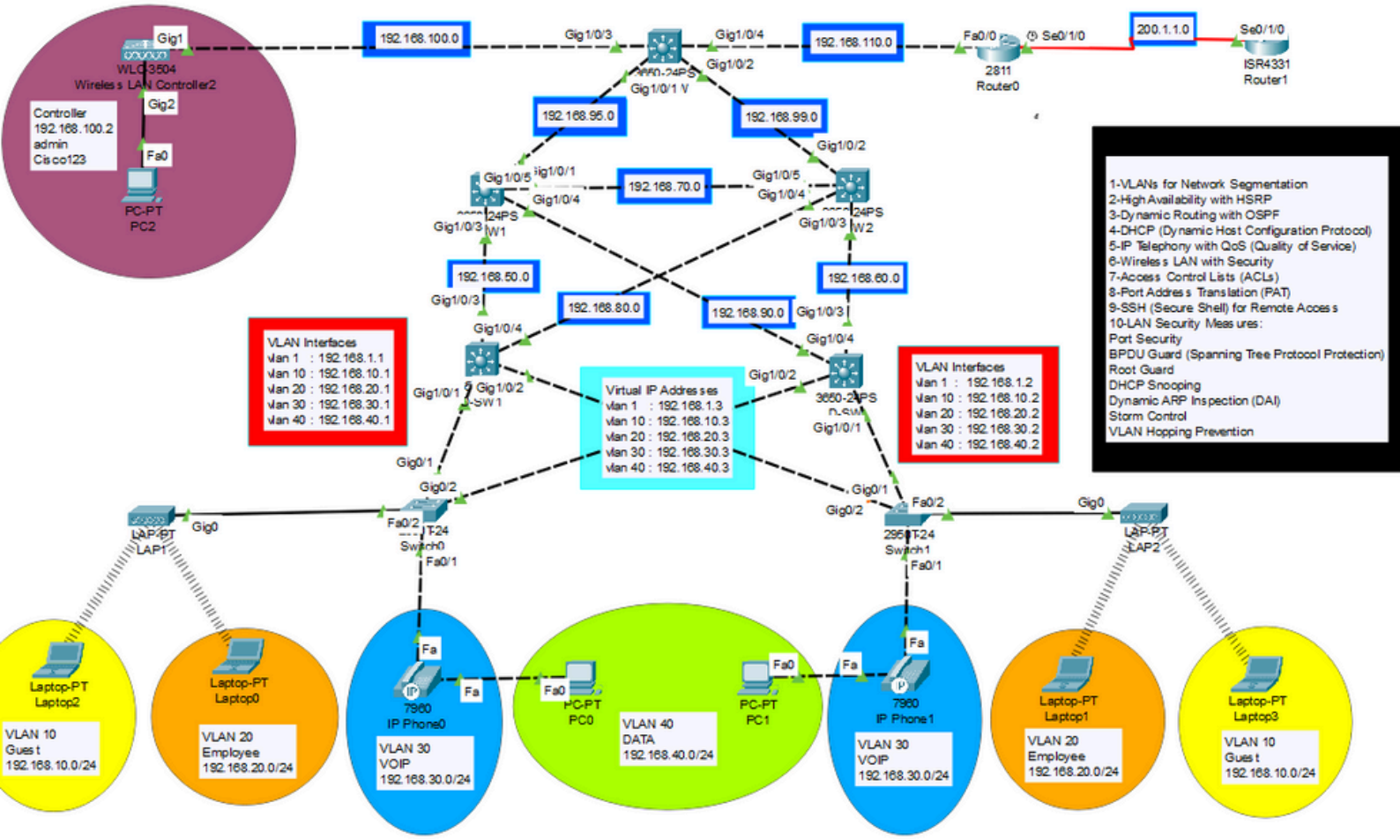
Egypt Digital Pioneers Initiative (EDPI)

Final Project

Comprehensive Network Infrastructure Setup

Network Topology Diagram



This project aims to create and establish a network infrastructure for an organization that is scalable, secure, and efficient. The design incorporates a range of technologies to guarantee optimal performance, robust security, and flexibility.

Technologies Used

1. VLANs for Network Segmentation
2. High Availability with HSRP
3. Dynamic Routing with OSPF
4. DHCP (Dynamic Host Configuration Protocol)
5. IP Telephony with QoS (Quality of Service)
6. Wireless LAN with Security
7. Access Control Lists (ACLs)
8. Port Address Translation (PAT)
9. SSH (Secure Shell) for Remote Access
10. LAN Security Measures:
    - Port Security
    - BPDU Guard (Spanning Tree Protocol Protection)
    - Root Guard
    - DHCP Snooping
    - Dynamic ARP Inspection (DAI)
    - Storm Control
    - VLAN Hopping Prevention

Key Components:

1-VLANs for Network Segmentation:

- VLANs (Virtual Local Area Networks) were configured to segment the network into distinct logical groups. Each VLAN isolates traffic and enhances network security.

  - VLAN 1 : Native (192.168.10.0/24)
  - VLAN 10: Guest Network (192.168.10.0/24)
  - VLAN 20: Employee Network (192.168.20.0/24)
  - VLAN 30: VoIP (Voice over IP) (192.168.30.0/24)
  - VLAN 40: Data Network (192.168.40.0/24)

A-SW1

```
en
conf t
hostname A-SW1
vlan 1
vlan 10
name GUST
vlan 20
name EMPLOYEE
vlan 30
name VOIP
vlan 40
name DATA
exit
int fa0/1
sw mode access
sw access vlan 40
sw voice vlan 30
exit
int fa0/2
sw mode trunk
exit
int rang Gig0/1-2
sw mode trunk
exit
```

A-SW2

```
en
conf t
hostname A-SW2
vlan 1
vlan 10
name GUST
vlan 20
name EMPLOYEE
vlan 30
name VOIP
vlan 40
name DATA
exit
int fa0/1
sw mode access
sw access vlan 40
sw voice vlan 30
exit
int fa0/2
sw mode trunk
exit
int rang Gig0/1-2
sw mode trunk
exit
```

2-High Availability with HSRP:

- HSRP (Hot Standby Router Protocol) was configured for router redundancy. This ensures that if the active router fails, a backup router automatically takes over, minimizing downtime.

D-SW1 standby

```
en
conf t
hostname D-SW1
vlan 1
vlan 10
name GUST
vlan 20
name EMPLOYEE
vlan 30
name VOIP
vlan 40
name DATA
exit
ip routing
int Gig1/0/1
sw mode trunk
exit
int Gig1/0/2
sw mode trunk
exit
int vlan 1
ip add 192.168.1.1 255.255.255.0
standby version 2
standby 5 ip 192.168.1.3
standby 5 priority 150
standby 5 preempt
no sh
exit
```

```
int vlan 10
ip add 192.168.10.1 255.255.255.0
standby version 2
standby 1 ip 192.168.10.3
standby 1 priority 150
standby 1 preempt
no sh
exit
int vlan 20
ip add 192.168.20.1 255.255.255.0
standby version 2
standby 2 ip 192.168.20.3
standby 2 priority 150
standby 2 preempt
no sh
exit
int vlan 30
ip add 192.168.30.1 255.255.255.0
standby version 2
standby 3 ip 192.168.30.3
standby 3 priority 150
standby 3 preempt
no sh
exit
int vlan 40
ip add 192.168.40.1 255.255.255.0
standby version 2
standby 4 ip 192.168.40.3
standby 4 priority 150
standby 4 preempt
no sh
exit
```

D-SW2 Backup

```
en
conf t
hostname D-SW2
vlan 1
vlan 10
name GUST
vlan 20
name EMPLOYEE
vlan 30
name VOIP
vlan 40
name DATA
exit
ip routing
int Gig1/0/1
sw mode trunk
exit
int Gig1/0/2
sw mode trunk
exit
int vlan 1
ip add 192.168.1.2 255.255.255.0
standby version 2
standby 1 ip 192.168.1.3
no sh
exit
int vlan 10
ip add 192.168.10.2 255.255.255.0
standby version 2
standby 1 ip 192.168.10.3
no sh
exit
```

```
int vlan 20
ip add 192.168.20.2 255.255.255.0
standby version 2
standby 2 ip 192.168.20.3
no sh
exit
int vlan 30
ip add 192.168.30.2 255.255.255.0
standby version 2
standby 3 ip 192.168.30.3
no sh
exit
int vlan 40
ip add 192.168.40.2 255.255.255.0
standby version 2
standby 4 ip 192.168.40.3
no sh
exit
```

3-Dynamic Routing with OSPF:

- OSPF (Open Shortest Path First) was implemented for dynamic routing between different networks. It ensures optimal path selection for data transmission.
- All switches and routers exchange routing information dynamically, improving network scalability and redundancy.

D-SW1 standby

```
ip routing
int Gig1/0/3
no switchport
ip add 192.168.50.2 255.255.255.0
no sh
exit
int Gig1/0/4
no switchport
ip add 192.168.80.2 255.255.255.0
no sh
exit
router ospf 1
router-id 1.1.1.1
network 192.168.1.0 0.0.0.255 area 0
network 192.168.10.0 0.0.0.255 area 0
network 192.168.20.0 0.0.0.255 area 0
network 192.168.30.0 0.0.0.255 area 0
network 192.168.40.0 0.0.0.255 area 0
network 192.168.50.0 0.0.0.255 area 0
network 192.168.80.0 0.0.0.255 area 0
exit
```

D-SW2 Backup

```
ip routing
int Gig1/0/3
no switchport
ip add 192.168.60.2 255.255.255.0
no sh
exit
int Gig1/0/4
no switchport
ip add 192.168.90.2 255.255.255.0
no sh
exit
router ospf 1
router-id 2.2.2.2
network 192.168.1.0 0.0.0.255 area 0
network 192.168.10.0 0.0.0.255 area 0
network 192.168.20.0 0.0.0.255 area 0
network 192.168.30.0 0.0.0.255 area 0
network 192.168.40.0 0.0.0.255 area 0
network 192.168.60.0 0.0.0.255 area 0
network 192.168.90.0 0.0.0.255 area 0
exit
```

C-SW1

```
en
conf t
hostname C-SW1
ip routing
int Gig1/0/1
no switchport
ip add 192.168.95.3 255.255.255.0
no sh
exit
int Gig1/0/5
no switchport
ip add 192.168.70.3 255.255.255.0
no sh
exit
int Gig1/0/3
no switchport
ip add 192.168.50.3 255.255.255.0
no sh
exit
int Gig1/0/4
no switchport
ip add 192.168.90.3 255.255.255.0
no sh
exit
router ospf 1
router-id 3.3.3.3
network 192.168.50.0 0.0.0.255 area 0
network 192.168.90.0 0.0.0.255 area 0
network 192.168.95.0 0.0.0.255 area 0
network 192.168.70.0 0.0.0.255 area 0
exit
```

C-SW2

```
en
conf t
hostname C-SW2
ip routing
int Gig1/0/2
no switchport
ip add 192.168.99.3 255.255.255.0
no sh
exit
int Gig1/0/3
no switchport
ip add 192.168.60.3 255.255.255.0
no sh
exit
int Gig1/0/4
no switchport
ip add 192.168.80.3 255.255.255.0
no sh
exit
int Gig1/0/5
no switchport
ip add 192.168.70.2 255.255.255.0
no sh
exit
router ospf 1
router-id 4.4.4.4
network 192.168.99.0 0.0.0.255 area 0
network 192.168.60.0 0.0.0.255 area 0
network 192.168.70.0 0.0.0.255 area 0
network 192.168.80.0 0.0.0.255 area 0
exit
```

core-SW

```
en
conf t
hostname core-SW1
ip routing
int Gig1/0/1
no switchport
ip add 192.168.95.2 255.255.255.0
no sh
exit
int Gig1/0/2
no switchport
ip add 192.168.99.2 255.255.255.0
no sh
exit
int Gig1/0/3
no switchport
ip add 192.168.100.1 255.255.255.0
no sh
exit
int Gig1/0/4
no switchport
ip add 192.168.110.2 255.255.255.0
no sh
exit
router ospf 1
router-id 5.5.5.5
network 192.168.95.0 0.0.0.255 area 0
network 192.168.99.0 0.0.0.255 area 0
network 192.168.100.0 0.0.0.255 area 0
network 192.168.110.0 0.0.0.255 area 0
exit
```

Router0

```
en
conf t
hostname R0
int fa0/0
ip add 192.168.110.1 255.255.255.0
no sh
exit
int Se0/1/0
ip add 200.1.1.1 255.255.255.0
no sh
exit
router ospf 1
router-id 6.6.6.6
network 192.168.110.0 0.0.0.255 area 0
network 200.1.1.0 0.0.0.255 area 0
exit
```

Router1

```
en
conf t
hostname R1
int Se0/1/0
ip add 200.1.1.2 255.255.255.0
no sh
exit
router ospf 1
router-id 7.7.7.7
network 200.1.1.0 0.0.0.255 area 0
exit
```

4-DHCP (Dynamic Host Configuration Protocol):

- DHCP servers were configured for automatic IP allocation to devices, making IP management easy and reducing manual configuration errors.

Router0

```
ip dhcp excluded-address 192.168.1.1
192.168.1.10
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 excluded-address
192.168.40.1 192.168.40.10

ip dhcp pool Native
network 192.168.1.0 255.255.255.0
default-router 192.168.1.3
option 43 ip 192.168.100.2
ip dhcp pool Guest
network 192.168.10.0 255.255.255.0
default-router 192.168.10.3
ip dhcp pool Employee
network 192.168.20.0 255.255.255.0
default-router 192.168.20.3
ip dhcp pool Voice
network 192.168.30.0 255.255.255.0
default-router 192.168.30.3
option 150 ip 192.168.110.1
ip dhcp pool Data
network 192.168.40.0 255.255.255.0
default-router 192.168.40.3
```

D-SW1 standby

```
interface vlan 1
ip helper-address 192.168.110.1
interface vlan 10
ip helper-address 192.168.110.1
interface vlan 20
ip helper-address 192.168.110.1
interface vlan 30
ip helper-address 192.168.110.1
interface vlan 40
ip helper-address 192.168.110.1
```

D-SW2 Backup

```
interface vlan 1
ip helper-address 192.168.110.1
interface vlan 10
ip helper-address 192.168.110.1
interface vlan 20
ip helper-address 192.168.110.1
interface vlan 30
ip helper-address 192.168.110.1
interface vlan 40
ip helper-address 192.168.110.1
```

5-IP Telephony with QoS (Quality of Service):

- IP telephony was integrated into the network, allowing for voice communication over IP.
- QoS was configured to prioritize voice traffic, ensuring low latency for VoIP calls (VLAN 30 is dedicated to IP phones).

Router0

```
ip dhcp pool Voice
network 192.168.30.0 255.255.255.0
default-router 192.168.30.3
option 150 ip 192.168.110.1
exit

telephony-service
max-dn 2
max-ephones 2
ip source-address 192.168.110.1 port 2000
auto assign 1 to 2

ephone-dn 1
number 1122
exit
ephone-dn 2
number 1133
exit

ephone 1
type 7960
button 1:1

ephone 2
type 7960
button 1:2
```

6-Access Control Lists (ACLs):

- ACLs control traffic flow and ensure that only authorized devices can access specific network parts.
- Standard and extended ACLs are applied to filter traffic based on IP addresses, protocols, and ports.

7-Port Address Translation (PAT):

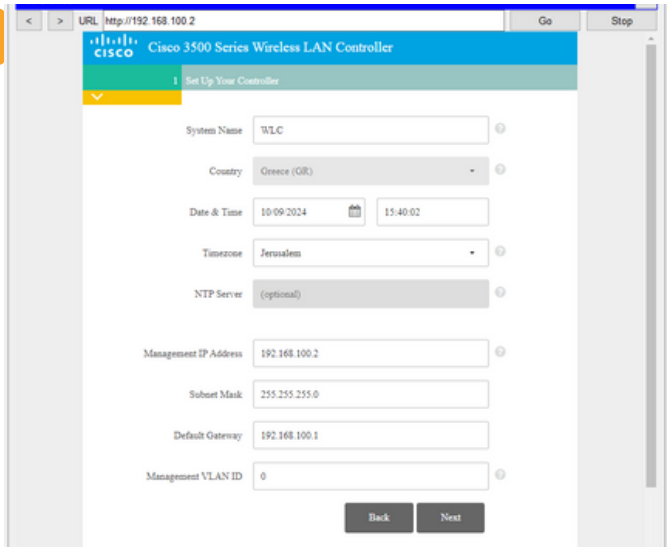
- PAT was set up for efficient internet access, allowing multiple devices within the LAN to access the internet using a single public IP address.

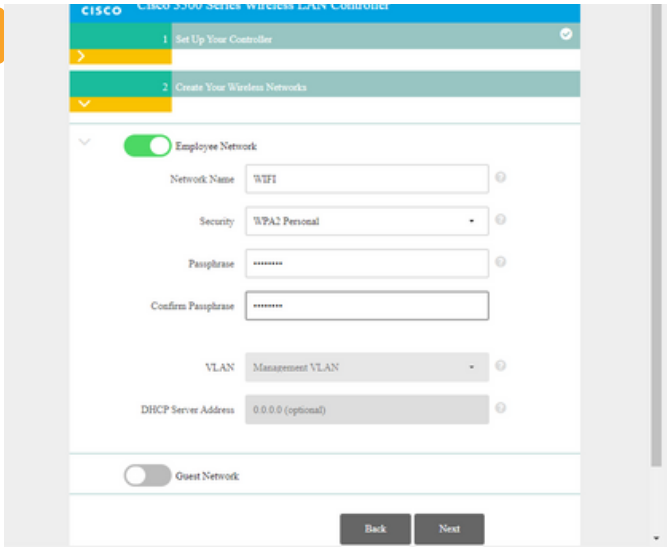
Router0

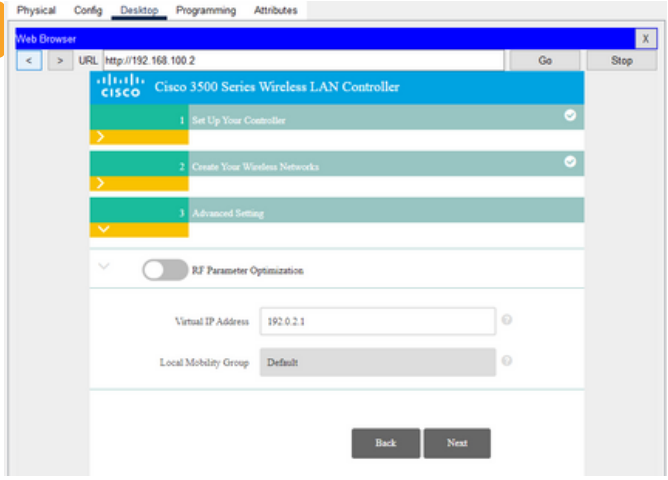
```
int fa0/0
ip nat inside

int se0/1/0
ip nat outside

access-list 1 permit 192.168.1.0 0.0.0.255
access-list 1 permit 192.168.10.0 0.0.0.255
access-list 1 permit 192.168.20.0 0.0.0.255
access-list 1 permit 192.168.30.0 0.0.0.255
access-list 1 permit 192.168.40.0 0.0.0.255

ip nat inside source list 1 interface fastethernet 0/1 overload
```

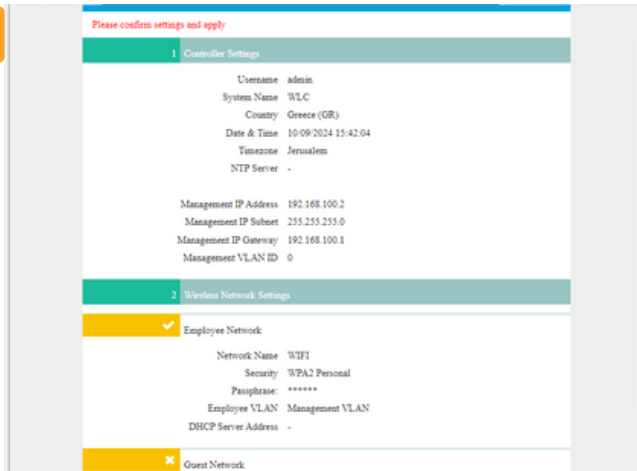
8-Wireless LAN with Security:

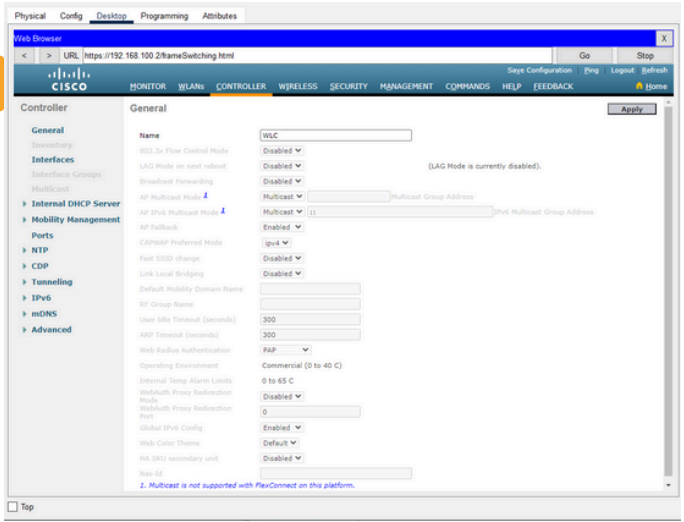
- A secure Wireless LAN (WLAN) was set up using WPA2/WPA3 encryption for secure communication.
- A Wireless LAN Controller (WLC) manages the access points, ensuring central management and security.
- Clients can connect to the wireless network securely with encrypted sessions.











9-SSH (Secure Shell) for Remote Access:

- SSH was implemented to provide encrypted remote management of network devices, enhancing security and ensuring safe remote configuration.

in all devices

```
ip domain-name security.com
crypto key generate rsa
1024
username admin privilege 15 secret
cisco123
line vty 0 4
login local
transport input ssh
ip ssh version 2
exec-timeout 5 0
```

A-SW1

```
interface vlan 1
ip add 192.168.1.4 255.255.255.0
no shutdown
interface vlan 10
ip add 192.168.10.4 255.255.255.0
interface vlan 20
ip add 192.168.20.4 255.255.255.0
interface vlan 30
ip add 192.168.30.4 255.255.255.0
interface vlan 40
ip add 192.168.40.4 255.255.255.0
```

PC

```
ssh -l admin 192.168.40.4

pass=cisco123
```

A-SW2

```
interface vlan 1
ip add 192.168.1.5 255.255.255.0
no shutdown
interface vlan 10
ip add 192.168.10.5 255.255.255.0
interface vlan 20
ip add 192.168.20.5 255.255.255.0
interface vlan 30
ip add 192.168.30.5 255.255.255.0
interface vlan 40
ip add 192.168.40.5 255.255.255.0
```

10-LAN Security Measures:

1-Port Security:

- Port security was enabled to prevent unauthorized devices from connecting to the network.
- This feature limits the number of MAC addresses per port, protecting against MAC flooding attacks.
- Configure Violation Action (What happens when the rule is violated):
  - Protect – Only blocks traffic from violating devices.
  - Restrict – Blocks traffic and logs the violation.
  - Shutdown – Shuts down the port when a violation occurs.

A-SW1

```
int fa0/1
sw mode access
switchport port-security
switchport port-security maximum 2
switchport port-security mac-address sticky
switchport port-security violation restrict
```

A-SW1

```
int fa0/1
sw mode access
switchport port-security
switchport port-security maximum 2
switchport port-security mac-address sticky
switchport port-security violation restrict
```

2-BPDU Guard (Spanning Tree Protocol Protection):

- BPDU Guard was configured to protect the Spanning Tree Protocol (STP) from being manipulated by unauthorized devices, preventing topology changes.

A-SW1

```
spanning-tree portfast bpduguard default
int fa0/1
spanning-tree portfast
```

A-SW2

```
spanning-tree portfast bpduguard default
int fa0/1
spanning-tree portfast
```

3-Root Guard:

- Used Root Guard to prevent devices from attempting to become the root bridge in the spanning tree.

A-SW1

```
int fa0/1
spanning-tree guard root
```

A-SW2

```
int fa0/1
spanning-tree guard root
```

4-DHCP Snooping:

- DHCP Snooping was enabled to protect the network from rogue DHCP servers. This prevents devices from receiving incorrect IP configurations from unauthorized DHCP servers.

A-SW1

```
ip dhcp snooping
ip dhcp snooping vlan 1
ip dhcp snooping vlan 10
ip dhcp snooping vlan 20
ip dhcp snooping vlan 30
ip dhcp snooping vlan 40
int range gig 0/1-2
ip dhcp snooping trust
int range fa0/1-2
no ip dhcp snooping trust
ip dhcp snooping limit rate 10
ip dhcp snooping database flash:dhcp-snooping-database
no ip dhcp snooping information option
```

A-SW1

```
p dhcp snooping
ip dhcp snooping vlan 1
ip dhcp snooping vlan 10
ip dhcp snooping vlan 20
ip dhcp snooping vlan 30
ip dhcp snooping vlan 40
int rang gig 0/1-2
ip dhcp snooping trust
int rang fa0/1-2
no ip dhcp snooping trust
ip dhcp snooping limit rate 10
exit
ip dhcp snooping database flash:dhcp-snooping-database
ip dhcp snooping information option
```

5-Dynamic ARP Inspection (DAI):

- DAI was configured to prevent ARP spoofing attacks, ensuring that only legitimate ARP replies are processed by network devices.

A-SW1

```
ip arp inspection vlan 1
ip arp inspection vlan 10
ip arp inspection vlan 20
ip arp inspection vlan 30
ip arp inspection vlan 40
int rang gig0/1-2
ip arp inspection trust
int rang fa0/1-2
no ip arp inspection trust
ip arp inspection limit rate 15
```

A-SW2

```
ip arp inspection vlan 1
ip arp inspection vlan 10
ip arp inspection vlan 20
ip arp inspection vlan 30
ip arp inspection vlan 40
int rang gig0/1-2
ip arp inspection trust
int rang fa0/1-2
no ip arp inspection trust
ip arp inspection limit rate 15
```

6-Storm Control:

- Storm Control was implemented to prevent broadcast, multicast, or unicast storms on the network, which could overwhelm network resources and degrade performance.

A-SW1

```
int rang fa0/1-2
storm-control broadcast level 10.00
storm-control multicast level 5.00
storm-control unicast level 5.00
storm-control action trap
storm-control action shutdown
```

A-SW12

```
int rang fa0/1-2
storm-control broadcast level 10.00
storm-control multicast level 5.00
storm-control unicast level 5.00
storm-control action trap
storm-control action shutdown
```

7-VLAN Hopping Prevention:

- VLAN Hopping Prevention was enabled to prevent attacks where a device tries to send traffic across VLANs it is not authorized to access.

A-SW1

```
int fa0/1
switchport nonegotiate
```

A-SW12

```
int fa0/1
switchport nonegotiate
```

Conclusion

This network infrastructure setup provides a highly scalable, secure, and efficient solution tailored to the organization's needs. It combines advanced routing, IP telephony with QoS, secure wireless communication, and robust security measures to protect the integrity and availability of the network.

Thank You!

designed by

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