

CS 305 Lab Tutorial

Lab13 MAC, ARP and Switch

Dept. Computer Science and Engineering
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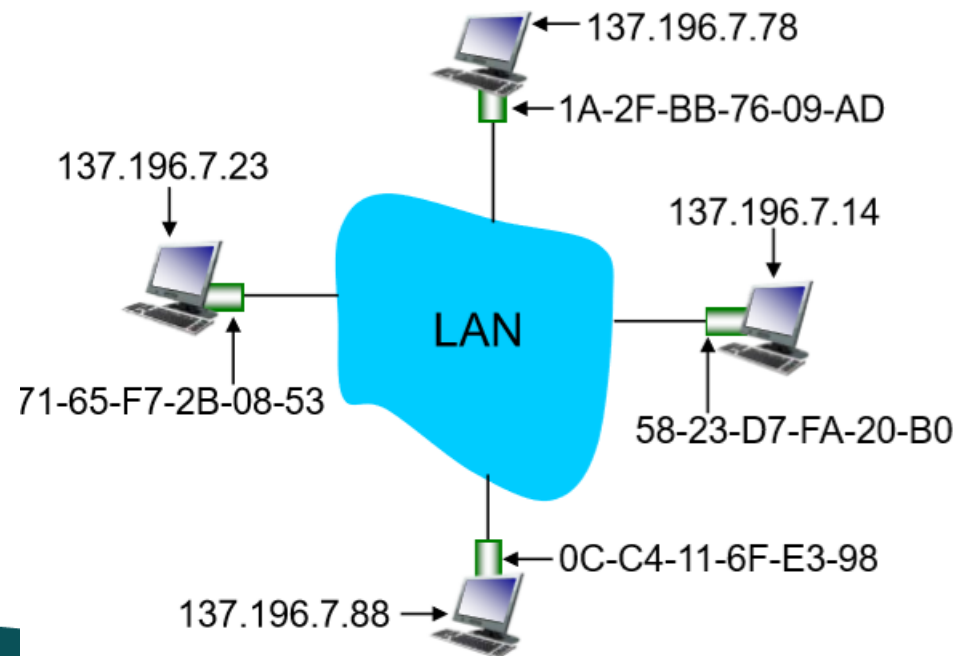
Topic

- MAC address & ARP
- Device
 - Bridge (Lay2) vs Hub (Lay1)
 - Switch (Lay2/Lay3)
- Practice
 - STP
 - VLAN
 - MultiLayer Switch

MAC address

- MAC (or LAN or physical or Ethernet) address:
 - function: *used 'locally' to get frame from one interface to another physically-connected interface (same network, in IP-addressing sense)*
 - 48 bit MAC address (for most LANs) burned in NIC ROM, also sometimes software settable
 - e.g.: 1A-2F-BB-76-09-AD

hexadecimal (base 16) notation
(each "numeral" represents 4 bits)



ARP(Address Resolution Protocol)

23	3.409057	Micro-St_b3:5c:39	Broadcast	ARP	Who has 172.18.130.25? Tell 172.18.130.27
24	3.409348	Micro-St_b0:d9:cd	Micro-St_b3:5c:39	ARP	172.18.130.25 is at 44:8a:5b:b0:d9:cd

>	Frame 23: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface 0
>	Ethernet II, Src: Micro-St_b3:5c:39 (44:8a:5b:b3:5c:39), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
✓	Address Resolution Protocol (request)
	Hardware type: Ethernet (1)
	Protocol type: IPv4 (0x0800)
	Hardware size: 6
	Protocol size: 4
	Opcode: request (1)
	Sender MAC address: Micro-St_b3:5c:39 (44:8a:5b:b3:5c:39)
	Sender IP address: 172.18.130.27 (172.18.130.27)
	Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
	Target IP address: 172.18.130.25 (172.18.130.25)

1. using “arp -d” to clear the mac-address table on PC.
2. “ping” an reachable IP.
3. use “arp” in WireShark to display ARP frame.
4. use “eth.addr == *:*:*:*:*:*:*” in WireShark to filter MAC addresses.

24	3.409348	Micro-St_b0:d9:cd	Micro-St_b3:5c:39	ARP	172.18.130.25 is at 44:8a:5b:b0:d9:cd
----	----------	-------------------	-------------------	-----	---------------------------------------

>	Frame 24: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface 0
>	Ethernet II, Src: Micro-St_b0:d9:cd (44:8a:5b:b0:d9:cd), Dst: Micro-St_b3:5c:39 (44:8a:5b:b3:5c:39)
✓	Address Resolution Protocol (reply)
	Hardware type: Ethernet (1)
	Protocol type: IPv4 (0x0800)
	Hardware size: 6
	Protocol size: 4
	Opcode: reply (2)
	Sender MAC address: Micro-St_b0:d9:cd (44:8a:5b:b0:d9:cd)
	Sender IP address: 172.18.130.25 (172.18.130.25)
	Target MAC address: Micro-St_b3:5c:39 (44:8a:5b:b3:5c:39)
	Target IP address: 172.18.130.27 (172.18.130.27)

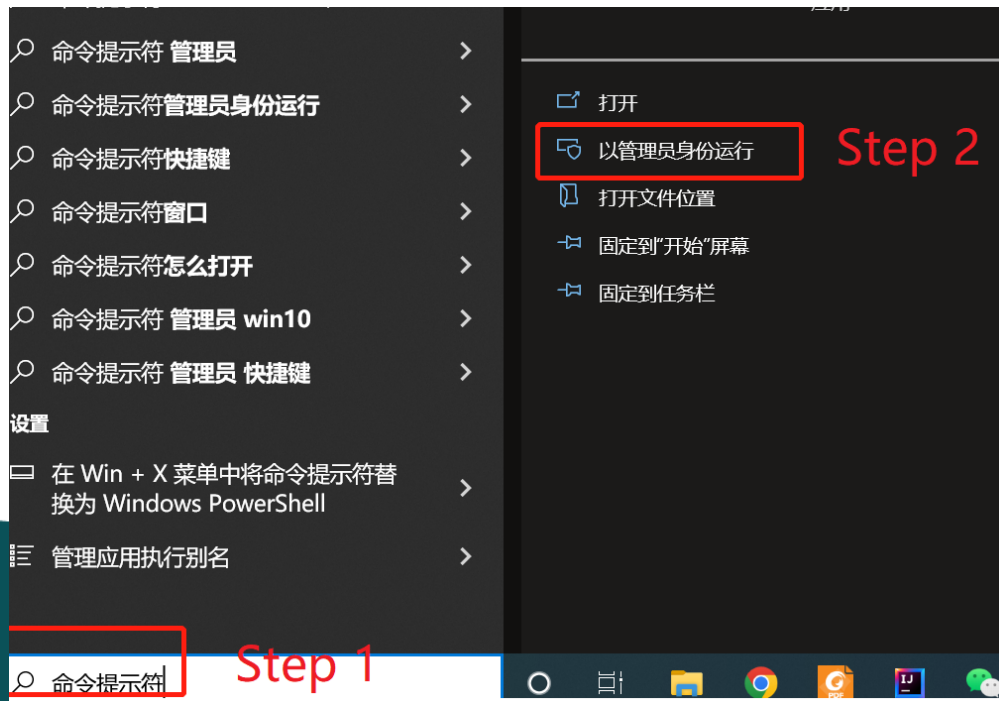
```
[H3C]display mac-address
MAC Address      VLAN ID   State
448a-5bb3-5c39   1         Learned
448a-5bb3-5f55   1         Learned
[H3C]
```

Port/Nickname	Aging
GE1/0/23	Y
GE1/0/1	Y

Tips

```
C:\Windows\system32\cmd.exe  
Microsoft Windows [版本 10.0.19041.1110]  
(c) Microsoft Corporation. 保留所有权利。  
C:\Users\wq>arp -d  
ARP 项删除失败: 请求的操作需要提升。
```

If you are not allowed to use
“arp -d” command, you should
change to administrator.

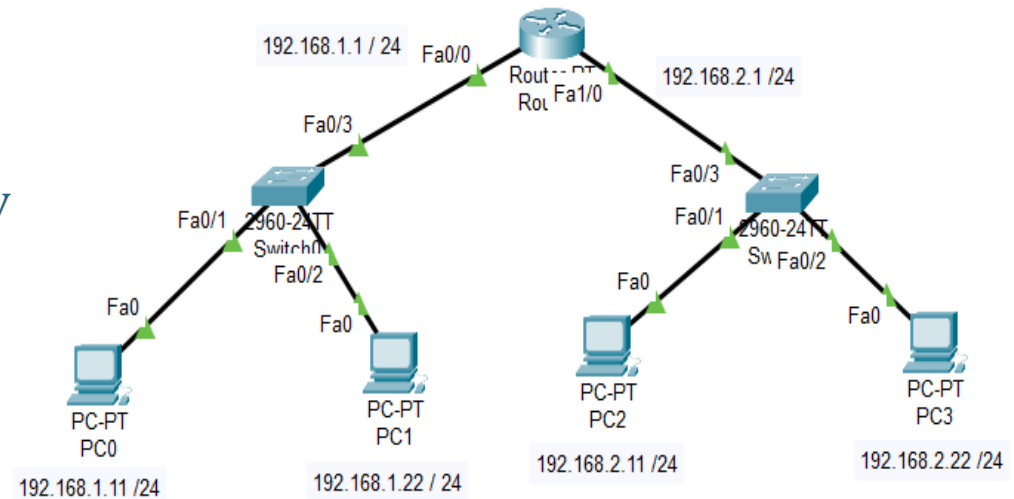


```
管理员: 命令提示符  
Microsoft Windows [版本 10.0.19041.1110]  
(c) Microsoft Corporation. 保留所有权利。  
C:\Windows\system32>arp -d  
C:\Windows\system32>
```

Practice 13.1

Build the network as below topology, do the following test on simulation mode of packet-tracer

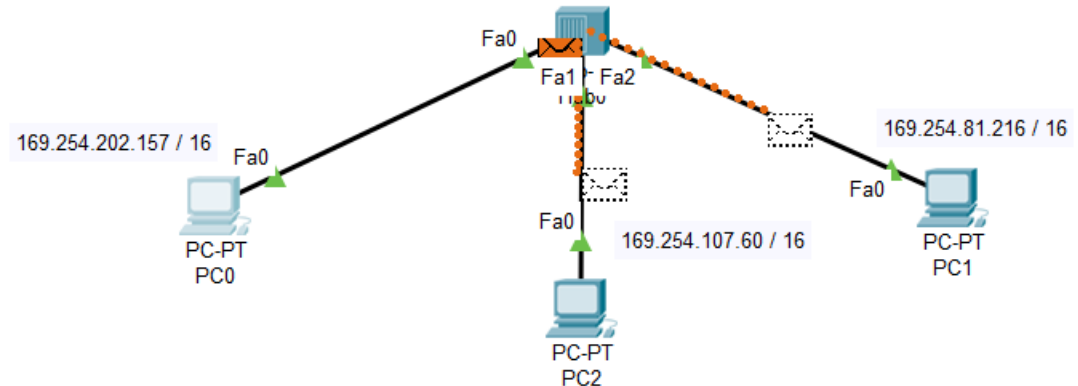
- invoke “ping” on PC0 to reach PC1
 - Is there any arp message?
 - Does the arp message reach to the router? If yes, what does the router do after receiving the arp message?
- Invoke “ping” on PC0 to reach PC2
 - How many arp messages are used before the 1st icmp reply packet is received by PC0?
 - Which device send these arp messages?
 - Is there any info about gateway in these arp messages?



Tips: 1. “arp -d” could be used to clear the arp-table on PC;
2. Turn off the interface on Switch / Route could clear its arp-table/ mac-address table. The CLI command is “shutdown”.

Hub(Layer 1) broadcast

- Hub is a Layer 1 device which only broadcast the package while not check the address of it.



PC0

Physical Config Desktop Programming Attributes

Command Prompt

Packet Tracer PC Command Line 1.0

```
C:\>ping 169.254.81.216
```

Pinging 169.254.81.216 with 32 bytes of data:

```
Reply from 169.254.81.216: bytes=32 time=8ms TTL=128
```

```
Reply from 169.254.81.216: bytes=32 time=4ms TTL=128
```

```
Reply from 169.254.81.216: bytes=32 time=4ms TTL=128
```

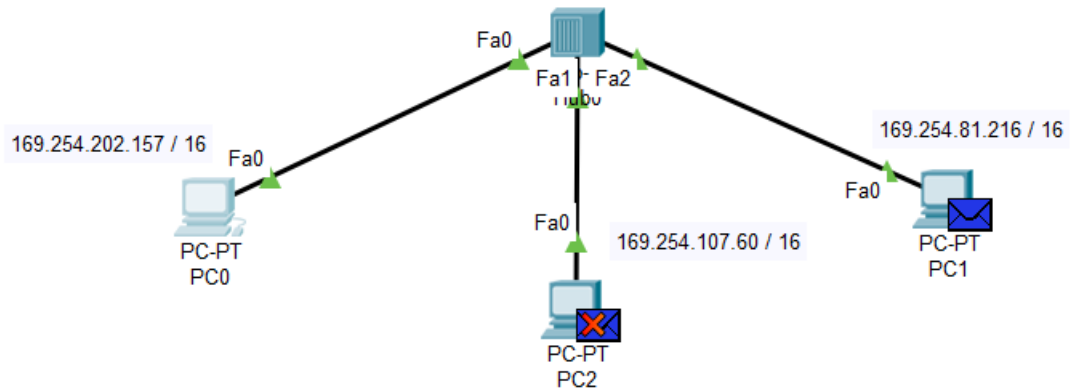
```
Reply from 169.254.81.216: bytes=32 time=4ms TTL=128
```

Ping statistics for 169.254.81.216:

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

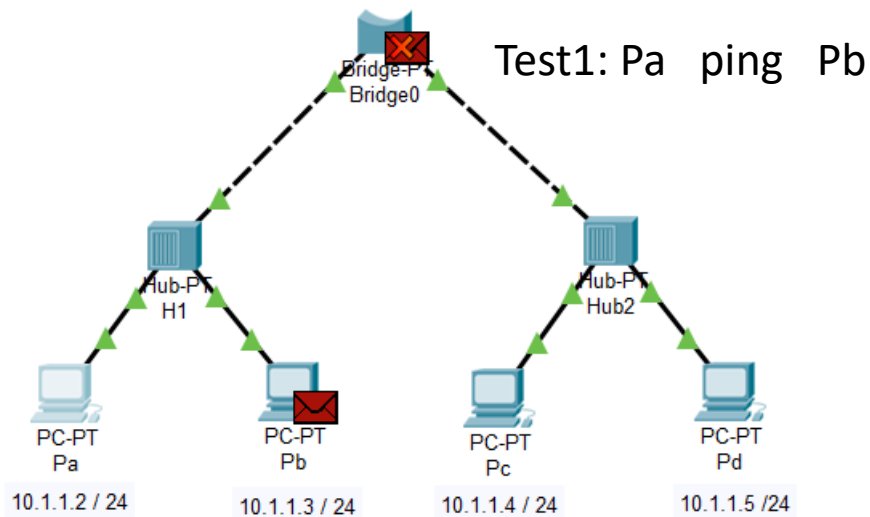
```
Approximate round trip times in milli-seconds:
```

```
Minimum = 4ms, Maximum = 8ms, Average = 5ms
```



Bridge(Layer 2) forwarding

- Bridge is a Layer 2 device transfer the packages according to MAC address.

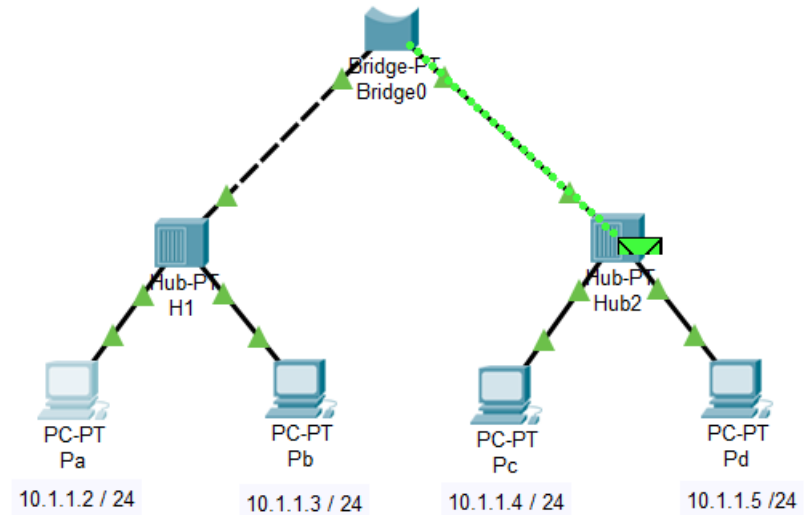


Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	1.012	--	Pa	ICMP
	1.013	Pa	H1	ICMP
	1.014	H1	Pb	ICMP
	1.014	H1	Bridge0	ICMP
	1.015	Pb	H1	ICMP
	1.016	H1	Pa	ICMP
	1.016	H1	Bridge0	ICMP

Test2: Pa ping Pd



Simulation Panel

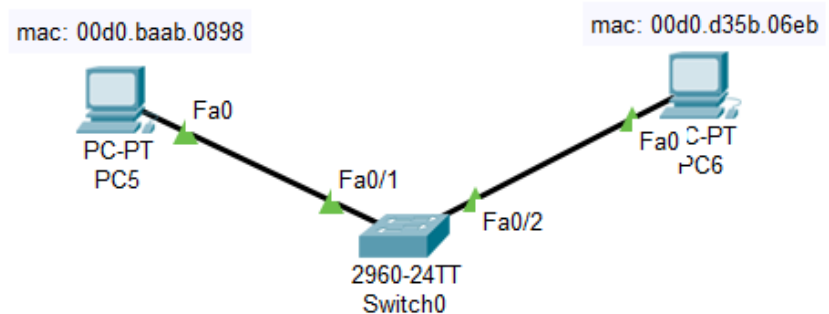
Event List

Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	Pa	ICMP
	0.001	Pa	H1	ICMP
	0.002	H1	Pb	ICMP
	0.002	H1	Bridge0	ICMP
	0.003	Bridge0	Hub2	ICMP
	0.004	Hub2	Pc	ICMP
	0.004	Hub2	Pd	ICMP
	0.005	Pd	Hub2	ICMP
	0.006	Hub2	Pc	ICMP
	0.006	Hub2	Bridge0	ICMP
	0.007	Bridge0	H1	ICMP
	0.008	H1	Pa	ICMP
	0.008	H1	Pb	ICMP

Switch(Layer 2)

- Switch can **learn** from the received package: to gain its source mac address and the interface id to make a **Mac-address Table**.
- Switch use the Mac-address Table to forward the package on Layer2.

Make **PC5** “ping” **PC6** to invoke **Switch0** switch packets and learn mac-address-table



```
Switch# show mac address-table
Mac Address Table
```

Vlan	Mac Address	Type	Ports
1	00d0.baab.0898	DYNAMIC	Fa0/1
1	00d0.d35b.06eb	DYNAMIC	Fa0/2

Tips: Both PC5 and PC6 has an local ipv6 address which are in the same network.

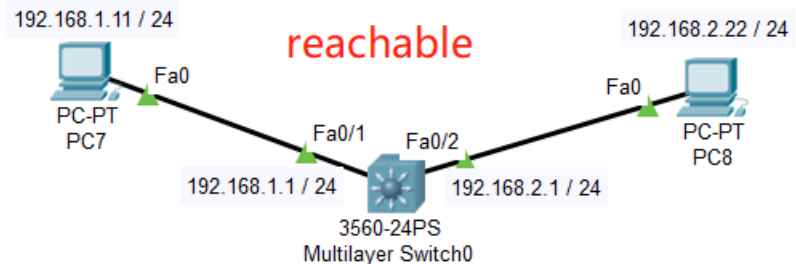
Switch(Layer 3)

The Switch on Layer 3 gains the features on fast forwarding and routing

In the following topology, if replacing the Multilayer switch with Layer2 switch, could PC7 still communicate with PC8?

Tips:

1. On the Multilayer Switch, using 'ip routing' in global config mode to make Multilayer Switch work on Layer 3
2. Using 'no switchport' in config-if mode to change the work-mode of interface from Layer 2 to Layer 3.



Multilayer Switch0

Physical Config CLI Attributes

IOS Command Line Interface

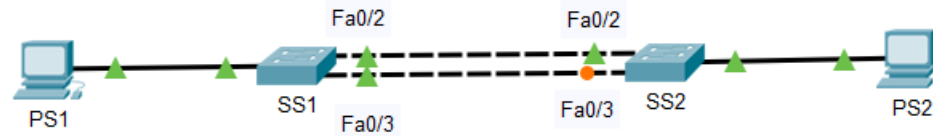
```
:
interface FastEthernet0/1
no switchport
ip address 192.168.1.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet0/2
no switchport
ip address 192.168.2.1 255.255.255.0
duplex auto
speed auto
!
```

```
Switch(config)#interface fastEthernet 0/2
Switch(config-if)#
Switch(config-if)#no switchport
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up

Switch(config-if)#
Switch(config-if)#
%
Switch(config-if)#ip address 192.168.2.1 255.255.255.0
Switch(config-if)#
```

STP: Spanning-Tree Protocol

- Spanning Tree algorithm is always used in the Ethernet network to create a spanning tree with a interface of a switch as the root, automatically block one or more redundant ports in logic to avoid loops.



```
SS1#show spanning-tree
VLAN0001
```

Spanning tree enabled protocol ieee

```
Root ID    Priority    32769
Address    0090.0C79.A27E
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    0090.0C79.A27E
Hello Time  2 sec  Max Age 20 sec  Forward Delay 15
sec
Aging Time  20
```

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/3	Desg	FWD	19	128.3	P2p
Fa0/2	Desg	FWD	19	128.2	P2p
Fa0/1	Desg	FWD	19	128.1	P2p

```
SS2#show spanning-tree
VLAN0001
```

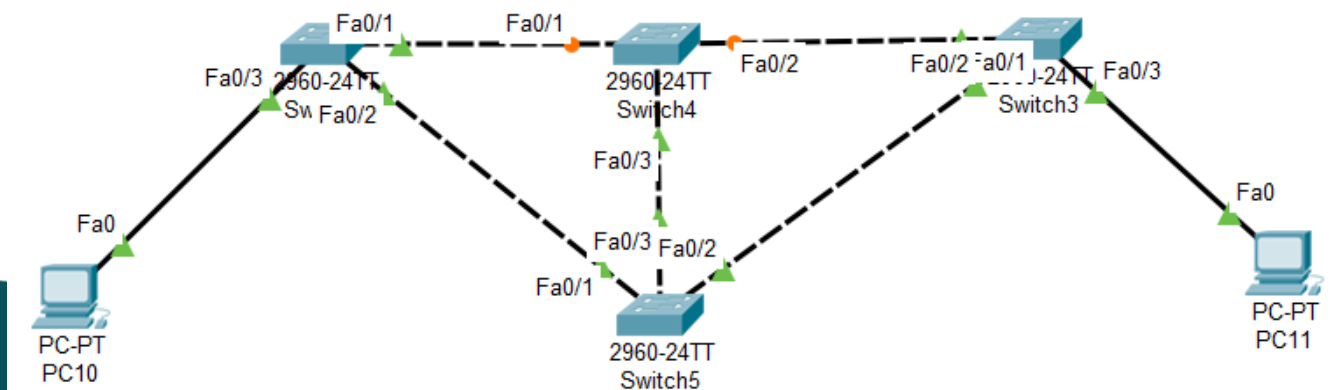
```
Spanning tree enabled protocol ieee
Root ID    Priority    32769
Address    0090.0C79.A27E
Cost       19
Port       1 (FastEthernet0/1)
Hello Time  2 sec  Max Age 20 sec  Forward Delay 15
sec
```

```
Bridge ID  Priority    32769 (priority 32768 sys-id-ext 1)
Address    00D0.5837.D0AC
Hello Time  2 sec  Max Age 20 sec  Forward Delay 15
sec
Aging Time  20
```

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Root	FWD	19	128.1	P2p
Fa0/2	Desg	FWD	19	128.2	P2p
Fa0/3	Altn	BLK	19	128.3	P2p

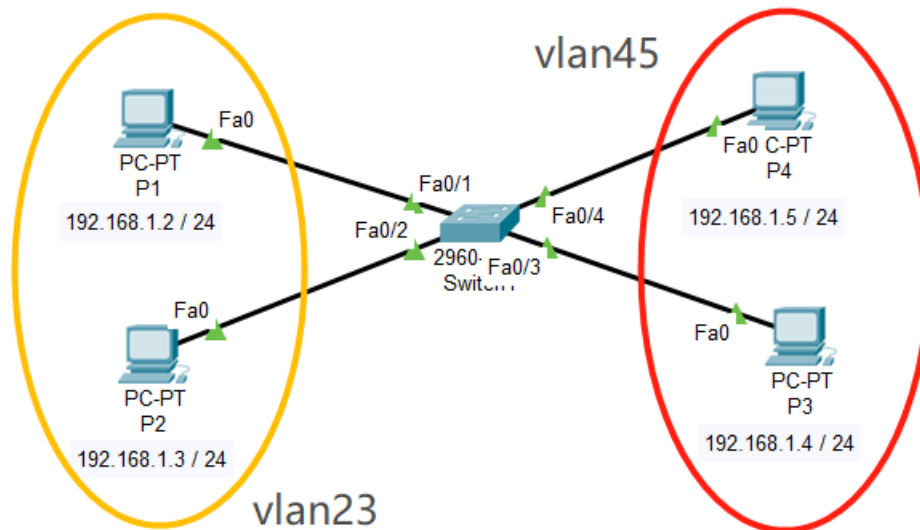
Practice 13.2

- Build a LAN as the topology:
 - What's the state of link marked with **yellow spot** in the following network, will it block the communication between PC10 and PC11?
 - Find the **root of the spanning-tree**
 - **Shutdown the Fa0/3 of switch5**, will the root and yellow spot changes? Will the communication between PC10 and PC11 be blocked?
 - Is there any way to set a new root of the **spanning-tree**(option)



VLAN(1)

- VLAN(Virtual Local Area Network) is a communication technology that divides a physical LAN into multiple broadcast domains logically. The hosts in VLAN can communicate with each other directly, but the VLANs cannot communicate with each other directly, so the broadcast message is limited in one VLAN .



```
Switch(config)#vlan 23
Switch(config-vlan)#exit
Switch(config)#inter
Switch(config)#interface fast
Switch(config)#interface fastEthernet 0/1
Switch(config-if)#switchport access vlan 23
Switch(config-if)#exit
```

```
Switch#show vlan brief
```

VLAN	Name	Status	Ports
1	default	active	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 Gig0/1, Gig0/2
23	VLAN0023	active	Fa0/1, Fa0/2
45	VLAN0045	active	Fa0/3, Fa0/4
1002	fddi-default	active	

VLAN(2)

- **Access Link:**

- A link used to connect **a user host to a switch**. Generally, the host does not need to know which VLAN it belongs to, and the host hardware usually does not recognize the frame with VLAN tag. Therefore, the frames sent and received by the host are untagged frames.

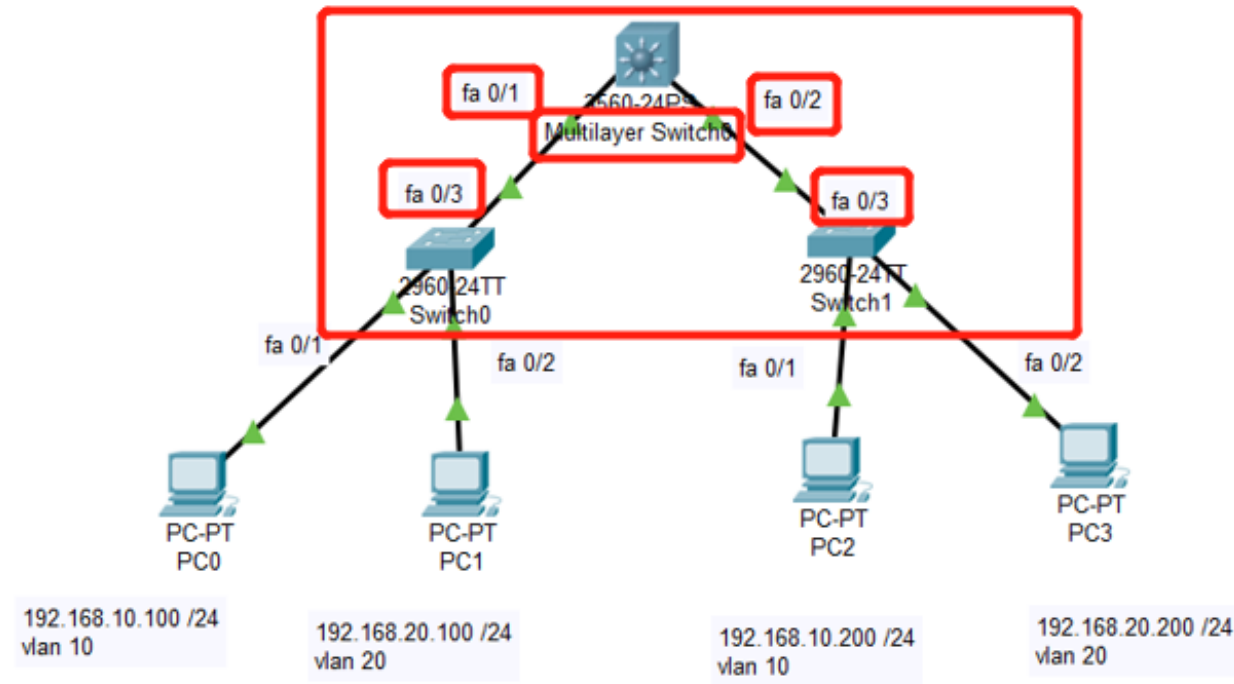
- **Trunk Link:**

- Used for **interconnection between switches or connection between switches and routers**. The trunk link can carry multiple different VLAN data. When the data frame is transmitted on the trunk link, the devices at both ends of the trunk link need to be able to identify which VLAN the data frame belongs to, so the frames transmitted on the trunk link are tagged frames.

```
Switch(config)#interface fa 0/3  
Switch(config-if)#switchport mode trunk  
Switch(config-if)#exit
```

Practice 13.3

Build a LAN as the topology: **PC0, PC2 access to vlan 10; PC1, PC3 access to vlan 20**



1) check if PCs in the same VLAN could communicate with each other.

2) make '**trunk link**' in the network, configure on the **Multilayer Switch** to make the PC in vlan 10 could communicate with the PC in vlan 20

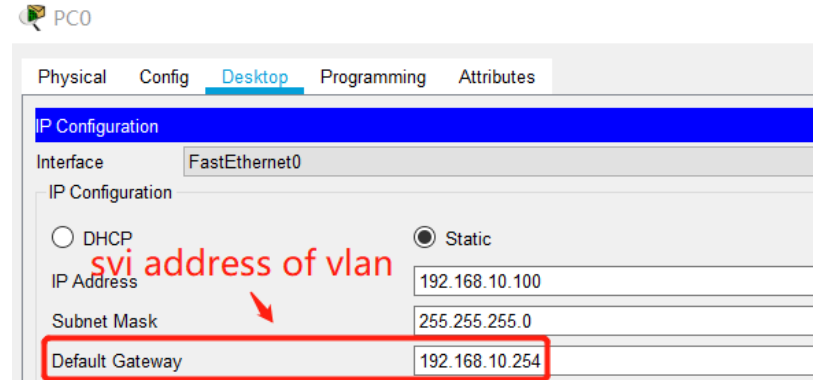
Tips:

For switch0 and switch 1, make the mode of interface which connected with multilayer switch as trunk

Tips

For multilayer switch

- Make the mode of interface connect with switch0 and switch1 as trunk
 1. interface fa 0/1
 2. switchport trunk encapsulation dot1q
 3. Switchport mode trunk
- Make the same vlan as switch0 and switch1
- Make the interface of vlan, configure its ip address and subnet mask
 1. interface vlan10
 2. ip address 192.168.10.254 255.255.255.0
- invoke the ip routing function of multilayer switch
 1. ip routing



```
Switch#show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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

Gateway of last resort is not set

C    192.168.10.0/24 is directly connected, Vlan10
C    192.168.20.0/24 is directly connected, Vlan20

Switch#
```