CS 305 Lab Tutorial
Lab13 MAC, ARP and Switch

Dept. Computer Science and Engineering
Southern University of Science and Technology

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Thanks to Wei WANG

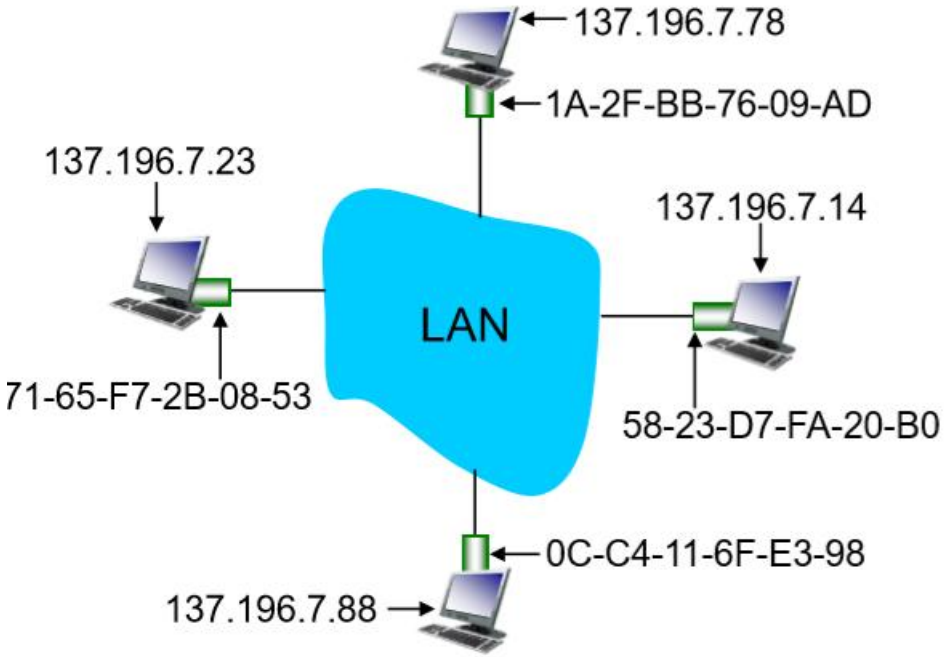
Topic

- MAC address & ARP
  - Layer 2 address
  - ARP request, ARP reply
- Device
  - Hub (broadcast)
  - Switch (Active learning, mac-address table)
    - VLAN
    - VLAN interface
    - link-type (access, trunk)
- Practice

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… 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)
v 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)
```

```
    24 3.409348   Micro-St_b0:d9:cd   Micro-St_b3:5c… 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)
v 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)
```

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.

```
[H3C]display mac-address
MAC Address      VLAN ID    State          Port/Nickname          Aging
448a-5bb3-5c39   1          Learned        GE1/0/23               Y
448a-5bb3-5f55   1          Learned        GE1/0/1                Y
[H3C]
```

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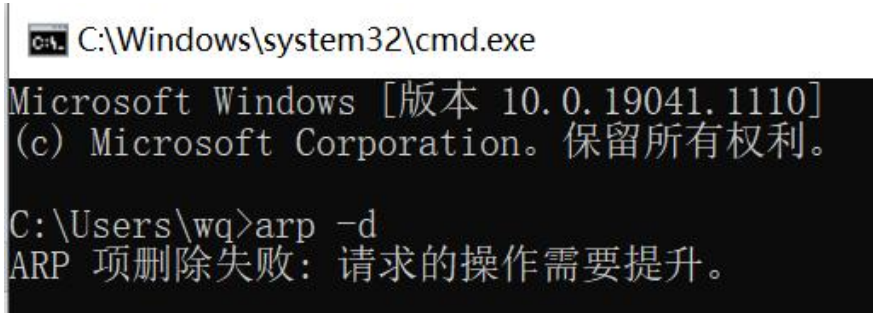
https://www.rfc-editor.org/rfc/rfc826.txt

Tips



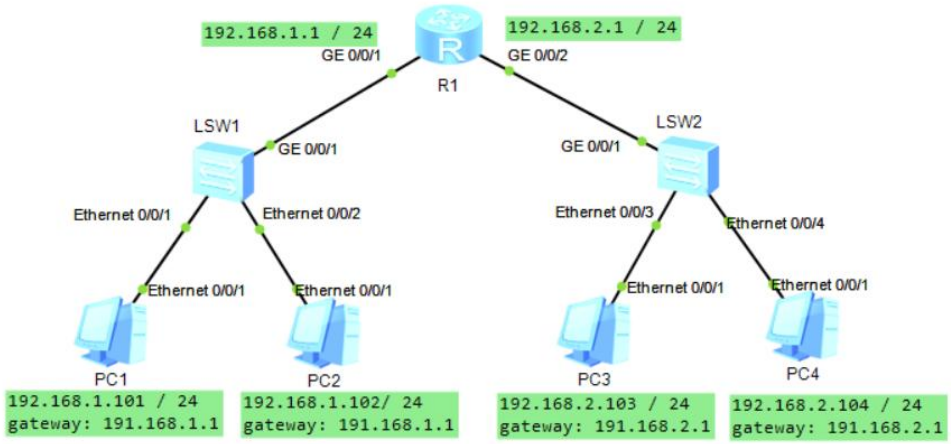
If you are not allowed to use "arp -d" command, you should change to administrator.

Practice 13.1

Build the network as below topology, do the following test on eNSP

- using “arp -d” on PC1 to clear its arp-table
- invoke“ping”on PC1 to reach PC2
  - While the ARP request reach to LSW1, How dose it do for the packet?
  - Does the arp message reach to the router? If yes, what does the router do after receiving the arp message?
  - in this test, could the MAC address of Gateway(192.168.1.1) be learnt by PC1?

- using “arp -d” on PC1 to clear its arp-table
- Invoke “ping” on PC1 to reach PC3
  - What’s the “target IP” in the ARP request sent by PC1 ?
  - Would the Router(R1) send the ARP request? if yes, What’s the “target IP” in the ARP request sent by PC1 ?
  - After these test, what’s the arp-table on PC1 and PC3? Does it learnt the MAC address of its Gateway?



Tips:

1.*“arp -d”* could be used to clear the arp-table on PC;

2. “undo mac-address” could be used to clear the mac-address table on Switch.

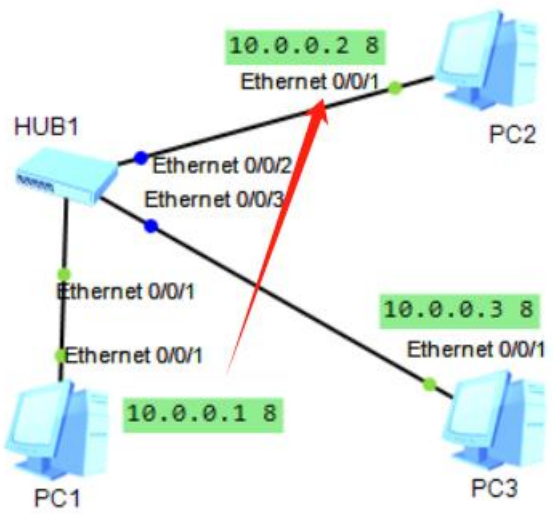
3. “dis mac-address” could be used to show the mac-address table on Switch.

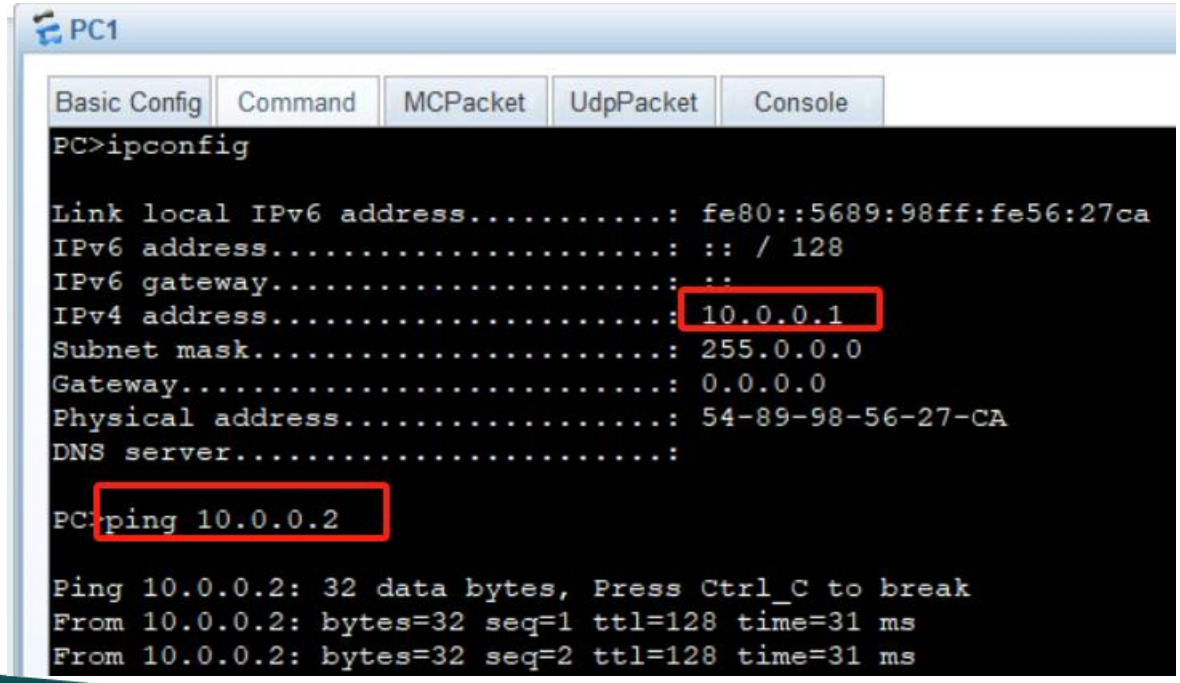
4. “dis int <interface name>” in system view could be used to show the details about the interface on both switch and router

Hub(Layer 1) broadcast(1)

Hub broadcasts the package while not check the destination address of it.

Demo1. Build a simple network topology, with 3 PCs and a Hub. Complete the basic configuration of the PCs as shown in the figure. Capture packets on the Ethernet 0/0/2 and Ethernet 0/0/3, then initiate “ping” test from PC1 to PC2.





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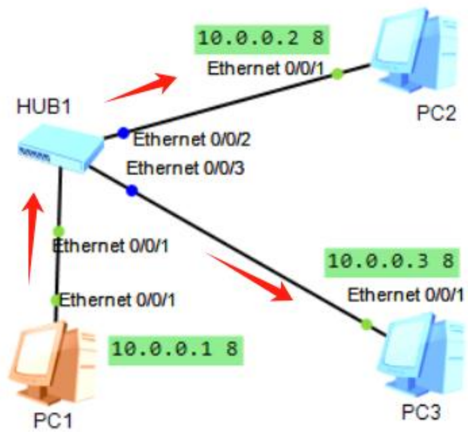
Hub(Layer 1) broadcast(2)

Capture packets on the Ethernet 0/0/2 and Ethernet 0/0/3, then initiate “ping” test from PC1 to PC2.



Q1. Which device sends ARP request? while HUB1 receives the ARP request from its interface X, would it broadcast the ARP request to the interface X?

Q2. Which device sends ARP reply? would PC3 receive the ARP reply ?

Q3. What’s the ARP-Table on PC1, PC2 and PC3 after the “ping” test from PC1 to PC2 ?

Source	Protocol	Destination	Length	Info
HuaweiTe_56:2…	ARP	Broadcast	60	Who has 10.0.0.2? Tell 10.0.0.1
HuaweiTe_5a:4…	ARP	HuaweiTe…	60	10.0.0.2 is at 54:89:98:5a:45:72
10.0.0.1	ICMP	10.0.0.2	74	Echo (ping) request id=0x7f01, seq=1/256, ttl
10.0.0.2	ICMP	10.0.0.1	74	Echo (ping) reply id=0x7f01, seq=1/256, ttl
10.0.0.1	ICMP	10.0.0.2	74	Echo (ping) request id=0x8001, seq=2/512, ttl
10.0.0.2	ICMP	10.0.0.1	74	Echo (ping) reply id=0x8001, seq=2/512, ttl
10.0.0.1	ICMP	10.0.0.2	74	Echo (ping) request id=0x8101, seq=3/768, ttl
10.0.0.2	ICMP	10.0.0.1	74	Echo (ping) reply id=0x8101, seq=3/768, ttl
10.0.0.1	ICMP	10.0.0.2	74	Echo (ping) request id=0x8201, seq=4/1024, tt
10.0.0.2	ICMP	10.0.0.1	74	Echo (ping) reply id=0x8201, seq=4/1024, tt
10.0.0.1	ICMP	10.0.0.2	74	Echo (ping) request id=0x8301, seq=5/1280, tt
10.0.0.2	ICMP	10.0.0.1	74	Echo (ping) reply id=0x8301, seq=5/1280, tt

packets captured on Eth0/0/2

Source	Protocol	Destination	Length	Info
HuaweiTe_…	ARP	Broadcast	60	Who has 10.0.0.2? Tell
HuaweiTe_…	ARP	HuaweiTe…	60	10.0.0.2 is at 54:89:9
10.0.0.1	ICMP	10.0.0.2	74	Echo (ping) request i
10.0.0.2	ICMP	10.0.0.1	74	Echo (ping) reply i
10.0.0.1	ICMP	10.0.0.2	74	Echo (ping) request i
10.0.0.2	ICMP	10.0.0.1	74	Echo (ping) reply i
10.0.0.1	ICMP	10.0.0.2	74	Echo (ping) request i
10.0.0.2	ICMP	10.0.0.1	74	Echo (ping) reply i
10.0.0.1	ICMP	10.0.0.2	74	Echo (ping) request i
10.0.0.2	ICMP	10.0.0.1	74	Echo (ping) reply i
10.0.0.1	ICMP	10.0.0.2	74	Echo (ping) request i
10.0.0.2	ICMP	10.0.0.1	74	Echo (ping) reply i

packets captured on Eth0/0/3

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Hub(Layer 1) broadcast(3)

PC1

Basic Config | Command | MCPacket | UdpPacket | Console

```
PC>ping 10.0.0.2

Ping 10.0.0.2: 32 data bytes, Press Ctrl_C to break
From 10.0.0.2: bytes=32 seq=1 ttl=128 time=32 ms
From 10.0.0.2: bytes=32 seq=2 ttl=128 time=31 ms
From 10.0.0.2: bytes=32 seq=3 ttl=128 time=31 ms
From 10.0.0.2: bytes=32 seq=4 ttl=128 time=32 ms
From 10.0.0.2: bytes=32 seq=5 ttl=128 time=31 ms

--- 10.0.0.2 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 31/31/32 ms

PC>arp -a

Internet Address      Physical Address      Type
10.0.0.2              54-89-98-5A-45-72     dynamic
```

PC2

Basic Config | Command | MCPacket | UdpPacket | Console

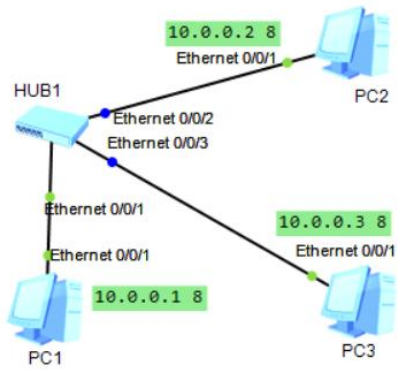
```
PC>arp -a

Internet Address      Physical Address      Type
10.0.0.1              54-89-98-56-27-CA     dynamic
```

PC3

Basic Config | Command | MCPacket | UdpPacket | Console

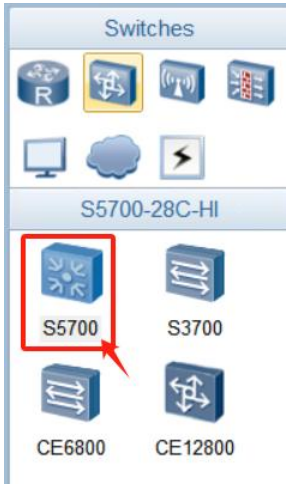
```
PC>arp -a

Internet Address      Physical Address      Type
10.0.0.2              54-89-98-5A-45-72     dynamic
10.0.0.1              54-89-98-56-27-CA     dynamic
```

- PC1 learns the MAC address of PC2 by ARP reply from PC2
- PC2 learns the MAC address of PC1 by ARP request from PC1
- PC3 learns the MAC address of PC1 by ARP reply from PC2, learns the MAC address of PC1 by ARP request from PC1.

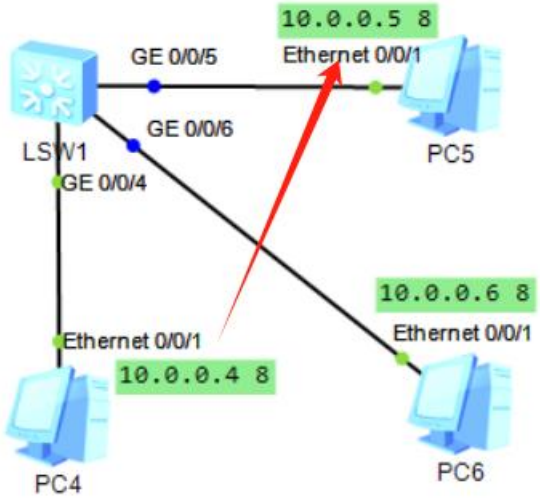


Switch - Mac address table(1)

- 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.



Demo2. Build a simple network topology, with 3 PCs and a Switch. Complete the basic configuration of the PCs as shown in the figure. Capture packets on the Ethernet 0/0/5 and Ethernet 0/0/6, then initiate "ping" test from PC4 to PC5.



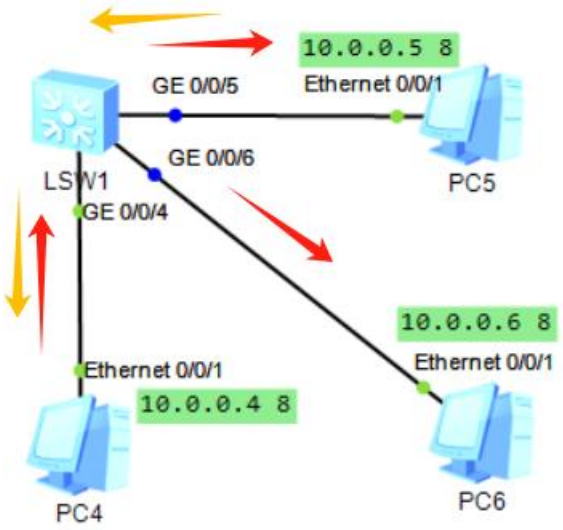
PC4

Basic Config | Command | MCPacket | UdpPacket | Console

```
PC>ipconfig

Link local IPv6 address.....: fe80::5689:98ff:fe0a:2252
IPv6 address.....: :: / 128
IPv6 gateway.....: ::
IPv4 address.....: 10.0.0.4
Subnet mask.....: 255.0.0.0
Gateway.....: 0.0.0.0
Physical address.....: 54-89-98-0A-22-52
DNS server.....:

PC>ping 10.0.0.5

Ping 10.0.0.5: 32 data bytes, Press Ctrl_C to break
From 10.0.0.5: bytes=32 seq=1 ttl=128 time=47 ms
From 10.0.0.5: bytes=32 seq=2 ttl=128 time=47 ms
From 10.0.0.5: bytes=32 seq=3 ttl=128 time=47 ms
From 10.0.0.5: bytes=32 seq=4 ttl=128 time=47 ms
From 10.0.0.5: bytes=32 seq=5 ttl=128 time=46 ms
```

Switch - Mac address table(2)

Capture packets on the GE 0/0/5 and GE 0/0/6, then initiate “ping” test from PC4 to PC5.



Q1. While ARP request reachs the Switch(LSW1), what would the Switch do? broadcast it or send it to PC5 ? How about ARP reply reachs the Switch(LSW1)?

Q2. While ICMP request reachs the Switch(LSW1), what would the Switch do? broadcast it or send it to PC5 ? How about ICMP reply reachs the Switch(LSW1)?

Q3. What’s the ARP-Table on PC4, PC5 and PC6 after the “ping” test from PC4 to PC6 ? What’s the MAC-Address table on the Switch(LSW1) ?

packets captured on GE0/0/5 of Switch

not stp

No.	Time	Source	Protocol	Destination	Length	Info
…	32.703000	HuaweiTe_0a:2…	ARP	Broadcast	60	Who has 10.0.0.5? Tell 10.0.0.4
…	32.719000	HuaweiTe_f0:1…	ARP	HuaweiTe…	60	10.0.0.5 is at 54:89:98:f0:18:25
…	32.781000	10.0.0.4	ICMP	10.0.0.5	74	Echo (ping) request id=0xa90c, seq=1/256, ttl=12
…	32.797000	10.0.0.5	ICMP	10.0.0.4	74	Echo (ping) reply id=0xa90c, seq=1/256, ttl=12
…	33.844000	10.0.0.4	ICMP	10.0.0.5	74	Echo (ping) request id=0xaa0c, seq=2/512, ttl=12
…	33.844000	10.0.0.5	ICMP	10.0.0.4	74	Echo (ping) reply id=0xaa0c, seq=2/512, ttl=12
…	34.891000	10.0.0.4	ICMP	10.0.0.5	74	Echo (ping) request id=0xab0c, seq=3/768, ttl=12
…	34.906000	10.0.0.5	ICMP	10.0.0.4	74	Echo (ping) reply id=0xab0c, seq=3/768, ttl=12
…	35.953000	10.0.0.4	ICMP	10.0.0.5	74	Echo (ping) request id=0xac0c, seq=4/1024, ttl=1
…	35.953000	10.0.0.5	ICMP	10.0.0.4	74	Echo (ping) reply id=0xac0c, seq=4/1024, ttl=1
…	37.016000	10.0.0.4	ICMP	10.0.0.5	74	Echo (ping) request id=0xad0c, seq=5/1280, ttl=1
…	37.031000	10.0.0.5	ICMP	10.0.0.4	74	Echo (ping) reply id=0xad0c, seq=5/1280, ttl=1

packets captured on GE0/0/6 of Switch

not stp

No.	Time	Source	Protocol	Destination	Length	Info
…	23.703000	HuaweiTe_0a:2…	ARP	Broadcast	60	Who has 10.0.0.5? Tell 10.0.0.4

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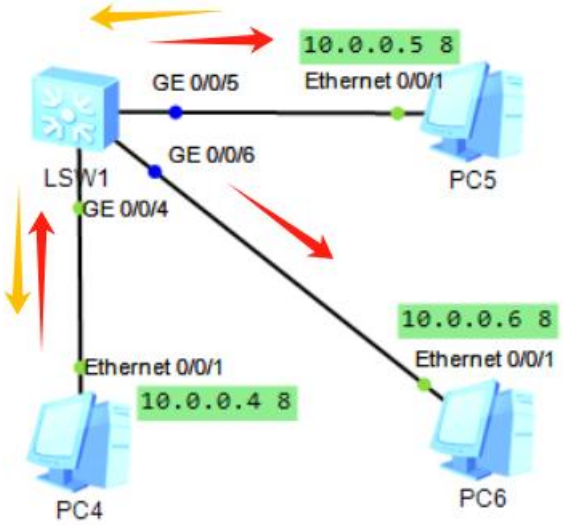
Switch - Mac address table(3)

- 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.




```
[Huawei]dis mac-address
MAC address table of slot 0:
-------------------------------------------------------------------------------
MAC Address    VLAN/       PEVLAN CEVLAN Port            Type      LSP/LSR-ID
               VSI/SI                                               MAC-Tunnel
-------------------------------------------------------------------------------
5489-98f0-1825 1           -      -      GE0/0/5         dynamic   0/-
5489-980a-2252 1           -      -      GE0/0/4         dynamic   0/-
-------------------------------------------------------------------------------
Total matching items on slot 0 displayed = 2
```

In this demo, Switch (LSW1) learns the MAC address of PC4 from the interface GE0/0/4 while received the ARP request packet. Switch(LSW1) learns the MAC address of PC5 from the interface GE0/0/5 while received the ARP reply packet.

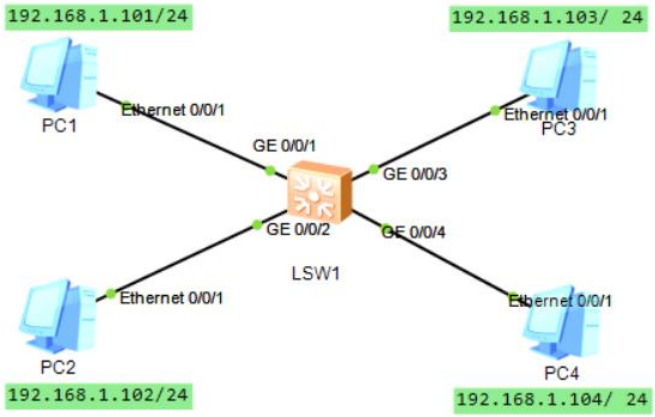
Q. If the MAC address of PC5 is added by “add -s” on PC4 before PC4 invoke “ping” test to PC5, what would the Switch (LSW1) do after receiving the ICMP request from PC4?

Switch - 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
- The VLANs cannot communicate with each other directly, so the broadcast message is limited in one VLAN .

Demo3-1. Build a simple network topology, with 4 PCs and a Switch. Complete the basic configuration of the PCs as shown in the figure. Using "display vlan 1" to display the default vlan in the Switch(LSW1).
All the interface are in the vlan 1 by default.



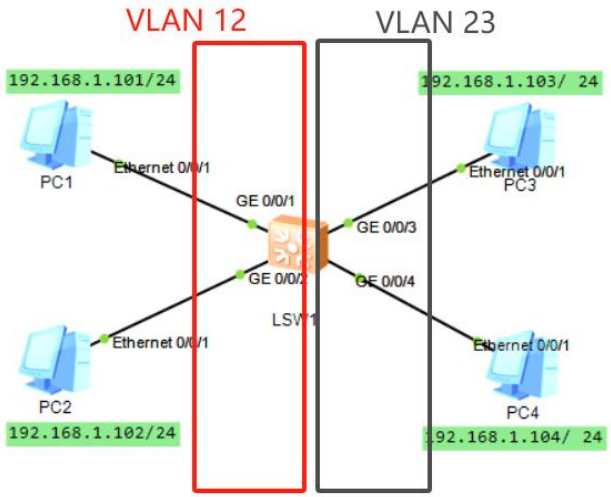
LSW1

```
[Huawei]dis vlan 1
--------------------------------------------------------------------------------
U: Up;         D: Down;         TG: Tagged;         UT: Untagged;
MP: Vlan-mapping;               ST: Vlan-stacking;
#: ProtocolTransparent-vlan;    *: Management-vlan;
--------------------------------------------------------------------------------

VID  Type    Ports
--------------------------------------------------------------------------------
1    common  UT:GE0/0/1(U)      GE0/0/2(U)      GE0/0/3(U)      GE0/0/4(U)
                GE0/0/5(D)      GE0/0/6(D)      GE0/0/7(D)      GE0/0/8(D)
                GE0/0/9(D)      GE0/0/10(D)     GE0/0/11(D)     GE0/0/12(D)
                GE0/0/13(D)     GE0/0/14(D)     GE0/0/15(D)     GE0/0/16(D)
                GE0/0/17(D)     GE0/0/18(D)     GE0/0/19(D)     GE0/0/20(D)
                GE0/0/21(D)     GE0/0/22(D)     GE0/0/23(D)     GE0/0/24(D)

VID  Status  Property      MAC-LRN Statistics Description
--------------------------------------------------------------------------------
1    enable  default       enable  disable    VLAN 0001
[Huawei]
```

Switch - VLAN(2)



Configuration:

- step 1. create vlan (in the system view)
  - command: # to create one vlan
    - vlan <vlan-ID>
    - .e.g. **vlan 12**
  - command: # to create several vlan(s)
    - vlan batch <vlan1-ID> <vlan2-ID> <vlann-ID>
    - .e.g. **vlan batch 12 34**
- step 2. specify the interface which access to the vlan and the vlan id(in the interface configuration view)
  - command: **port link-type access**
  - command: **port default vlan 12**

Demo3-2:

make GE 0/0/1 and GE0/0/2 of Switch(LSW1) access to vlan 12;

make GE 0/0/3 and GE0/0/4 of Switch(LSW1) access to vlan 34

```
[Huawei-GigabitEthernet0/0/1]dis this
#
interface GigabitEthernet0/0/1
 port link-type access
 port default vlan 12
#
return
[Huawei-GigabitEthernet0/0/1]
```

```
[Huawei-GigabitEthernet0/0/3]dis this
#
interface GigabitEthernet0/0/3
 port link-type access
 port default vlan 34
#
return
[Huawei-GigabitEthernet0/0/3]
```

```
[Huawei-GigabitEthernet0/0/2]dis this
#
interface GigabitEthernet0/0/2
 port link-type access
 port default vlan 12
#
return
[Huawei-GigabitEthernet0/0/2]
```

```
[Huawei-GigabitEthernet0/0/4]dis this
#
interface GigabitEthernet0/0/4
 port link-type access
 port default vlan 34
#
return
[Huawei-GigabitEthernet0/0/4]
```

Switch - VLAN(3)

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
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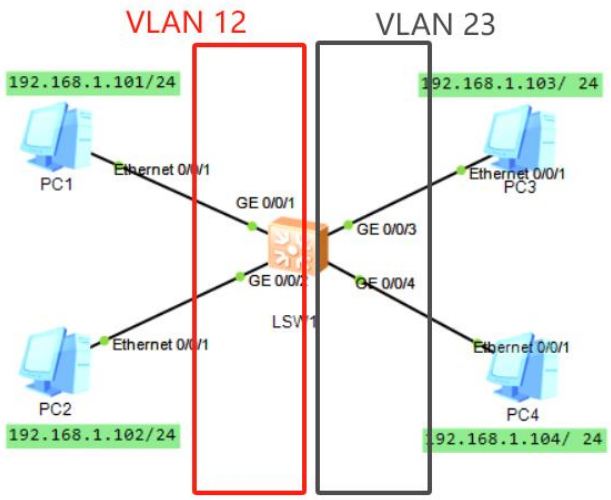


Demo3-3. After finish the configuration on the Switch(LSW1), do the following test, initiate packet capture to verify the following conclusions:

1. initiate “ping” test from PC1 to PC2

Q1. while PC1 send an ARP request, which PC(s) could receive the ARP request? PC2, PC3 PC4? PC2

would PC1 receive the ICMP reply from PC2? yes

2. initiate “ping” test from PC1 to PC4

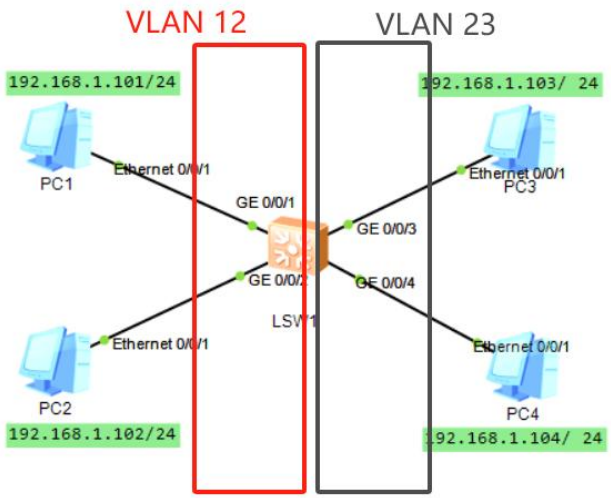
Q2. while PC1 send an ARP request, which PC(s) could receive the ARP request? PC2, PC3 PC4? PC2

would PC1 receive the ICMP reply from PC4? NO

3. using “dis play vlan 1” , “dis play vlan 12” and “dis play vlan 34” to find the details about these vlan

Switch - VLAN interface(1)

Each VLAN has its own corresponding virtual interface, which can be configured with IP address.



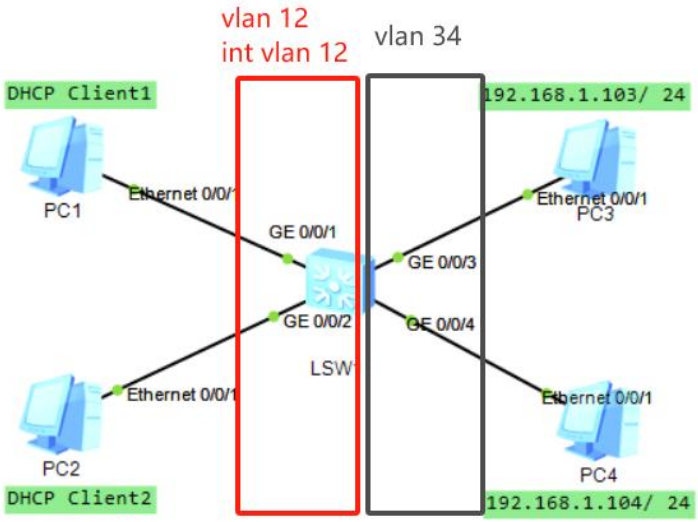
Configuration:

- step 1. create vlan virtual interface (in the system view)
  - command: **interface vlan <vlan-ID>**
    - .e.g. **interface vlan 12**
- step 2. specify the IP address of the vlan virtual interface(in the virtual interface configuration view)
  - command:

  ip address <x.x.x.x IPv4 address> <x.x.x.x subnet mask>
    - .e.g. : **ip address 192.168.1.1 255.255.255.0**
    - .e.g. : **ip address 192.168.1.1 24**

```
[Huawei]int vlan 12
[Huawei-Vlanif12]ip addr 192.168.1.1 24
```

Switch - VLAN interface(2)



Apply the DHCP service on the virsual interface

Configuration:

- step 1. enable dhcp service <in the system view>
  - command： **dhcp enable**
- step 2. enter the virtual interface configuration view
  - command: **interface vlan** < vlan id>
  - .e.g. **interface vlan 12**
- step 3. command: **dhcp select interface**
- step 4. configure the excluded-ip-address (optional)
- step 5. configure the dns-list(optional)

NOTE!: the IP address of the interface would be applied as the gateway

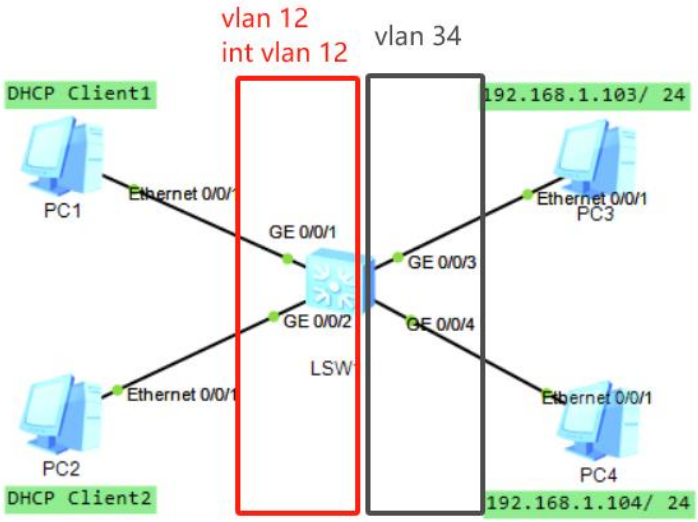
Demo3-4. configuration

0. The vlan 12 and vlan 34 has been create and configured in the previous steps.

1. Set PC1 and PC2 as DHCP client
2. Set virtual interface of vlan 12 as DHCP server to provide DHCP service to the VLAN 12.

```
[Huawei-Vlanif12]dis this
#
interface Vlanif12
 ip address 192.168.1.1 255.255.255.0
 dhcp select interface
 dhcp server excluded-ip-address 192.168.1.100 192.168.1.254
 dhcp server dns-list 114.114.114.114
#
return
```

Switch - VLAN interface(3)



Demo3-4. tests(1)

Run the “ipconfig /renew”command on the PC and initiate a DHCP request message to obtain the relevant configuration.

The relevant configuration obtained by the client is shown in the figure on the right.

PC1

Basic Config | Command | MCPacket | UdpPacket | Console

```
PC>ipconfig /renew

IP Configuration


Link local IPv6 address...........: fe80::5689:98ff:fe5d:49c5
IPv6 address......................: :: / 128
IPv6 gateway......................: ::
IPv4 address......................: 192.168.1.99
Subnet mask.......................: 255.255.255.0
Gateway...........................: 192.168.1.1
Physical address..................: 54-89-98-5D-49-C5
DNS server........................: 114.114.114.114
```

PC2

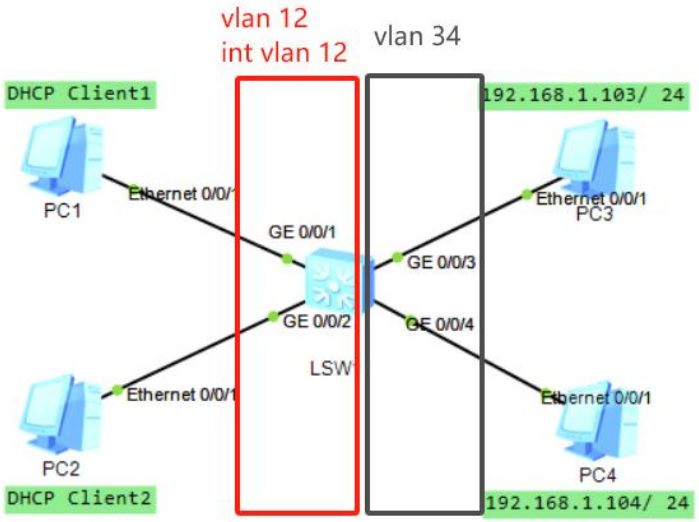
Basic Config | Command | MCPacket | UdpPacket | Console

```
PC>ipconfig /renew

IP Configuration


Link local IPv6 address...........: fe80::5689:98ff:fe87:957
IPv6 address......................: :: / 128
IPv6 gateway......................: ::
IPv4 address......................: 192.168.1.98
Subnet mask.......................: 255.255.255.0
Gateway...........................: 192.168.1.1
Physical address..................: 54-89-98-87-09-57
DNS server........................: 114.114.114.114
```

Switch - VLAN interface(4)



There are two new direct routing-entry about the vlan interface 12 ?

```
[Huawei]dis ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 4        Routes : 4

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

      127.0.0.0/8   Direct  0    0           D   127.0.0.1       InLoopBack0
      127.0.0.1/32  Direct  0    0           D   127.0.0.1       InLoopBack0
    192.168.1.0/24  Direct  0    0           D   192.168.1.1     Vlanif12
    192.168.1.1/32  Direct  0    0           D   127.0.0.1       Vlanif12
```

The mac-address table keep unchanged ?

```
[Huawei]dis mac-address
MAC address table of slot 0:
-------------------------------------------------------------------------------
MAC Address    VLAN/       PEVLAN CEVLAN Port            Type       LSP/LSR-ID
               VSI/SI                                                MAC-Tunnel
-------------------------------------------------------------------------------
5489-9887-0957 12          -      -      GE0/0/2         dynamic    0/-
5489-985d-49c5 12          -      -      GE0/0/1         dynamic    0/-
5489-983c-43ab 34          -      -      GE0/0/3         dynamic    0/-
5489-9827-47c4 34          -      -      GE0/0/4         dynamic    0/-
-------------------------------------------------------------------------------
Total matching items on slot 0 displayed = 4
```

Demo3-4. tests(2)

While vlan virtual interface is configured with an IP address, would routing-table and mac-address table be changed?

Q. initiate “ping” test from PC3 to PC1, would the ARP request reach PC1? would ICMP request reach PC1?

Switch - VLAN: port link-type(1)

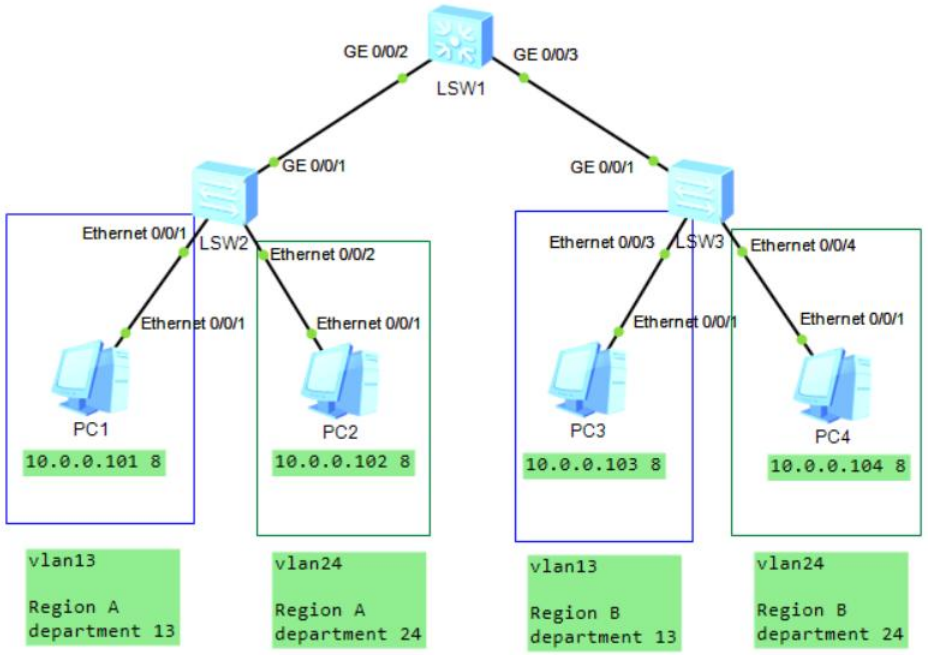
- **Access Link:**
  - A link used to connect **a user host to a switch**. Generally, the host does not need to know which VLAN it belongs to, and the host hardware usually does not recognize the frame with VLAN tag. Therefore, the frames sent and received by the host are untagged frames.

- **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.

Demo 4-1. Build a network topology as shown in the right figure:

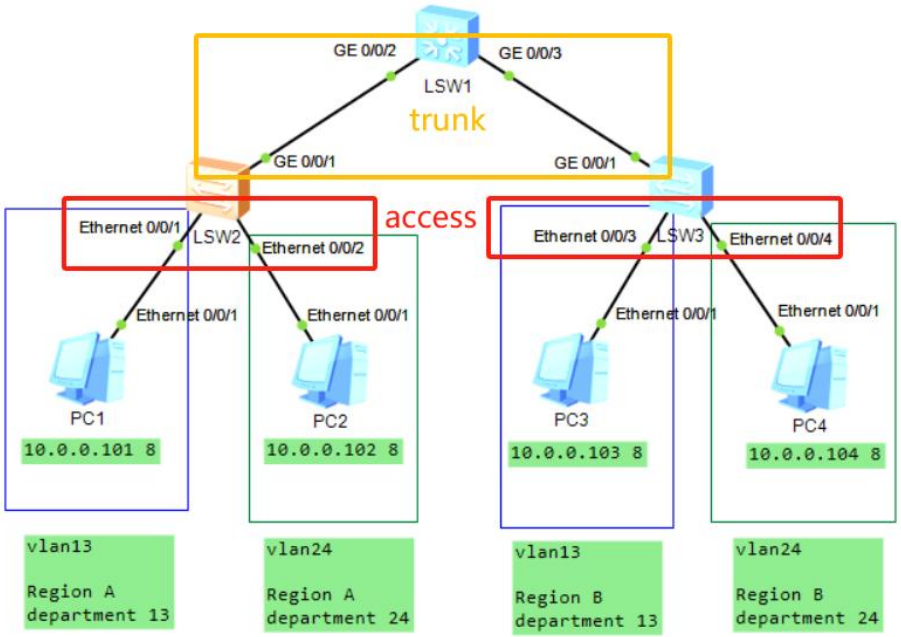
- there are three switches in a local area network, among which LSW1 is the aggregation layer switch, LSW2 and LSW3 are the access layer switches.
- There are two VLANs(vlan13 , vlan24) in the network, corresponding to two different departments.
- **Terminals within department COULD access each other, but departments CANNOT access each other.**
- The PC configuration is shown in the figure.

Complete the configurations on the three switches .



http://grouper.ieee.org/groups/802/1/pages/802.1Q.html

Switch - VLAN: port link-type(2)



Analysis:

1) all the switches need to create the two vlans (vlan 13, vlan24)

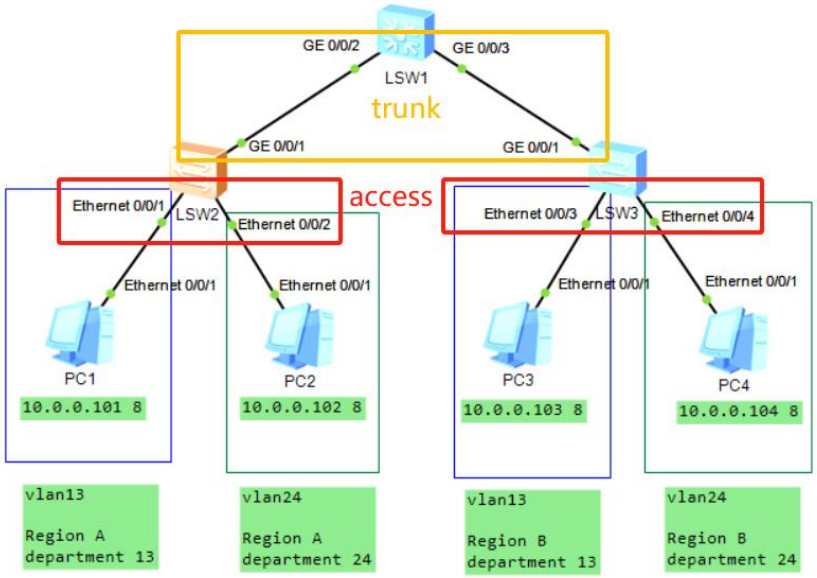
2) the link-type of the interfaces connects to the terminal should be access, and sepecify the default vlan of the interface

3) the link-type of the interconnection between switches should be trunk

4) to make terminal in regin B of vlan 24 be reachable from the terminal in regin A of vlan 24, on trunk link between LSW1 and LSW2, LSW1 and LSW3, vlan 24 should be allowed to pass

5) to make termianl in regin B of vlan 13 be reachable from the terminal in regin A of vlan 13, on trunk link between LSW1 and LSW2, LSW1 and LSW3, vlan 13 should be allowed to pass

Switch - VLAN: port link-type(3)



Configuration:

1) all the switches need to create the two vlans (vlan 13, vlan24)

- command: vlan <vlan-id> (in system view)
- .e.g. **vlan 13**

2) the link-type of the interfaces connects to the terminal should be "access" and sepecify the default vlan of the interface

- command: port link-type access (in interface view)
- .e.g. **port link-type access**
- command: port default vlan <vlan-id>
- .e.g. **port defult vlan 13**

3) the link-type of the interconnection between switches should be "trunk"

- command: port link-type trunk (in interface view)
- .e.g. **port link-type trunk**

4) on trunk link between LSW1 and LSW2, LSW1 and LSW3, vlan 13 and vlan 24 should be allowed to pass

- command: port trunk allow-pass <vlanx-id> <vlany-id>
- .e.g. **port trunk allow-pass vlan 13 vlan24**

LSW1

```
[Huawei-GigabitEthernet0/0/2]dis this
#
interface GigabitEthernet0/0/2
 port link-type trunk
 port trunk allow-pass vlan 13 24
#
return
[Huawei-GigabitEthernet0/0/2]int gi0/0/3
[Huawei-GigabitEthernet0/0/3]dis this
#
interface GigabitEthernet0/0/3
 port link-type trunk
 port trunk allow-pass vlan 13 24
#
return
[Huawei-GigabitEthernet0/0/3]
```

LSW2

```
[Huawei-GigabitEthernet0/0/1]dis this
#
interface GigabitEthernet0/0/1
 port link-type trunk
 port trunk allow-pass vlan 13 24
#
return
[Huawei-GigabitEthernet0/0/1]int eth0/0/1
[Huawei-Ethernet0/0/1]dis this
#
interface Ethernet0/0/1
 port link-type access
 port default vlan 13
#
return
[Huawei-Ethernet0/0/1]int eth 0/0/2
[Huawei-Ethernet0/0/2]dis this
#
interface Ethernet0/0/2
 port link-type access
 port default vlan 24
#
return
[Huawei-Ethernet0/0/2]
```

LSW3

```
[Huawei]int gi0/0/1
[Huawei-GigabitEthernet0/0/1]dis this
#
interface GigabitEthernet0/0/1
 port link-type trunk
 port trunk allow-pass vlan 13 24
#
return
[Huawei-GigabitEthernet0/0/1]int eth0/0/3
[Huawei-Ethernet0/0/3]dis this
#
interface Ethernet0/0/3
 port link-type access
 port default vlan 13
#
return
[Huawei-Ethernet0/0/3]int eth0/0/4
[Huawei-Ethernet0/0/4]dis this
#
interface Ethernet0/0/4
 port link-type access
 port default vlan 24
#
return
[Huawei-Ethernet0/0/4]
```

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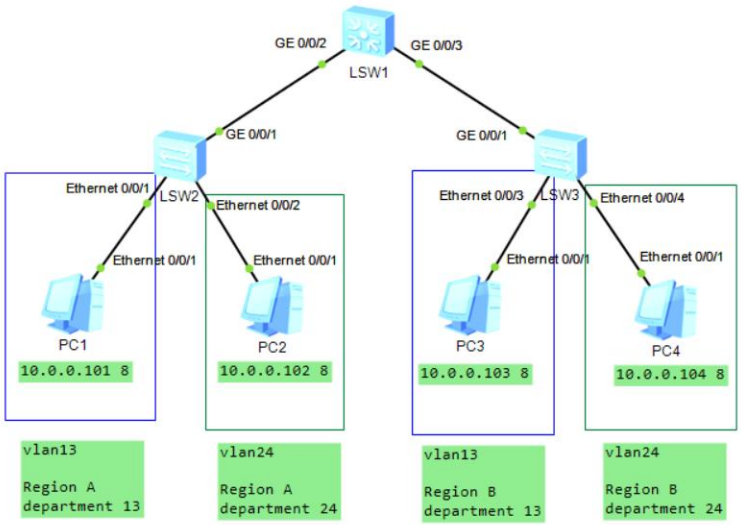
Switch - VLAN: port link-type(4)

Demo 4-2. tests to check if terminals within department COULD access each other, while departments CANNOT access each other.



PC1

Basic Config | Command | MCPacket | UdpPacket | Console

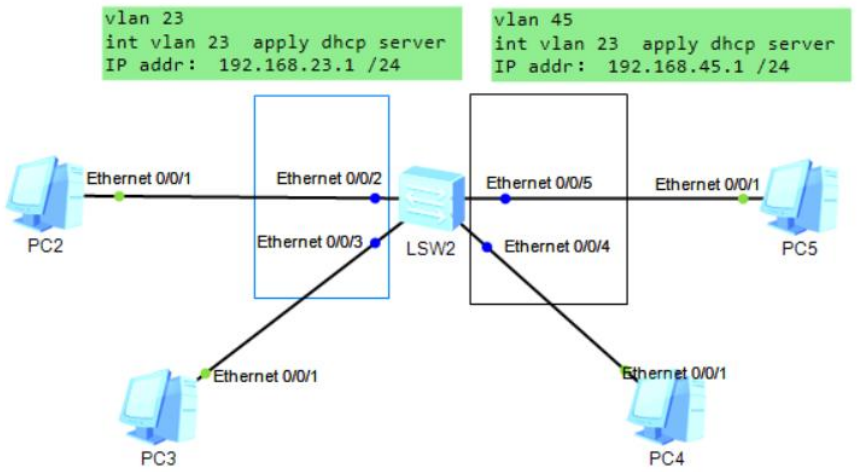
```
PC>ping 10.0.0.103 -c 2

Ping 10.0.0.103: 32 data bytes, Press Ctrl_C to break
From 10.0.0.103: bytes=32 seq=1 ttl=128 time=94 ms
From 10.0.0.103: bytes=32 seq=2 ttl=128 time=93 ms

--- 10.0.0.103 ping statistics ---
  2 packet(s) transmitted
  2 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 93/93/94 ms

PC>ping 10.0.0.102 -c 2

Ping 10.0.0.102: 32 data bytes, Press Ctrl_C to break
From 10.0.0.101: Destination host unreachable
From 10.0.0.101: Destination host unreachable

--- 10.0.0.102 ping statistics ---
  2 packet(s) transmitted
  0 packet(s) received
  100.00% packet loss

PC>ping 10.0.0.104 -c 2

Ping 10.0.0.104: 32 data bytes, Press Ctrl_C to break
From 10.0.0.101: Destination host unreachable
From 10.0.0.101: Destination host unreachable

--- 10.0.0.104 ping statistics ---
  2 packet(s) transmitted
  0 packet(s) received
  100.00% packet loss
```

PC2

Basic Config | Command | MCPacket | UdpPacket | Console

```
PC>ping 10.0.0.104 -c 2

Ping 10.0.0.104: 32 data bytes, Press Ctrl_C to break
From 10.0.0.104: bytes=32 seq=1 ttl=128 time=94 ms
From 10.0.0.104: bytes=32 seq=2 ttl=128 time=78 ms

--- 10.0.0.104 ping statistics ---
  2 packet(s) transmitted
  2 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 78/86/94 ms

PC>ping 10.0.0.103 -c 2

Ping 10.0.0.103: 32 data bytes, Press Ctrl_C to break
From 10.0.0.102: Destination host unreachable
From 10.0.0.102: Destination host unreachable

--- 10.0.0.103 ping statistics ---
  2 packet(s) transmitted
  0 packet(s) received
  100.00% packet loss

PC>ping 10.0.0.101 -c 2

Ping 10.0.0.101: 32 data bytes, Press Ctrl_C to break
From 10.0.0.102: Destination host unreachable
From 10.0.0.102: Destination host unreachable

--- 10.0.0.101 ping statistics ---
  2 packet(s) transmitted
  0 packet(s) received
  100.00% packet loss
```

Practice 13.2



Build a simple network topology with 4PCs and 1 switch.
Do the following configuration:
1) create two vlan (vlan 23, vlan 45) on the switch
2) Create virtual interfaces corresponding to VLANs, configure the vlan interface 23 with IP address(192.168.23.1 /24), set the interface as DHCP server, configure the vlan interface 45 with IP address(192.168.45.1/24), set the interface as DHCP server
3) Both interface Eth0/0/2 and Eth0/0/3 access to vlan23; Both interface Eth0/0/4 and Eth 0/0/5 access to vlan45;
4) set 4 PC as DHCP client.

Do the testing, capture the packets on the interfaces of the switch and answer the following question:

Q1. While initiate “ping” test from PC2 to PC3, would PC5 and PC4 receive the ARP request or ICMP request? why ?
Q2. While initiate “ping” test from PC2 to PC4, would PC3, PC5 or PC4 receive the ARP request? which one(s) would receive it. what’s the value of “destination IP” and “source IP” fields in the ARP request?
Q3. What’s the routing-table on the switch? (the switch here used is a Layer3 switch, which means the virsual interace could be configured with IP address, the layer3 switch could act as a route in special scenario)