Week 7. Review (Troubleshooting Lab)

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credit to phlin, zyyang

LAB Outline

- Lab3 IOS
- Lab4 VLAN
- Lab5 STP
- Lab6 Routing

LAB Outline

- Lab3 IOS
  - IOS Operation Mode
  - SSH
  - Password Recovery in Packet Tracer (with lab)
  - CDP (with lab)
- Lab4 VLAN
- Lab5 STP
- Lab6 Routing

IOS Operation Mode

- User EXEC mode: "**>**"

- Privileged EXEC mode: "**#**"

- Global mode: "**(conf)#**"

- Specific mode: "**(conf-XX)#**"

IOS Mode Hierarchical Structure

User EXEC Command - `Router>`
```
ping
show (limited)
enable
etcetera
```

Privileged EXEC Commands - `Router#`
```
all User EXEC commands
debug commands
reload
configure
etcetera
```

Global Configuration Commands - `Router(config)#`
```
hostname
enable secrect
ip route

interface ethernet
          serial
          dsl
          etcetera

router rip
       ospf
       eigrp
       etcetera

line vty
     console
     etcetera
```

Interface Commands - `Router(config-if)#`
```
ip address
ipv6 address
encapsulation
shutdown/no shutdown
etcetera
```

Routing Engine Commands - `Router(config-router)#`
```
network
version
auto summary
etcetera
```

Line Commands - `Router(config-line)#`
```
password
login
modem commands
etcetera
```

Operation Mode In Packet Tracer

```
Switch>                          ──────→   User EXEC mode
Switch>en
Switch#                          ──────→   Privileged EXEC mode
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#                  ──────→   Global mode
Switch(config)#int fa0/1
Switch(config-if)#               ──────→   Specific mode
Switch(config-if)#exit
Switch(config)#
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

[112B_LAB0_SSH]

VLAN1
192.168.1.254/24

VLAN1
192.168.1.200/24

Gig1/0/1

Gig0/1

3650-24PS
Multilayer Switch0

SSH login user

User: ccna
PW: ccna

2960-24TT
Switch0

Fa0/1

Fa0

192.168.1.1/24

PC-PT
PC0
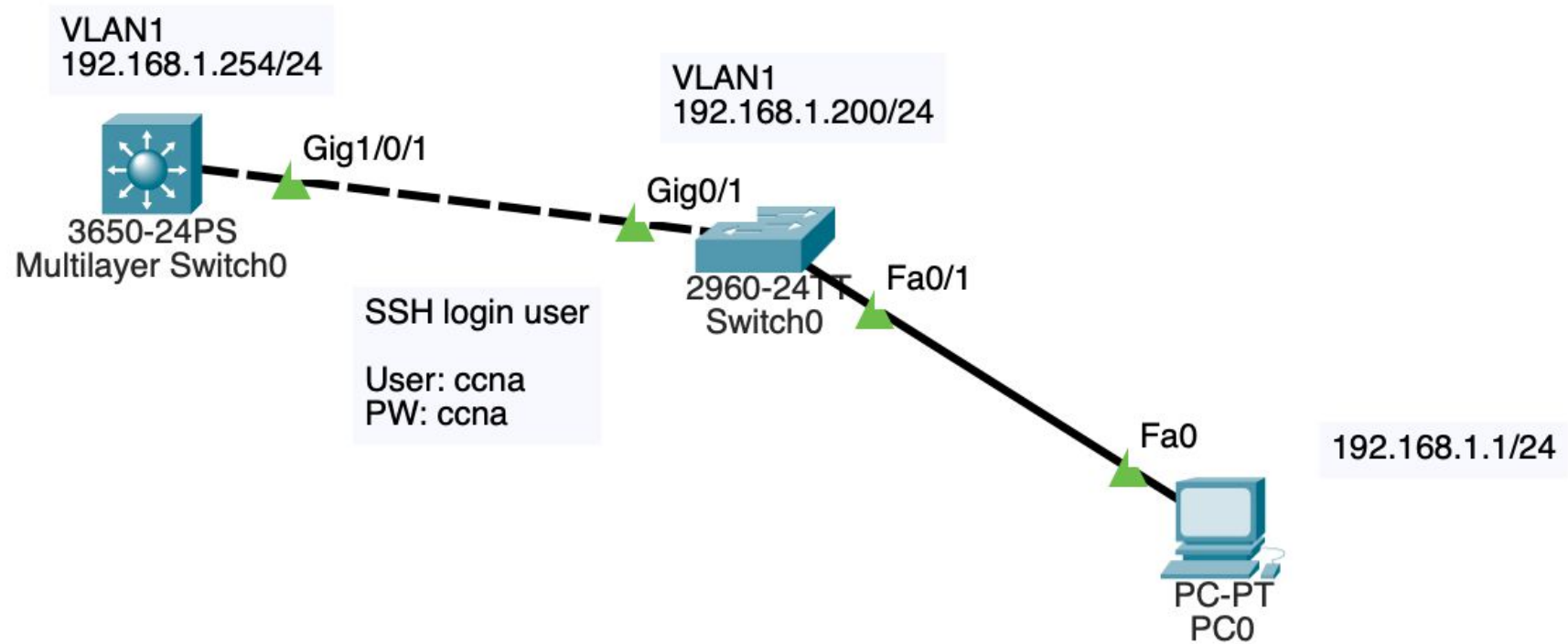
SSH

- Step0. Define a hostname
- Step1. Create an account

```
(conf)# username {YOUR_ACCOUNT_NAME} secret {PASSWORD}
```

- Step2. Set domain-name then generate key

```
(conf)# ip domain-name {DOMAIN_NAME}
(conf)# crypto key generate rsa
How many bit in the modulus[512]: {BITS}
```

- Step3. Set SVI

```
(config)# interface vlan 1
(config-if)# ip address {IP_ADDRESS} {NETMASK}
(config-if)# no shutdown
```

SSH

- Step4. Apply setting on vty

```
(conf)# ip ssh version 2
(conf)# line vty 0 15
(conf-line)# login local
(conf-line)# transport input ssh
```
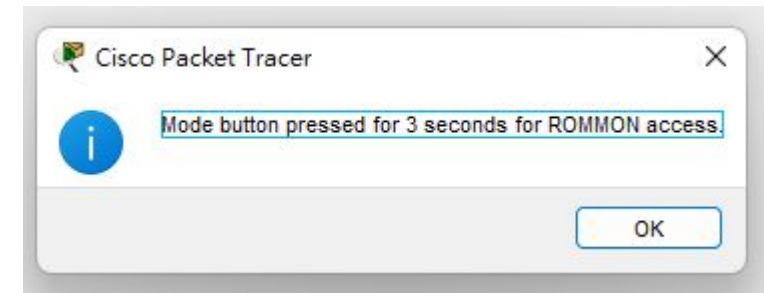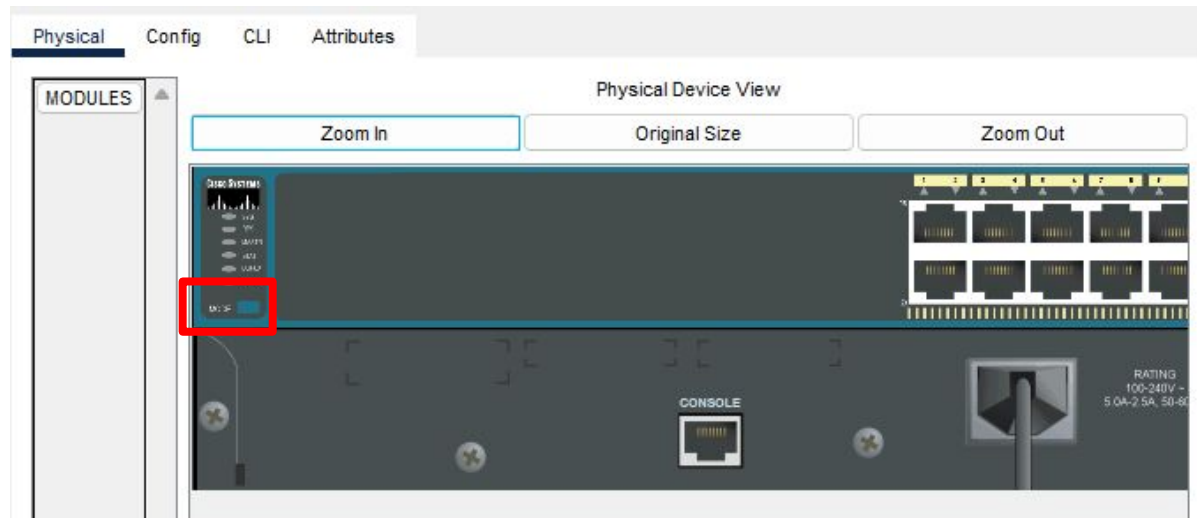
[112B_LAB1_Password_Recovery]

- Unknown enable password

2960-24TT
Switch0

Password Recovery in Packet Tracer -1

- Step1. Reload Devices
    - Way1: Press "Power Cycle Devices" button
    - Way2: 'alt' + 's'

Password Recovery in Packet Tracer -2

- Step2. Click the 'MODE' button several times until the message appears.

Password Recovery in Packet Tracer -3

- Step3. Mount flash file system

```
The system has been interrupted ...
...
switch: flash_init
```

- Step4. Show files

```
switch: dir flash:

Directory of flash:/
    13  drwx          192    Mar 01 1993 22:30:48  c2960-lanbase-mz.122-25.FX
    11  -rwx         5825    Mar 01 1993 22:31:59  config.text
    18  -rwx          720    Mar 01 1993 02:21:30  vlan.dat
```

Password Recovery in Packet Tracer -4

- Step5. Rename config.text

```
switch: rename flash:config.text flash:config.bak
```

- Step6. Boot

```
switch: boot
```

- Step7. Enter no to reject initial configuration dialog

```
In order to access the device manager, ...
...
Would you like to enter the initial configuration dialog?
[yes/no]: no
Switch>
```

Password Recovery in Packet Tracer -5

- Step8. Restore config.text and running-config

```
Switch> enable
Switch# copy running-config startup-config
Switch# copy flash startup-config
Source filename []? config.bak
Destination filename [startup-config]?
Switch# copy startup-config running-config
```

- Step9. Reset Password

[112B_LAB2_CDP]

- Discover Cluster0 topology

- SSH
  - Username: ccna
  - Password: ccna
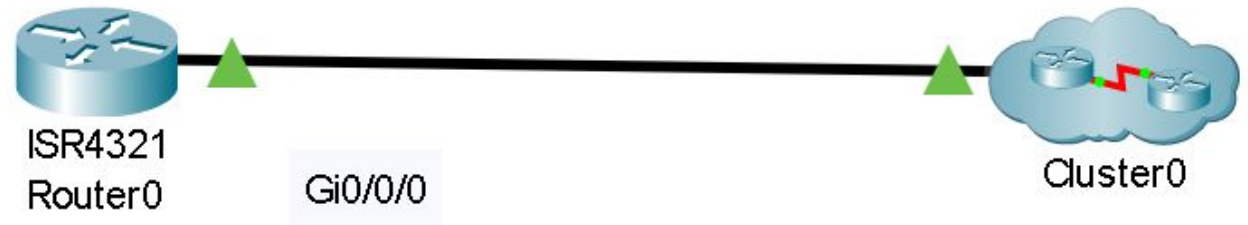
CDP Neighbors Detail

```
Router#sh cdp neighbors detail


Device ID: Core
Entry address(es):
 IP address : 10.1.0.2
Platform: cisco 3650, Capabilities:
Interface: GigabitEthernet0/0/0, Port ID (outgoing port): GigabitEthernet1/0/24
Holdtime: 153

Version :
Cisco IOS Software [Denali], Catalyst L3 Switch Software (CAT3K_CAA-UNIVERSALK9-M),
Version 16.3.2, RELEASE SOFTWARE (fc4)
Technical Support : http://www.cisco.com/techsupport
Copyright(c) 1986 - 2016 by Cisco Systems, Inc.
Compiled Tue 08 - Nov - 16 17:31 by pt_team

advertisement version: 2
Duplex: full
```

CDP Neighbors Detail

```
Router#
Router#ssh -l ccna 10.1.0.2

Password:

Core>
Core>sh cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone
Device ID      Local Intrfce     Holdtme     Capability     Platform     Port ID
agre0          Gig 1/0/1         133                        3650         Gig 1/0/1
Router         Gig 1/0/24        133             R          ISR4300      Gig 0/0/0
agre1          Gig 1/0/2         133                        3650         Gig 1/0/1
```
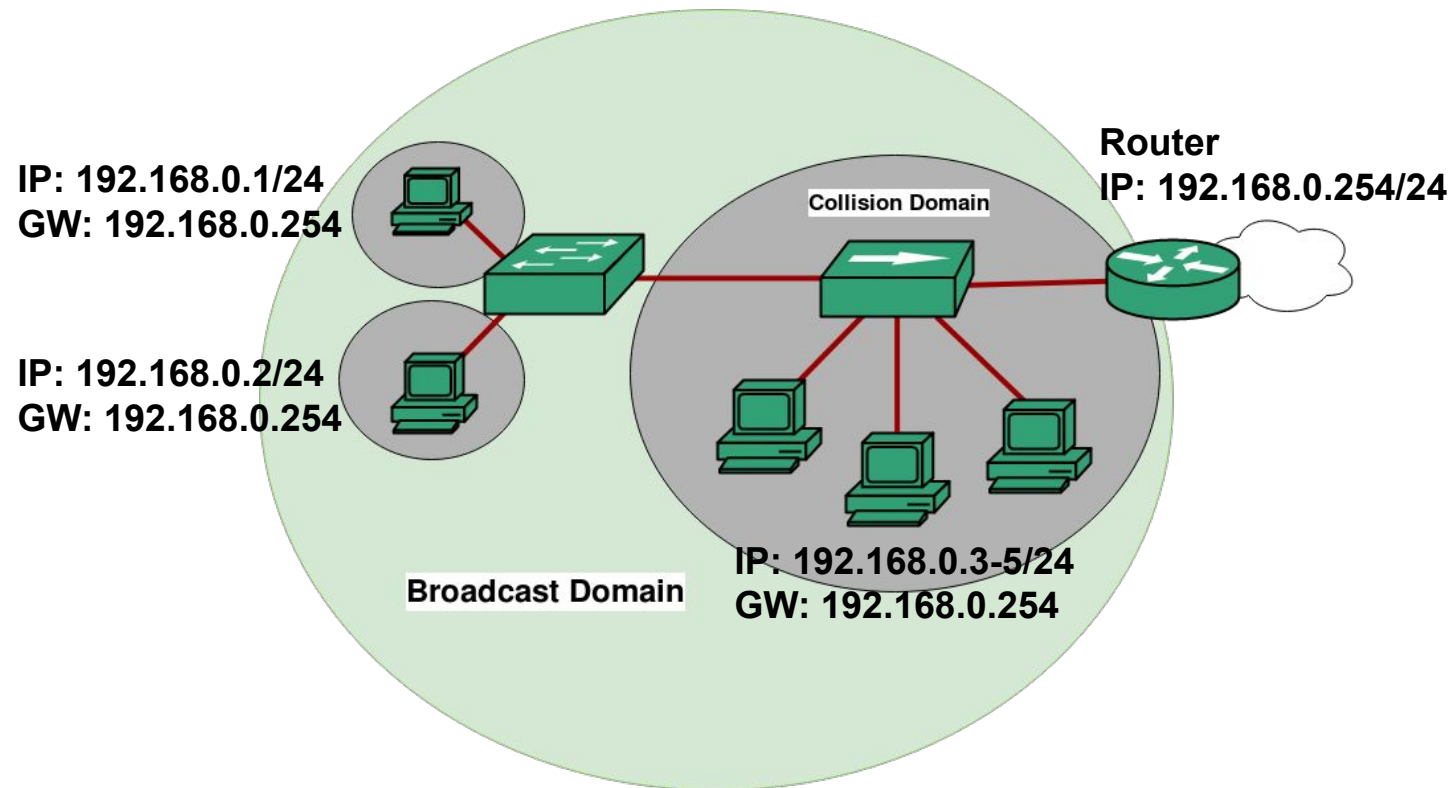
LAB Outline

- Lab3 IOS
- Lab4 VLAN
  - LAN
  - VLAN
  - Interface Mode
  - SVI
  - Config "int vlan" vs. "vlan"
  - [Lab] VLAN
- Lab5 STP
- Lab6 Routing

LAN (Local Area Network)

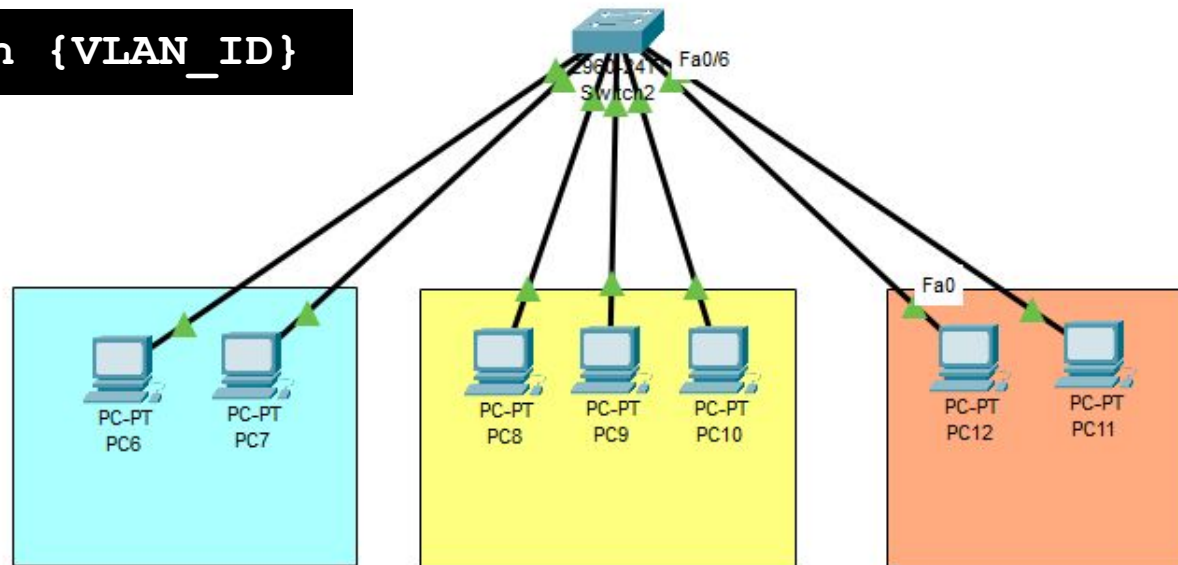A computer network that interconnects computers within a limited area of a single broadcast domain.
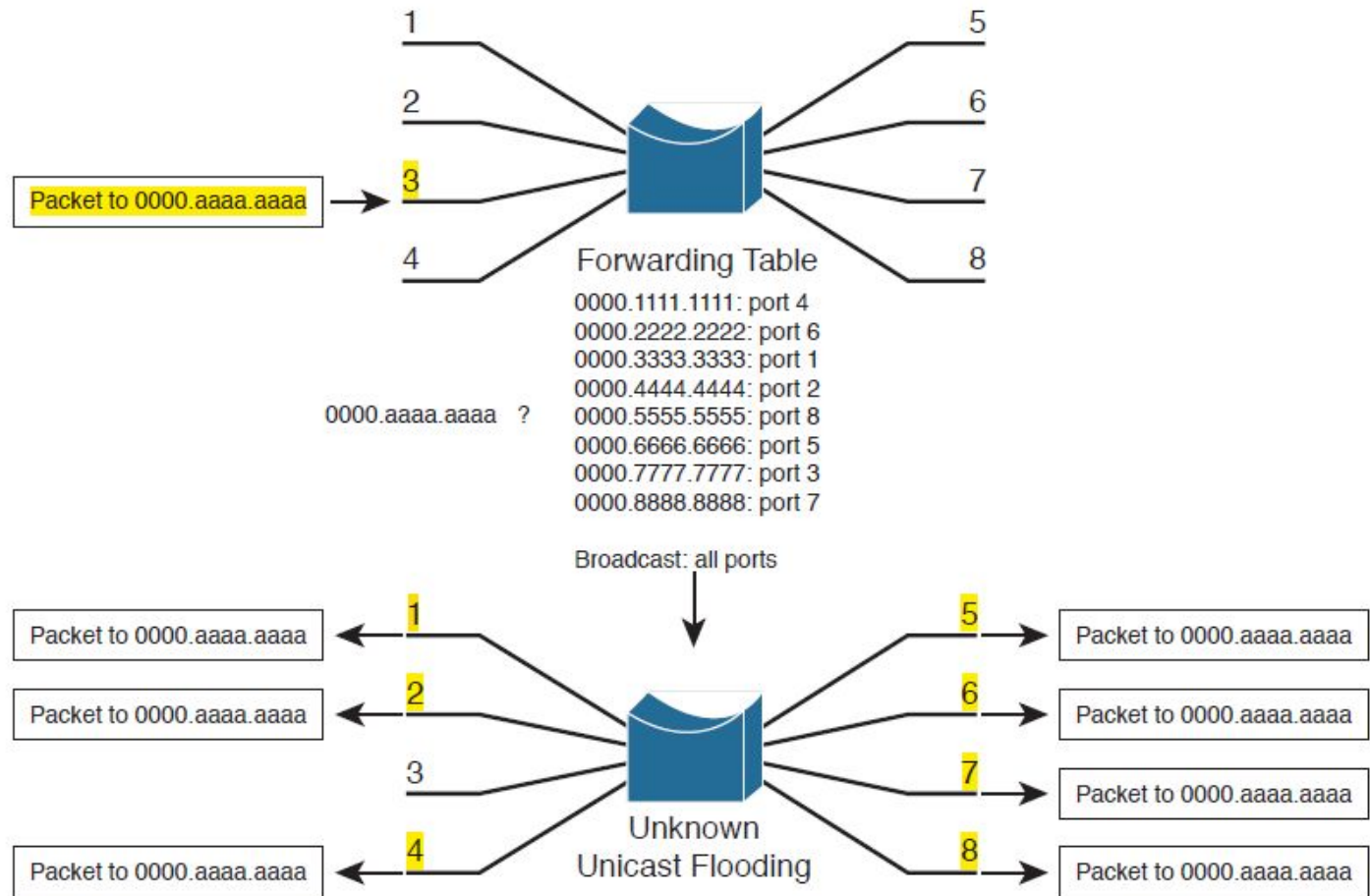
VLAN

Multiple LANs in the same physical switch
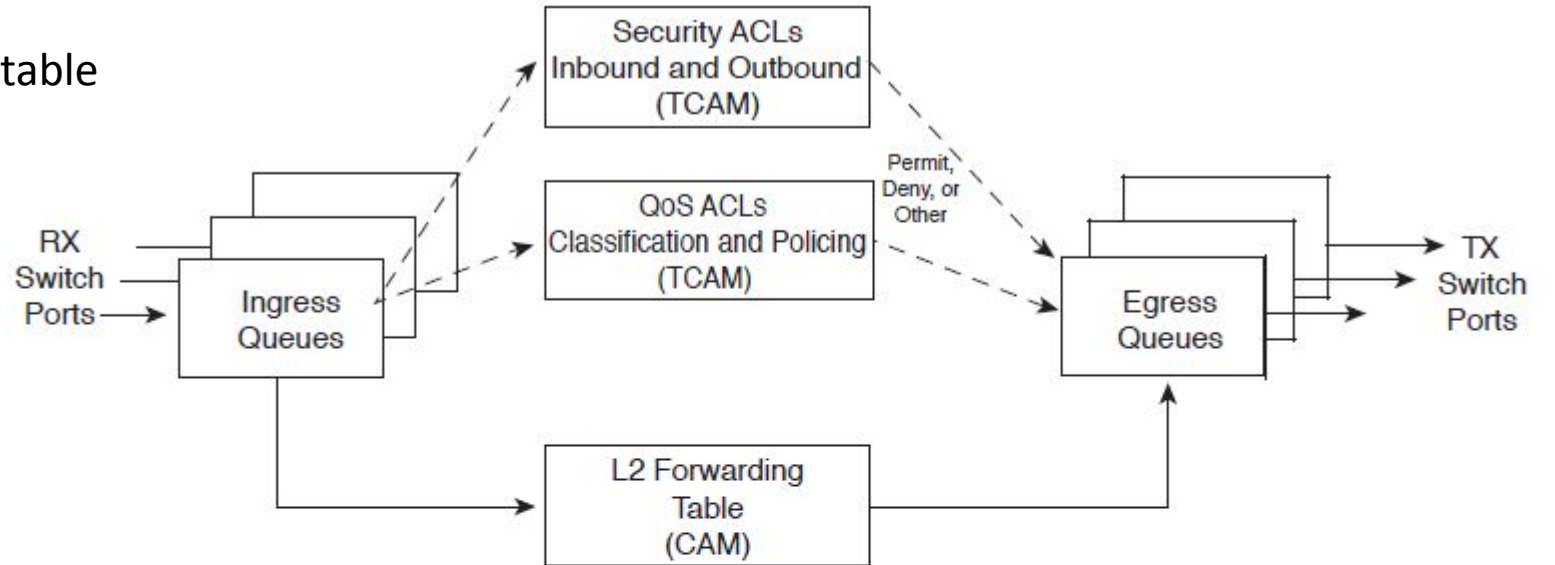
- Command

```
(conf)# vlan {VLAN_ID}
```

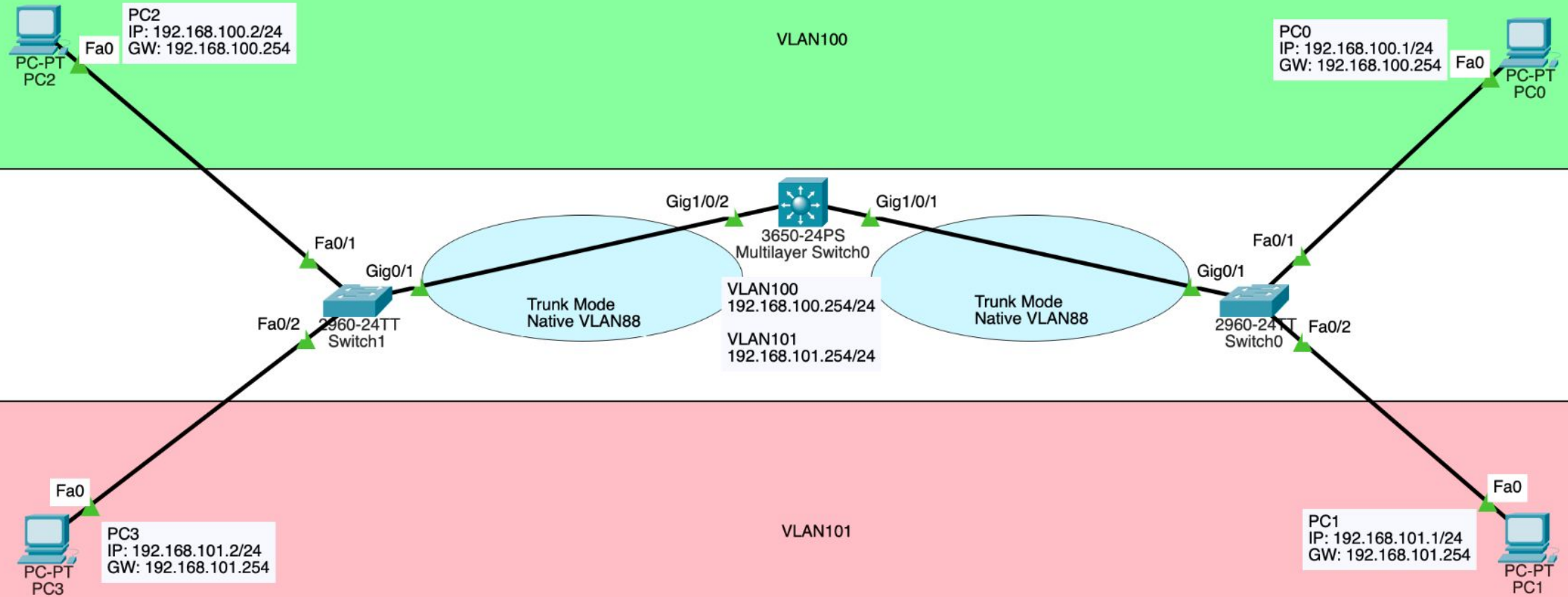# Layer2 Switch MAC Table

Layer2 Catalyst Switch CAM Table

CAM: content-addressable memory table

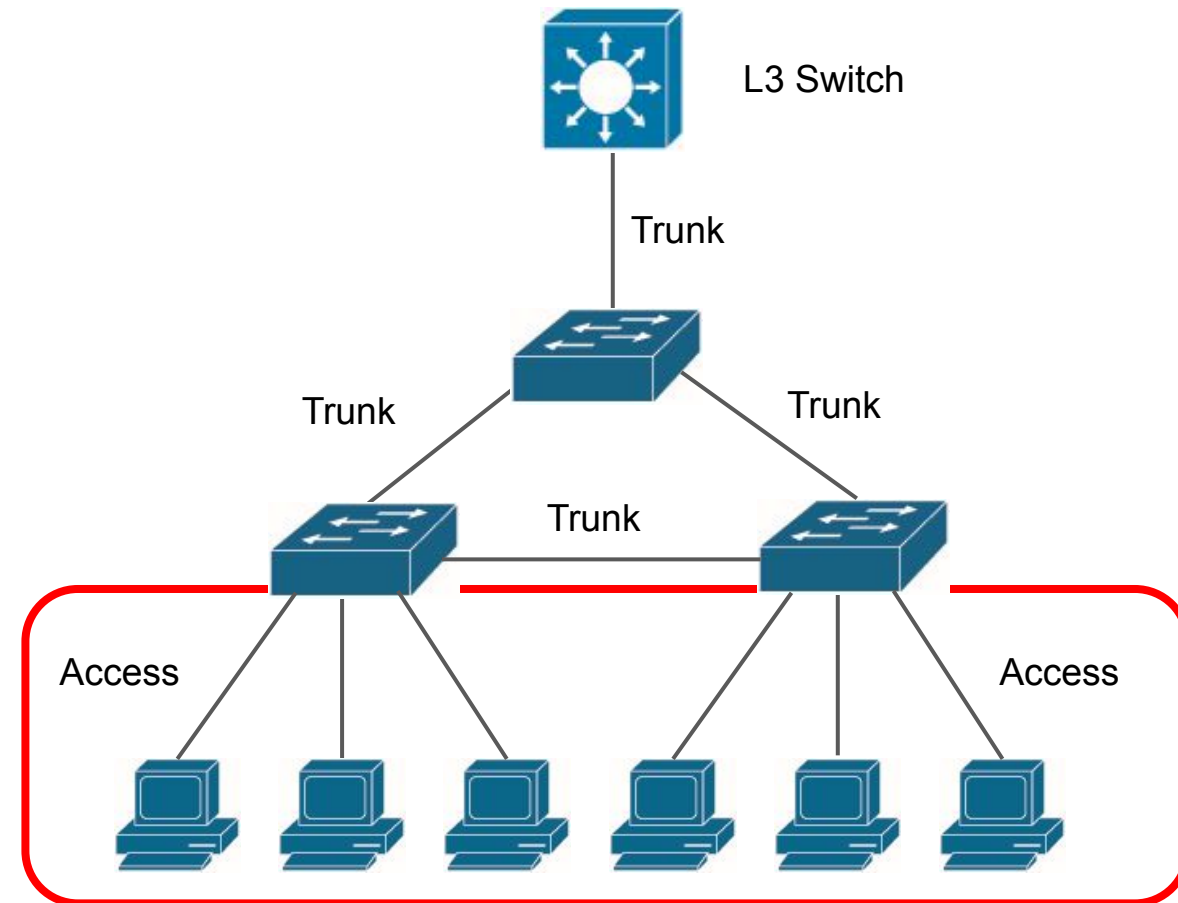| MAC Address	Egress Port	VLAN

[112B_LAB3_VLAN]

Interface Mode: Access

- Only one VLAN

- Accept untagged packets

```
(conf-if)# sw mode access
(conf-if)# sw access vlan {VLAN_ID}
```
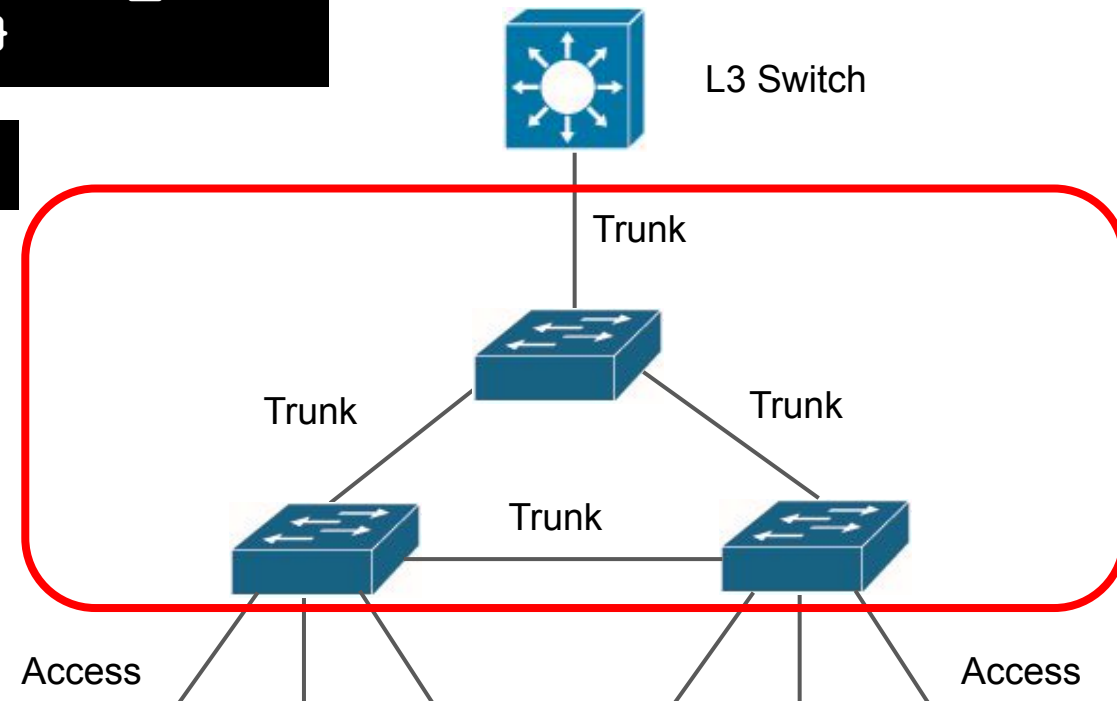
Interface Mode: Trunk

- Multi VLAN

- Accept packets tagged with any VLAN ID

```
(conf-if)# sw mode trunk
(conf-if)# sw trunk allow vlan {VLAN_ID[,VLAN_ID]}
(conf-if)# sw trunk native vlan {VLAN_ID}
```

```
(conf-if)# sw trunk encapsulation dot1q
```

L3 Switch

Trunk

Trunk   Trunk

Trunk

Access   Access

Switched Virtual Interface (SVI)

- A single SVI can only be mapped to a VLAN.

- A SVI cannot be activated unless that VLAN associated with at least one active physical port.

- SVI provides the Layer 3 processing for packets from all active physical ports associated with the VLAN.
  - routing packet from/to other SVI
  - no need physical router for inter-VLAN routing

SVI

- Usually use in
  - Gateway
  - Management interface

- Command

```
(conf)# int vlan {VLAN_ID}
```
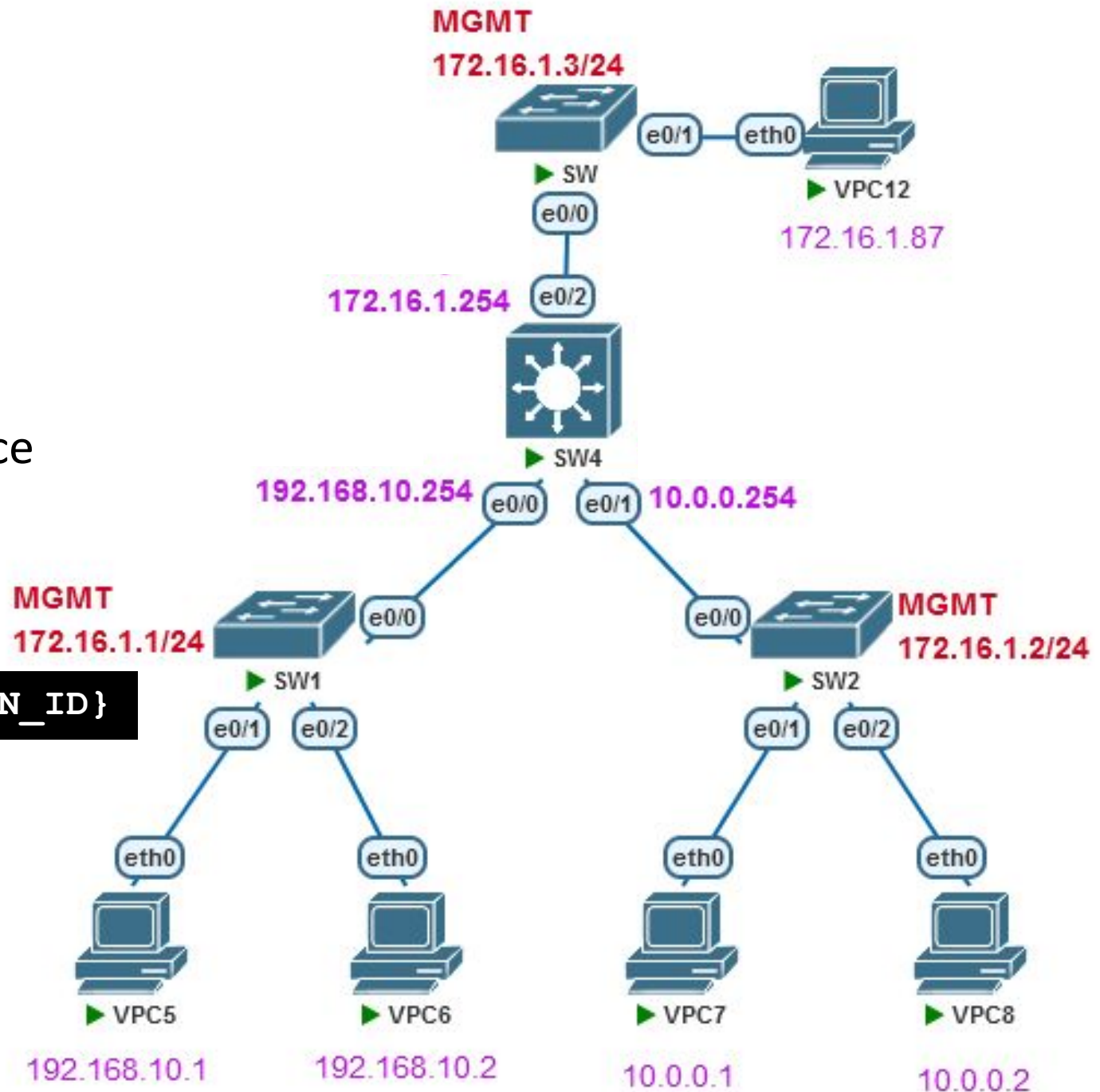
Config "int vlan {ID}" vs. "vlan {ID}"

PARAMETER	SVI	VLAN
Abbreviation for	Switched Virtual Interface	Virtual Local Area Network
Platform support	Only configurable on Layer 3 devices.	Can be configured on Layer 3 and Layer 2 devices
Routing across IP subnets	SVI can perform routing across IP subnets	Cannot perform Routing between VLANs
Configuration	Interface VLAN (VLAN ID)	Can be enabled via following command: VLAN (VLAN ID)
OSI Layer	Works on Layer 3 of OSI Model	Works on Layer 2 of OSI Model

Comparison By: https://ipwithease.com

Source: https://ipwithease.com/vlan-vs-svi/

LAB Outline

- Lab3 IOS
- Lab4 VLAN
- Lab5 STP
  - STP
  - STP Election
  - STP Enhancements
 - [Lab] Loop
  - [Lab] STP Guard
- Lab6 Routing

STP

Protocol	Standard	Resources Needed	Convergence	Tree Calculation
STP	802.1D	Low	Slow	All VLANs
PVST+ [1]	Cisco	High	Slow	Per VLAN
RSTP	802.1w	Medium	Fast	All VLANs
Rapid PVST+	Cisco	Very high	Fast	Per VLAN
MSTP	802.1s	Medium or high	Fast	Per Instance

```
(config)# spanning-tree mode {MODE}
```
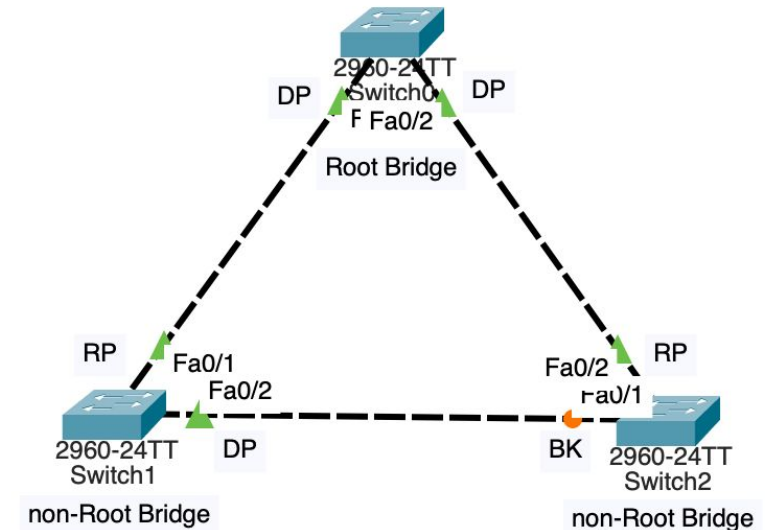
STP Election

Step1. Switch roles election

- Root Bridge (switch)
- non-Root Bridge (switches)
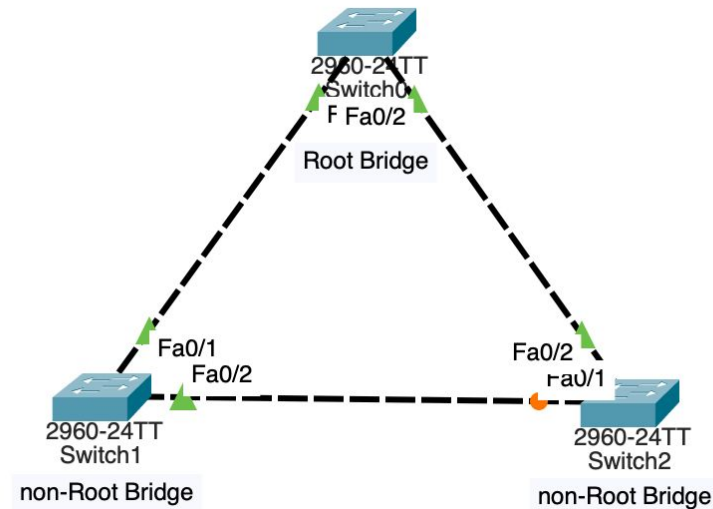
Step2. Switch ports roles election

- Root port
- Designated Port
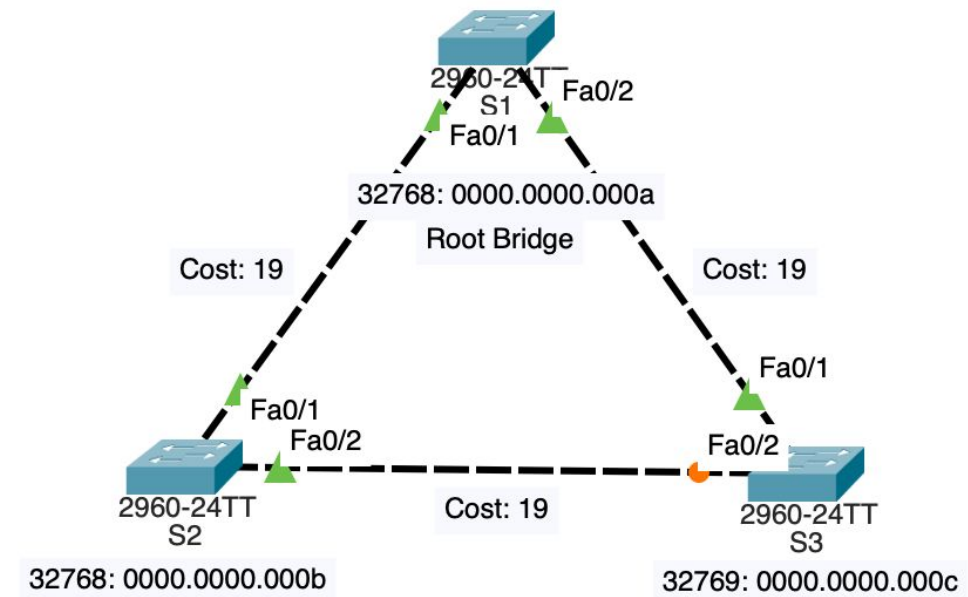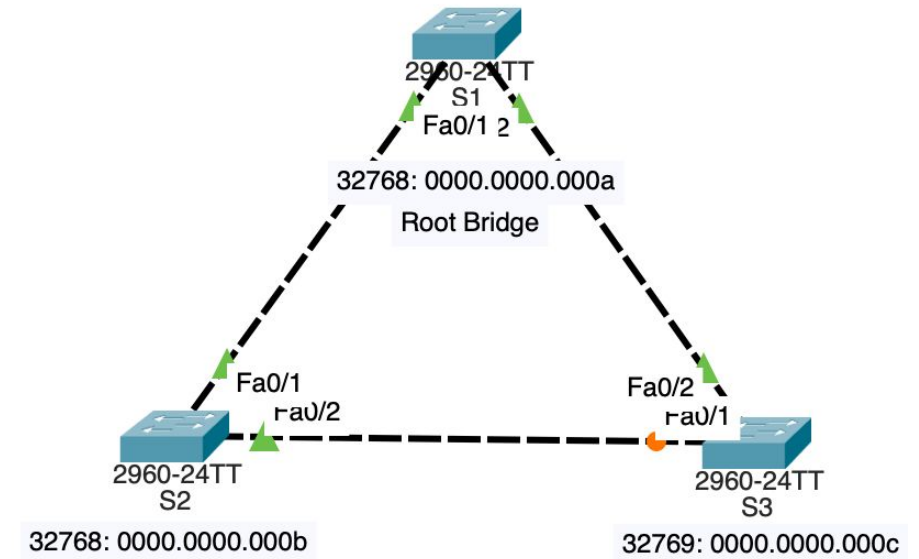- Blocking Port

STP Election Priority

Lowest win

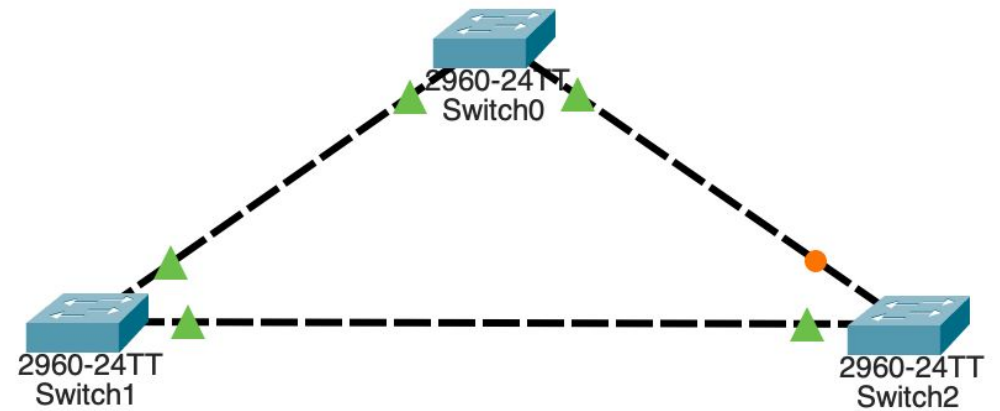Switch roles election Priority
- Bridge ID => priority + MAC
  - When priority is the same, lowest MAC will win

Switch port roles election Priority
- Root Cost
- Opposite (interconnect switches) Bridge ID
- Opposite (interconnect switches) Port ID

Root Switch Election


```
Switch0#sh spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee          Switch0
  Root ID    Priority    32769
             Address     0001.9705.2497
             Cost        19
             Port        1(FastEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     00D0.D346.B64D
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
                                    MAC ADDR: 00D0.D346.B64D

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- --------
--------------------------------
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/1            Root FWD 19        128.1    P2p

Switch0#
```

```
Switch1#sh spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee          Switch1
  Root ID    Priority    32769
             Address     0001.9705.2497
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0001.9705.2497
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
                                    MAC ADDR: 0001.9705.2497

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- --------
--------------------------------
Fa0/1            Desg FWD 19        128.1    P2p
Fa0/2            Desg FWD 19        128.2    P2p

Switch1#
```

```
(config)# spanning-tree vlan {vlan_id} root [ primary|secondary ]
(config)# spanning-tree vlan {vlan_id} priority {Value}
```

Root Cost


```
Switch0#sh spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.9705.2497
             Cost        19
             Port        1(FastEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     00D0.D346.B64D
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20


Interface        Role Sts Cost       Prio.Nbr Type
---------------- ---- --- --------- --------
------------------------------------

Fa0/2            Desg FWD 19         128.2    P2p
Fa0/1            Root FWD 19         128.1    P2p

Switch0#
```
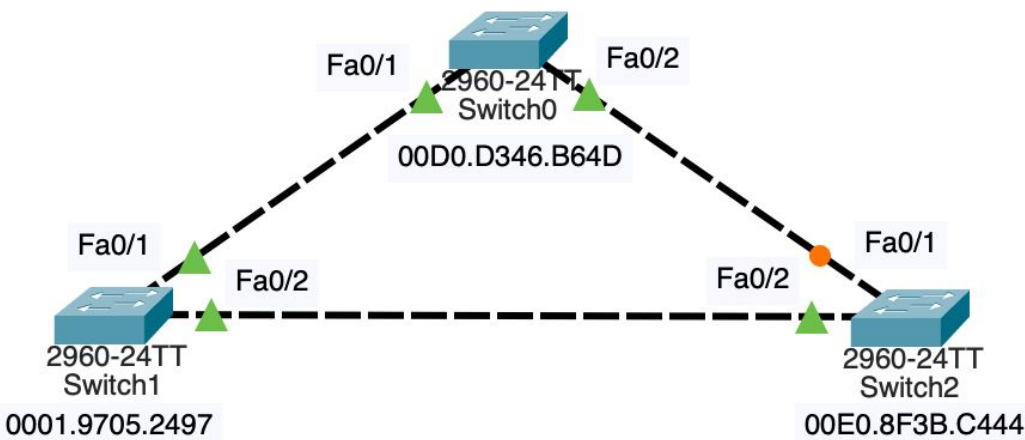
```
Switch2#sn spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.9705.2497
             Cost        19
             Port        2(FastEthernet0/2)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     00E0.8F3B.C444
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20


Interface        Role Sts Cost       Prio.Nbr Type
---------------- ---- --- --------- --------
------------------------------------

Fa0/1            Altn BLK 19         128.1    P2p
Fa0/2            Root FWD 19

Switch2#
```

```
(config-if)# spanning-tree vlan {vlan_id} cost {Value}
```

Link Speed	Cost
10 Gb/s	2
1 Gb/s	4
100 Mb/s	19

[112B_LAB4_STP_Loop]

Goal

Switch0
- set root bridge

ALL switched
- Gig 1/0/3
  > set BPDU guard
  > set PortFast

PC0
192.168.0.1/24
00D0.9799.17C1

PC-PT
PC0

Gig 1/0/3

3650-24PS
Switch0

Gig 1/0/1

Gig 1/0/2

PC1
192.168.0.2/24
0001.C9A0.8363

PC2
192.168.0.3/24
0001.97D2.3411

PC-PT
PC1

PC-PT
PC2

Gig 1/0/2

LOOP Zone

Gig 1/0/2

Gig 1/0/3

Gig 1/0/3

Gig 1/0/1

Gig 1/0/1
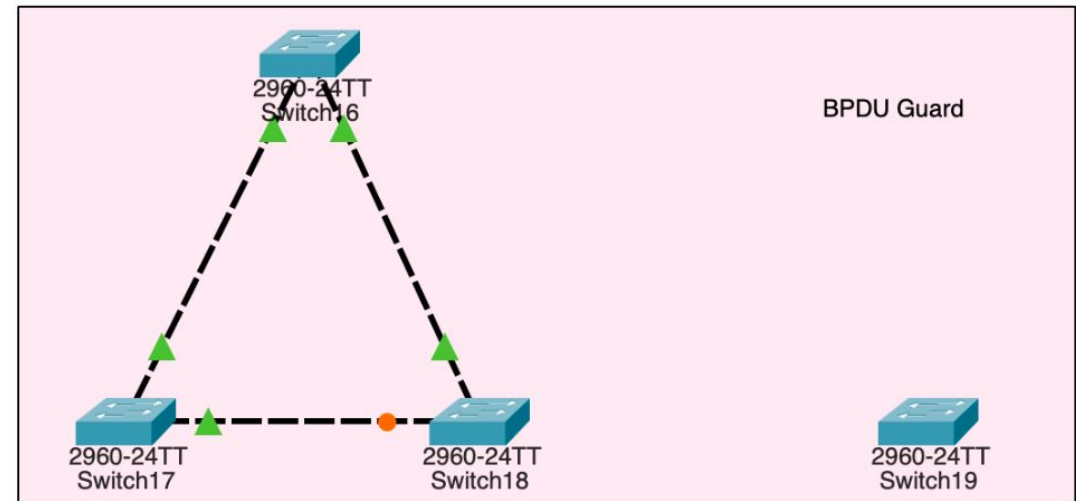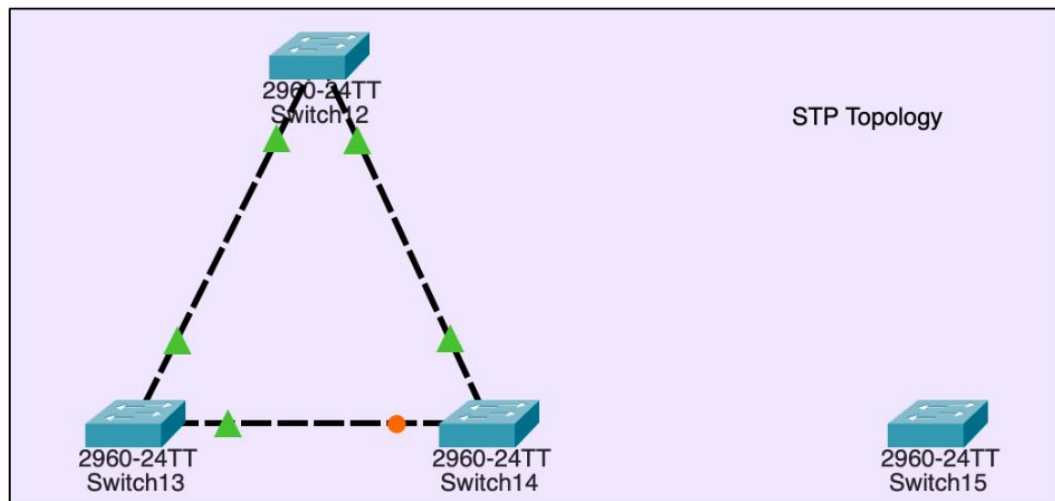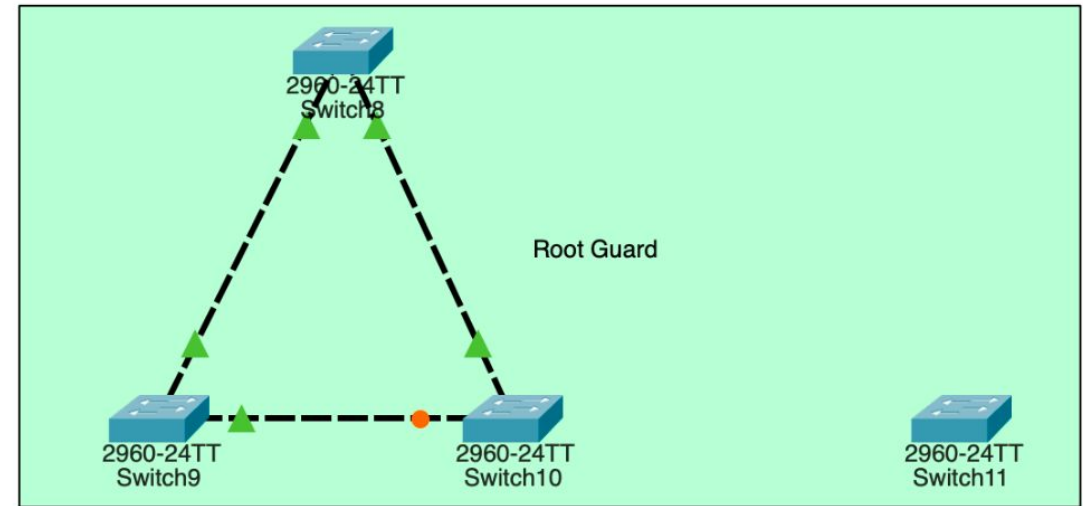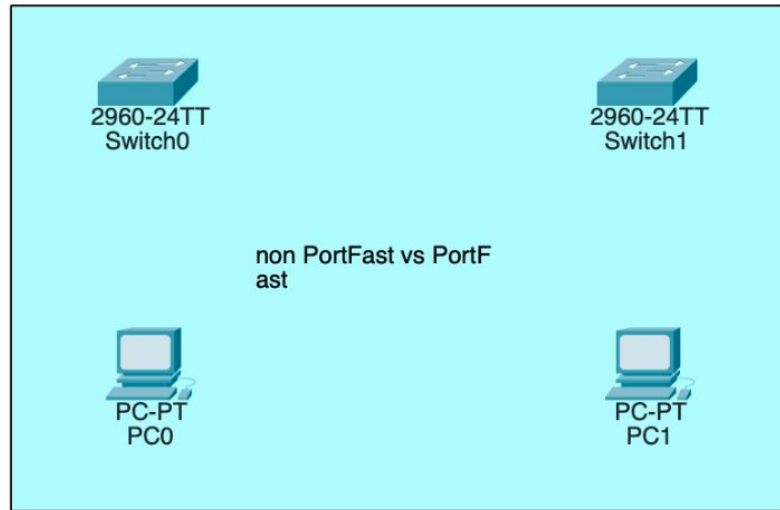
3650-24PS
Switch1

3650-24PS
Switch2
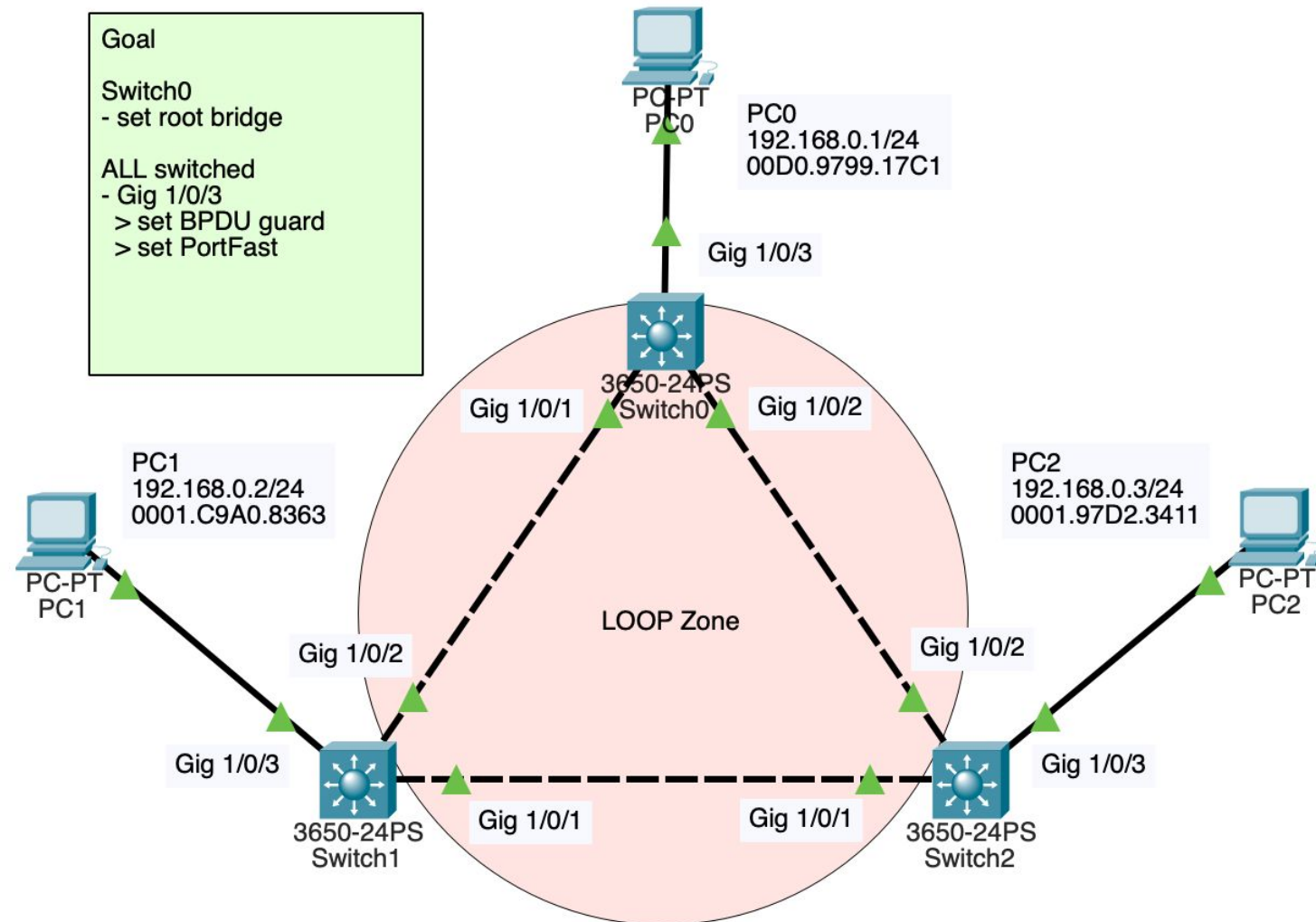
STP_Loop

```
(config)# spanning-tree vlan 1

(config)# interface GigabitEthernet1/0/3
(config-if)# spanning-tree portfast
(config-if)# spanning-tree bpduguard enable

! Set on Root Switch
(config)# spanning-tree vlan 1 priority {Value}
```

[112B_LAB5_STP_Guard]

STP Enhancements: PortFast

- Bypassing listening and learning step
- Blocking -> forwarding

```
(config-if)# spanning-tree portfast
```

STATUS	Disabled	Blocking	Listening	Learning	Forwarding
Receive BPDU	X	O	O	O	O
Send BPDU	X	X	O	O	O
Learn MAC	X	X	X	O	O
Forwarding	X	X	X	X	O
Duration	Until no shutdown	Until topology changed	Forward Delay (default 15s)	Forward Delay (default 15s)	Until shutdown or not root/designated port

STP Enhancements: BPDU guard

- Disable interface when receiving BPDU
- Prevent loop on portfast mode interface

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

STP Enhancements: Root guard

- Prevent root switch change to another switch

```
(config-if)# spanning-tree guard root
```

STP Enhancements: BPDU filter

- Global mode : portfast interface will disable portfast when receive an BPDU

- Interface mode : this interface will not send and receive any BPDU

- Priority : BPDU filter > BPDU guard

```
! deprecated on Packet Tracer
(config)# spanning-tree portfast bpdufilter default
(config-if)# spanning-tree bpdufilter enable
```

LAB Outline

- Lab3 IOS
- Lab4 VLAN
- Lab5 STP
- Lab6 Routing
  - Network traffic flow
  - Entries in the Routing Table
  - Route Configuration
    - Static
    - RIP
  - [Lab] Routing

Network Traffic Flow

Source: https://ciscoiseasy.blogspot.com/2010/11/lesson-31-what-is-router.html
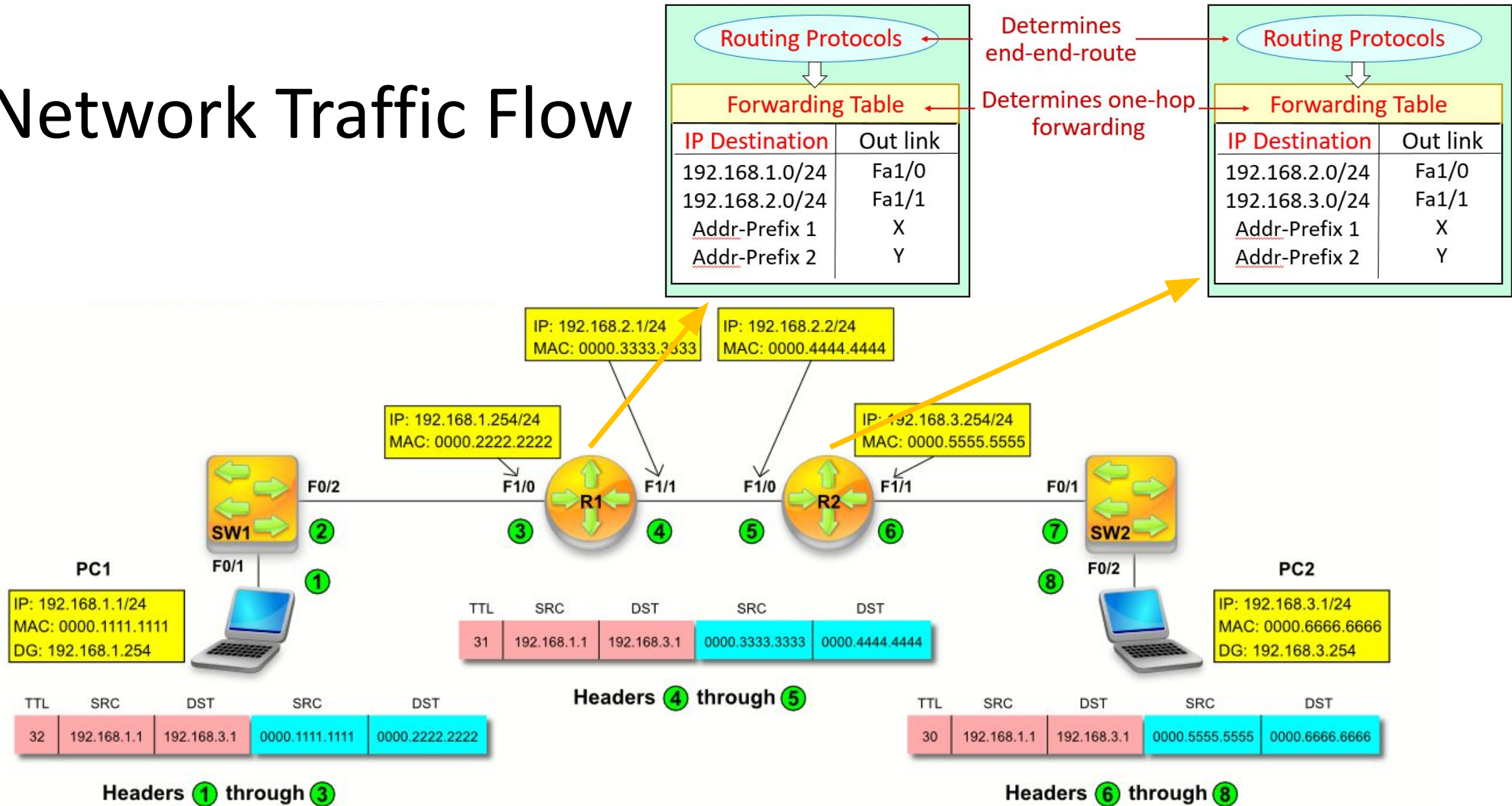
Determines end-end-route

- Static routing
  - Manually configured into the routing table.
  - Must be reconfigured whenever the network topology changed.

- Dynamic routing
  - Automatically learned through dynamic routing protocols.

Entries in the Routing Table

Route source	Destination network	AD	Metric	Next-hop	Route timestamp	Outgoing interface
D	140.113.235.0/24	[120	/ 212057] via	10.0.1.24,	00:00:05,	Gi0/24

- **Route source**: how the route was learned

- **Destination network**: the destination of the packets

- **Administrative distance (AD)**
  - the trustworthiness of the route source
  - the lower value, the more preferred <u>route source</u>

- **Metric**
  - the value assigned to reach the remote network
  - the lower value, the more preferred <u>route</u>

- **Next-hop**: where the router should send to

- **Route timestamp**: after the route was learned

- **Outgoing interface**: the exit interface to forward packets

Route Source	Administrative Distance
Connected	0
Static	1
EIGRP summary route	5
External BGP	20
Internal EIGRP	90
IGRP	100
OSPF	110
RIP	120
External EIGRP	170
Internal BGP	200

Route Configuration:
Show Routing Table, Config Static route

```
Router# show ip route
```

```
Router(config)# ip route {network-address} {subnet-mask} {exit-intf | next
hop ip-address}
```

Route Configuration: Static Default Route

```
! Method #1: exit-interface
R1# ip route 0.0.0.0 0.0.0.0 Gi0/1
%Default route without gateway, if not a point-to-point interface, may impact
performance


! Method #2: ip-address
R2# ip route 0.0.0.0 0.0.0.0 192.168.0.5
```
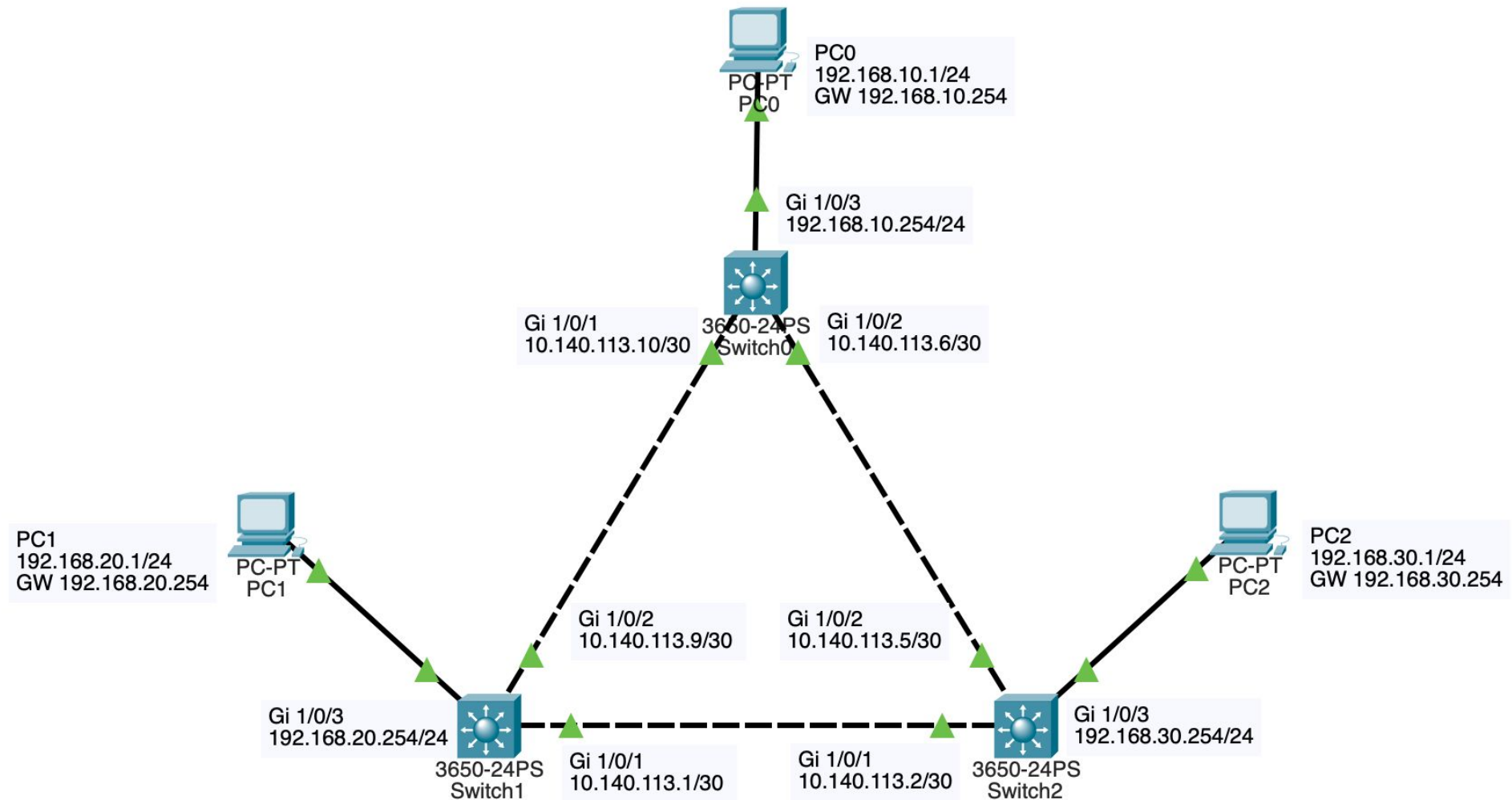

Router0

Switch3

Router0(1)   Router0(1)(1)

NOT P2P interface

```
network-address 0.0.0.0
subnet-mask 0.0.0.0
```
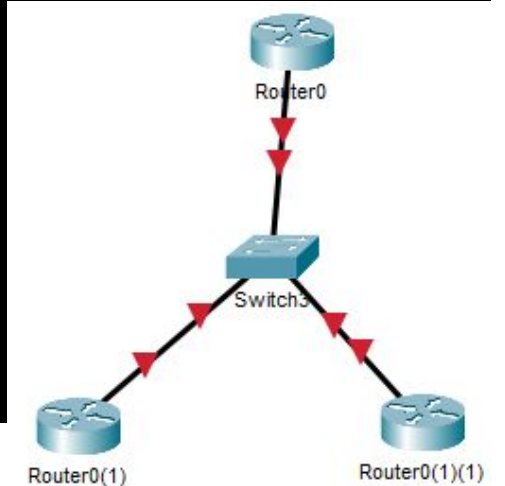
[112B_LAB6_RIP_Routing]

RIP Routing

Transforms the interface of an L3 switch from a Layer 2 port into a Layer 3 port, making the port operate like a router interface rather than a switch port.

```
Switch(config)# ip routing


! Switch interface to L3 mode
Switch(config)# interface range GigabitEthernet1/0/1-3
Switch(config-if)# no switchport


! Set IP Address
Switch(config)# interface range GigabitEthernet1/0/1
Switch(config-if)# ip address {IP} {MASK}
```

Route Configuration: RIP

```
Router(config)# router rip
Router(config-router)# version 2
Router(config-router)# network {network-address}


! Example for Switch0
Switch0(config)# router rip
Switch0(config-router)# version 2
Switch0(config-router)# network 10.0.0.0
Switch0(config-router)# network 192.168.10.0
Switch0(config-router)# no auto-summary
```


R.I.P.
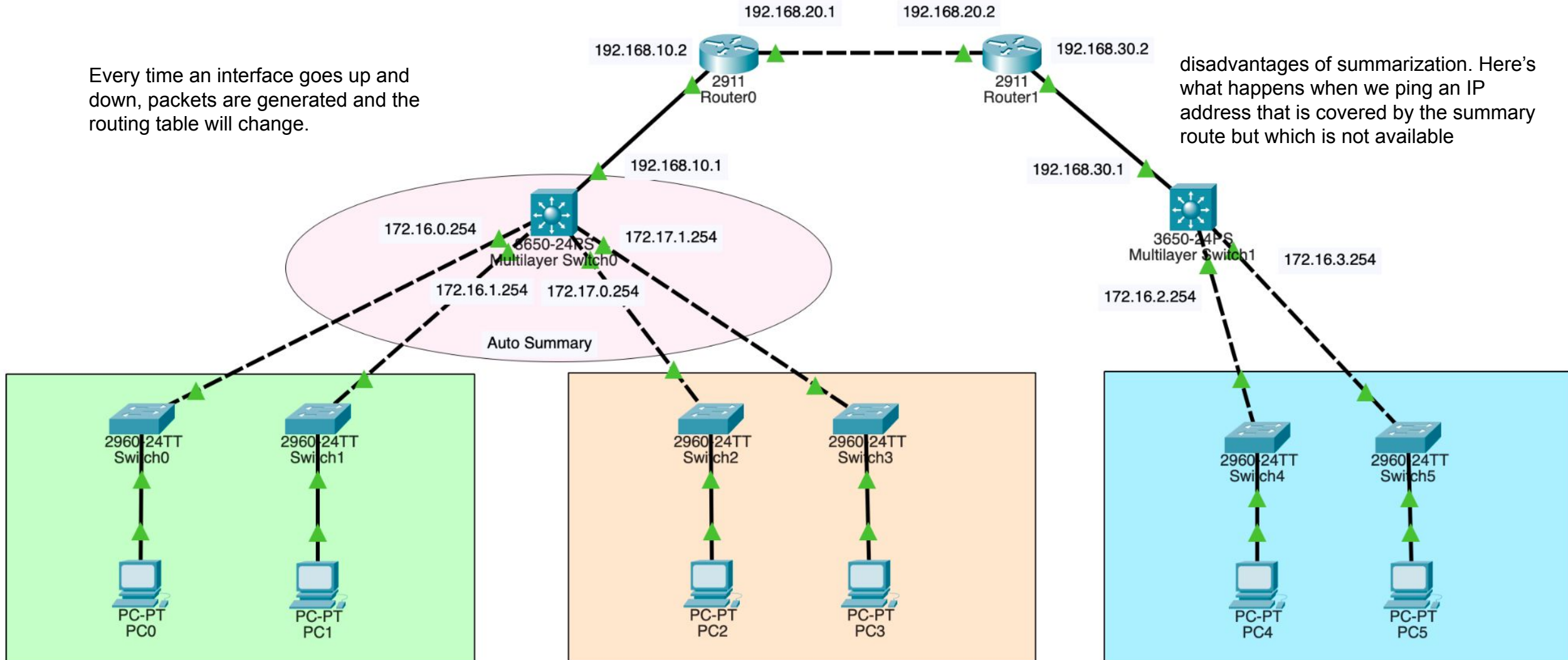
[112B_LAB7_RIP_Passive_Interface]
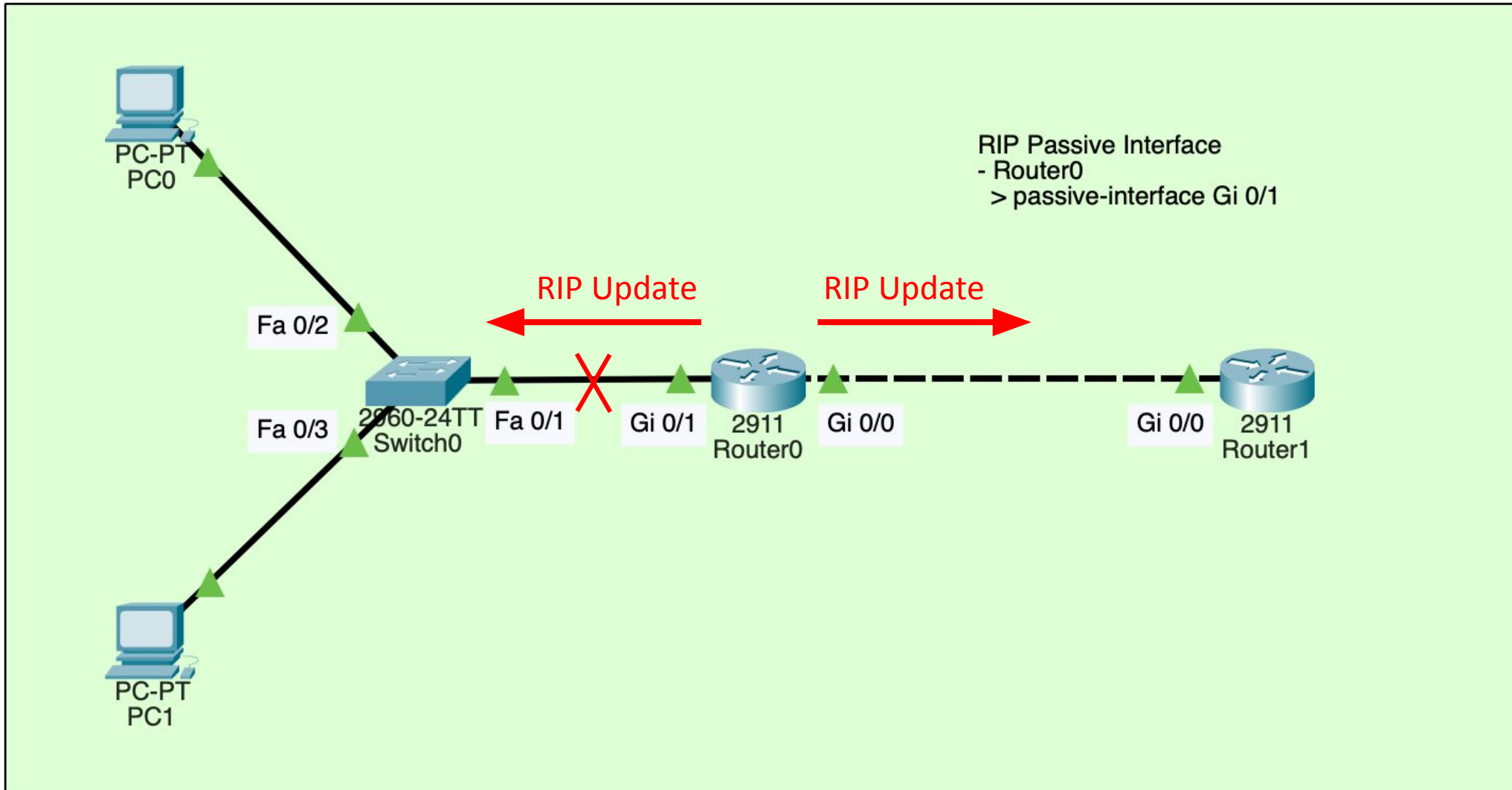
RIP Passive Interfaces

- By default, RIP updates are forwarded out all RIP-enabled interfaces

- Sending out unneeded updates in a LAN impacts the network
  - **Wasted Bandwidth and Resources** :
    - RIP updates are either broadcasted or multicasted, switches also forward the updates out all ports
    - All devices on the LAN must process the packet
  - **Security Risk:** RIP updates can be intercepted (listened) with packet sniffing software. Routing updates can be <u>modified</u> and sent back to the router.

- Solution: stop sending updates on the particular interface.

```
Router(config-router)# passive-interface {interface_name}
```

[112B_LAB8_RIP_Summarization]

Every time an interface goes up and down, packets are generated and the routing table will change.

disadvantages of summarization. Here's what happens when we ping an IP address that is covered by the summary route but which is not available

RIP Auto Summarization

- Auto summarization is a feature which allows RIP to summarize its routes to their classful networks automatically.

```
Router(config-router)# no auto-summary
```

"ip default-gateway" vs. "ip route 0.0.0.0 0.0.0.0"

Layer 2 switch : Use ''ip default-gateway" (no routing table)

Layer 3 switch : Use "ip route 0.0.0.0 0.0.0.0 {interface}"

When your switch is configured to route with IP, it does not need to have a default gateway set.

```
switch(config)# ip route 0.0.0.0 0.0.0.0 gigabitEthernet 1/0/1
% Must specify a L3 port as the next hop interface

! Switch interface to L3 mode
switch(config-if)# no switchport
```