## Lab 2: EtherChannel, VTP, and Spanning Tree Protocol (STP) Implementation

This lab focuses on implementing **EtherChannel (LACP)** for link aggregation and redundancy, centralizing VLAN management using **VTP**, and controlling Layer 2 loop prevention with **Rapid PVST+ Spanning Tree Protocol**. This lab builds on the previous VLAN and trunking setup by introducing switch hierarchy (Distribution and Access layers), **STP root bridge tuning**, and edge-port protections such as **PortFast**, **BPDU Guard**, and **disabling unused ports** to improve stability, resilience, and security.

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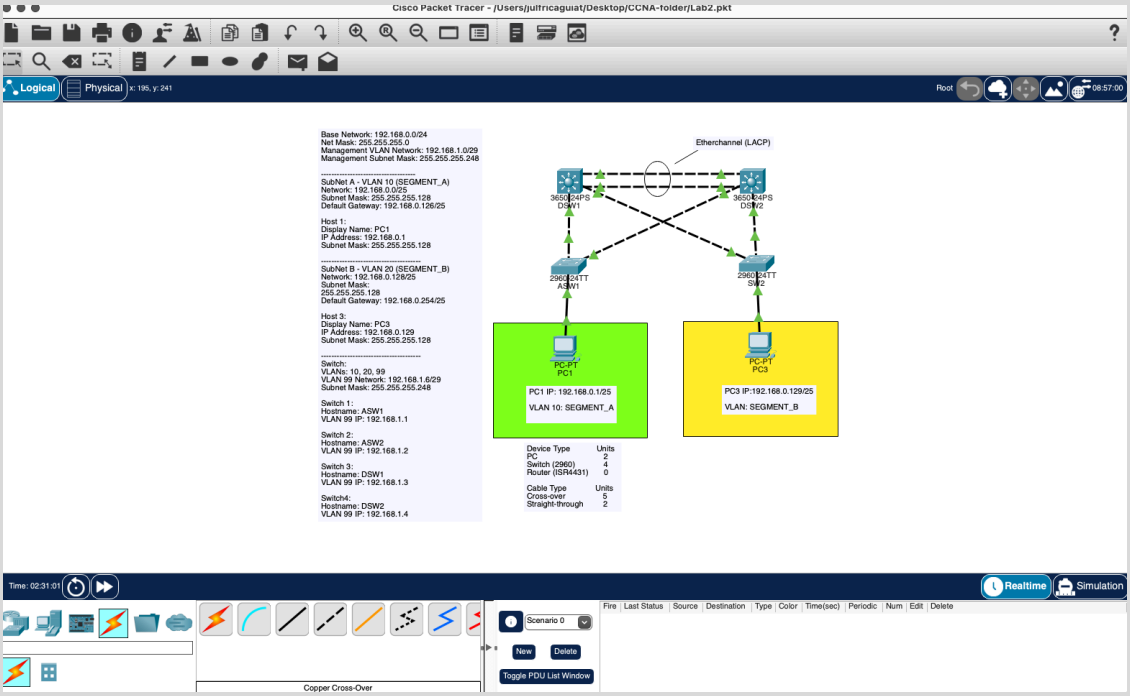
### Network Topology:

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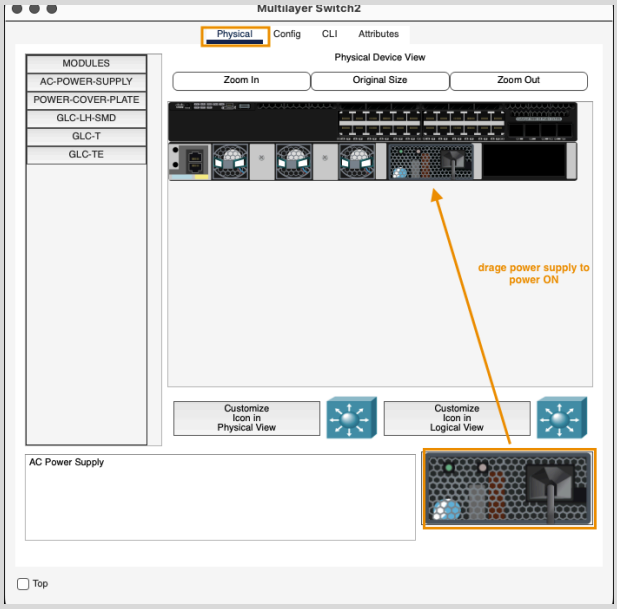
### Powering On Devices: Multi-Layer Switch



**Network Addressing Plan (Subnetting):**

**Overall Network:**

| Parameter | Value |
|---|---|
| Base Network | 192.168.0.0/24 |
| Subnet Mask | 255.255.255.0 |
| Management VLAN Network | 192.168.1.0/29 |
| Management Subnet Mask | 255.255.255.248 |

**Subnet A – VLAN 10 (SEGMENT_A)**

| Parameter | Host 1 (PC1) |
|---|---|
| IP Address | 192.168.0.1 |
| Subnet Mask | 255.255.255.128 |
| Default Gateway | 192.168.0.126 |
| VLAN | 10 |
| Network | 192.168.0.0/25 |

**Subnet B – VLAN 20 (SEGMENT_B)**

| Parameter | Host 3 (PC3) |
|---|---|
| IP Address | 192.168.0.129 |
| Subnet Mask | 255.255.255.128 |
| Default Gateway | 192.168.0.254 |
| VLAN | 20 |
| Network | 192.168.0.128/25 |

**Switch 1 – ASW1**

| Parameter | Value |
|---|---|
| Hostname | ASW1 |
| VLANs | 10, 20, 99 |
| SVI VLAN 99 IP Address | 192.168.1.1 /29 |
| Default Gateway | 192.168.1.6 |

**Switch 2 – ASW2**

| Parameter | Value |
|---|---|
| Hostname | ASW2 |
| VLANs | 10, 20, 99 |
| SVI VLAN 99 IP | 192.168.1.2 /29 |
| Default Gateway | 192.168.1.6 |

**Switch 3 – DSW1**

| Parameter | Value |
|---|---|
| Hostname | DSW1 |
| VLANs | 10, 20, 99 |
| SVI VLAN 99 IP | 192.168.1.3 /29 |
| Default Gateway | 192.168.1.6 |

**Switch 4 – DSW2**

| Parameter | Value |
|---|---|
| Hostname | DSW2 |
| VLANs | 10, 20, 99 |
| SVI VLAN 99 IP | 192.168.1.4 /29 |
| Default Gateway | 192.168.1.6 |

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**Initial Switch Setup (refer to Lab1 ): Optional**

- Configure hostnames
- Set system clock
- Configure NTP for time synchronization
- Secure device access (console & VTY)
- Save configurations

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**VLAN Creation (Centralized on DSW1 – VTP Server)**

- Create user VLANs and management VLAN
- Assign VLAN names

**on DSW1:**

! Configure VTP Server

```
vtp mode server
vtp domain jcagLab
vtp version 2
```

! Create VLANs

```
vlan 10
  name SEGMENT_A
  exit
vlan 20
 name SEGMENT_B
 exit
vlan 99
  name MGMT
  exit
```

**! Configure DSW2, ASW1, ASW2 to operate as VTP clients**

```
vtp mode client
```

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**EtherChannel Configuration (DSW1 and DSW2 port-channel link)**

- Bundle parallel trunk links
- Use LACP (mode active)
- Configure Port-Channel as trunk

**on DSW1 & DSW2:**

! Configure physical interfaces for DSW channel

```
interface range gigabitEthernet1/0/3 - 4
  channel-group 1 mode active
  exit
```

! Configure Port-Channel interface for DSW channel

```
interface po1
  sw trunk encapsulation dot1q
  sw mode trunk
  sw trunk native vlan 1000
  sw trunk allowed vlan 10,20,99
  exit
```

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**Manual Trunking + DTP Disabled (DSWs and trunk links)**

- Configure trunk links between switches
- Set non-default native VLAN
- Disable DTP negotiation

**On DSW1 & DSW2:**

! Configure physical  interface

```
int range g1/0/1-2
  sw mode trunk
  sw nonegotiate
  sw trunk native vlan 1000
  sw trunk allowed vlan 10,20,99
  exit
```

**on ASW1 & ASW2:**

! Configure physical interfaces

```
int range g0/1 - 2
  switchport mode trunk
  switchport nonegotiate
  switchport trunk native vlan 1000
  switchport trunk allowed vlan 10,20,99
  exit
```

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**Spanning Tree Protocol (Rapid PVST+)**

- Enable Rapid PVST+
- Manually define root bridge roles per VLAN

! Enable Rapid PVST+

```
spanning-tree mode rapid-pvst
```

! Root bridge configuration (DSW1)

```
spanning-tree vlan 10,99 root primary
spanning-tree vlan 20 root secondary
```

! Root bridge configuration (DSW2)

```
spanning-tree vlan 20 root primary
spanning-tree vlan 10,99 root secondary
```

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**Management VLAN (SVI Configuration)**

- Configure management SVI on each switch
- Assign IP addresses from VLAN 99 subnet
- Set default gateway

**on DSW1:**

! Configure management SVI

```
interface vlan 99
  ip address 192.168.1.1 255.255.255.248
  no shutdown
  exit
```

! Set default gateway

```
ip default-gateway 192.168.1.6
```

**! Configure DSW2, ASW1, ASW2 -** Increment IP addresses on ASW2, DSW1, DSW2:

ASW2 = `ip address 192.168.1.2 255.255.255.248`

DSW1 = `ip address 192.168.1.3 255.255.255.248`

DSW2 = `ip address 192.168.1.4 255.255.255.248`

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## Access Port Configuration (End Devices)

- Assign access ports to VLANs
- Enable PortFast and BPDU Guard! Configure access port

**on ASW1 & ASW2:**

! Configure access port

```
interface f0/1
  switchport mode access
  switchport access vlan 10
  spanning-tree portfast
 spanning-tree bpduguard enable
```

→ change to `switchport access vlan 20` on ASW2

! Shutdown unused ports

```
int range f0/1
  shutdown
```

**!Repeat configuration on ASW2 - change command line to:** `switchport access vlan 20`

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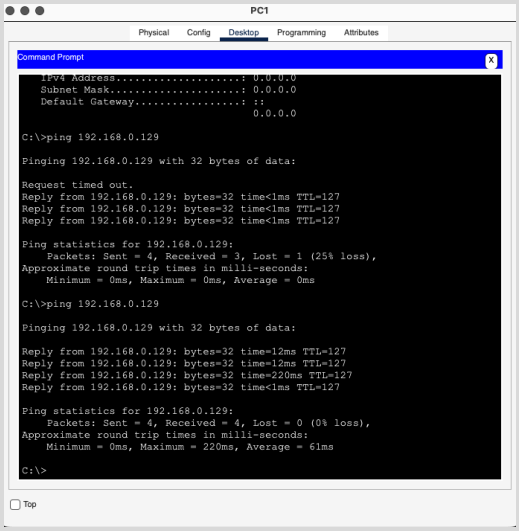
## Verification & Testing

| Command | What It Shows |
|---|---|
| `show vlan brief` | VLAN IDs, names, status, and access ports per VLAN |
| `show interfaces trunk` | Trunk ports, native VLAN, allowed and active VLANs |
| `show etherchannel summary` | Port-channel status, protocol (LACP/PAgP), member ports |
| `show spanning-tree vlan 10` | STP role, root bridge, port states for VLAN 10 |
| `show spanning-tree vlan 20` | STP role, root bridge, port states for VLAN 20 |
| `show ip interface brief` | Interface IPs, admin status, and line protocol state |
| `show vtp status` | VTP mode, domain name, version, and revision number |

**! Successful Pings from PC1 : VLAN 10:**

`ping 192.168.0.129` (PC_3 : VLAN 20)



## DSW1 Running Configuration