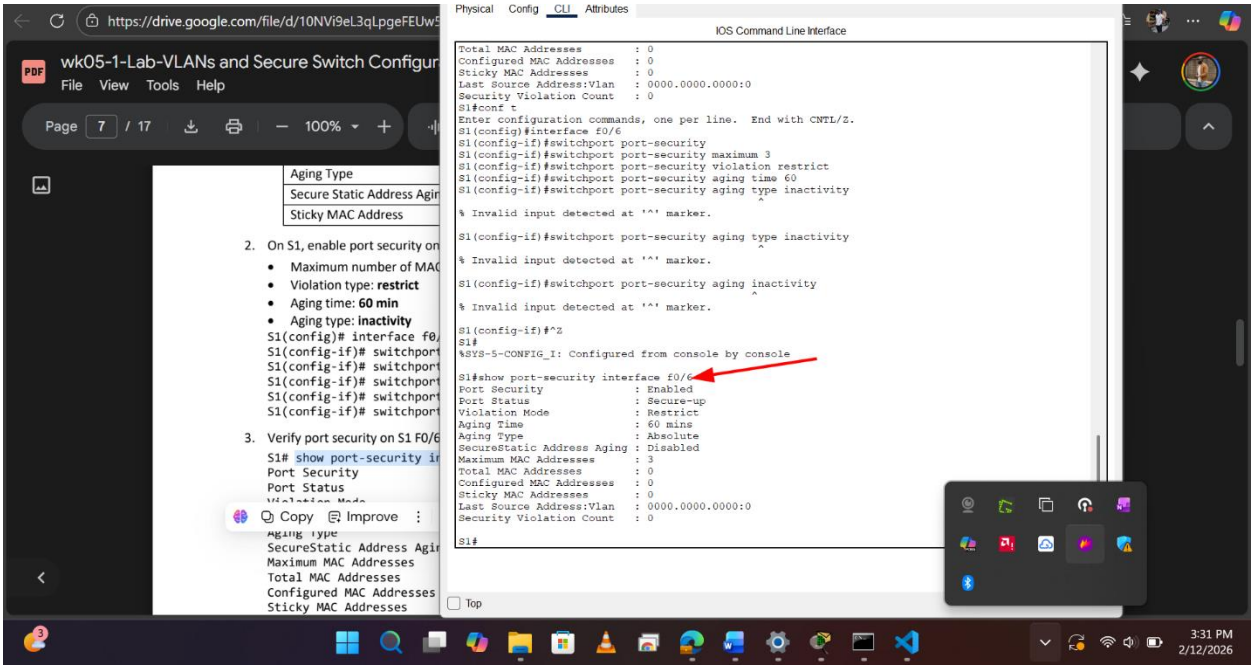
Total MAC Addresses : 1

Configured MAC Addresses : 0

Sticky MAC Addresses : 0

Last Source Address:Vlan : 0022.5646.3411:10

Security Violation Count : 0



S1# **show port-security address**

Secure Mac Address Table

Vlan Mac Address Type Ports Remaining Age

(mins)

---- ----------- ---- ----- -------------

10 0022.5646.3411 SecureDynamic Fa0/6 60 (I)

Total Addresses in System (excluding one mac per port) : 0

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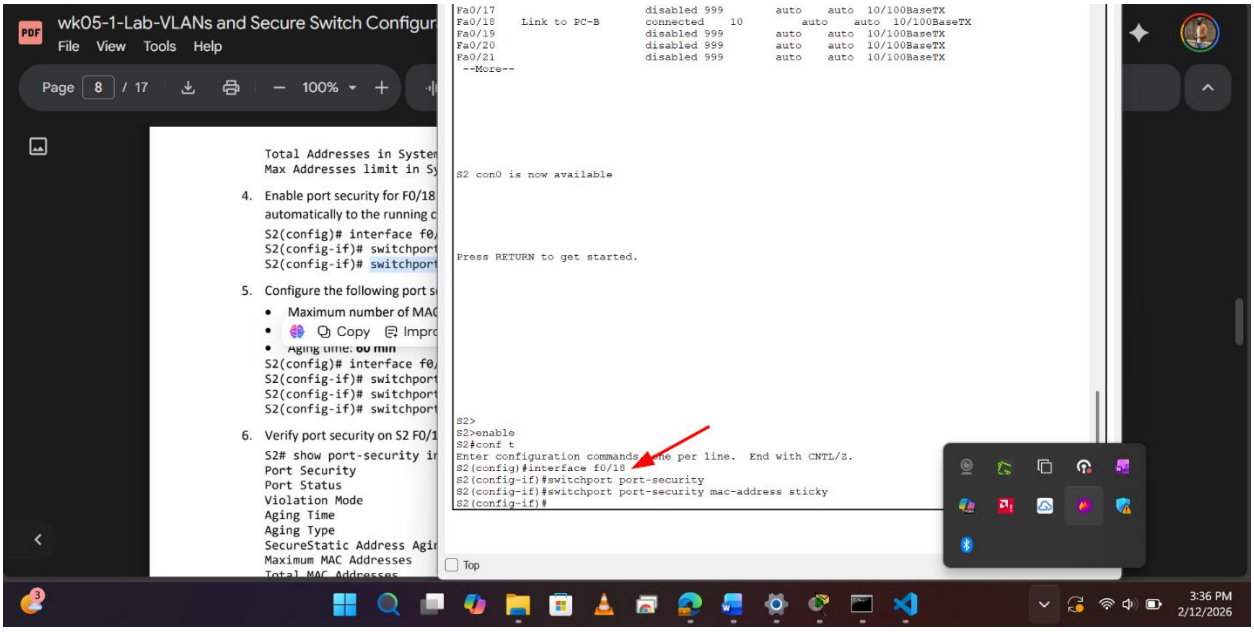
Max Addresses limit in System (excluding one mac per port) : 8192

d. Enable port security for F0/18 on S2. Configure the port to add MAC addresses learned on the port automatically to the running configuration.

S2(config)# interface f0/18

S2(config-if)# switchport port-security

S2(config-if)# switchport port-security mac-address sticky



e. Configure the following port security settings on S2 F/18:

- Maximum number of MAC addresses: **2**
- Violation type: **Protect**
- Aging time: **60 min**

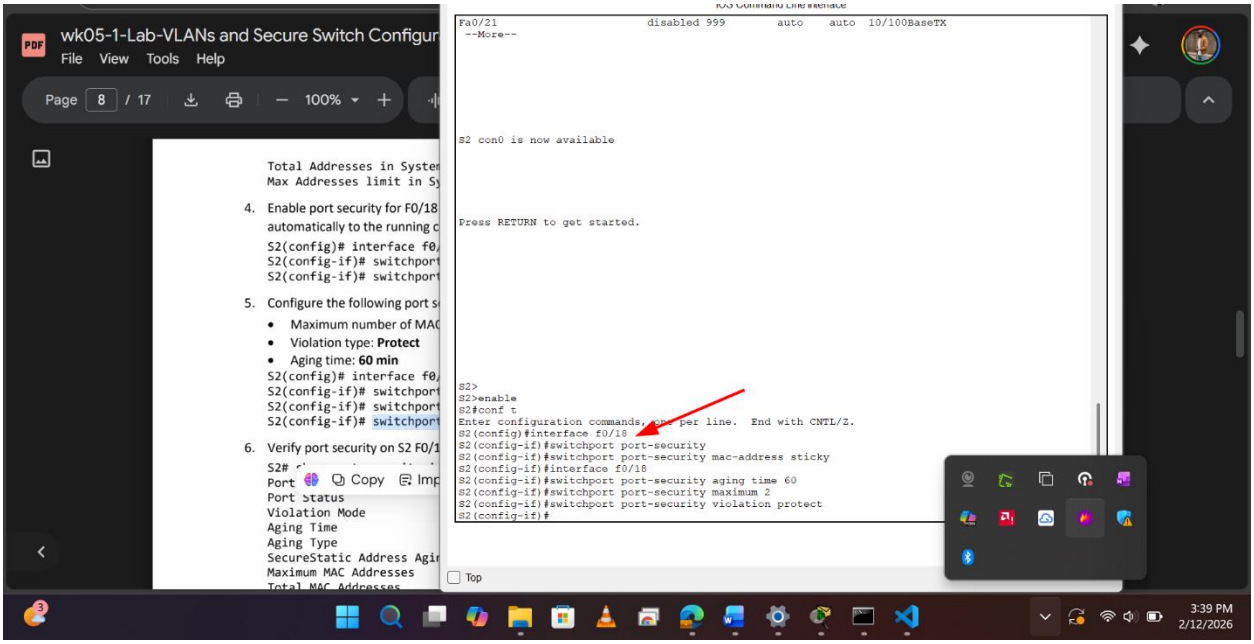
S2(config)# interface f0/18

S2(config-if)# switchport port-security aging time 60

S2(config-if)# switchport port-security maximum 2

S2(config-if)# switchport port-security violation protect

Week 4 Assignment 1



f. Verify port security on S2 F0/18.

S2# **show port-security interface f0/18**

Port Security : Enabled

Port Status : Secure-up

Violation Mode : Protect

Aging Time : 60 mins

Aging Type : Absolute

SecureStatic Address Aging : Disabled

Maximum MAC Addresses : 2

Total MAC Addresses : 1

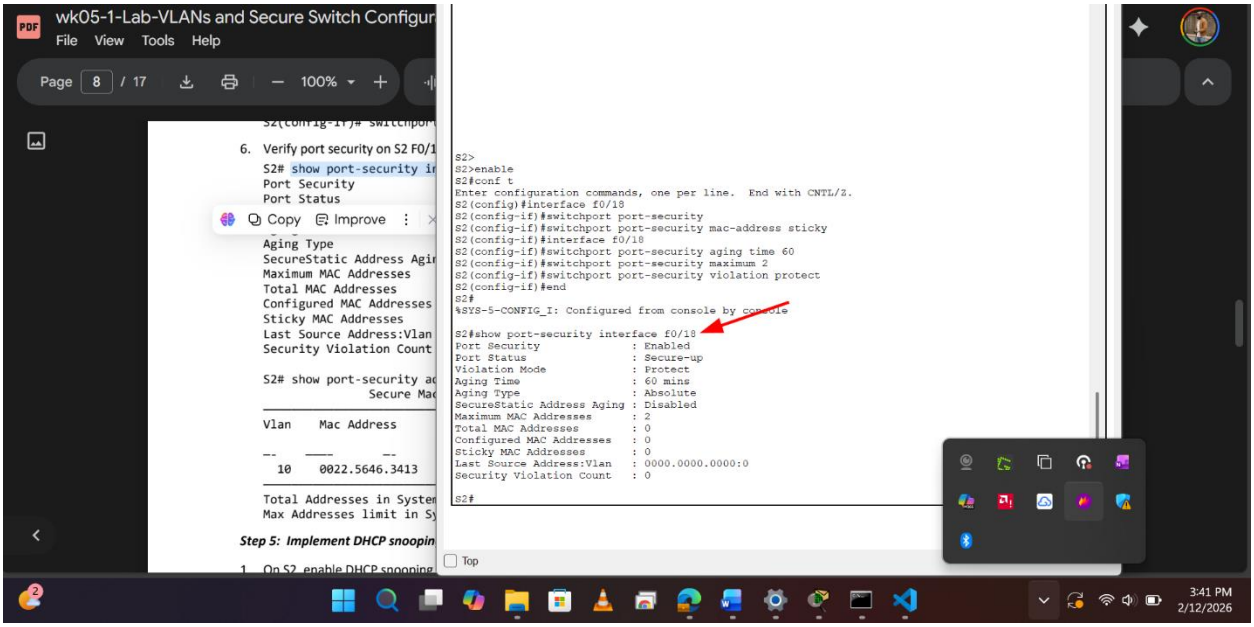
Configured MAC Addresses : 0

Sticky MAC Addresses : 0

Last Source Address:Vlan : 0022.5646.3413:10

Security Violation Count : 0

Week 4 Assignment 1



S2# **show port-security address**

Secure Mac Address Table

Vlan Mac Address Type Ports Remaining Age

(mins)

---- ----------- ---- ----- -------------

10 0022.5646.3413 SecureSticky Fa0/18 -

Total Addresses in System (excluding one mac per port) : 0

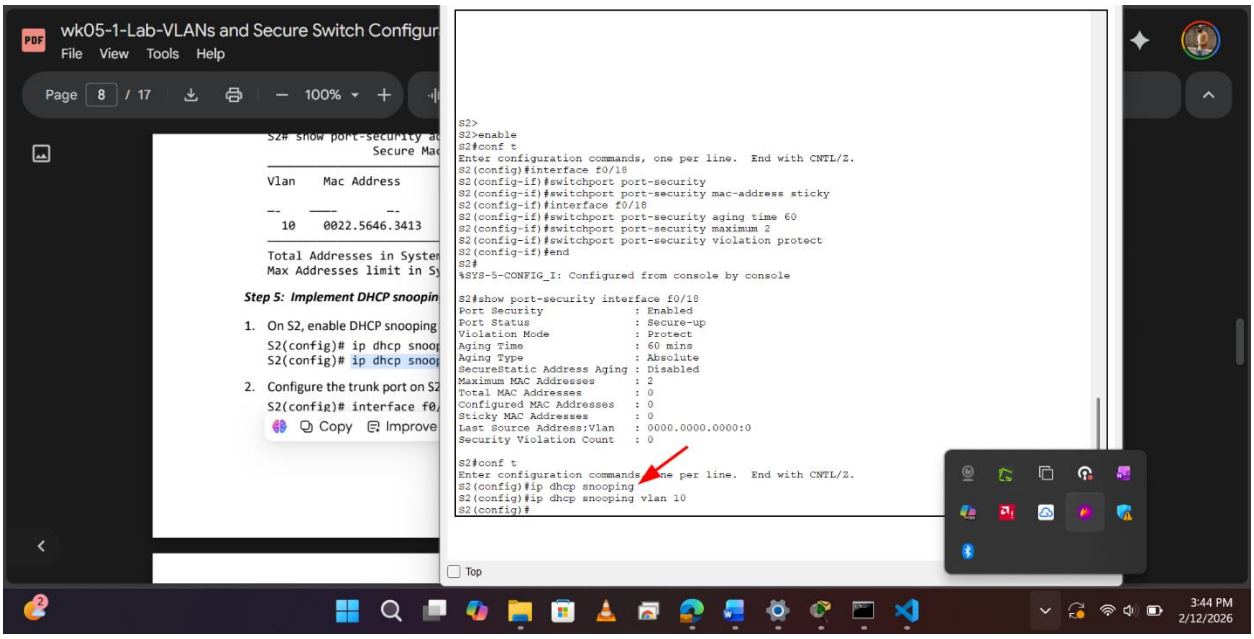
Max Addresses limit in System (excluding one mac per port) : 8192

Step 5: Implement DHCP snooping security.

a. On S2, enable DHCP snooping and configure DHCP snooping on VLAN 10.

S2(config)# ip dhcp snooping

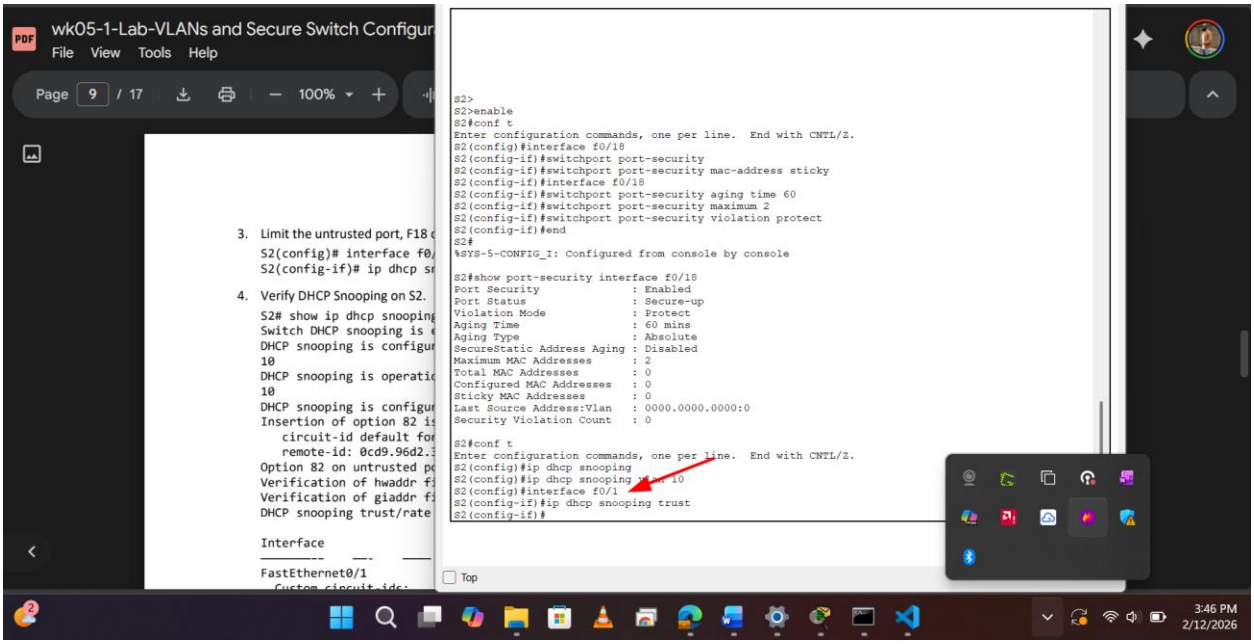
S2(config)# ip dhcp snooping vlan 10



b. Configure the trunk port on S2 as a trusted port.

S2(config)# interface f0/1

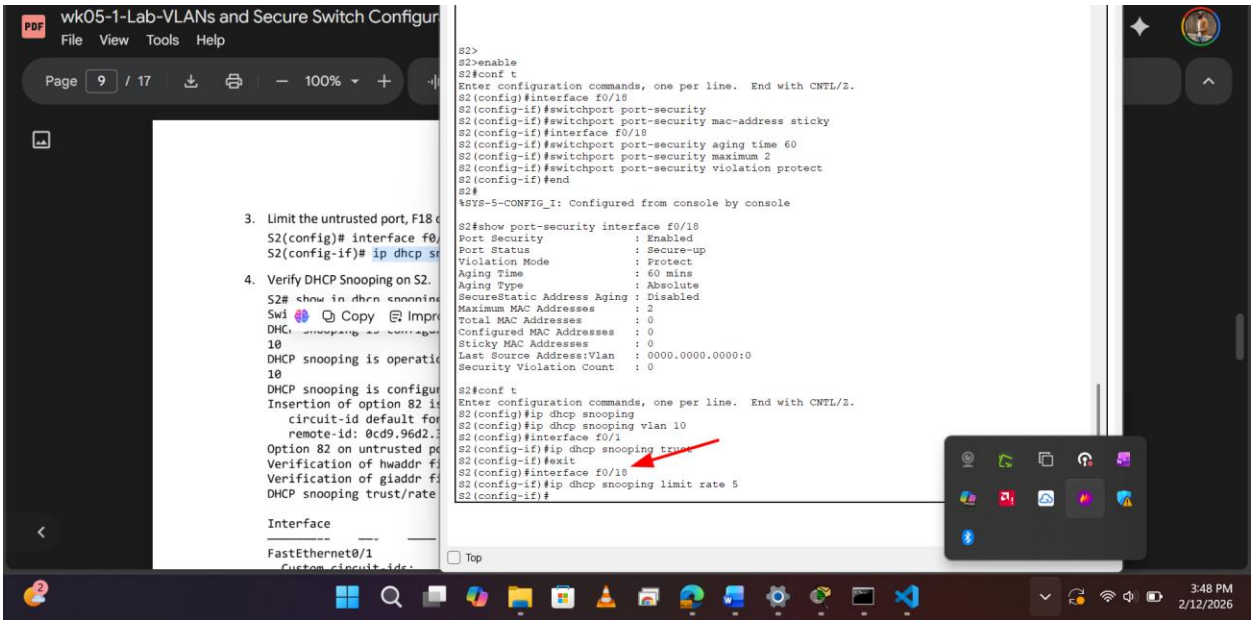
S2(config-if)# ip dhcp snooping trust



c. Limit the untrusted port, F18 on S2, to five DHCP packets per second.

S2(config)# interface f0/18

S2(config-if)# ip dhcp snooping limit rate 5



d. Verify DHCP Snooping on S2.

S2# **show ip dhcp snooping**

Switch DHCP snooping is enabled

DHCP snooping is configured on following VLANs:

10

DHCP snooping is operational on following VLANs:

10

DHCP snooping is configured on the following L3 Interfaces:

Insertion of option 82 is enabled

circuit-id default format: vlan-mod-port

remote-id: 0cd9.96d2.3f80 (MAC)

Option 82 on untrusted port is not allowed

Verification of hwaddr field is enabled

Verification of giaddr field is enabled

DHCP snooping trust/rate is configured on the following Interfaces:

Week 4 Assignment 1

Interface Trusted Allow option Rate limit (pps)

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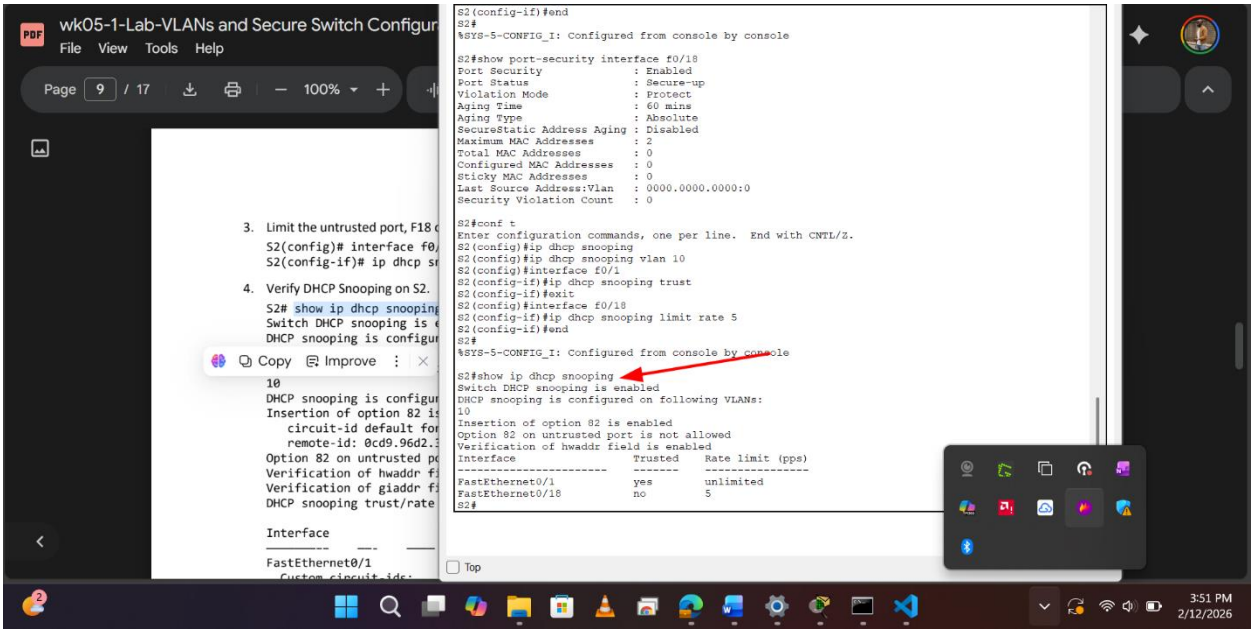
FastEthernet0/1 yes yes unlimited

Custom circuit-ids:

FastEthernet0/18 no no 5

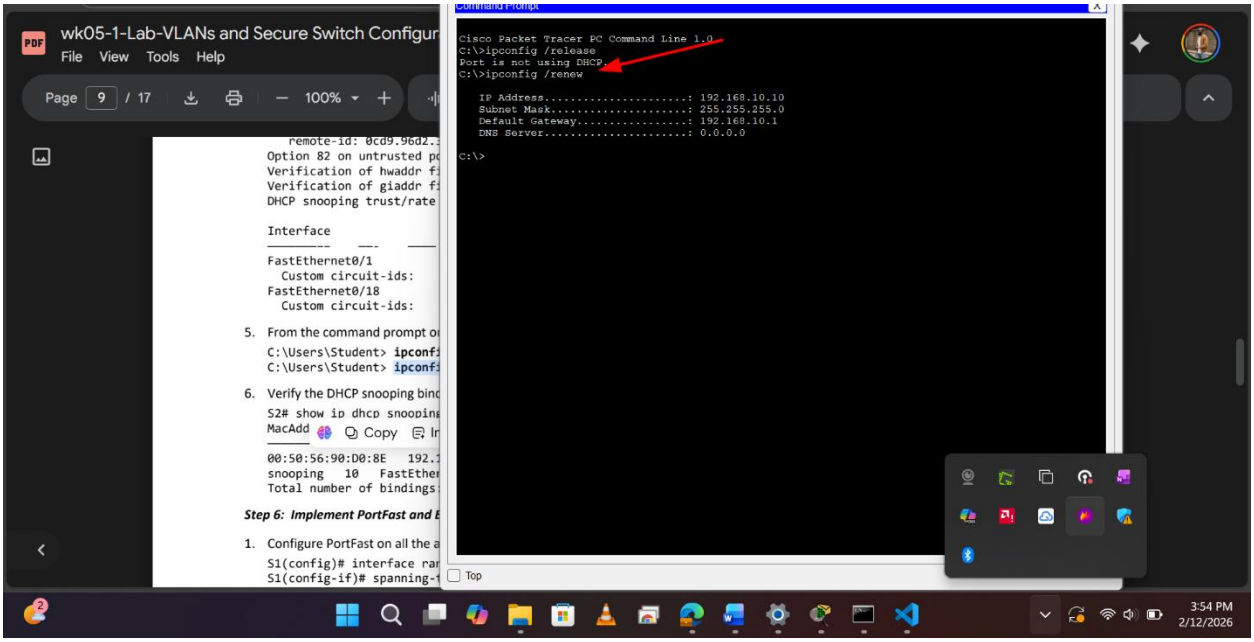
Custom circuit-ids:



e. From the command prompt on PC-B, release and then renew the IP address.

C:\Users\Student> **ipconfig /release**

C:\Users\Student> **ipconfig /renew**



f. Verify the DHCP snooping binding using the **show ip dhcp snooping binding** command.

S2# **show ip dhcp snooping binding**

MacAddress IpAddress Lease(sec) Type VLAN Interface

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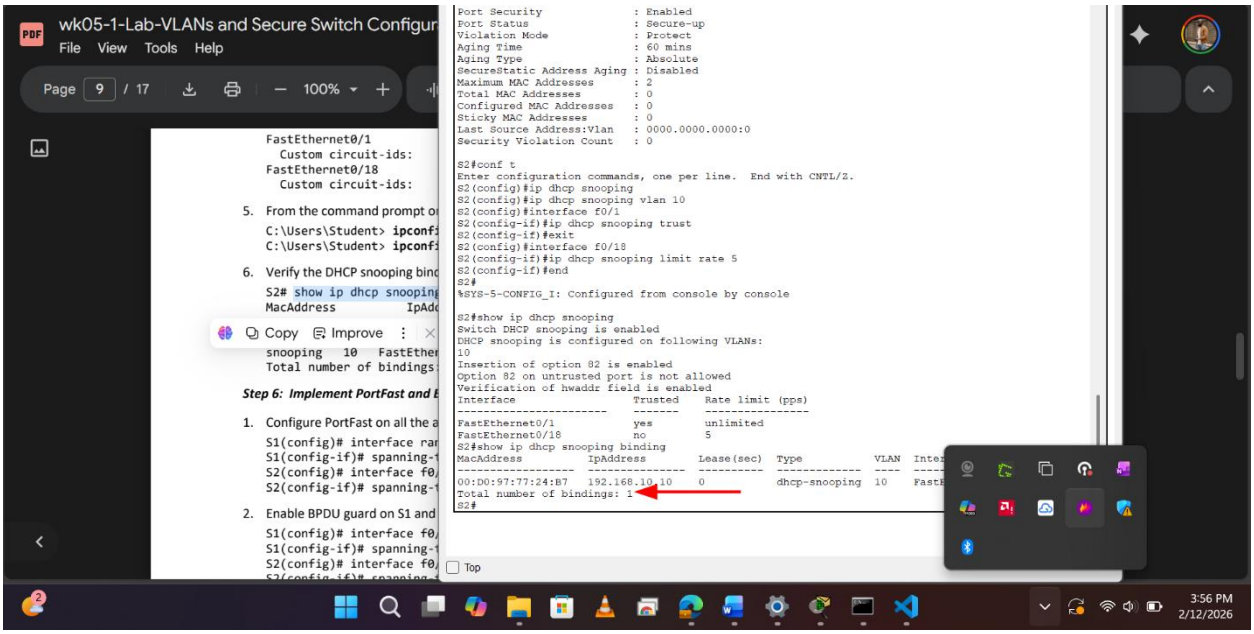
00:50:56:90:D0:8E 192.168.10.11 86213 dhcp-snooping 10 FastEthernet0/18

Total number of bindings: 1



Week 4 Assignment 1

Step 6: Implement PortFast and BPDU guard.

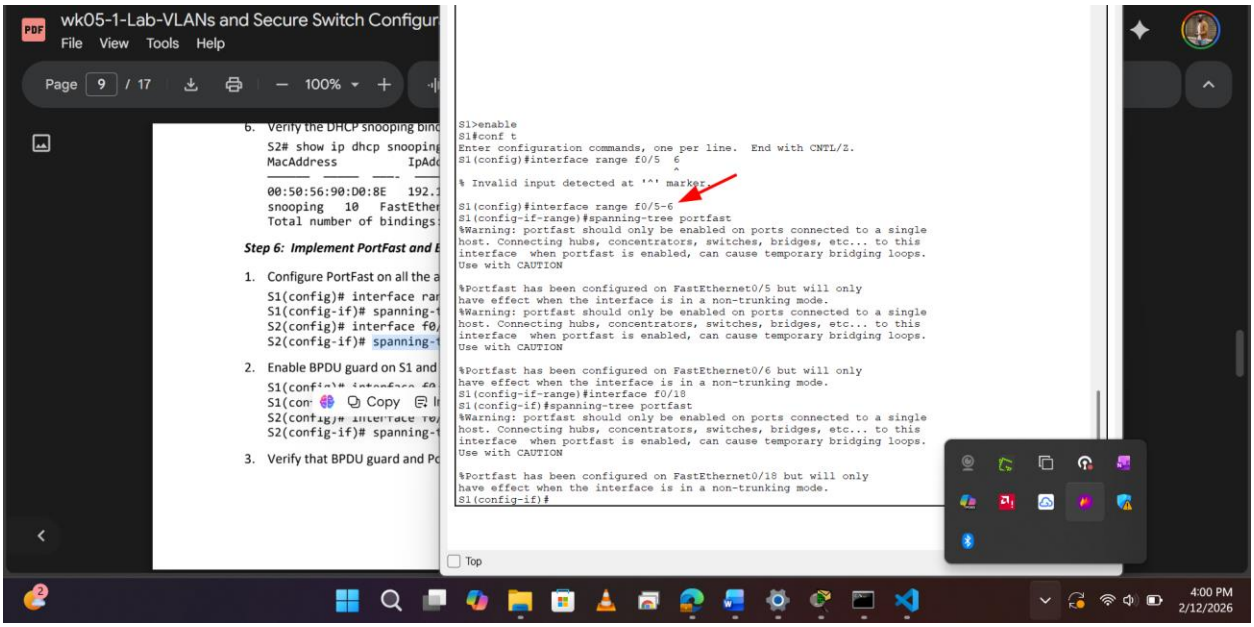
a. Configure PortFast on all the access ports that are in use on both switches.

S1(config)# interface range f0/5-6

S1(config-if)# spanning-tree portfast

S2(config)# interface f0/18

S2(config-if)# spanning-tree portfast



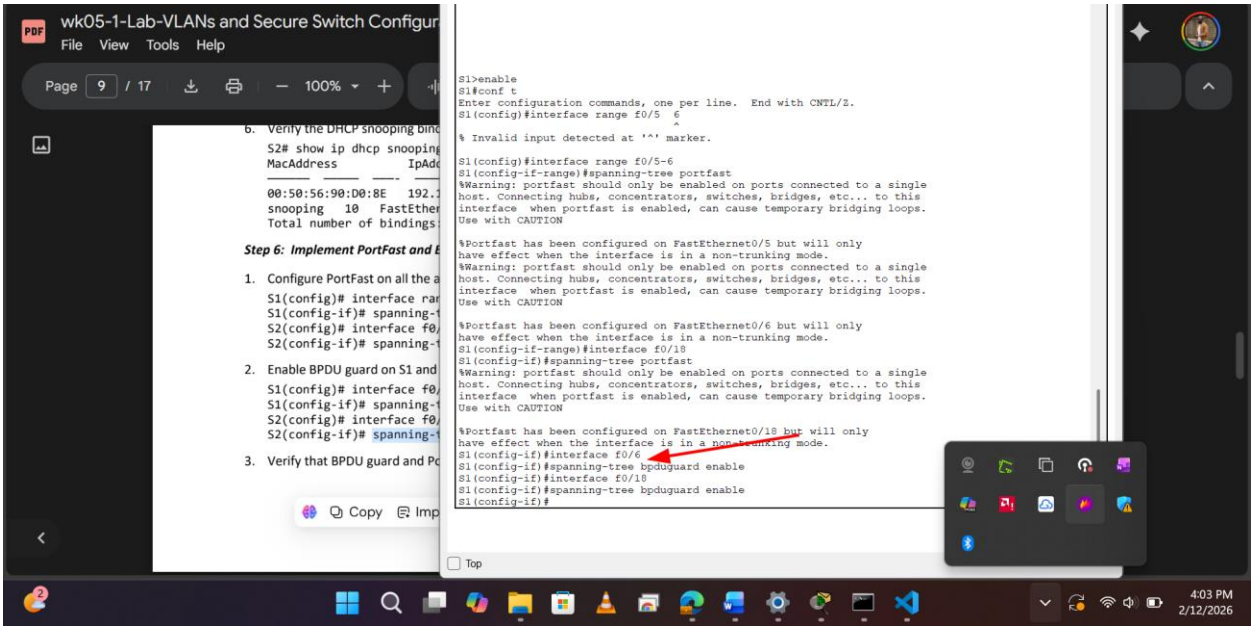
b. Enable BPDU guard on S1 and S2 VLAN 10 access ports connected to PC-A and PC-B.

S1(config)# interface f0/6

S1(config-if)# spanning-tree bpduguard enable

S2(config)# interface f0/18

S2(config-if)# spanning-tree bpduguard enable



c. Verify that BPDU guard and PortFast are enabled on the appropriate ports.

S1# **show spanning-tree interface f0/6 detail**

Port 8 (FastEthernet0/6) of VLAN0010 is designated forwarding

Port path cost 19, Port priority 128, Port Identifier 128.6.

<output omitted for brevity>

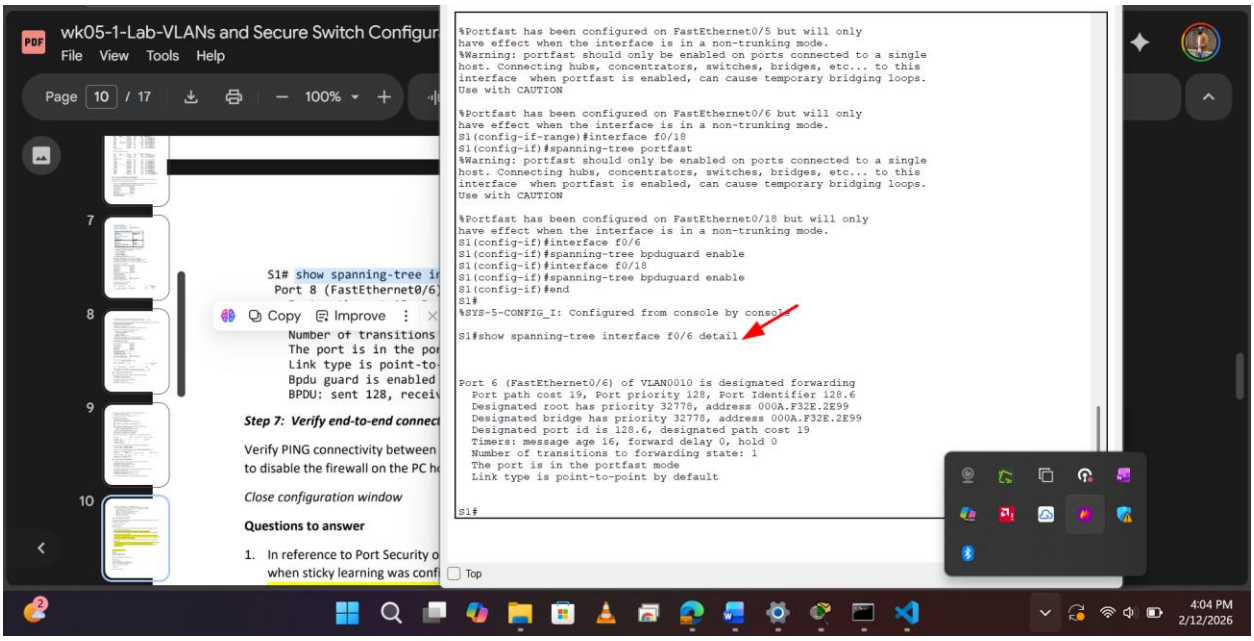
Number of transitions to forwarding state: 1

The port is in the portfast mode

Link type is point-to-point by default

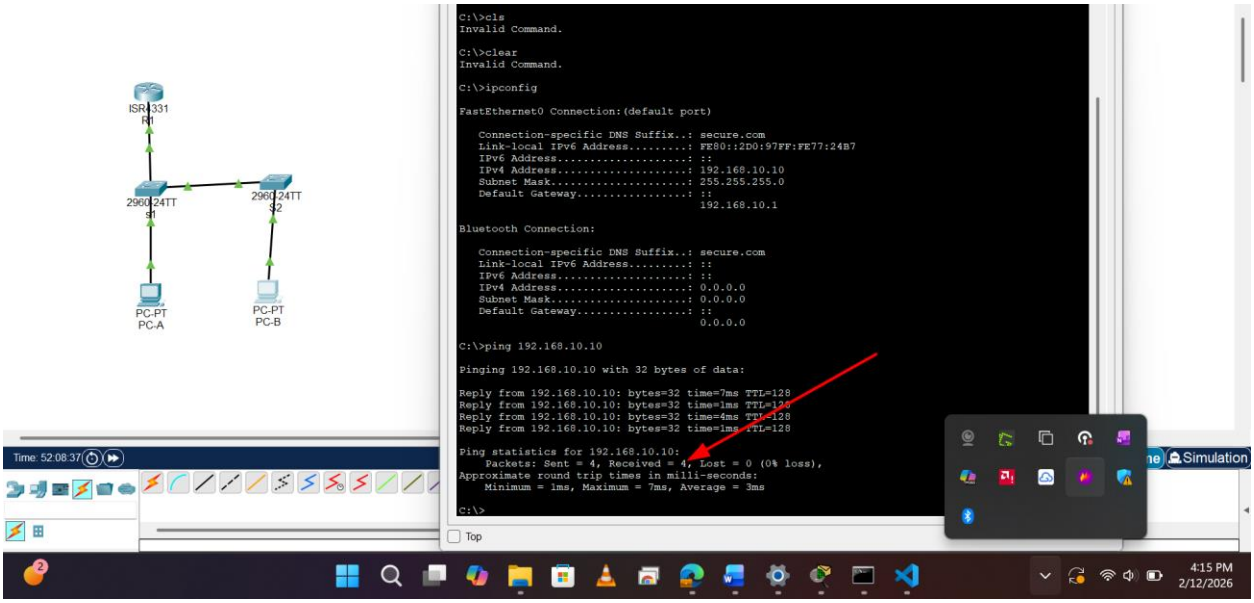
Bpdu guard is enabled

BPDU: sent 128, received 0



Step 7: Verify end-to-end connectivity.

Verify PING connectivity between all devices in the IP Addressing Table. If the pings fail, you may need to disable the firewall on the PC hosts.



Reflection Questions

1**. In reference to Port Security on S2, why is there no timer value for the remaining age in minutes when sticky learning was configured?**

This switch does not support the port security aging of sticky secure addresses.

2**. In reference to Port Security on S2, if you load the running-config script on S2, why will PC-B on port 18 never get an IP address via DHCP?**

Port security is set for only two MAC addresses and port 18 has two “sticky” MAC address bound to the port. Additionally, the violation is protect, which will never send a console/syslog message or increment the violation counter.

3**. In reference to Port Security, what is the difference between the absolute aging type and inactivity aging type?**

If the inactivity type is set, then the secure addresses on the port will be removed only if there is no data traffic from the secure source addresses for the specified time period.

If the absolute type is set, then all secure addresses on this port age out exactly after the time specified ends.

Conclusion

By completing this lab, we have successfully established a secure and optimized Layer 2 network environment. We demonstrated the importance of network segmentation by configuring specific VLANs for management and properly handling unused ports by moving them to a "Parking Lot" VLAN to prevent unauthorized access.

Critically, we reinforced the network's defenses through several key security implementations:

Trunk Security: We secured trunk links by manually configuring 802.1Q encapsulation and assigning a dedicated Native VLAN (VLAN 333) to mitigate VLAN hopping attacks.

Access Control: We implemented Port Security with specific violation modes (Restrict and Protect) and aging timers, ensuring that only authorized MAC addresses can communicate through the switch ports.

Threat Mitigation: We defended the network against DHCP spoofing and starvation attacks by configuring DHCP Snooping and rate-limiting untrusted ports.

Topology Stability: Finally, we enhanced the efficiency and security of the Spanning Tree Protocol by enabling PortFast and BPDU Guard on user-facing ports, preventing rogue switches from disrupting the network topology.

This lab confirms that applying these "defense-in-depth" strategies is essential for maintaining network integrity and preventing common LAN-based attacks.