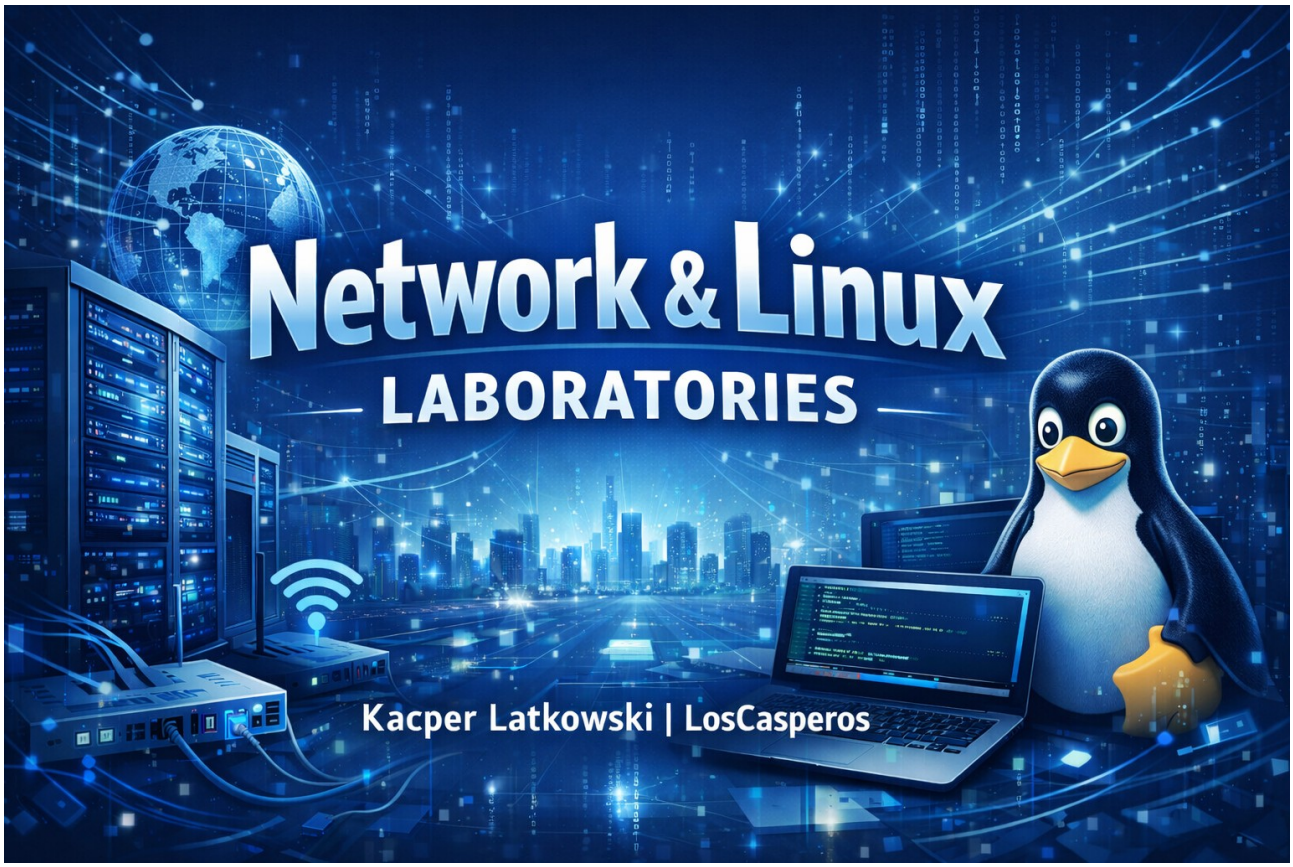
Lab 1 VLAN and Inter-VLAN Routing with DHCP + Basic Hardening



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1. Lab Metadata

- **Lab Name:** Lab 1 VLAN and Inter-VLAN Routing with DHCP + Basic Hardening
- **Tools:** Cisco Packet Tracer
- **Devices:** 1x Router (R1), 1x Switch (S1), 6x Pcs
- **Date:** 06.01.2026
- **Author:** Kacper Latkowski aka LosCasperos
- **Contact:** kacperlatkowski@gmail.com / LinkedIn / mobile +48 725 140 666

2. Overview

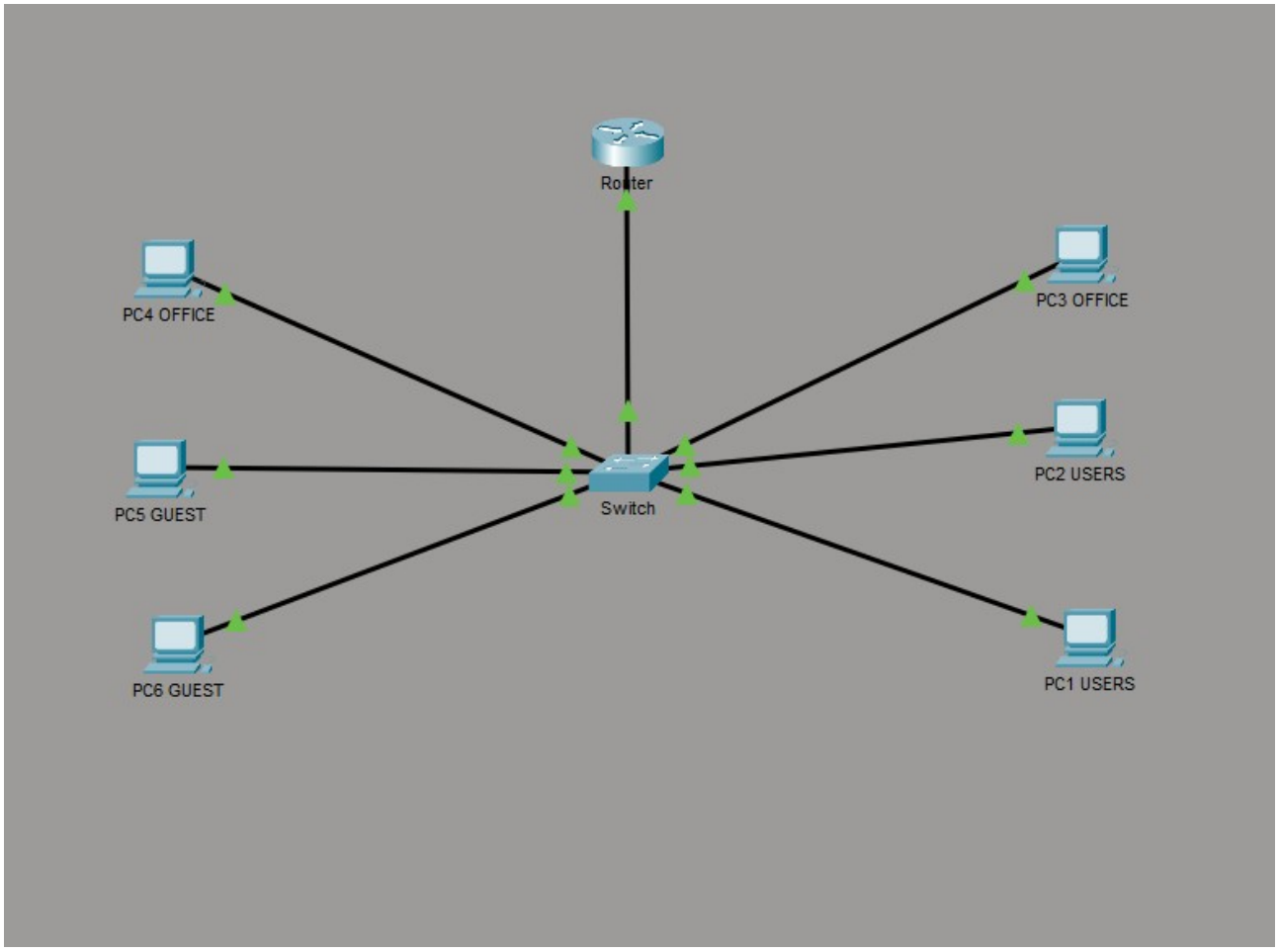
2.1. Objectives

- Create VLAN segmentation on a Layer 2 switch (VLAN 10 / 20 / 30).
- Configure a trunk link between the switch and router (802.1Q).
- Implement inter-VLAN routing using router-on-a-stick (router subinterfaces).
- Configure DHCP on the router with separate pools per VLAN.
- Apply basic Layer 2 and router hardening practices.
- Verify end-to-end connectivity (DHCP + inter-VLAN ping).

3. Network Topology

3.1. Topology Summary

- **R1 G0/0** is connected to **S1 G0/1** (802.1Q trunk).
- PCs are connected to S1 access ports:
  - VLAN 10: PC1 (F0/1), PC2 (F0/2)
  - VLAN 20: PC3 (F0/3), PC4 (F0/4)
  - VLAN 30: PC5 (F0/5), PC6 (F0/6)



01_topology.png

4. IP Addressing Plan

VLAN	Name	Network	Default Gateway	DHCP Range
10	USERS	192.168.10.0/24	192.168.10.1	192.168.10.11-254
20	OFFICE	192.168.20.0/24	192.168.20.1	192.168.20.11-254
30	GUEST	192.168.30.0/24	192.168.30.1	192.168.30.11-254

4.1. DHCP Exclusions (Infrastructure Reservation)

The first 10 IP addresses in each VLAN were excluded from DHCP to reserve them for infrastructure devices and to avoid address conflicts.

5. Step-by-Step Implementation

5.1. Build the Topology (Packet Tracer)

Actions:

- Place devices: R1, S1, PC1-PC6.
- Connect devices using Copper Straight-Through cables:
  - R1 G0/0 to S1 G0/1
  - PC1 to S1 F0/1
  - PC2 to S1 F0/2
  - PC3 to S1 F0/3
  - PC4 to S1 F0/4
  - PC5 to S1 F0/5
  - PC6 to S1 F0/6

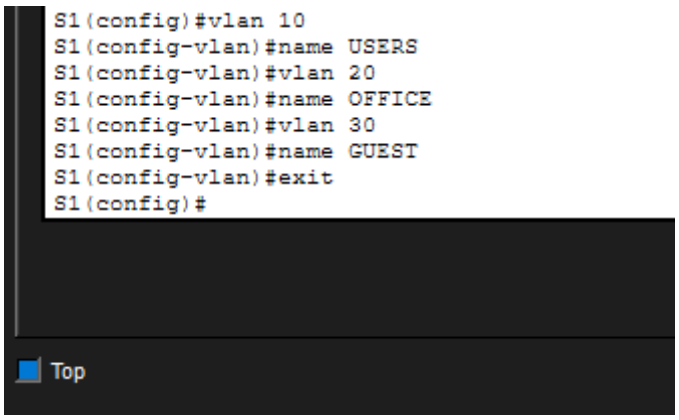
5.2. Switch S1 - Basic Setup

Configuration (S1 CLI)

The switch was configured with a hostname and DNS lookup was disabled to prevent unnecessary delays caused by mistyped commands.

5.3. Switch S1 - Create VLANs

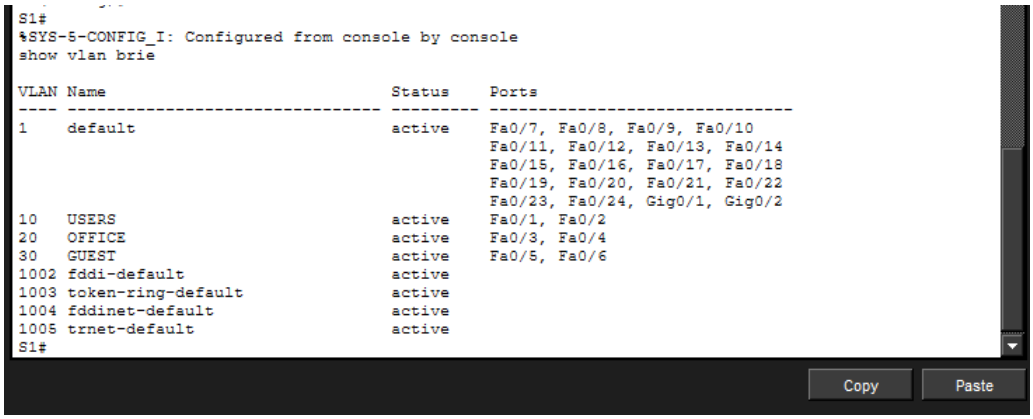
VLANs 10, 20, and 30 were created on switch S1 and named according to their purpose



02_vlan_create.png

5.4. Switch S1 - Assign Access Ports to VLANs

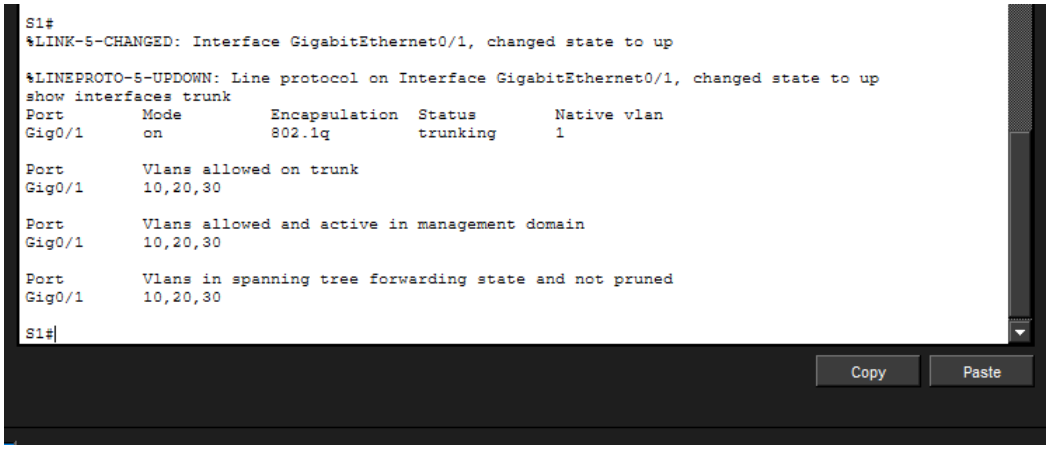
Access ports were configured in access mode and assigned to the appropriate VLANs based on the connected end devices.



03_show_vlan_brief.png

5.5. Switch S1 - Configure Trunk to Router

An IEEE 802.1Q trunk link was configured between switch S1 and router R1, allowing VLANs 10, 20, and 30.



04_show_interfaces_trunk.png

5.6. Router R1 - Basic Setup and Enable Physical Interface

Basic router configuration was applied, including hostname assignment and enabling the physical interface connected to the switch.

```
        --- System Configuration Dialog ---

Would you like to enter the initial configuration dialog? [yes/no]: no


Press RETURN to get started!



Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#no ip domain
R1(config)#no ip domain-lo
R1(config)#no ip domain-lookup
R1(config)#int gi 0/0
R1(config-if)#no shut
R1(config-if)#no shutdown

R1(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

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

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05_router_basic.png

5.7. Router R1 - Inter-VLAN Routing (Router-on-a-Stick)

Inter-VLAN routing was implemented using the router-on-a-stick method with 802.1Q subinterfaces for each VLAN.

```
R1>en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#int
R1(config)#interface gi
R1(config)#interface gigabit
R1(config)#interface gigabitEthernet 0/0.10
R1(config-subif)#
%LINK-3-UPDOWN: Interface GigabitEthernet0/0.10, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.10, changed state to up
enc
R1(config-subif)#encapsulation do
R1(config-subif)#encapsulation dot1Q 10
R1(config-subif)#ip add
R1(config-subif)#ip address 192.168.10.1 255.255.255.0
R1(config-subif)#exit
R1(config)#int
R1(config)#interface gi
R1(config)#interface gigabitEthernet 0/0.20
R1(config-subif)#
%LINK-3-UPDOWN: Interface GigabitEthernet0/0.20, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.20, changed state to up
enc
R1(config-subif)#encapsulation d
R1(config-subif)#encapsulation dot1Q 20
R1(config-subif)#ip add
R1(config-subif)#ip address 192.168.20.1 255.255.255.0
R1(config-subif)#exit
R1(config)#inte
R1(config)#interface gia
R1(config)#interface gi
R1(config)#interface gigabitEthernet 0/0.30
R1(config-subif)#
%LINK-3-UPDOWN: Interface GigabitEthernet0/0.30, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.30, changed state to up
enca
R1(config-subif)#encapsulation do
R1(config-subif)#encapsulation dot1Q 30
R1(config-subif)#ip add
R1(config-subif)#ip address 192.168.30.1 255.255.255.0
R1(config-subif)#exit
R1(config)#
R1(config)#
R1(config)#do wr
Building configuration...
[OK]
```

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06_subinterfaces_config.png

```
R1(config)#exit
R1#
%SYS-5-CONFIG_I: Configured from console by console
show
R1#show ip i
R1#show ip interface b
R1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  up                    up
GigabitEthernet0/0.10  192.168.10.1    YES manual up                    up
GigabitEthernet0/0.20  192.168.20.1    YES manual up                    up
GigabitEthernet0/0.30  192.168.30.1    YES manual up                    up
GigabitEthernet0/1     unassigned      YES unset  administratively down down
Vlan1                  unassigned      YES unset  administratively down down
R1#
```

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07_show_ip_int_brief.png

5.8. Router R1 - DHCP Configuration

DHCP pools were configured on the router for each VLAN. The first ten IP addresses in each subnet were excluded to reserve them for infrastructure devices.

```
R1#
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip dhcp ex
R1(config)#ip dhcp excluded-address 192.168.10.1 192.168.10.10
R1(config)#ip dhcp excluded-address 192.168.20.1 192.168.20.10
R1(config)#ip dhcp excluded-address 192.168.30.1 192.168.30.10
R1(config)#do wr
Building configuration...
[OK]
R1(config)#ip dhcp pool1 VLAN10_USERS
                         ^
% Invalid input detected at '^' marker.

R1(config)#ip dhcp pool VLAN10_USERS
R1(dhcp-config)#net
R1(dhcp-config)#network 192.168.10.0 255.255.255.0
R1(dhcp-config)#defa
R1(dhcp-config)#default-router 192.168.10.1
R1(dhcp-config)#dns
R1(dhcp-config)#dns-server 8.8.8.8
R1(dhcp-config)#exit
R1(config)#ip dhcp pool VLAN20_OFFICE
R1(dhcp-config)#ne
R1(dhcp-config)#network 192.168.20.0 255.255.255.0
R1(dhcp-config)#defa
R1(dhcp-config)#default-router 192.168.20.1
R1(dhcp-config)#dns
R1(dhcp-config)#dns-server 8.8.8.8
R1(dhcp-config)#exit
R1(config)#ip dhcp pool VLAN30 GUEST
```

08_dhcp_config.png

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

R1#
R1#
R1#show ip dhcp pool

Pool VLAN10_USERS :
 Utilization mark (high/low)    : 100 / 0
 Subnet size (first/next)       : 0 / 0
 Total addresses                : 254
 Leased addresses               : 0
 Excluded addresses             : 3
 Pending event                  : none

 1 subnet is currently in the pool
 Current index        IP address range                    Leased/Excluded/Total
 192.168.10.1         192.168.10.1     - 192.168.10.254    0    / 3     / 254

Pool VLAN20_OFFICE :
 Utilization mark (high/low)    : 100 / 0
 Subnet size (first/next)       : 0 / 0
 Total addresses                : 254
 Leased addresses               : 0
 Excluded addresses             : 3
 Pending event                  : none

 1 subnet is currently in the pool
 Current index        IP address range                    Leased/Excluded/Total
 192.168.20.1         192.168.20.1     - 192.168.20.254    0    / 3     / 254

Pool VLAN30_GUEST :
 Utilization mark (high/low)    : 100 / 0
 Subnet size (first/next)       : 0 / 0
 Total addresses                : 254
 Leased addresses               : 0
 Excluded addresses             : 3
 Pending event                  : none

 1 subnet is currently in the pool
 Current index        IP address range                    Leased/Excluded/Total
 192.168.30.1         192.168.30.1     - 192.168.30.254    0    / 3     / 254
R1#
```

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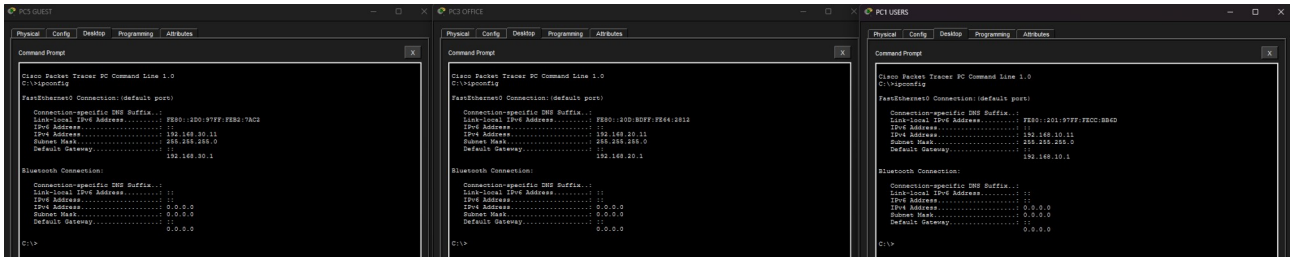
09_show_ip_dhcp_pool.png

5.9. End Devices - DHCP Configuration

End devices were configured to obtain IP addressing information dynamically via DHCP.

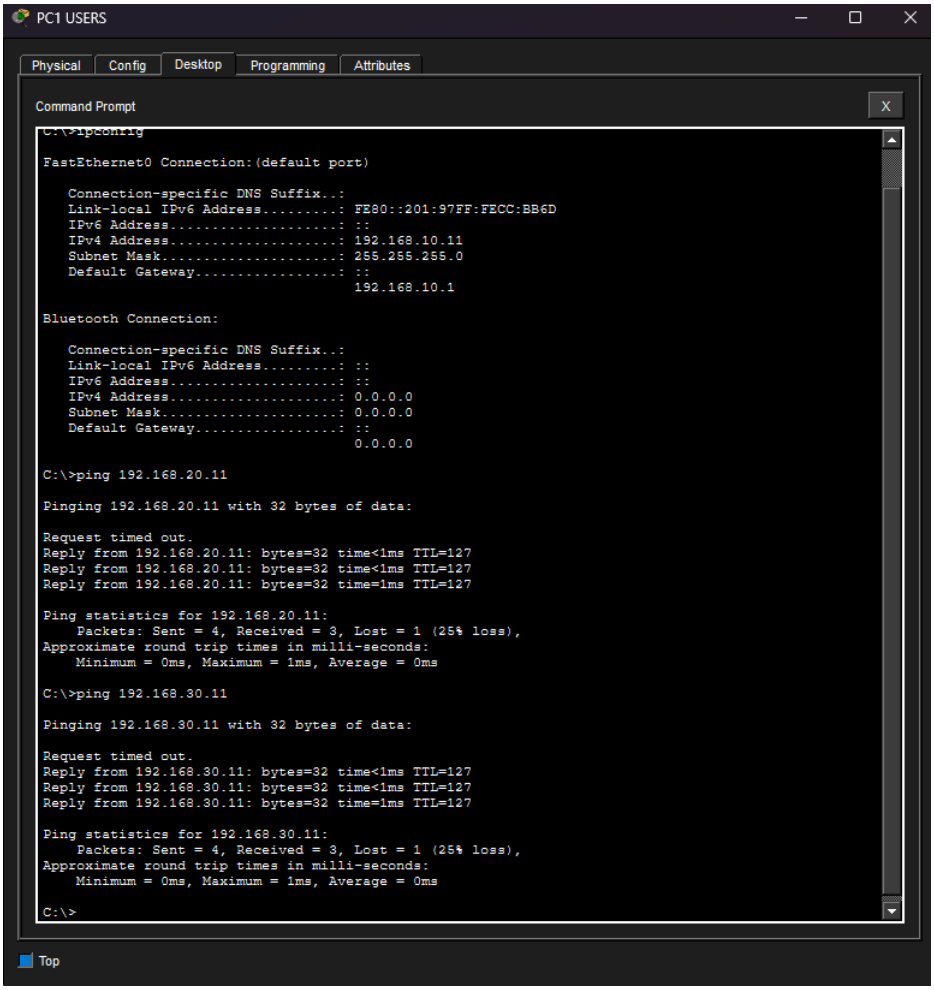


10_pc1_ipconfig.png

6. Verification & Testing

6.1. Inter-VLAN Connectivity Test

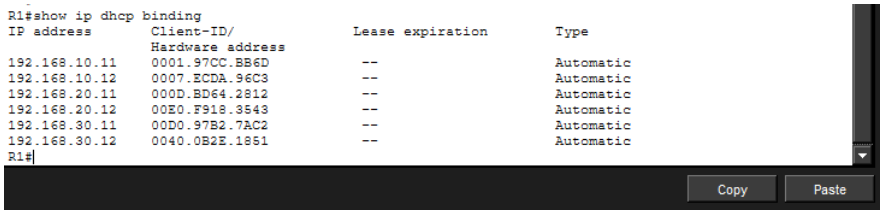
Inter-VLAN connectivity was verified using ICMP echo requests between hosts.



11_ping_intervlan.png

6.2. DHCP Lease Verification

DHCP lease assignments were verified on the router.

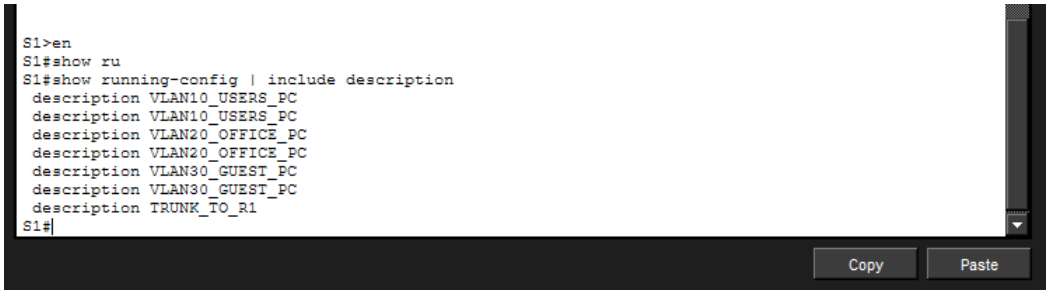


19_show_dhcp_binding.png

7. Security Hardening

7.1. Switch S1 - Port Descriptions (Documentation Hygiene)

Interface descriptions were added to improve configuration readability and network documentation.



12_port_descriptions.png

7.2. Switch S1 - Unused Ports and Parking VLAN

Unused switch ports were administratively shut down and assigned to a parking VLAN to reduce the attack surface.

13_show_int_status_unused.png

```
S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gig0/2
10   USERS                            active    Fa0/1, Fa0/2
20   OFFICE                           active    Fa0/3, Fa0/4
30   GUEST                            active    Fa0/5, Fa0/6
999  PARKING_LOT                      active    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
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

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14_vlan999_parking.png

7.3. Switch S1 - Port Security

Port security was enabled on access ports using sticky MAC addresses, allowing a single device per port. Violation Mode set to Restrict.

```
S1#show port-security
Secure Port MaxSecureAddr CurrentAddr SecurityViolation Security Action
              (Count)       (Count)        (Count)
-----------------------------------------------------------------------
        Fa0/1        1           0                0         Restrict
        Fa0/2        1           0                0         Restrict
        Fa0/3        1           0                0         Restrict
        Fa0/4        1           0                0         Restrict
        Fa0/5        1           0                0         Restrict
        Fa0/6        1           0                0         Restrict
-----------------------------------------------------------------------
S1#
```

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15_show_port_security.png

```
S1#show port-security interface f0/1
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
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

S1#
```

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16_ps_int_f01.png

7.4. Switch S1 — Disable DTP on Trunk

Dynamic Trunking Protocol (DTP) was disabled on the trunk interface to prevent unauthorized trunk negotiations.

```
S1#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Gig0/1      10,20,30

Port        Vlans allowed and active in management domain
Gig0/1      10,20,30

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      10,20,30

S1#
```

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17_trunk_after_hardening.png

7.5. Router R1 — Basic Hardening

Basic router hardening was applied, including password encryption and a login warning banner.

```
R1#
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#enable secret cisco123
R1(config)#ser
R1(config)#service pass
R1(config)#service password-encryption
R1(config)#banner motd # UNAUTHORIZED ACCESS PROHIBITED #
R1(config)#
```

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18_router_hardening.png

7.6. Post-Hardening Verification

Network functionality was re-verified after hardening to ensure that security measures did not impact connectivity.

```
C:\>ping 192.168.20.11

Pinging 192.168.20.11 with 32 bytes of data:

Reply from 192.168.20.11: bytes=32 time<1ms TTL=127
Reply from 192.168.20.11: bytes=32 time<1ms TTL=127
Reply from 192.168.20.11: bytes=32 time<1ms TTL=127
Reply from 192.168.20.11: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.20.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.30.11

Pinging 192.168.30.11 with 32 bytes of data:

Reply from 192.168.30.11: bytes=32 time<1ms TTL=127
Reply from 192.168.30.11: bytes=32 time<1ms TTL=127
Reply from 192.168.30.11: bytes=32 time=3ms TTL=127
Reply from 192.168.30.11: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.30.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 0ms

C:\>
```

Top

20_ping_after_hardening.png

8. Appendix A - Screenshot Checklist

- 01_topology.png
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9. Appendix B – Device Configuration

9.1. Switch S1 — Running Configuration

```
S1#show running-config
Building configuration...

Current configuration : 4630 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname S1
!
!
!
no ip domain-lookup
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
description VLAN10_USERS_PC
switchport access vlan 10
switchport mode access
switchport port-security
switchport port-security mac-address sticky
switchport port-security violation restrict
switchport port-security mac-address sticky 0001.97CC.BB6D
spanning-tree portfast
!
interface FastEthernet0/2
description VLAN10_USERS_PC
switchport access vlan 10
switchport mode access
switchport port-security
switchport port-security mac-address sticky
```

```
switchport port-security violation restrict
switchport port-security mac-address sticky 0007.ECDA.96C3
spanning-tree portfast
!
interface FastEthernet0/3
description VLAN20_OFFICE_PC
switchport access vlan 20
switchport mode access
switchport port-security
switchport port-security mac-address sticky
switchport port-security violation restrict
switchport port-security mac-address sticky 000D.BD64.2812
spanning-tree portfast
!
interface FastEthernet0/4
description VLAN20_OFFICE_PC
switchport access vlan 20
switchport mode access
switchport port-security
switchport port-security mac-address sticky
switchport port-security violation restrict
switchport port-security mac-address sticky 00E0.F918.3543
spanning-tree portfast
!
interface FastEthernet0/5
description VLAN30_GUEST_PC
switchport access vlan 30
switchport mode access
switchport port-security
switchport port-security mac-address sticky
switchport port-security violation restrict
switchport port-security mac-address sticky 00D0.97B2.7AC2
spanning-tree portfast
!
interface FastEthernet0/6
description VLAN30_GUEST_PC
switchport access vlan 30
switchport mode access
switchport port-security
switchport port-security mac-address sticky
switchport port-security violation restrict
switchport port-security mac-address sticky 0040.0B2E.1851
```

```
spanning-tree portfast
!
interface FastEthernet0/7
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/8
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/9
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/10
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/11
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/12
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/13
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
```

```
shutdown
!
interface FastEthernet0/14
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/15
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/16
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/17
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/18
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/19
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/20
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
```

```
shutdown
!
interface FastEthernet0/21
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/22
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/23
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/24
description UNUSED_PORT_SHUTDOWN
switchport access vlan 999
switchport mode access
shutdown
!
interface GigabitEthernet0/1
description TRUNK_TO_R1
switchport trunk allowed vlan 10,20,30
switchport mode trunk
switchport nonegotiate
!
interface GigabitEthernet0/2
!
interface Vlan1
no ip address
shutdown
!
!
!
!
line con 0
```

```
!
line vty 0 4
login
line vty 5 15
login
!
!
!
!
end
```

9.2. Router R1 — Running Configuration

```
R1#show run

Building configuration...


Current configuration : 1492 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname R1
!
!
!
enable secret 5 $1$mERr$5.a6P4JqbNiMX01usIfka/
!
!
ip dhcp excluded-address 192.168.10.1 192.168.10.10
ip dhcp excluded-address 192.168.20.1 192.168.20.10
ip dhcp excluded-address 192.168.30.1 192.168.30.10
!
ip dhcp pool VLAN10_USERS
network 192.168.10.0 255.255.255.0
default-router 192.168.10.1
dns-server 8.8.8.8
ip dhcp pool VLAN20_OFFICE
network 192.168.20.0 255.255.255.0
default-router 192.168.20.1
```

```
dns-server 8.8.8.8
ip dhcp pool VLAN30_GUEST
network 192.168.30.0 255.255.255.0
default-router 192.168.30.1
dns-server 8.8.8.8
!
!
!
ip cef
no ipv6 cef
!
!
!
!
license udi pid CISCO1941/K9 sn FTX1524JO4X-
!
!
!
!
!
!
!
!
!
!
!
!
no ip domain-lookup
!
!
spanning-tree mode pvst
!
!
!
!
!
!
!
interface GigabitEthernet0/0
no ip address
duplex auto
speed auto
!
interface GigabitEthernet0/0.10
```

```
encapsulation dot1Q 10
ip address 192.168.10.1 255.255.255.0
!
interface GigabitEthernet0/0.20
encapsulation dot1Q 20
ip address 192.168.20.1 255.255.255.0
!
interface GigabitEthernet0/0.30
encapsulation dot1Q 30
ip address 192.168.30.1 255.255.255.0
!
interface GigabitEthernet0/1
no ip address
duplex auto
speed auto
shutdown
!
interface Vlan1
no ip address
shutdown
!
ip classless
!
ip flow-export version 9
!
!
!
banner motd ^C UNAUTHORIZED ACCESS PROHIBITED ^C
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
!
end
```