



VLANs & Inter VLAN

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- VLANs
 - Overview of VLANs
 - VLAN Definitions / Benefits of VLANs / Type of VLANs
 - VLANs in a Multi-Switched Environment
 - VLAN Trunk
 - Controlling Broadcast Domains with VLANs
 - Tagging Ethernet Frames for VLAN
 - VLAN Implementation

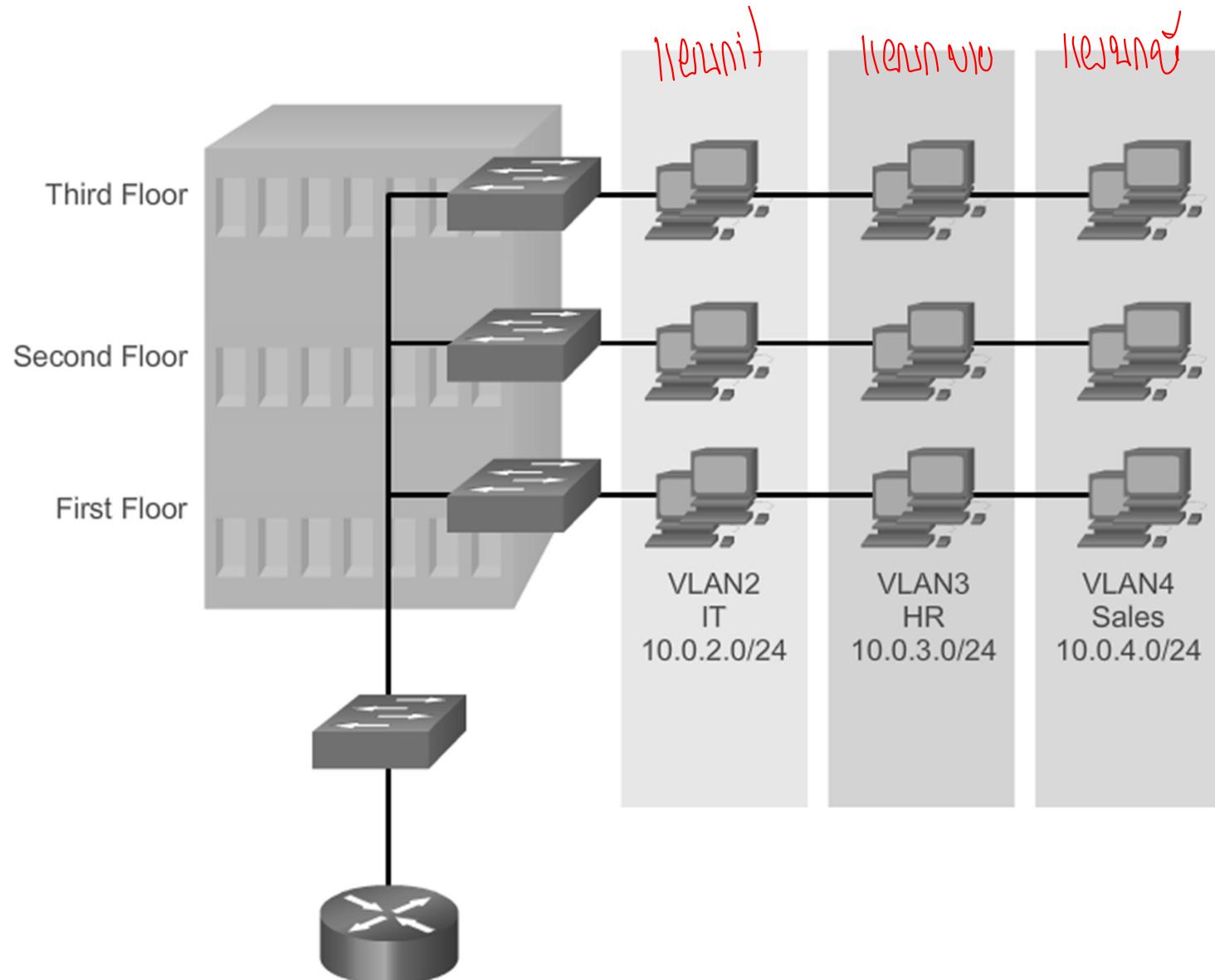
VLAN Definitions

- VLAN (virtual LAN) is a **logical partition** of a layer 2 network
- Multiple partition can be created, allowing for multiple VLANs to co-exist
- Each VLAN is a broadcast domain, usually with its own IP network
- VLANs are mutually isolated and packets can only pass between them through a router
- The partitioning of the layer 2 network takes place inside a layer 2 device, usually a switch.
- The hosts grouped within a **VLAN** are unaware of the VLAN's existence

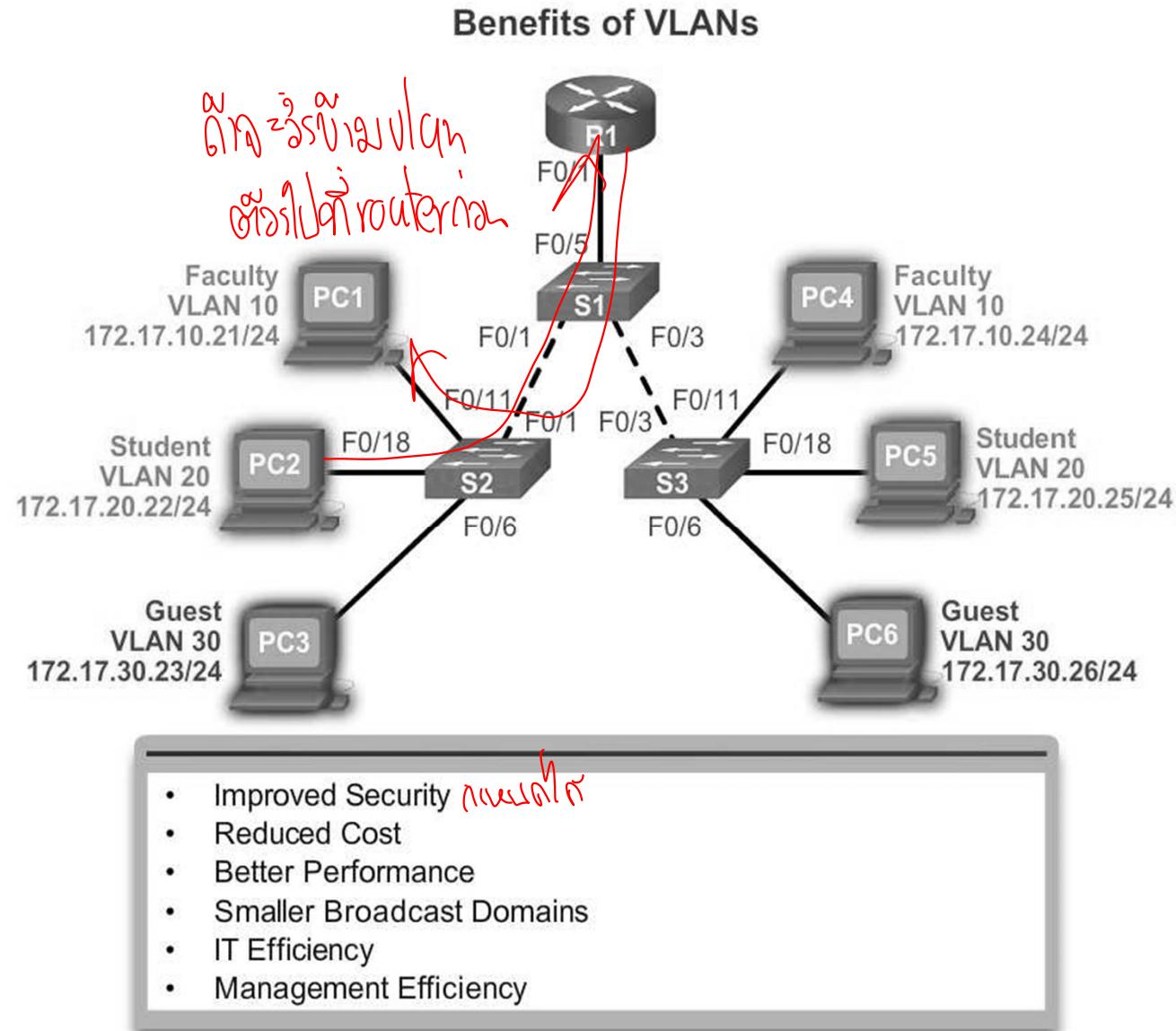
→ **an IEEE broadcast domain** (IP subnet)

→ **switches are unaware of logical**

VLAN Definitions



Benefits of VLANs



Types of VLANs

VLAN 1

```
Switch# show vlan brief
```

VLAN Name	Status	Ports
1 default	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/6, 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 Gi0/1, Gi0/2
1002 fddi-default	act/unsup	
1003 token-ring-default	act/unsup	
1004 fddinet-default	act/unsup	
1005 trnet-default	act/unsup	

default

- All ports assigned to VLAN 1 to forward data by default.
- Native VLAN is VLAN 1 by default.
- Management VLAN is VLAN 1 by default.
- VLAN 1 cannot be renamed or deleted.

VLANs in a Multi-Switched Environment

ມີ VLAN ໃໝ່ 1 ສານລາຍດີ 1 ດາວໂຫຼວງ interface 1 interface

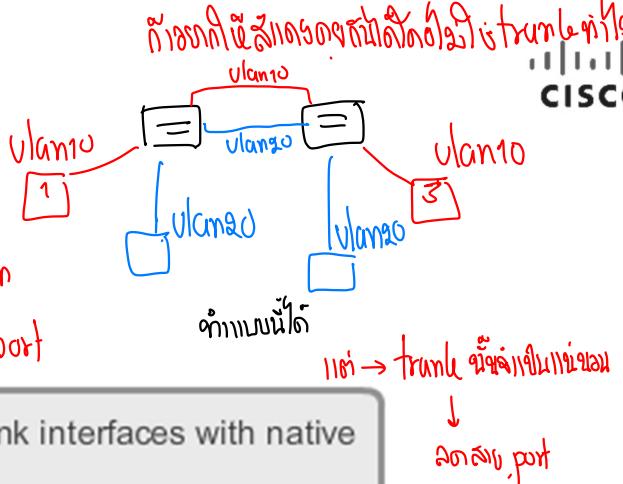
- VLAN Trunks

ຖື trunk → ຢົກ 1 int : 1 VLAN → ອິນໄດ້ trunk
1 int & many VLAN

- A VLAN trunk carries more than one VLAN
- Usually established between switches so same-VLAN devices can communicate even if physically connected to different switches
Carry ນັບສະດອນໃນໜີ 1 VLAN
- A VLAN trunk is not associated to any VLANs.
Neither is the trunk ports used to establish the trunk link
- Cisco IOS supports IEEE802.1q, a popular VLAN trunk protocol

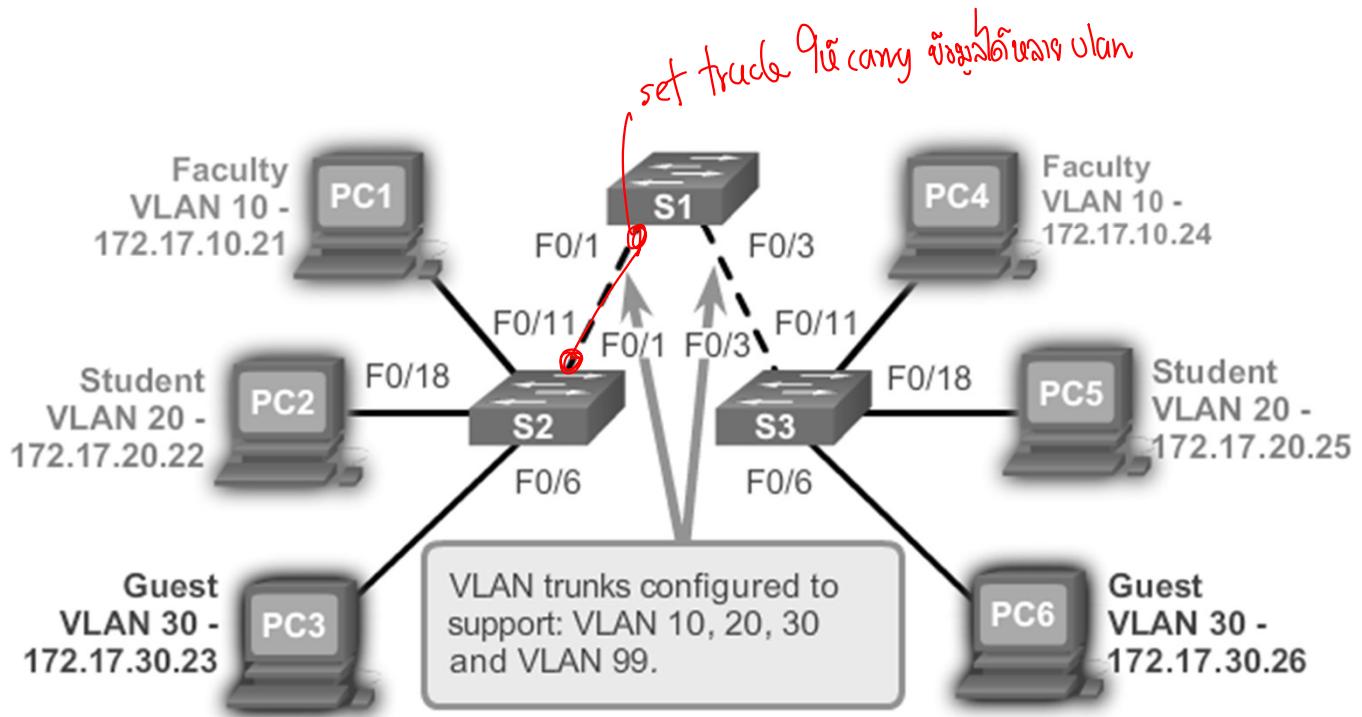
VLAN Trunks

សម្រេចការណា បង្កើតការណានៃ VLAN
ចាប់ពីភាពខ្លួន → មាន 1 port



VLAN 10 Faculty/Staff - 172.17.10.0/24
 VLAN 20 Students - 172.17.20.0/24
 VLAN 30 Guest - 172.17.30.0/24
 VLAN 99 Management and Native -
 172.17.99.0/24

F0/1-5 are 802.1Q trunk interfaces with native VLAN 99.
 F0/11-17 are in VLAN 10.
 F0/18-24 are in VLAN 20.
 F0/6-10 are in VLAN 30.



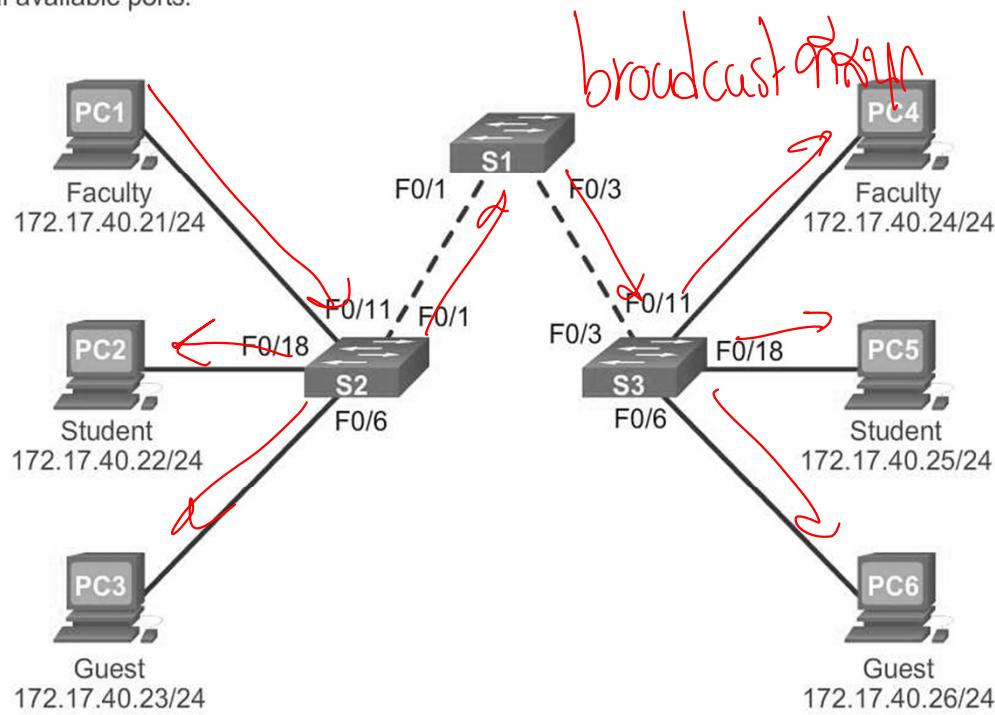
Controlling Broadcast Domains with VLANs

- VLANs can be used to limit the reach of broadcast frames
↳ one VLAN = one broadcast domain
- A VLAN is a broadcast domain of its own
- Therefore, a broadcast frame sent by a device in a specific VLAN is forwarded within that VLAN only.
- This helps controlling the reach of broadcast frames and their impact in the network
- Unicast and multicast frames are forwarded within the originating VLAN as well

Controlling Broadcast Domains with VLANs

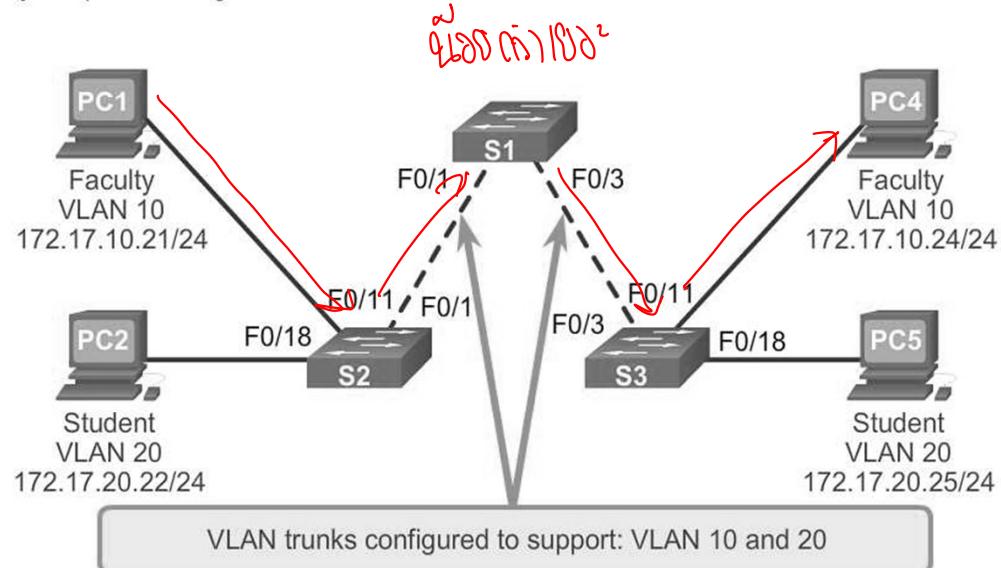
No VLAN Segmentation

PC1 sends out a local Layer 2 broadcast. The switches forward the broadcast frame out all available ports.



With VLAN Segmentation

PC1 sends out a local Layer 2 broadcast. The switches forward the broadcast frame only out ports configured for VLAN10.



ເພື່ອຍໍານາມຂອງໂຄງການນັ້ນ VLAN ບໍລິສັດ → trunk 9 ໂັບປະນຸມ → ເວັທ່າງໄປແຈ້ງໃຫຍ່ໄດ້

Tagging Ethernet Frames for VLAN Identification

↳ ແຜນນັ້ນທີ່ຈະສໍາເລັດຂອງ VLAN → ໄລກປີຕົວ → ຂະຫຍາຍສຳເນົານ bus ຕາງ 9 ອີconcept

- Frame tagging is used to properly transmit multiple VLAN frames through a trunk link
- Switches will tag frames to identify the VLAN they belong. Different tagging protocols exist, with IEEE 802.1q being a very popular one
- The protocol defines the structure of the tagging header added to the frame
- Switches will add VLAN tags to the frames before placing them into trunk links and remove the tags before forwarding frames through non-trunk ports
- Once properly tagged, the frames can transverse any number of switches via trunk links and still be forward within the correct VLAN at the destination

ຈູ່ສິນໄຕສະໜັບ ດີນໃຈ trunk ທີ່ສິນໄຕ

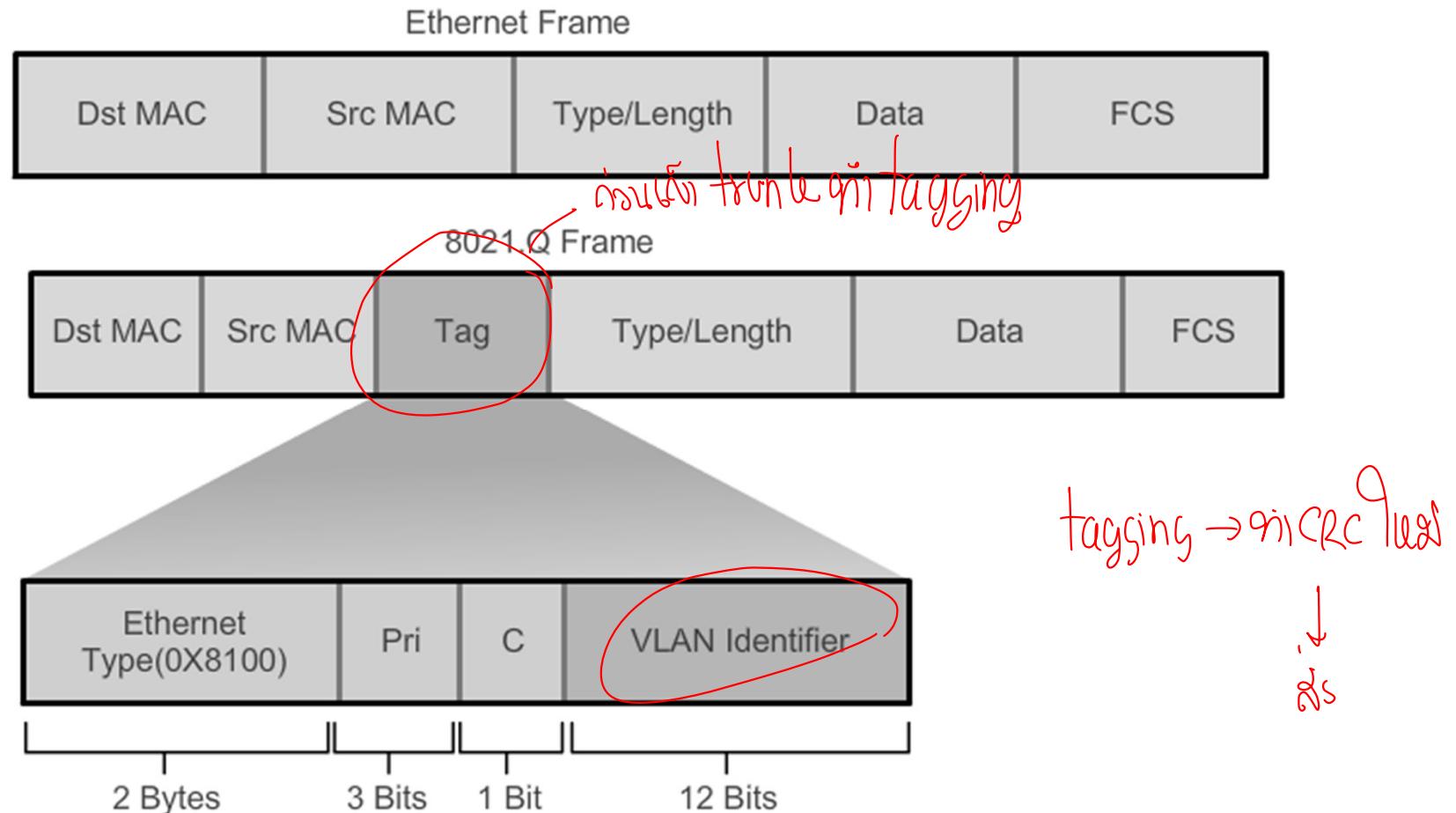
11: VLAN
tag header

tagging ຂຶ້ນໃຈ trunk only!

ກູ່ອອນໄຕສານ

Tagging Ethernet Frames for VLAN Identification

for trunk

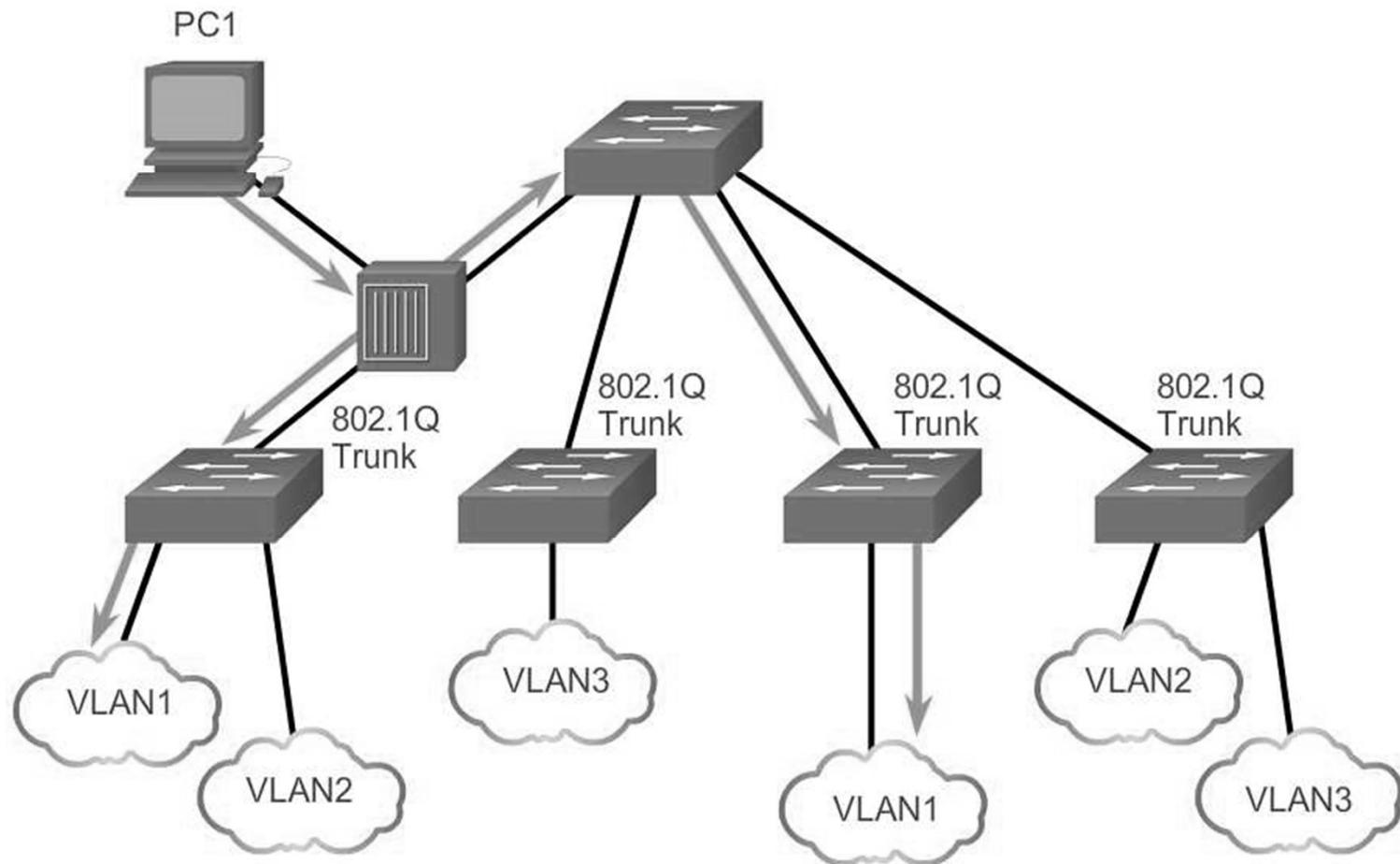


Native VLAN & 802.1Q Tagging

- A frame that belongs to the native VLAN will not be tagged
- A frame that is received untagged will remain untagged and placed in the native VLAN when forwarded
- If there are not ports associated to the native VLAN and no other trunk links, an untagged frame will be dropped
- In Cisco switches, the native VLAN is VLAN 1 by default

Native VLAN & 802.1Q Tagging

Native VLAN on 802.1Q Trunk



VLAN Assignment

ωimsconf

- VLAN Ranges On Catalyst Switches
 - The Catalyst 2960 and 3560 Series switches support over 4,000 VLANs
 - These VLANs are split into 2 categories:
 - Normal Range VLANs
 - VLAN numbers from 1 through 1005
 - Configurations stored in the vlan.dat (in the flash)
 - VTP can only learn and store normal range VLANs
 - Extended Range VLANs
 - VLAN numbers from 1006 through 4096
 - Configurations stored in the running-config (in the NVRAM)
 - VTP does not learn extended range VLANs

VLAN Assignment

- Creating a VLAN

Cisco Switch IOS Commands

Enter global configuration mode.	S1# configure terminal
Create a VLAN with a valid id number.	S1(config)# vlan vlan_id
Specify a unique name to identify the VLAN.	S1(config)# name vlan_name
Return to the privileged EXEC mode.	S1(config)# end

VLAN Assignment

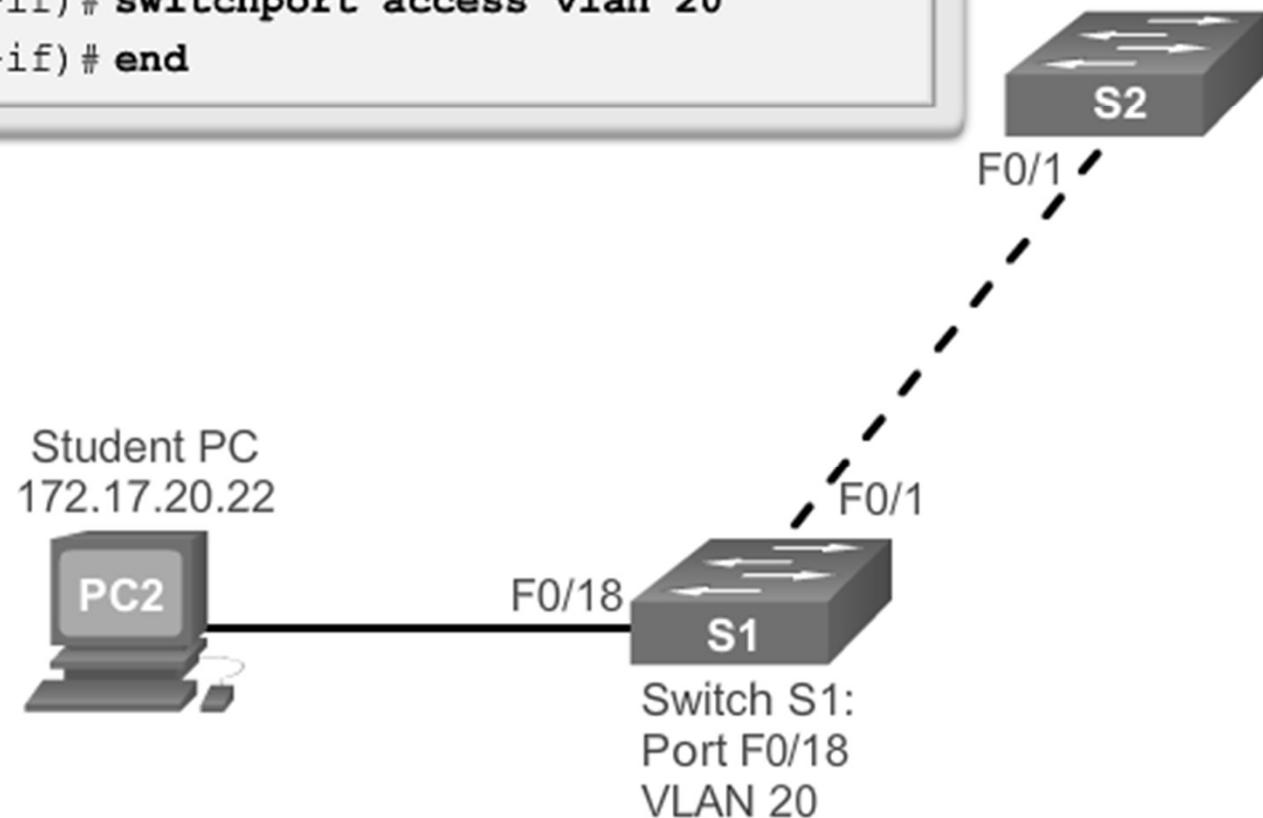
- Assigning Ports To VLANs

Cisco Switch IOS Commands	
Enter global configuration mode.	S1 # configure terminal
Enter interface configuration mode for the SVI.	S1(config) # interface interface_id
Configure the management interface IP address.	S1(config) # ip address 172.17.99.11 <i>interface_id</i>
Set the port to access mode.	S1(config-if) # switchport mode access
Assign the port to a VLAN.	S1(config-if) # switchport access vlan <i>vlan_id</i>
Return to the privileged EXEC mode.	S1(config-if) # end

VLAN Assignment

- Assigning Ports To VLANs

```
s1# configure terminal  
s1(config)# interface F0/18  
s1(config-if)# switchport mode access  
s1(config-if)# switchport access vlan 20  
s1(config-if)# end
```



VLAN Assignment

- Changing VLAN Port Membership

```
S1(config)# int fa0/18
S1(config-if)# no switchport access vlan
S1(config-if)# end
S1# show vlan brief
          VLAN Name           Status    Ports
----- -----
      1   default         active   Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                         Fa0/5, Fa0/6, 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
                                         Gi0/1, Gi0/2
      20  student          active
     1002 fddi-default    act/unsup
     1003 token-ring-default act/unsup
     1004 fddinet-default act/unsup
     1005 trnet-default   act/unsup
S1#
```

Ø กำหนดเป็น VLAN default

VLAN Assignment

- Changing VLAN Port Membership

```
S1# config t  
S1(config)# int fa0/11  
S1(config-if)# switchport mode access  
S1(config-if)# switchport access vlan 20  
S1(config-if)# end  
S1#  
S1# show vlan brief
```

VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/6, Fa0/7, Fa0/8 Fa0/9, Fa0/10, Fa0/12, Fa0/11 Fa0/14, Fa0/15, Fa0/16, Fa0/17 Fa0/18, Fa0/19, Fa0/20, Fa0/21 Fa0/22, Fa0/23, Fa0/24, Gi0/1 Gi0/2
20	student	active	Fa0/11
1002	fdci-default	act/unsup	
1003	token-ring-default	act/unsup	
1004	fddinet-default	act/unsup	
1005	trnet-default	act/unsup	

VLAN Assignment

- Deleting VLANs

```
S1# conf t
S1(config)# no vlan 20
S1(config)# end

S1#
S1# sh vlan brief

VLAN Name          Status      Ports
-----  -----
1    default        active     Fa0/1, Fa0/2, Fa0/3, Fa0/4
                           Fa0/5, Fa0/6, Fa0/7, Fa0/8
                           Fa0/9, Fa0/10, 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, Gi0/1
                           Gi0/2
1002 fddi-default   act/unsup
1003 token-ring-default act/unsup
1004 fddinet-default act/unsup
1005 trnet-default   act/unsup
```

លើកបង្កាត់លូ VLAN ចាប់ឡើង

លើកនៃការសម្រេច membership រវាង VLAN ទាំងអស់

Fa11 តិចឡាយ

VLAN Assignment

- Verifying VLAN Information

```
S1# show vlan name student
```

VLAN Name	Status	Ports
20 student	active	Fa0/11, Fa0/18

VLAN Type SAID MTU Parent RingNo BridgeNo Stp BrdgMode Trans1 Trans2

20 enet 100020 1500 - - - - 0 0

Remote SPAN VLAN

Disabled

Primary Secondary Type	Ports
------------------------	-------

```
S1# show vlan summary
```

Number of existing VLANs	: 7
Number of existing VTP VLANs	: 7
Number of existing extended VLANS	: 0

```
S1#
```

```
S1#show interfaces vlan 20
```

```
Vlan20 is up, line protocol is down
  Hardware is EtherSVI, address is 001c.57ec.0641 (bia
  001c.57ec.0641)
    MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
      reliability 255/255, txload 1/255, rxload 1/255
    Encapsulation ARPA, loopback not set
    ARP type: ARPA, ARP Timeout 04:00:00
    Last input never, output never, output hang never
    Last clearing of "show interface" counters never
    Input queue: 0/75/0/0 (size/max/drops/flushes); Total output
    drops: 0
    Queueing strategy: fifo
    Output queue: 0/40 (size/max)
    5 minute input rate 0 bits/sec, 0 packets/sec
    5 minute output rate 0 bits/sec, 0 packets/sec
      0 packets input, 0 bytes, 0 no buffer
      Received 0 broadcasts (0 IP multicast)
      0 runts, 0 giants, 0 throttles
      0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
      0 packets output, 0 bytes, 0 underruns
      0 output errors, 0 interface resets
      0 output buffer failures, 0 output buffers swapped out
```

VLAN Assignment

- Configuring IEEE 802.1q Trunk Links

Cisco Switch IOS Commands

Enter global configuration mode.	S1# configure terminal
Enter interface configuration mode for the SVI.	S1(config)# interface interface_id <i>(on)</i>
Force the link to be a trunk link.	S1(config)# switchport mode trunk
Specify a native VLAN for untagged 802.1Q trunks.	S1(config-if)# switchport trunk native vlan vlan_id
Specify the list of VLANs to be allowed on the trunk link.	S1(config-if)# switchport trunk allowed vlan vlan-list
Return to the privileged EXEC mode.	S1(config-if)# end

option

```
S1(config)# interface FastEthernet0/1
S1(config-if)# switchport mode trunk
S1(config-if)# switchport trunk native vlan 99
S1(config-if)# switchport trunk allowed vlan 10,20,30
S1(config-if)# end
```

VLAN Assignment

- Resetting the Trunk To Default State

Resetting Trunk Link Example

```
S1(config)# interface f0/1
S1(config-if)# no switchport trunk allowed vlan
S1(config-if)# no switchport trunk native vlan
S1(config-if)# end
S1# show interfaces f0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
<output omitted>
Administrative private-vlan trunk mappings: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
<output omitted>
```

Return Port to Access Mode

```
S1(config)# interface f0/1
S1(config-if)# switchport mode access
S1(config-if)# end
S1# show interfaces f0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
<output omitted>
```

VLAN Assignment

- Verifying Trunk Configuration

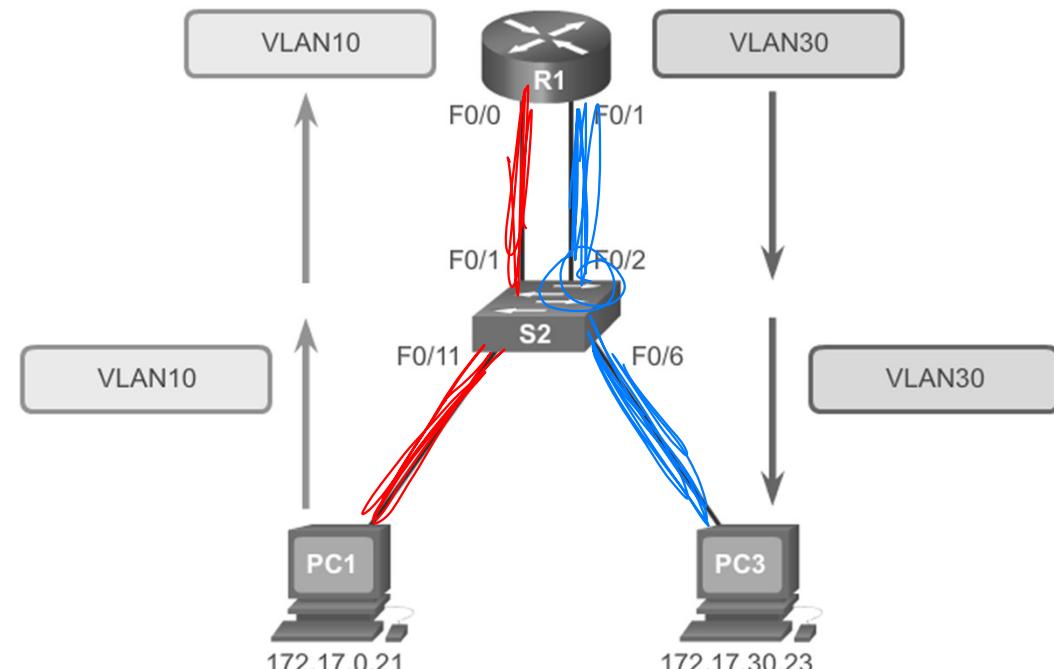
Verifying Trunk Configuration

```
S1(config)# interface f0/1
S1(config-if)# switchport mode trunk
S1(config-if)# switchport trunk native vlan 99
S1(config-if)# end
S1# show interfaces f0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 99 (VLAN0099)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk Native VLAN tagging: enabled
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk associations: none
Administrative private-vlan trunk mappings: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
<output omitted>
```

- Inter-VLAN Routing
 - Inter-VLAN Routing Operation
 - Inter-VLAN Routing Configuration
 - Troubleshooting Inter-VLAN Routing

Inter-VLAN Routing Operation

- What is Inter-VLAN Routing?
 - Layer 2 switches can't forward traffic between VLANs without the assistance of a router
 - Inter-VLAN routing is a process for forwarding network traffic from one VLAN to another using a router

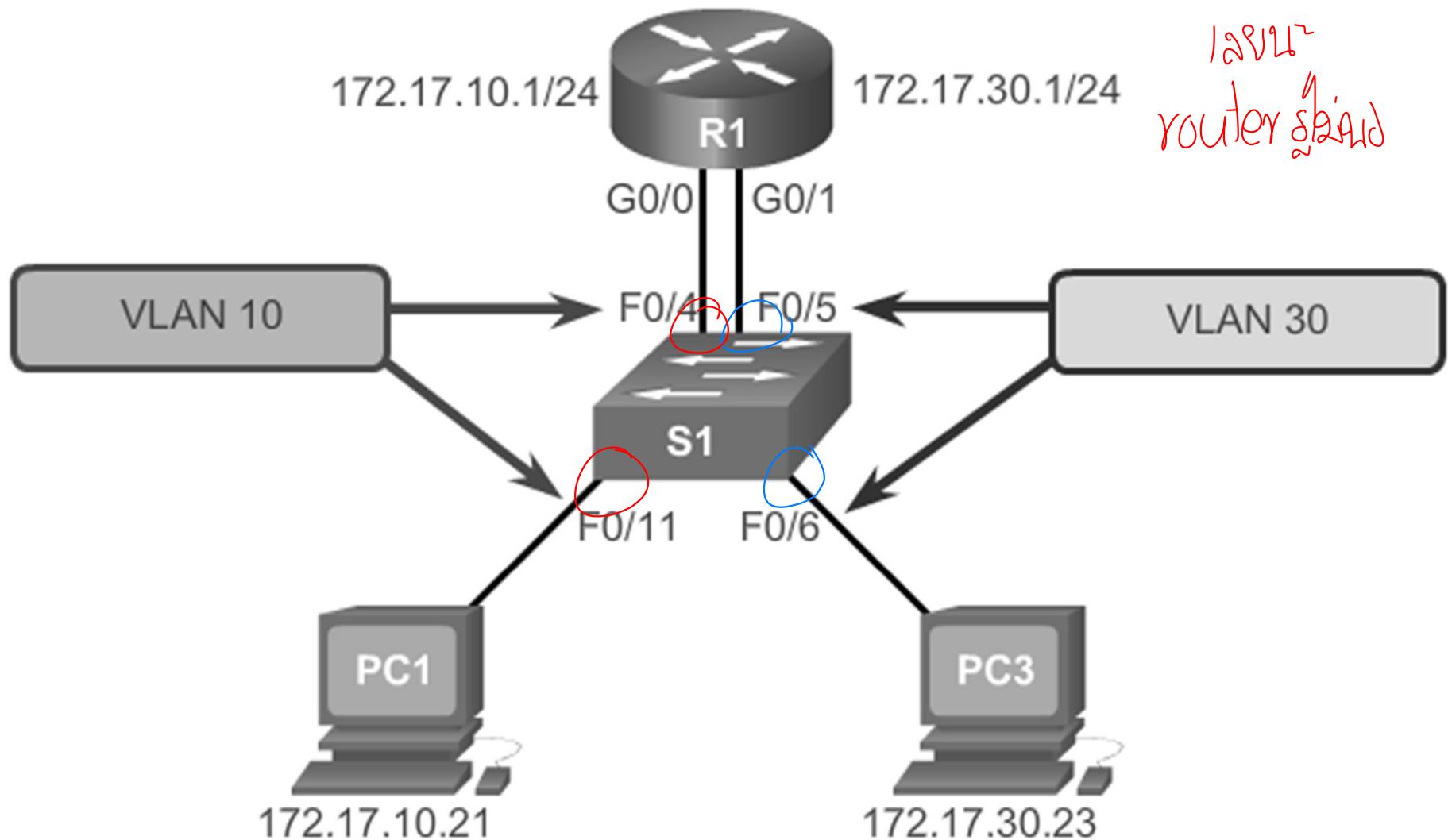


Inter-VLAN Routing Configuration

- Preparation

ជាមួយលទ្ធភាពនេះ

លទ្ធផល
router សម្រាប់
1 នាយក



Inter-VLAN Routing Configuration

- Switch Configuration

msconfig ก็ได้เหมือน

จะต้อง switch port mode access

```
S1(config)# vlan 10
S1(config-vlan)# vlan 30
S1(config-vlan)# interface f0/11
S1(config-if)# switchport access vlan 10
S1(config-if)# interface f0/4
S1(config-if)# switchport access vlan 10
S1(config-if)# interface f0/6
S1(config-if)# switchport access vlan 30
S1(config-if)# interface f0/5
S1(config-if)# switchport access vlan 30
S1(config-if)# end
*Mar 20 01:22:56.751: %SYS-5-CONFIG_I: Configured from console by
console
```

```
S1# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Inter-VLAN Routing Configuration

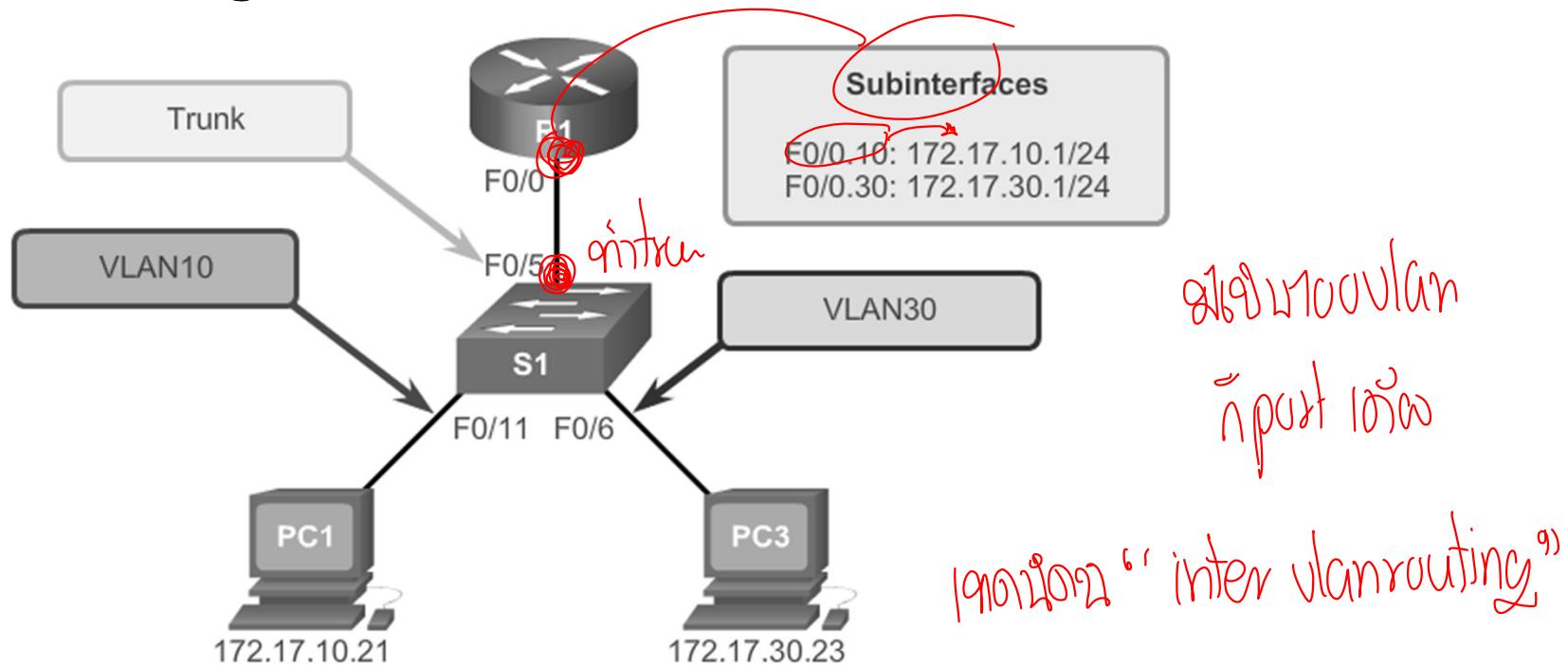
- Router Interface Configuration

at router

```
R1(config)# interface g0/0
R1(config-if)# ip address 172.17.10.1 255.255.255.0
R1(config-if)# no shutdown
*Mar 20 01:42:12.951: %LINK-3-UPDOWN: Interface GigabitEthernet0/0,
changed state to up
*Mar 20 01:42:13.951: %LINEPROTO-5-UPDOWN: Line protocol on Interface
GigabitEthernet0/0, changed state to up
R1(config-if)# interface g0/1
R1(config-if)# ip address 172.17.30.1 255.255.255.0
R1(config-if)# no shutdown
*Mar 20 01:42:54.951: %LINK-3-UPDOWN: Interface GigabitEthernet0/1,
changed state to up
*Mar 20 01:42:55.951: %LINEPROTO-5-UPDOWN: Line protocol on Interface
GigabitEthernet0/1, changed state to up
R1(config-if)# end
R1# copy running-config startup-config
```

Inter-VLAN Routing Configuration

- Switch Configuration



```

S1(config)# vlan 10
S1(config-vlan)# vlan 30
S1(config-vlan)# interface f0/5
S1(config-if)# switchport mode trunk
S1(config-if)# end
S1#

```

Inter-VLAN Routing Configuration

- Router Interface Configuration

```
R1(config)# interface g0/0.10
R1(config-subif)# encapsulation dot1q 10
R1(config-subif)# ip address 172.17.10.1 255.255.255.0
R1(config-subif)# interface g0/0.30
R1(config-subif)# encapsulation dot1q 30
R1(config-subif)# ip address 172.17.30.1 255.255.255.0
R1(config)# interface g0/0
R1(config-if)# no shutdown

*Mar 20 00:20:59.299: %LINK-3-UPDOWN: Interface GigabitEthernet0/0,
  changed state to down
*Mar 20 00:21:02.919: %LINK-3-UPDOWN: Interface GigabitEthernet0/0,
  changed state to up
*Mar 20 00:21:03.919: %LINEPROTO-5-UPDOWN: Line protocol on
  changed state to down
*Mar 20 00:21:02.919: %LINK-3-UPDOWN: Interface GigabitEthernet0/0,
  changed state to up
*Mar 20 00:21:03.919: %LINEPROTO-5-UPDOWN: Line protocol on
  Interface GigabitEthernet0/0, changed state to up
```

Verifying Subinterfaces

```
R1# show vlans
<output omitted>
Virtual LAN ID: 10 (IEEE 802.1Q Encapsulation)

  VLAN Trunk Interface: GigabitEthernet0/0.10

    Protocols Configured: Address: Received: Transmitted:
      IP           172.17.10.1     11          18
<output omitted>
Virtual LAN ID: 30 (IEEE 802.1Q Encapsulation)

  VLAN Trunk Interface: GigabitEthernet0/0.30

    Protocols Configured: Address: Received: Transmitted:
      IP           172.17.30.1     11          8
<output omitted>

R1# show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile,
      B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF,
      IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external
           type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1,
      L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default,
      U - per-user static route
      o - ODR, P - periodic downloaded static route, H - NHRP,
      1 - LISP
      + - replicated route, % - next hop override

Gateway of last resort is not set

  172.17.0.0/16 is variably subnetted, 4 subnets, 2 masks
C    172.17.10.0/24 is directly connected, GigabitEthernet0/0.10
L    172.17.10.1/32 is directly connected, GigabitEthernet0/0.10
C    172.17.30.0/24 is directly connected, GigabitEthernet0/0.30
L    172.17.30.1/32 is directly connected, GigabitEthernet0/0.30
```

```
R1# show vlans
<output omitted>
Virtual LAN ID: 10 (IEEE 802.1Q Encapsulation)

  VLAN Trunk Interface: GigabitEthernet0/0.10

    Protocols Configured: Address: Received: Transmitted:
      IP           172.17.10.1     11          18
<output omitted>
Virtual LAN ID: 30 (IEEE 802.1Q Encapsulation)

  VLAN Trunk Interface: GigabitEthernet0/0.30

    Protocols Configured: Address: Received: Transmitted:
      IP           172.17.30.1     11          8
<output omitted>
```

```
R1# show ip route
Gateway of last resort is not set

  172.17.0.0/16 is variably subnetted, 4 subnets, 2 masks
C    172.17.10.0/24 is directly connected, GigabitEthernet0/0.10
L    172.17.10.1/32 is directly connected, GigabitEthernet0/0.10
C    172.17.30.0/24 is directly connected, GigabitEthernet0/0.30
L    172.17.30.1/32 is directly connected, GigabitEthernet0/0.30
```

Questions and Answers

