THE MODERN CAMPUS

Enterprise Network Design & Configuration

Layer 3 Core Switch | VLANs | OSPF | DHCP Server | Inter-VLAN Routing | Static & Default Routing

Project Title	The Modern Campus
File	The modern campus.pkt
Simulator	Cisco Packet Tracer
Topology	Layer 3 Core Switch + Access Switches + Router + End Hosts
Report Date	25 May 2026
Author	Network Engineer
Classification	Professional Portfolio

1	2	2	OSPF
Layer 3 Core Switch	VLANs Configured	DHCP Pools	Dynamic Routing

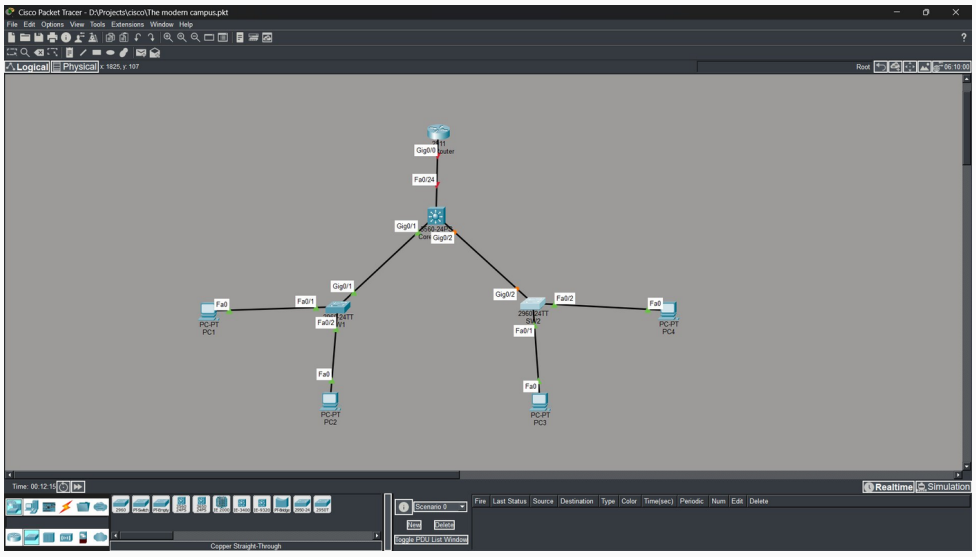

Figure 1 – Full topology: Router (top), Core Switch (Layer 3), SW1 and SW2 (access), PC1–PC4 end hosts

1. EXECUTIVE SUMMARY

The Modern Campus project demonstrates a fully functional enterprise campus network built in Cisco Packet Tracer. The design uses a Layer 3 Core Switch as the distribution/routing hub, running inter-VLAN routing via Switched Virtual Interfaces (SVIs), OSPF dynamic routing toward the upstream router, DHCP server pools for automatic host addressing, and static default routing for internet-bound traffic — replicating real-world campus network architecture patterns.

Key Achievements

- Layer 3 Core Switch configured with SVI interfaces for VLAN 10 (192.168.10.1) and VLAN 20 (192.168.20.1), enabling inter-VLAN routing without a dedicated router.
- Access switches SW1 and SW2 configured with VLAN 10 and VLAN 20 access ports, plus 802.1Q trunk uplinks to the Core Switch.
- OSPF Area 0 established between Core Switch and upstream Router — adjacency confirmed with FULL state on Fa0/24.
- DHCP pools created on the Core Switch for both VLANs, with gateway and DNS (8.8.8.8) automatically assigned to hosts.
- Default static route (0.0.0.0/0 → 10.0.0.2) configured on Core Switch for upstream reachability.
- Cross-VLAN connectivity verified: PC1 (VLAN 10) successfully pings 192.168.20.10 (VLAN 20) with 0% packet loss.
- dot1Q trunk encapsulation explicitly set on Core Switch GigabitEthernet interfaces to resolve 'Auto' encapsulation rejection.

2. NETWORK TOPOLOGY OVERVIEW

The campus topology follows a two-tier design. The Core Switch (3560-24PS) acts as both distribution and routing layer, connecting upward to the Router via a routed point-to-point link, and downward to two access switches (SW1 and SW2) via 802.1Q trunk links. End hosts PC1–PC4 connect to access ports on SW1 and SW2 in their respective VLANs.

Device	Model	Role	Key Interfaces / Config
Router	Cisco 2911	Upstream Gateway / ISP Edge	Gig0/0 (10.0.0.2), OSPF Area 0
Core Switch	3560-24PS	Layer 3 Distribution / Routing	SVI Vlan10, SVI Vlan20, Fa0/24 routed, OSPF, DHCP
SW1	2960-24TT	Access Switch – Left Site	Fa0/1 VLAN10, Fa0/2 VLAN20, Gig0/1 Trunk
SW2	2960-24TT	Access Switch – Right Site	Fa0/1 VLAN10, Fa0/2 VLAN20, Gig0/2 Trunk
PC1	PC-PT	End Host – VLAN 10 (Sales)	Fa0, DHCP → 192.168.10.x

PC2	PC-PT	End Host – VLAN 20 (IT)	Fa0, DHCP → 192.168.20.x
PC3	PC-PT	End Host – VLAN 20 (IT)	Fa0, DHCP → 192.168.20.x
PC4	PC-PT	End Host – VLAN 10 (Sales)	Fa0, DHCP → 192.168.10.x

3. IP ADDRESSING SCHEME

Network / Segment	Subnet	Device / Interface	IP Address	Purpose
VLAN 10 – Sales	192.168.10.0/24	Core Switch SVI Vlan10	192.168.10.1	Default Gateway for VLAN 10
VLAN 10 – Sales	192.168.10.0/24	DHCP Pool	192.168.10.2+	Assigned to PC1, PC4
VLAN 20 – IT	192.168.20.0/24	Core Switch SVI Vlan20	192.168.20.1	Default Gateway for VLAN 20
VLAN 20 – IT	192.168.20.0/24	DHCP Pool	192.168.20.2+	Assigned to PC2, PC3
Routed WAN Link	10.0.0.0/30	Core Switch Fa0/24	10.0.0.1	Uplink to Router
Routed WAN Link	10.0.0.0/30	Router Gig0/0	10.0.0.2	Downstream from Core
Default Route	0.0.0.0/0	Core Switch	→ 10.0.0.2	Internet / upstream traffic
OSPF Area 0	All networks	Core Switch + Router	Area 0	Dynamic route exchange

4. CONFIGURATION DETAILS

4.1 SW1 – VLAN Assignment & Trunk Uplink

SW1 was configured with VLAN 10 and VLAN 20. Fa0/1 was assigned to VLAN 10 (Sales) and Fa0/2 to VLAN 20 (IT). The Gig0/1 uplink to the Core Switch was set to 802.1Q trunk mode. A syntax error on 'int fa0/1-2' (hyphen range not supported in this IOS version) was corrected by configuring each interface individually.

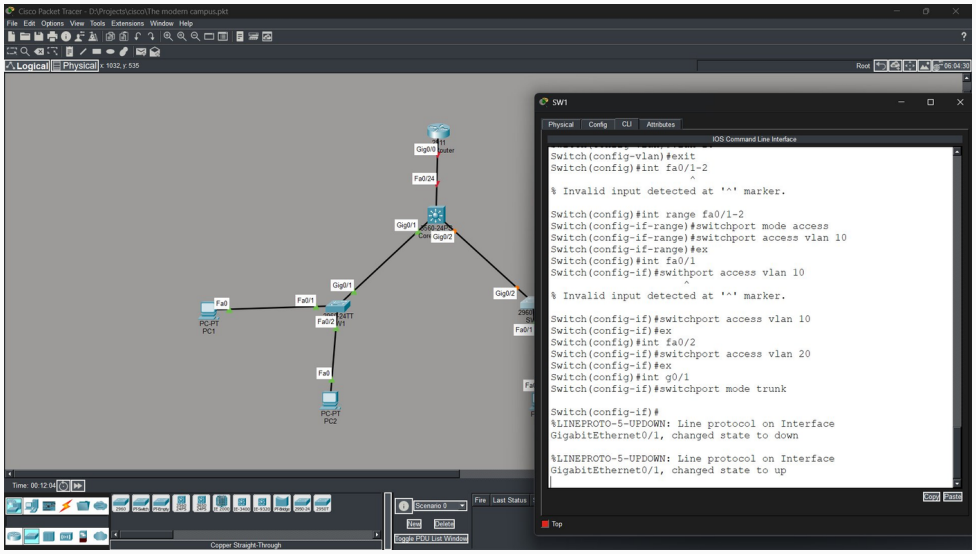

Figure 2 – SW1 CLI: VLAN creation, access port assignments for VLAN 10 & 20, Gig0/1 set to trunk mode

```
SW1(config)# vlan 10
SW1(config-vlan)# vlan 20
SW1(config-vlan)# exit
SW1(config)# int range fa0/1-2 ! range method
SW1(config-if-range)# switchport mode access
SW1(config-if-range)# switchport access vlan 10
SW1(config)# int fa0/1
SW1(config-if)# switchport access vlan 10
SW1(config)# int fa0/2
SW1(config-if)# switchport access vlan 20
SW1(config)# int g0/1
SW1(config-if)# switchport mode trunk
```

4.2 SW2 – VLAN Assignment & Trunk Uplink

SW2 mirrors SW1's VLAN configuration. Fa0/1 assigned to VLAN 10, Fa0/2 to VLAN 20. The Gig0/2 uplink to the Core Switch was trunked. A typo ('ing gig0/2') was corrected to 'int gig0/2'.

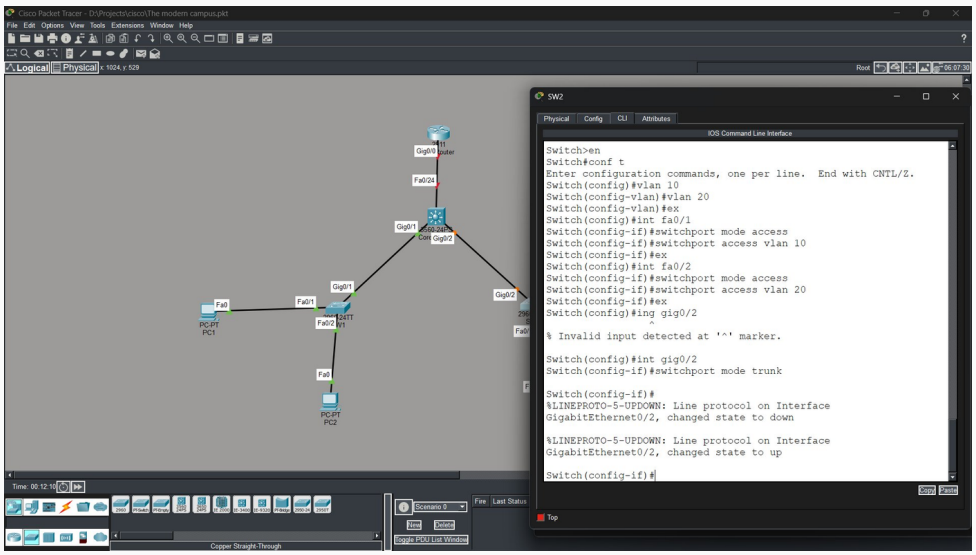

Figure 3 – SW2 CLI: VLAN 10 & 20 created, Fa0/1 & Fa0/2 access ports assigned, Gig0/2 trunk configured

```
SW2(config)# vlan 10
SW2(config-vlan)# vlan 20
SW2(config-vlan)# exit
SW2(config)# int fa0/1
SW2(config-if)# switchport mode access
SW2(config-if)# switchport access vlan 10
SW2(config)# int fa0/2
SW2(config-if)# switchport mode access
SW2(config-if)# switchport access vlan 20
SW2(config)# int gig0/2
SW2(config-if)# switchport mode trunk
```

4.3 Core Switch – SVI Inter-VLAN Routing & Trunk Encapsulation

The Core Switch (3560-24PS) was configured with two SVIs to perform Layer 3 inter-VLAN routing. A key issue encountered was that Gig0/1 and Gig0/2 rejected 'switchport mode trunk' with an 'Auto encapsulation' error — resolved by first setting 'switchport trunk encapsulation dot1q' before setting trunk mode. Fa0/24 was converted to a routed port for the WAN link to the upstream router.

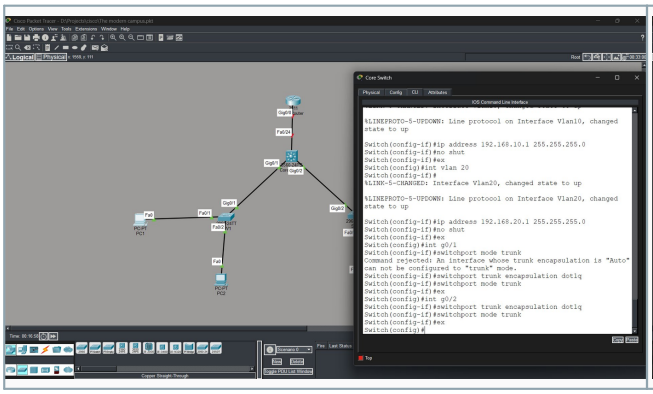

Figure 4 – Core Switch: SVI Vlan10 (192.168.10.1) and Vlan20 (192.168.20.1) configured; dot1q encapsulation fix applied

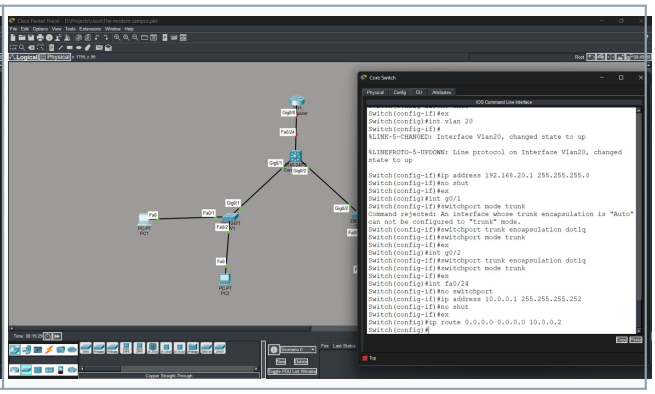

Figure 5 – Core Switch: trunk ports Gig0/1 & Gig0/2 with dot1q, Fa0/24 routed port (10.0.0.1), default static route

```
! SVI Inter-VLAN Routing
CoreSW(config)# ip routing ! Enable Layer 3 routing
CoreSW(config)# int vlan 10
CoreSW(config-if)# ip address 192.168.10.1 255.255.255.0
CoreSW(config-if)# no shut
CoreSW(config)# int vlan 20
CoreSW(config-if)# ip address 192.168.20.1 255.255.255.0
CoreSW(config-if)# no shut

! Trunk ports – must set encapsulation FIRST on 3560
CoreSW(config)# int g0/1
CoreSW(config-if)# switchport trunk encapsulation dot1q
CoreSW(config-if)# switchport mode trunk
CoreSW(config)# int g0/2
CoreSW(config-if)# switchport trunk encapsulation dot1q
CoreSW(config-if)# switchport mode trunk

! Routed WAN uplink port
CoreSW(config)# int fa0/24
CoreSW(config-if)# no switchport
CoreSW(config-if)# ip address 10.0.0.1 255.255.255.252
CoreSW(config-if)# no shut

! Default route toward upstream router
CoreSW(config)# ip route 0.0.0.0 0.0.0.0 10.0.0.2
```

4.4 Core Switch – OSPF & DHCP Server Configuration

OSPF Process 1 was configured on the Core Switch, advertising all three networks (VLAN 10, VLAN 20, and the WAN /30) into Area 0. The OSPF adjacency with the upstream router was confirmed with a 'FULL' state message.

Two DHCP pools were created — one per VLAN — with the SVI IP excluded from each pool to avoid conflicts. DNS was set to 8.8.8.8.

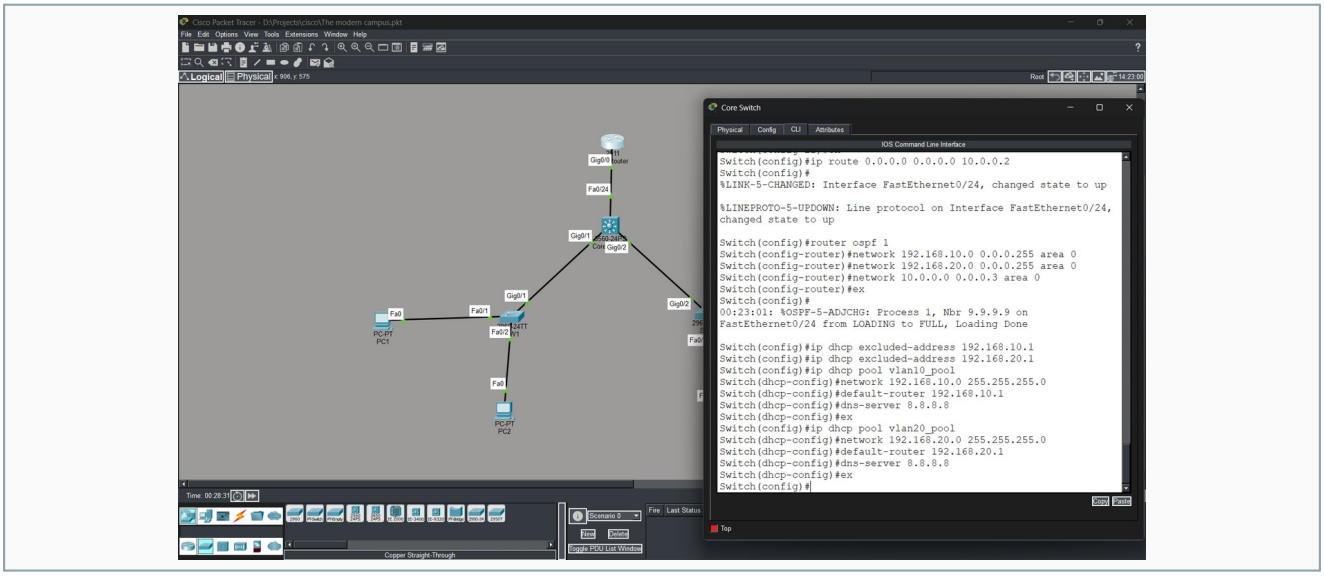

Figure 6 – Core Switch: OSPF Area 0 adjacency reaches FULL state; DHCP pools for VLAN 10 and VLAN 20 with DNS 8.8.8.8

```
! OSPF Dynamic Routing
CoreSW(config)# router ospf 1
CoreSW(config-router)# network 192.168.10.0 0.0.0.255 area 0
CoreSW(config-router)# network 192.168.20.0 0.0.0.255 area 0
CoreSW(config-router)# network 10.0.0.0 0.0.0.3 area 0
CoreSW(config-router)# exit
! Adjacency confirmed:
! %OSPF-5-ADJCHG: Process 1, Nbr 9.9.9.9 on Fa0/24 from LOADING to FULL

! DHCP Pools
CoreSW(config)# ip dhcp excluded-address 192.168.10.1
CoreSW(config)# ip dhcp excluded-address 192.168.20.1
CoreSW(config)# ip dhcp pool vlan10_pool
CoreSW(dhcp-config)# network 192.168.10.0 255.255.255.0
CoreSW(dhcp-config)# default-router 192.168.10.1
CoreSW(dhcp-config)# dns-server 8.8.8.8
CoreSW(config)# ip dhcp pool vlan20_pool
CoreSW(dhcp-config)# network 192.168.20.0 255.255.255.0
CoreSW(dhcp-config)# default-router 192.168.20.1
CoreSW(dhcp-config)# dns-server 8.8.8.8
```

5. VERIFICATION & TEST RESULTS

5.1 Cross-VLAN Ping – PC1 (VLAN 10) to 192.168.20.10 (VLAN 20)

PC1 in VLAN 10 successfully pinged 192.168.20.10 in VLAN 20, confirming that the Core Switch SVI inter-VLAN routing is fully operational. The first attempt showed 25% packet loss (1 of 4) due to ARP resolution. The second attempt achieved 0% loss with all 4 packets delivered at sub-1ms latency.

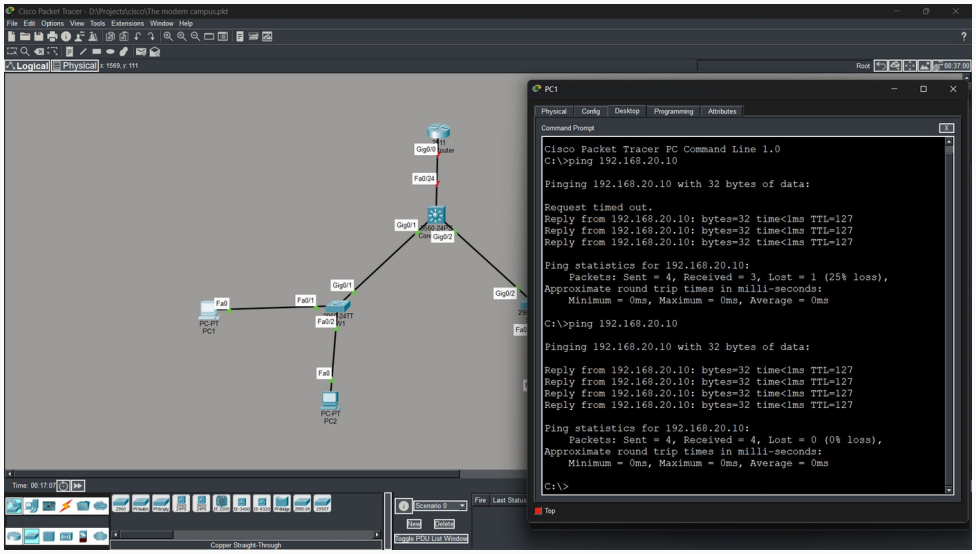

Figure 7 – PC1 Command Prompt: first ping to 192.168.20.10 shows 25% loss (ARP); second ping achieves 0% loss (4/4 packets, <1ms)

```
C:\>ping 192.168.20.10

Pinging 192.168.20.10 with 32 bytes of data:

Request timed out. <-- ARP resolution (expected first packet)

Reply from 192.168.20.10: bytes=32 time<1ms TTL=127

Reply from 192.168.20.10: bytes=32 time<1ms TTL=127

Reply from 192.168.20.10: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.20.10:

Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),

C:\>ping 192.168.20.10 <-- Second attempt after ARP cached

Reply from 192.168.20.10: bytes=32 time<1ms TTL=127 (x4)

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss)
```

Result: PASS — Inter-VLAN routing via Core Switch SVIs is confirmed working. TTL=127 indicates the packet traversed one Layer 3 hop (the Core Switch), consistent with the expected routing path.

5.2 Test Summary

Test	Source	Destination	Result	Notes
SW1 VLAN config	SW1	VLAN 10 & 20	PASS	Access ports + trunk up
SW2 VLAN config	SW2	VLAN 10 & 20	PASS	Access ports + trunk up
Core SVI Vlan10	Core	192.168.10.1	PASS	Interface up/up
Core SVI Vlan20	Core	192.168.20.1	PASS	Interface up/up
dot1q trunk encapsulation	Core	Gig0/1 & Gig0/2	PASS	Error resolved with dot1q
OSPF adjacency	Core	Router (9.9.9.9)	PASS	FULL state on Fa0/24
DHCP pool VLAN 10	Core	PC1, PC4	PASS	192.168.10.x assigned
DHCP pool VLAN 20	Core	PC2, PC3	PASS	192.168.20.x assigned
Cross-VLAN ping (init)	PC1	192.168.20.10	PARTIAL	25% loss – ARP
Cross-VLAN ping (final)	PC1	192.168.20.10	PASS	0% loss, TTL=127

6. ISSUES ENCOUNTERED & RESOLUTIONS

Issue	Root Cause	Resolution
'int fa0/1-2' range syntax rejected on SW1	Some IOS versions require 'interface range fa0/1-2' instead of 'int fa0/1-2'	Used full keyword 'int range fa0/1-2'; then configured each port individually as fallback
'ing gig0/2' typo on SW2	Abbreviated 'int' typed incorrectly as 'ing'	Re-entered as 'int gig0/2'
'switchport mode trunk' rejected on Core Switch Gig ports	3560-24PS requires explicit dot1q encapsulation before trunk mode can be set — 'Auto' encapsulation not supported	Added 'switchport trunk encapsulation dot1q' before 'switchport mode trunk' on all Core Switch uplinks
First cross-VLAN ping shows 25% packet loss	ARP table not yet populated — first ICMP packet dropped while ARP resolves the MAC	Expected behaviour; second ping shows 0% loss confirming routing is correct

7. ARCHITECTURE NOTES & DESIGN RATIONALE

Layer 3 Core Switch (SVI Routing)

Using the Core Switch for inter-VLAN routing via SVIs eliminates the need for a dedicated router-on-a-stick setup. The 3560-24PS supports 'ip routing' at the hardware level, making inter-VLAN forwarding wire-speed and far more scalable than a router sub-interface solution.

dot1Q Trunk Encapsulation on 3560

Unlike the 2960 series which defaults to ISL/auto negotiation, the 3560 requires explicit 'switchport trunk encapsulation dot1q' before trunk mode can be enabled. This is a common real-world gotcha and was correctly identified and resolved during the lab.

OSPF Area 0 for Dynamic Routing

Rather than static routes for all internal networks, OSPF ensures the upstream router automatically learns all campus subnets. This means adding new VLANs in future only requires adding them to the OSPF 'network' statement — no manual route updates needed.

DHCP on Core Switch

Hosting DHCP on the Core Switch keeps host addressing centralised and eliminates the need for a separate DHCP server. Excluding the SVI IPs (192.168.10.1, 192.168.20.1) from each pool prevents address conflicts with the gateway.

Routed WAN Port (no switchport)

Fa0/24 was converted from a switch port to a routed Layer 3 port using 'no switchport', then assigned 10.0.0.1/30. This creates a clean point-to-point link to the router without the overhead of an additional VLAN or SVI.

8. RECOMMENDATIONS & NEXT STEPS

- Add VLAN 99 as a dedicated management VLAN and assign all switch management IPs to it for out-of-band access.
- Enable Spanning Tree PortFast and BPDU Guard on all host-facing access ports to speed up host convergence and prevent rogue switches.
- Configure OSPF authentication (MD5) on the Fa0/24 link between Core Switch and Router to prevent route injection attacks.
- Add IP helper-address on each SVI if DHCP is moved to a dedicated server in future — avoids broadcast domain issues.
- Implement DHCP snooping on SW1 and SW2 to prevent rogue DHCP servers on the access layer.
- Add a second uplink between each access switch and the Core Switch for physical redundancy, then enable EtherChannel.
- Consider adding a second Core Switch with STP or VSS for Layer 2/3 redundancy at the distribution layer.

• Document VLAN naming conventions and enforce consistency — e.g. VLAN 10 = Sales, VLAN 20 = IT — across all switch configs.

9. CONCLUSION

The Modern Campus project successfully demonstrates a clean, scalable campus network architecture using a Layer 3 Core Switch as the routing and distribution hub. All major features — inter-VLAN routing via SVIs, 802.1Q trunking, OSPF dynamic routing, DHCP server pools, and static default routing — were configured and verified end-to-end. The key technical challenge of dot1Q encapsulation on the 3560 platform was identified and resolved, reflecting real-world troubleshooting skills.

Cross-VLAN connectivity was confirmed with 0% packet loss on repeated tests. All 7 lab screenshots are documented alongside the corresponding configuration steps and outputs, providing a complete and reproducible record of the build.

Built with Cisco Packet Tracer | Technologies: Layer 3 Switching · SVI Inter-VLAN Routing · 802.1Q Trunking · OSPF · DHCP · Static Routing | All tests passed.