

Agenda

● Management

- ▶ Config/Backup/Restore
- ▶ Upgrade Firmware

● VLAN

- ▶ 802.1Q Port based VLAN

● Security

- ▶ ACL

● Port Trunk

- ▶ LACP
- ▶ Static Trunk

● Management Utilities

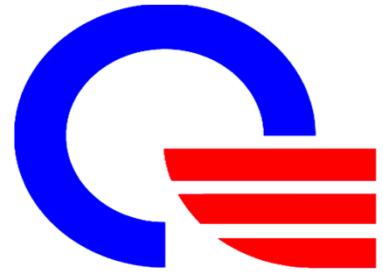
- ▶ Port mirror
- ▶ SNMP trap
- ▶ Syslog

● IGMP snooping

● Spanning Tree

- ▶ RSTP
- ▶ MSTP





Management Overview

Initial Configuration



Configuring the Device

- Terminal software

- Default baud rate

- ✓ 115200,n,8,1

- ✓ No flow control

- Change baud rate

- ✓ Console(config)# line console

- ✓ Console(config-console)#baudrate 9600

- Default username/password

- Username : admin , no password

- Create Username

- ✓ Console(config)#**username name {nopassword | password}**

- System will prompt you to enter the password.

RS232 connector



RJ 45 connector



Configuration mode

- User (exec) mode
 - Prompt : Console>
 - ✓ Console#disable
 - ✓ Only a few show commands available
- Privilege (enable) mode
 - Prompt : Console#
 - ✓ Console>enable
 - ✓ Console#
- Global (config) mode
 - Prompt : Console(config)#
 - ✓ Console#configure
- Interface mode
 - Prompt : Console(if)#
 - ✓ Console(config)#interface *IF_ID*
- Router mode
 - Prompt: Console(config-router)#
 - ✓ Console(config)#router {rip | ospf}

Prompt is >

Prompt is #

Prompt is
(config)#

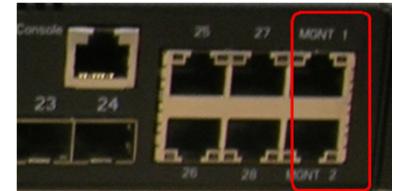
Depend on the
Mode

Shortcut Commands

- When you are in any mode (interface, config), you can use “**exit**” to go back to upper level.
 - Example :
 - ✓ (Quanta)(Config)#exit
 - ✓ (Quanta)#+
- Press “**CTRL + Z**” will directly go to enable mode, no matter where are you.
- You don’t need to key in the whole command, for ex: you don’t need to key in the whole “Configure”, type “**config**” is enough for software to distinguish the commands.
 - Example:
 - ✓ (Quanta)#config ← Don’t need to key in the whole “configure”
 - ✓ (Quanta)(Config)#+
 - Or you can press “**tab**” or **space** key, CLI will complete the most similar command automatically.
- Use “**no**“ form command can remove/disable the feature.
 - Example:
 - ✓ (Quanta)(if-vlan 1)#**no** ip address 192.168.1.254 255.255.255.0

Configuring the IP address

- 2 management IP addresses available for device management.
 - One is management VLAN interface.
 - The other is Serviceport
 - Default management IP address is 192.168.2.1/24. There is no default IP addresses configured for serviceports.
- Configure the management VLAN IP address (for Inband)
 - (Quanta)#config
 - (Quanta)(config)#interface vlan 1
 - (Quanta)(if-vlan 1)#ip address 192.168.1.253 255.255.255.0
 - (Quanta)(Config)#ip default-gateway 192.168.1.254
- Configure serviceport (for Outband)
 - (Quanta)#Config
 - (Quanta)(Config)# serviceport proto none
 - (Quanta)(Config)#serviceport ip 192.168.1.253 255.255.255.0 192.168.1.254
 - Serviceport is only used for management purpose. Switch will not route user traffic between MGMT port and front port.

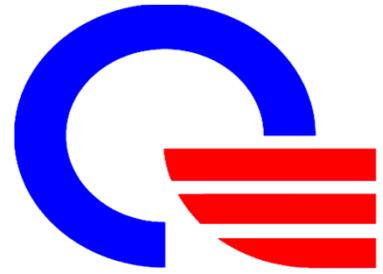


Serviceport/MGMT
IP address

Default
GW

MGMT VLAN vs Serviceport

- MGMT VLAN
 - Inband management
 - Performance is worse than serviceport
- Serviceport
 - Outband management
 - Performance is better than MGMT VLAN
- You don't need to setup both serviceport and mgmt vlan ip address. One of them is enough.
- If you need to setup both serviceport and mgmt VLAN, please remember:
 - The ip addresses should be in different network.
 - The whole system supports only one default gw, you should only specify one default on mgmt VLAN or serviceport.



Management Overview

File management



File management

- Running configuration

- The commands entering in global/interface/router are running in the RAM
- To display the running configuration , use “Console# **show running**”

```
(Quanta) #show run
!
! Current Configuration:
!
configure
!System Description "Quanta"
!System Software Version "0.1"
!
vlan database
vlan 1002
vlan name 1002 fddi-default
vlan 1003
vlan name 1003 token-ring-default
vlan 1004
vlan name 1004 fddinet-default
vlan 1005
vlan name 1005 trnet-default
exit

interface vlan 1
!
ip address 192.168.2.1 255.255.255.0
```



Use “**do show run**” in any other mode to show the running config

Save Configuration

Running configuration will be lost if power is down!

Remember to save the configuration file !

```
(Quanta) #copy running-config startup-config
Configuration Saved!
(Quanta) #dir
date          file name    file type startup size (byte)
-----
2009/04/21    LB4G-b-0.4.0420.bin Boot-Rom image   Y  1084948
2009/11/30    factory_default Config File      N   24730
2010/01/26    LB4G-r-0.41.1130.biz Operation Code N  8645621
2000/01/07    default.cfg  Config File      Y  25646
2000/01/01    16MP5Noop.lbg Config File      N   25163
2010/02/10    LB4G_Blinger Operation Code   Y  8646331
-----
Total: 6 files.
```

By default the saved file is called **default.cfg**

You can specify the filename while you save configuration.

copy run start *YOUR_FILE_NAME*

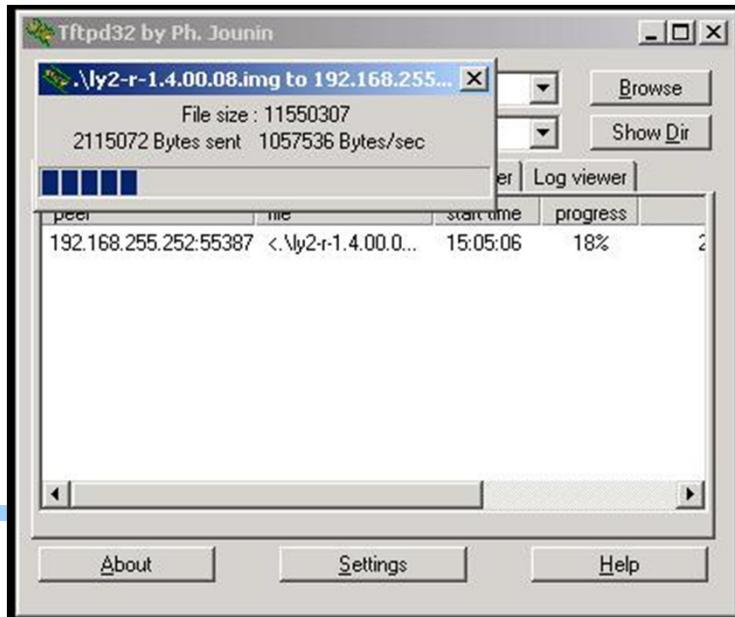
You can use “**dir**” command to list how many files in the flash and use “**delete**” command to delete the file”.

Backup Configuration file to TFTP Server

You can backup your configuration to remote TFTP server too!

```
(LB9A_LAB) #copy startup-config tftp://192.168.255.33/config.cfg default.cfg
Mode.....: TFTP
Set Server IP.....: 192.168.255.33
Path.....: /
Filename...: config.cfg
Data Type...: Config

Management access will be blocked for the duration of the transfer
Are you sure you want to start? (y/n) y
TFTP Text Configuration transfer starting
```



Restore Configuration file

And restore your configuration file from remote **TFTP** server.

```
(Quanta) #copy tftp://192.168.255.33/config.cfg startup-config default.cfg
```

```
Mode..... TFTP  
Set TFTP Server IP..... 192.168.255.33  
TFTP Path..... /  
TFTP Filename..... config.cfg  
Data Type..... Config
```

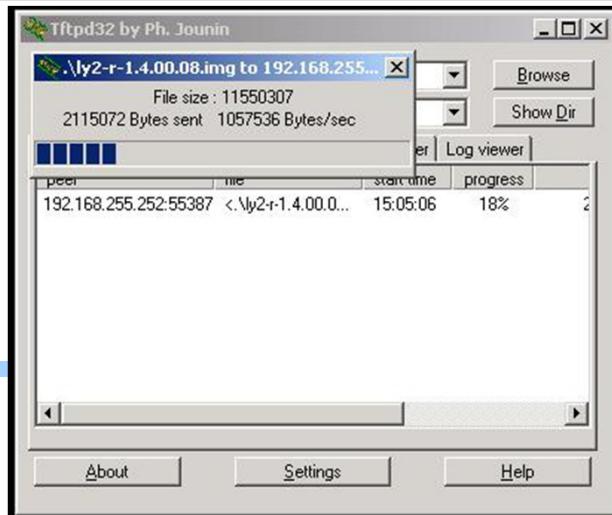
Management access will be blocked for the duration of the transfer

File is already exist. Are you sure you want to start and overwrite? (y/n) y

Verifying CRC of file in Flash File System

TFTP receive complete... storing in Flash File System...

File transfer operation completed successfully.



Set Configuration file as Boot-up Config

You can have several configuration file for different purposes at the same time.
Use ***boot-system config*** command to specify the **next start-up** config file.

| date | file name | file type | startup | size (byte) |
|------------|----------------------|----------------|---------|-------------|
| 2009/04/21 | LB4G-b-0.4.0420.bin | Boot-Rom image | Y | 1084948 |
| 2009/11/30 | factory_default | Config File | Y | 24730 |
| 2010/01/26 | LB4G-r-0.41.1130.biz | Operation Code | N | 8645621 |
| 2000/01/07 | default.cfg | Config File | N | 25646 |
| 2000/01/01 | IGMP Snooping | Config File | N | 25163 |
| 2010/02/10 | LB4G_Blinger | Operation Code | Y | 8646331 |

Total: 6 files.

```
(Quanta) #boot-system config default.cfg
```

```
Start Up Success!
```

```
(Quanta) #dir
```

| date | file name | file type | startup | size (byte) |
|------------|----------------------|----------------|---------|-------------|
| 2009/04/21 | LB4G-b-0.4.0420.bin | Boot-Rom image | Y | 1084948 |
| 2009/11/30 | factory_default | Config File | N | 24730 |
| 2010/01/26 | LB4G-r-0.41.1130.biz | Operation Code | N | 8645621 |
| 2000/01/07 | default.cfg | Config File | Y | 25646 |
| 2000/01/01 | IGMP Snooping | Config File | N | 25163 |
| 2010/02/10 | LB4G_Blinger | Operation Code | Y | 8646331 |

Remember to **reload** the system to use the new configuration file!

```
(Quanta) #reload
```

```
System will now restart!
```

Reset to Factory Default Configuration

- If you want to reset the whole system to the default configuration
 - Method 1:
 - ✓ **Use “clear config” command**
 - Only clear current configuration. Not really come back to factory default but you can use this method for most of the time!
 - Method 2:
 - ✓ Boot-system config factory_default
 - ✓ Reload
 - This method will completely reset the system to the factory default configuration.
- The default configuration file is called “factory_default”,
 - It's a read only file.
 - You can't delete it.
 - New linux image does not have this factory default file. You only can use clear config to restore the system to the default.

Show tech-support

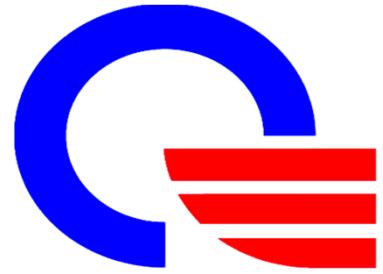
- This command is only available from the console/serial port.
 - Command
 - ✓ Show tech-support
- Providing useful information such as: Version, logging, counter, current configuration, memory usage ...
- When customer requests support, engineer should ask customer providing this information back to Quanta.

```
(Quanta) #show tech-support

----- show calendar -----

Current Time : TUE FEB 22 22:28:51 2005

----- show version -----
Serial number      : QTFCA602000001
Hardware Version   : 1.0
Number of ports     : 52
Label Revision Number : 123456789
Part Number        : ILB9BZ70ST0
```



Management Overview

Firmware Upgrade



Check Firmware Version

```
(LB9A_LAB) #show ver
Serial number          : 123456789
Hardware Version       : 1.0
Number of ports         : 52
Label Revision Number  : 1
Part Number             : DB Fixture
Machine Model           : DB Fixture
Loader version          : 1.0
Operation code version  : 1.24
Boot rom version        : 1.0
```

Delete Existing Firmware

```
(Quanta) #dir
```

| date | file name | file type | startup | size (byte) |
|------------|----------------------|----------------|---------|-------------|
| 2009/04/21 | LB4G-b-0.4.0420.bin | Boot-Rom image | Y | 1084948 |
| 2009/11/30 | factory_default | Config File | N | 24730 |
| 2010/01/26 | LB4G-r-0.41.1130.biz | Operation Code | N | 8645621 |
| 2000/01/07 | default.cfg | Config File | Y | 25646 |
| 2000/01/01 | IGMP Snooping | Config File | N | 25163 |
| 2010/02/10 | LB4G_Blinger | Operation Code | Y | 8646331 |

```
Total: 6 files.
```



```
(Quanta) #delete LB4G-r-0.41.1130.biz
Are you sure you want to delete? (y/n) y
Image File "LB4G-r-0.41.1130.biz" Deleted!
```

Quanta switch supports 2 operation codes. Before you upgrade the firmware, make sure only one Operation code exists in the flash.

If already has 2 operation codes, delete one operation code first.

Upgrade Firmware via TFTP

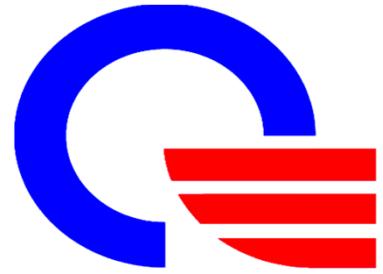
```
(Quanta) #copy tftp://192.168.255.33/LB4G-r-0.42.0316.img image LB4G-r-0.42.0316  
Mode..... TFTP  
Set TFTP Server IP..... 192.168.255.33  
TFTP Path..... /  
TFTP Filename..... LB4G-r-0.42.0316.img  
Data Type..... Code  
Destination Filename..... LB4G-r-0.42.0316.img  
  
Management access will be blocked for the duration of the transfer  
Are you sure you want to start? (y/n) y  
  
TFTP code transfer starting  
  
Verifying CRC of file in Flash File System  
  
TFTP receive complete... storing in Flash File System...  
  
File transfer operation completed successfully.
```

After download the image, remember to specify the new image as the next boot image.

```
(Quanta) #boot-system opcode LB4G-r-0.42.0316.img  
  
Start Up Success!
```

Remember to **reload** the system to use the new image!

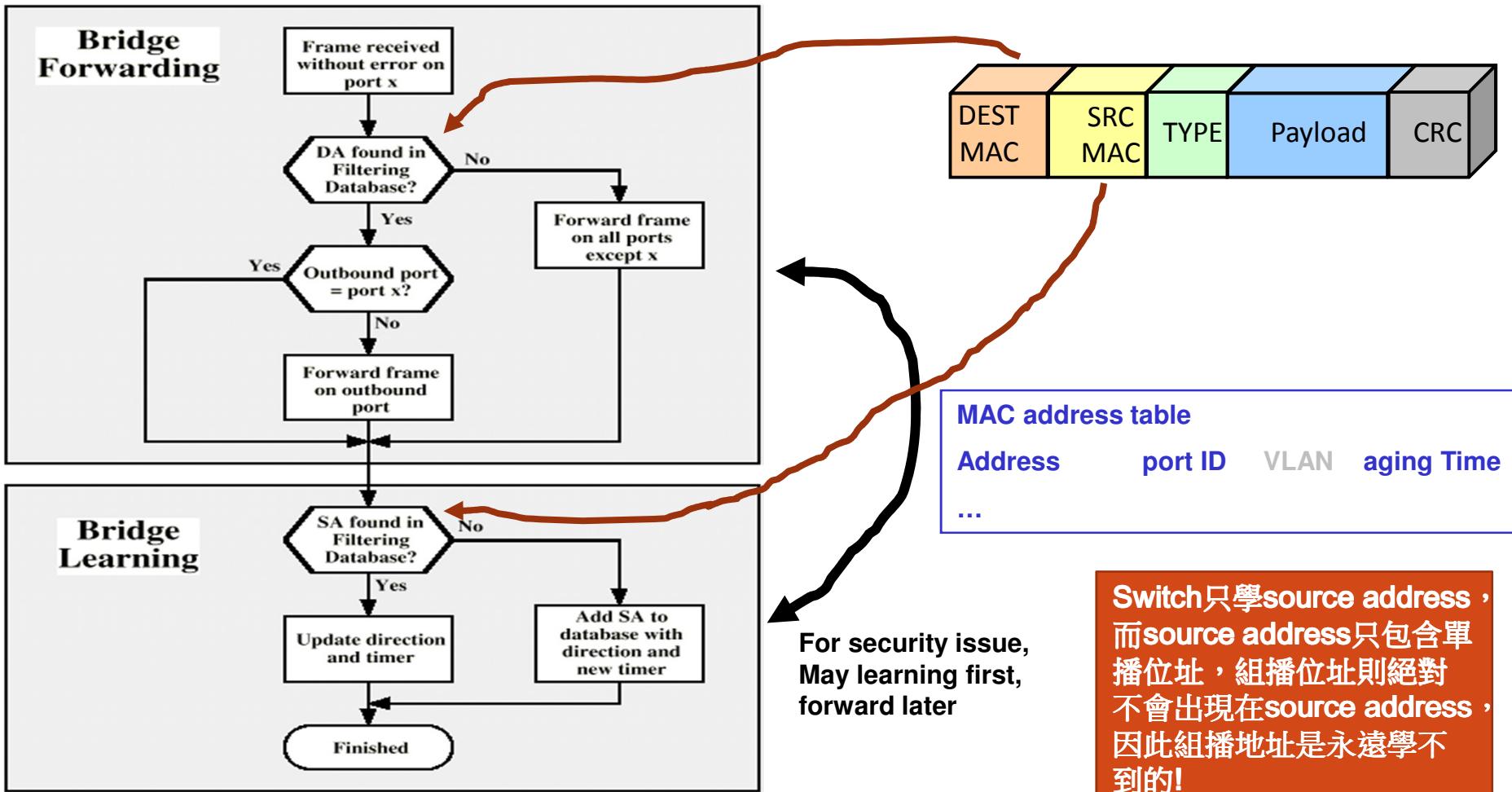
```
(Quanta) #reload  
  
System will now restart!
```



Switch Operation Overview



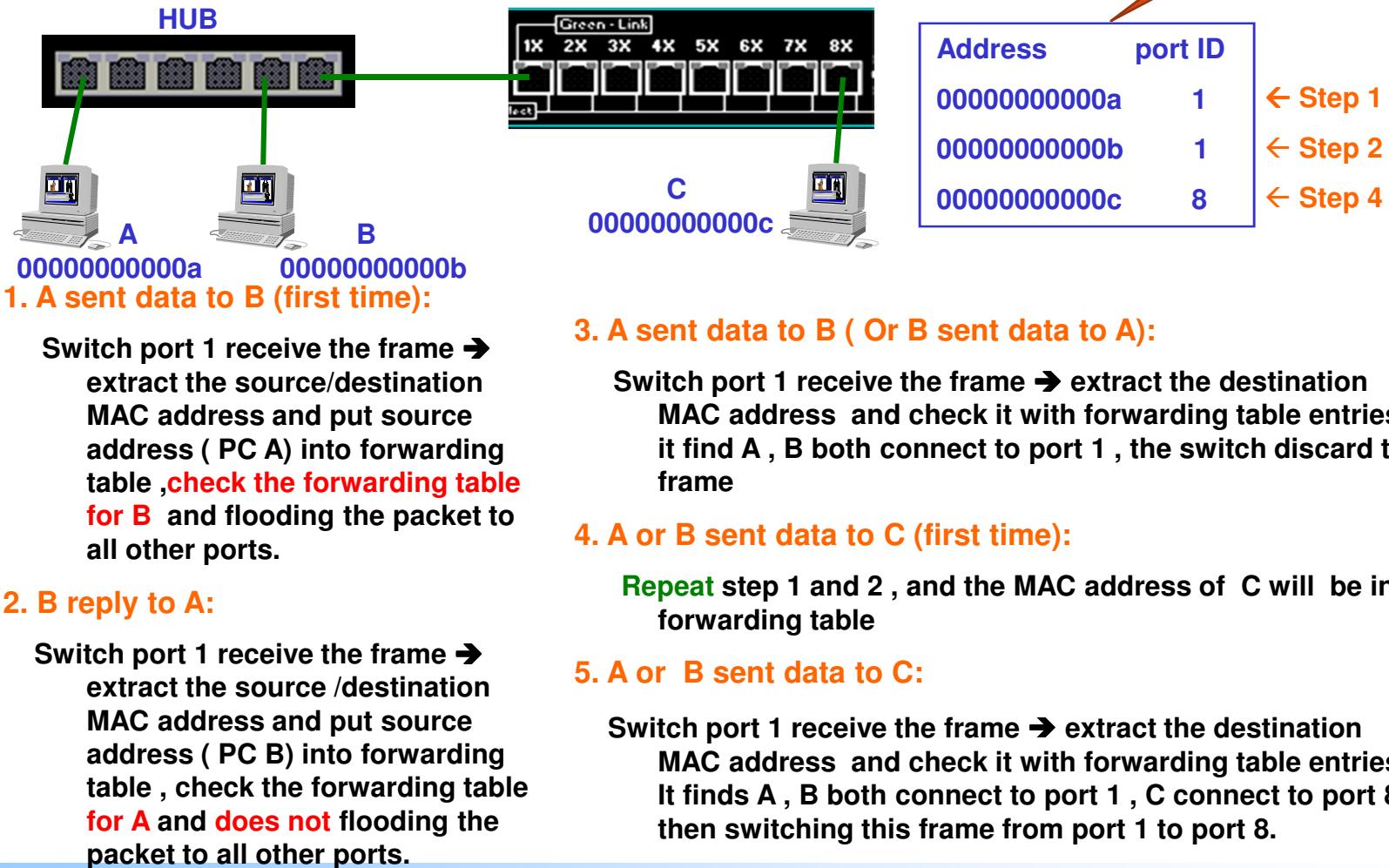
Bridge Operation

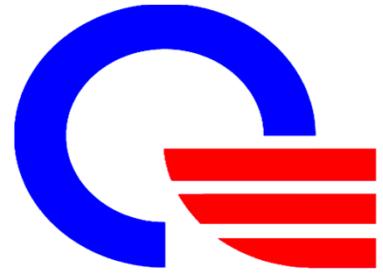


Source: Stallings: Local & metropolitan area Networks

L2 Training - 21

Switch/bridge Operation



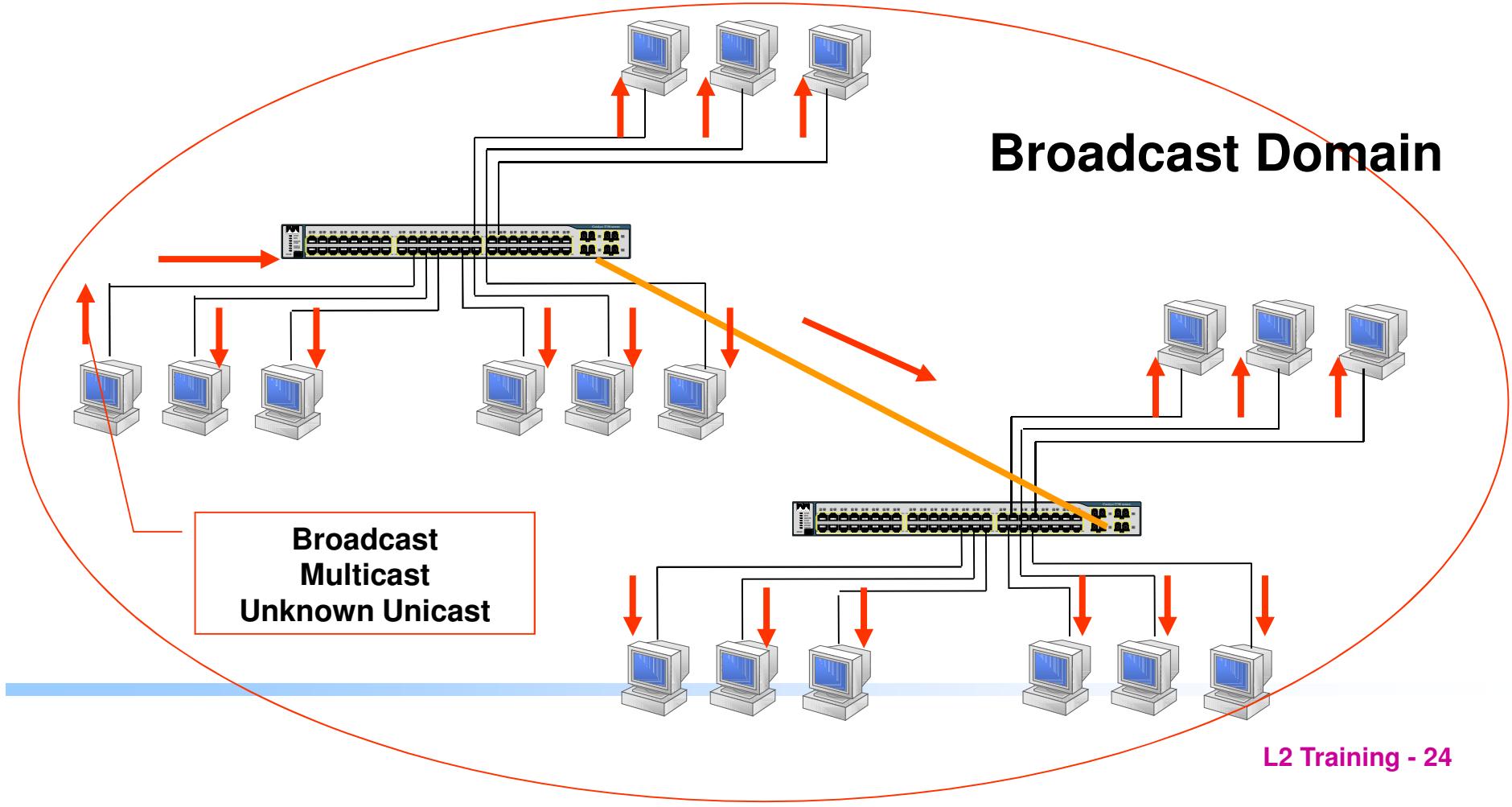


Introduction of VLAN



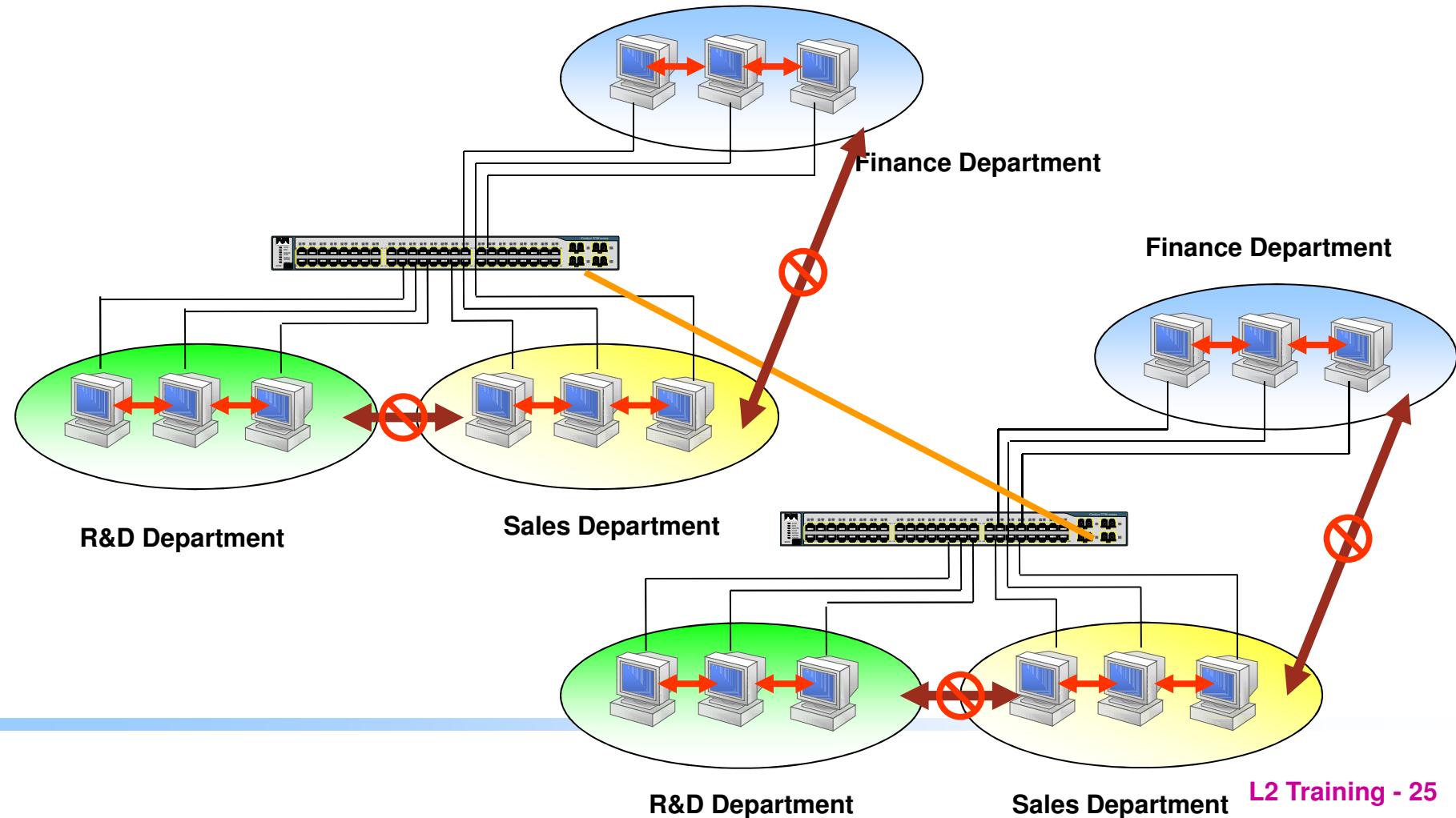
Broadcast Domain

- Broadcasts, Multicast & Unknown unicast flood to every switch port, they consume bandwidth
- When the number of the end devices increases, the broadcast storm tend to occur and reduce the network performance



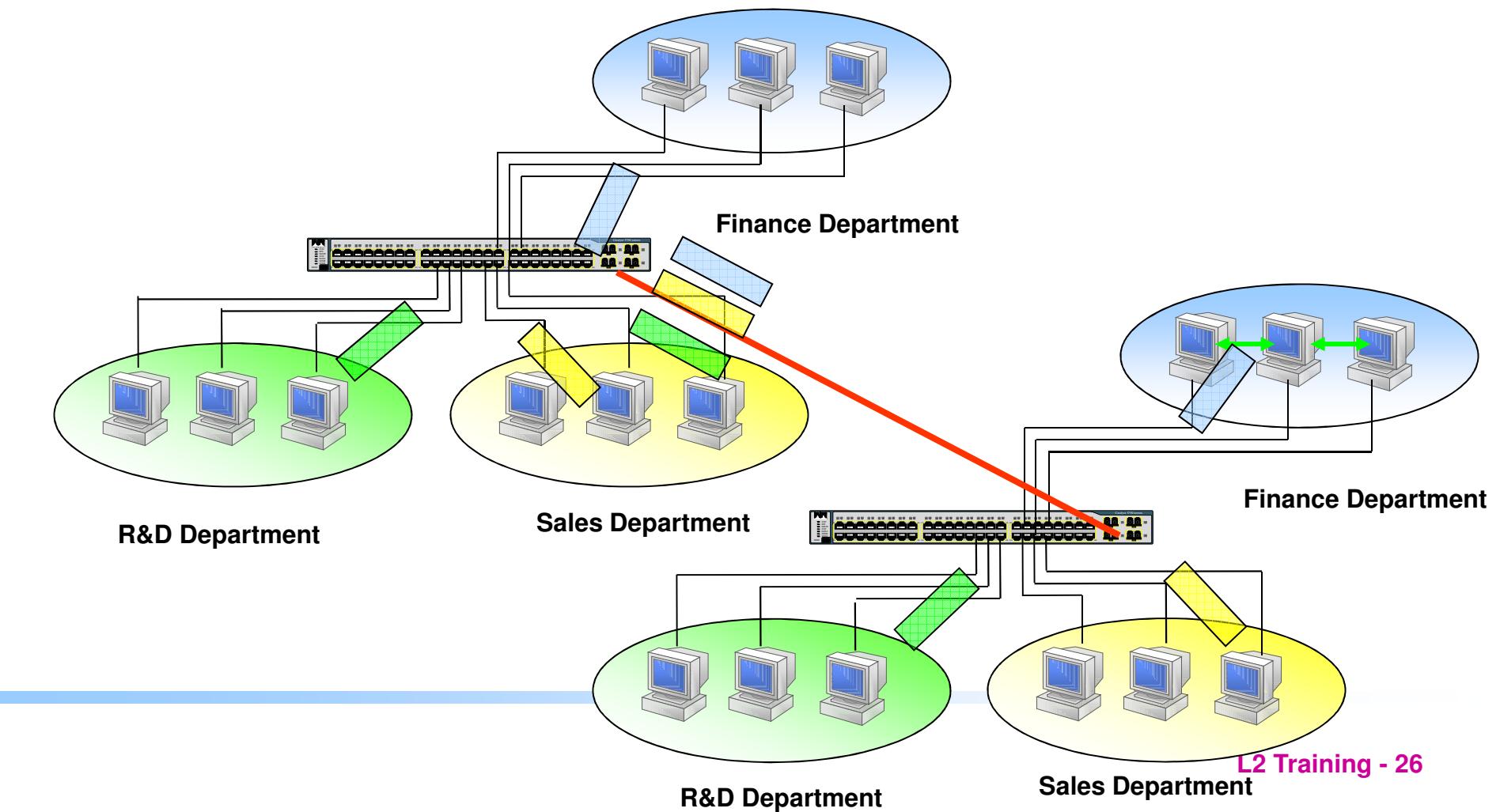
Virtual LAN

- VLAN segments broadcast domain, reduce broadcast traffic
- VLAN provides LAN security



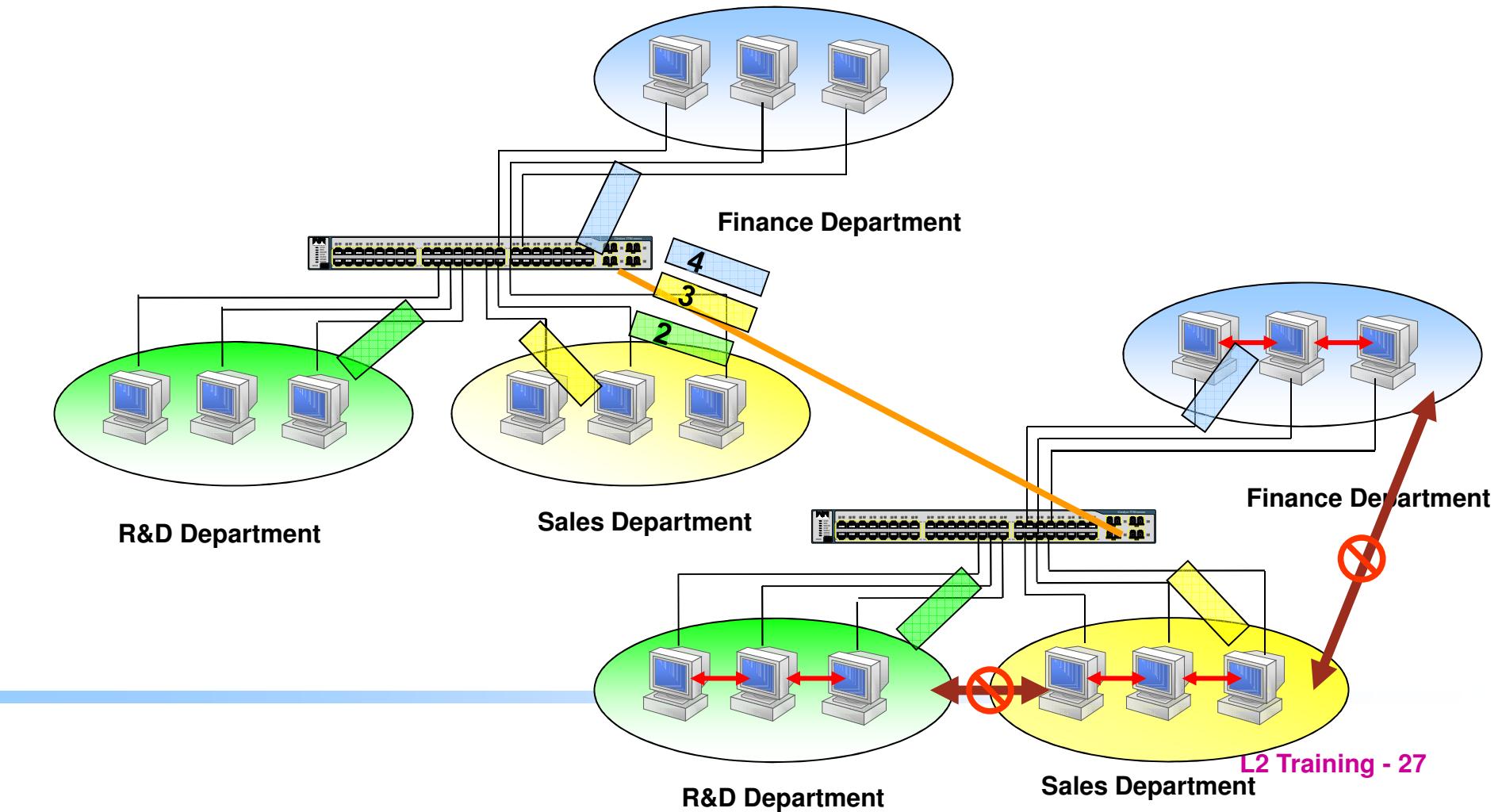
Inter-switch VLAN

- For users located in different switches but same VLAN to communicate, the switch must know how to determine the VLAN for received packets.

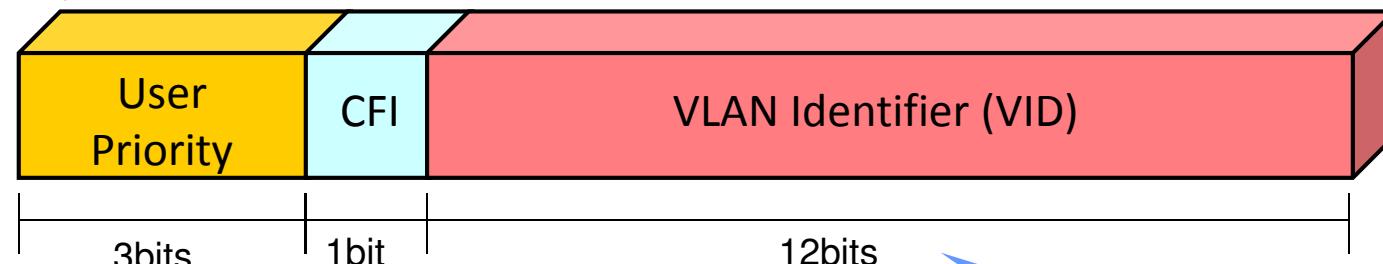
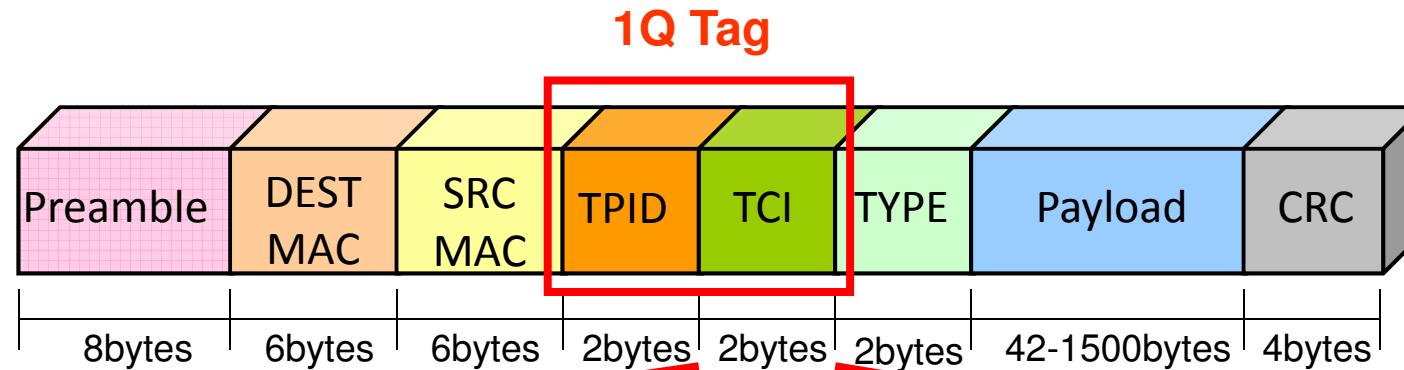


802.1Q VLAN tagging

- By adding a tag in the packet, switch can differentiate which VLAN the packet belong to, so only one link is needed for inter-switch VLAN communication



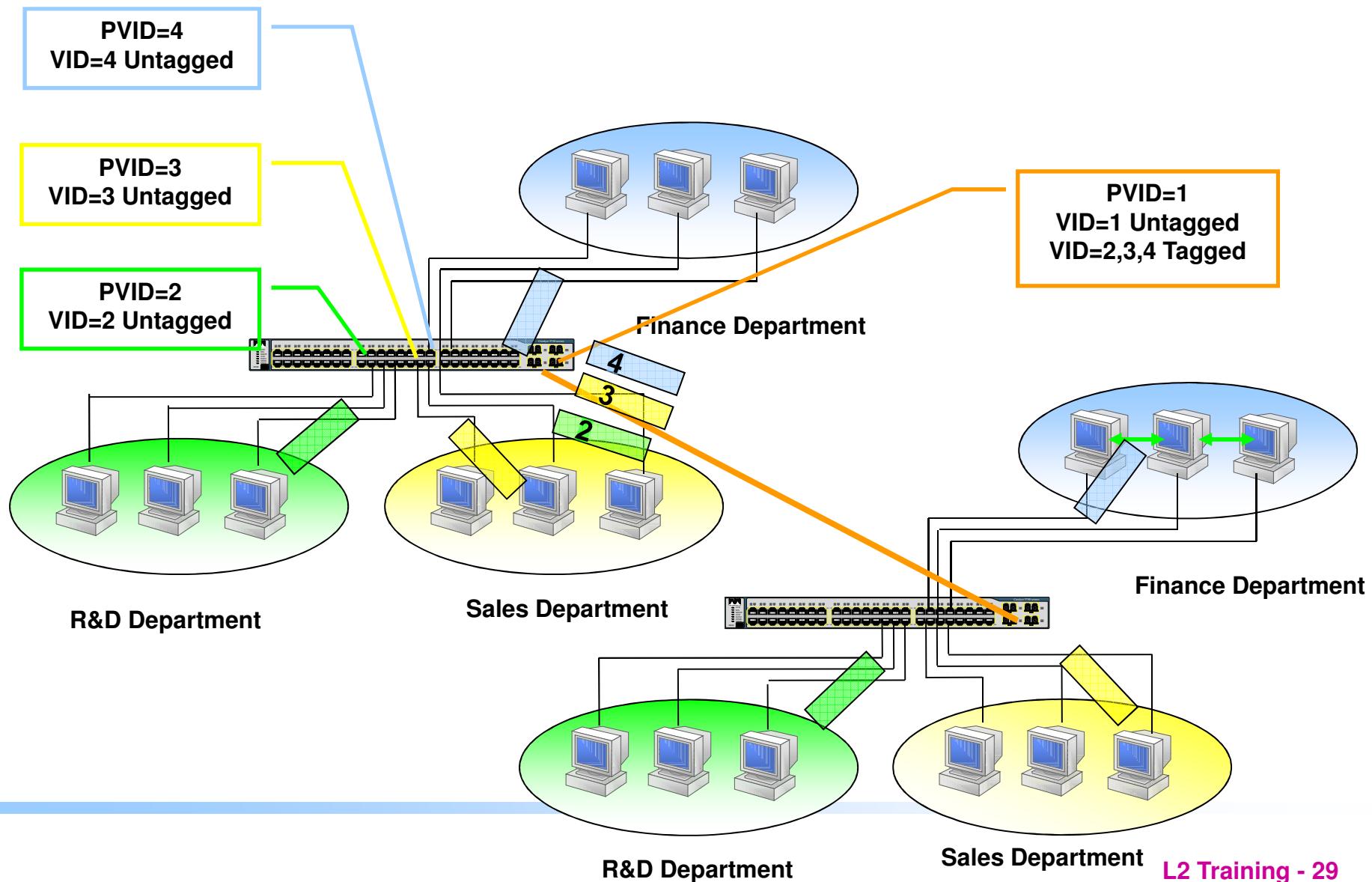
802.1Q Tagged Packet Format



**802.1p Priority ID
3 bits
 $2^3 = 8$ (0 to 7)**

**12 bits VID
 $2^{12} = 4096$ (0 to 4095)**

VLAN Trunk Configuration



Default VLAN

- By Default all ports join to untagged Default VLAN 1.

```
(Quanta) #show vlan
```

| VLAN ID | VLAN Name | VLAN Type | Interface(s) |
|---------|-----------|-----------|---|
| 1 | Default | Default | 0/1, 0/2, 0/3, 0/4, 0/5, 0/6, 0/7, 0/8, 0/9, 0/10, 0/11, 0/12, 0/13, 0/14, 0/15, 0/16, 0/17, 0/18, 0/19, 0/20, 0/21, 0/22, 0/23, 0/24, 0/25, 0/26, 0/27, 0/28, 0/29, 0/30, 0/31, 0/32, 0/33, 0/34, 0/35, 0/36, 0/37, 0/38, 0/39, 0/40, 0/41, 0/42, 0/43, 0/44, 0/45, 0/46, 0/47, 0/48, 0/49, 0/50, 0/51, 0/52 |

Create VLAN

```
(LB9A_LAB) (Config)#vlan database  
(LB9A_LAB) (Vlan)#vlan 2  
(LB9A_LAB) (Vlan)#vlan name 2 RD_VLAN  
(LB9A_LAB) (Vlan)#vlan 3  
(LB9A_LAB) (Vlan)#vlan name 3 SALES_VLAN  
(LB9A_LAB) (Vlan)#exit
```

- VID is between 1 ~ 3965. 3966 ~ 4094 is reserved for internal usage.

```
(LB9A_LAB) (Vlan)#no vlan 2  
(LB9A_LAB) (Vlan)#no vlan 3  
(LB9A_LAB) (Vlan)#exit
```

- Use no VLAN to remove the VLAN.

Add port to VLAN

```
{Right_LB4G} (Config)#interface range 0/1 - 0/6  
{Right_LB4G} (if-range)#switchport allowed vlan add untagged 2
```

```
(Right_LB4G) #show vlan
```

| VLAN ID | VLAN Name | VLAN Type | Interface(s) |
|---------|-----------|-----------|--|
| 1 | Default | Default | 0/1, 0/2, 0/3, 0/4, 0/5, 0/6, 0/7, 0/8, 0/9, 0/10, 0/11, 0/12, 0/13, 0/14, 0/15, 0/16, 0/17, 0/18, 0/19, 0/20, 0/21, 0/22, 0/23, 0/24, 0/27, 0/28, 0/29, 0/30, 0/31, 0/32, 0/33, 0/34, 0/35, 0/36, 0/37, 0/38, 0/39, 0/40, 0/41, 0/42, 0/43, 0/44, 0/45, 0/46, 0/47, 0/48, 0/49, 0/50, 0/51, 0/52 |
| 2 | RD | Static | 0/1, 0/2, 0/3, 0/4, 0/5, 0/6 |

- Quanta supports multiple untagged VLAN on one port.

Native VLAN

- A switch port can join to many VLANs at the same time
 - For ex: Tagged VLAN 2 and 3 , and untagged VLAN 4, and 5.
- How does switch determine which received packet is belonging to which VLAN ?
 - Use carried VLAN ID first, if the packets does not carry VLAN ID. Use the native VLAN as the VLAN of received packet!

If there is multiple untagged VLANs, You must select one of the untagged VLAN as the native VLAN (default PVID)!!!

```
(Right_LB4G) (Config)#interface range 0/1 - 0/6
(Right_LB4G) (if-range)#switchport allowed vlan add untagged 2
(Right_LB4G) (if-range)#switchport native vlan 2
```

```
(Right_LB4G) #show interface switchport 0/1
      Port   Acceptable   Ingress   Default
Interface VLAN ID Frame Types Filtering GVRP Priority
----- -----
  0/1        2          Admit All    Disable   Disable     0
```

Remove VLAN from a Port

```
(Right_LB4G) (Config)#interface range 0/1 - 0/6
(Right_LB4G) {if-range}#switchport allowed vlan remove 1
(Right_LB4G) {if-range}#
(Right_LB4G) {if-range}#exit
(Right_LB4G) (Config)#exit
(Right_LB4G) #show vlan
```

| VLAN ID | VLAN Name | VLAN Type | Interface(s) |
|---------|-----------|-----------|---|
| 1 | Default | Default | 0/7, 0/8, 0/9, 0/10, 0/11, 0/12, 0/13, 0/14, 0/15, 0/16, 0/17, 0/18, 0/19, 0/20, 0/21, 0/22, 0/23, 0/24, 0/27, 0/28, 0/29, 0/30, 0/31, 0/32, 0/33, 0/34, 0/35, 0/36, 0/37, 0/38, 0/39, 0/40, 0/41, 0/42, 0/43, 0/44, 0/45, 0/46, 0/47, 0/48, 0/49, 0/50, 0/51, 0/52 |

Configure VLAN Trunk

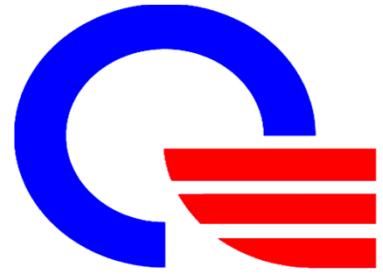
```
(Quanta) #configure  
(Quanta) (Config)#interface 0/48  
(Quanta) (Interface 0/48)#switchport allowed vlan add tagged 2  
(Quanta) (Interface 0/48)#switchport allowed vlan add tagged 3  
(Quanta) (Interface 0/48)#switchport allowed vlan add tagged 4
```

Or use the following command to join port to the tagged VLAN.

```
(LB9A_LAB) (Config)#interface 0/51  
(LB9A_LAB) (Interface 0/51)#switchport allowed vlan add 2  
(LB9A_LAB) (Interface 0/51)#switchport allowed vlan add 3  
(LB9A_LAB) (Interface 0/51)#switchport allowed vlan add 4  
(LB9A_LAB) (Interface 0/51)#switchport tagging 2  
(LB9A_LAB) (Interface 0/51)#switchport tagging 3  
(LB9A_LAB) (Interface 0/51)#switchport tagging 4  
(LB9A_LAB) (Interface 0/51)#[
```

Add to be untagged member

Then change to tagged member



Introduction of Security

Access Control List



Access Control List

● The Benefits of ACL

- ▶ Firewall from the edge
- ▶ Prevent unauthorized device from access the network
- ▶ Restrict access to network resources
- ▶ Prevent virus or hacker attack
- ▶ Isolated traffic between sub-network
- ▶ Offload the burden of firewall
- ▶ Filtered unwanted packets from the edge which cannot be controlled by firewall

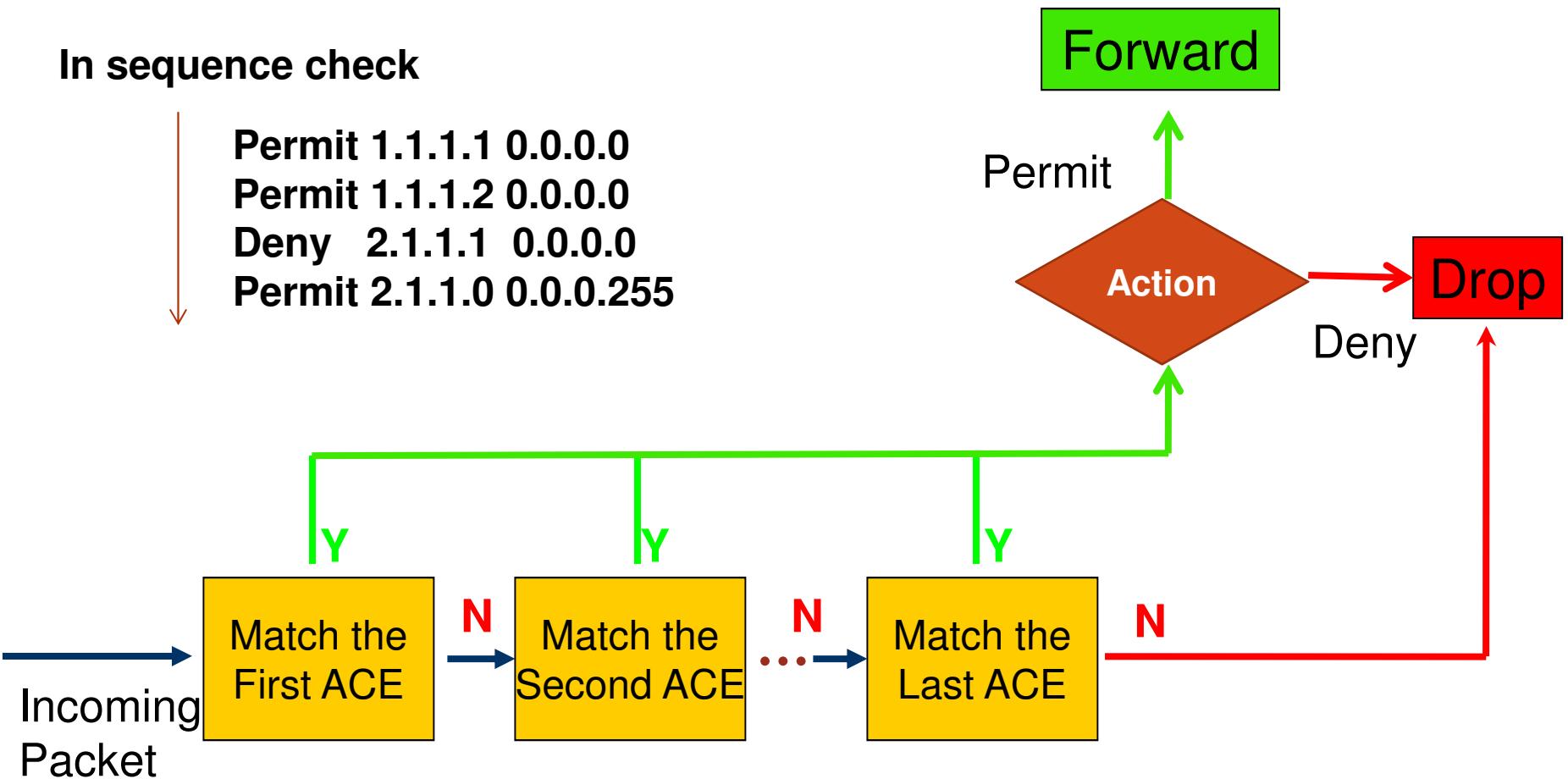
● 3 Types of ACL

- ▶ MAC Extended Access Control List
- ▶ IP Standard Access Control List
- ▶ IP extended Access Control List

ACL Definition

- Contains a list of ACE
 - ▶ Each ACE specifies permit or deny action and a set of conditions the packet must satisfy in order to match the ACE
 - ▶ Syntax of ACE can be extended
- Example of ACE
 - ▶ L3 ACE “permit 10.1.1.1 0.0.0.0“
 - ▶ L2 ACE “deny 00:07:e9:01:02:01 00:00:00:00:00:00 any “

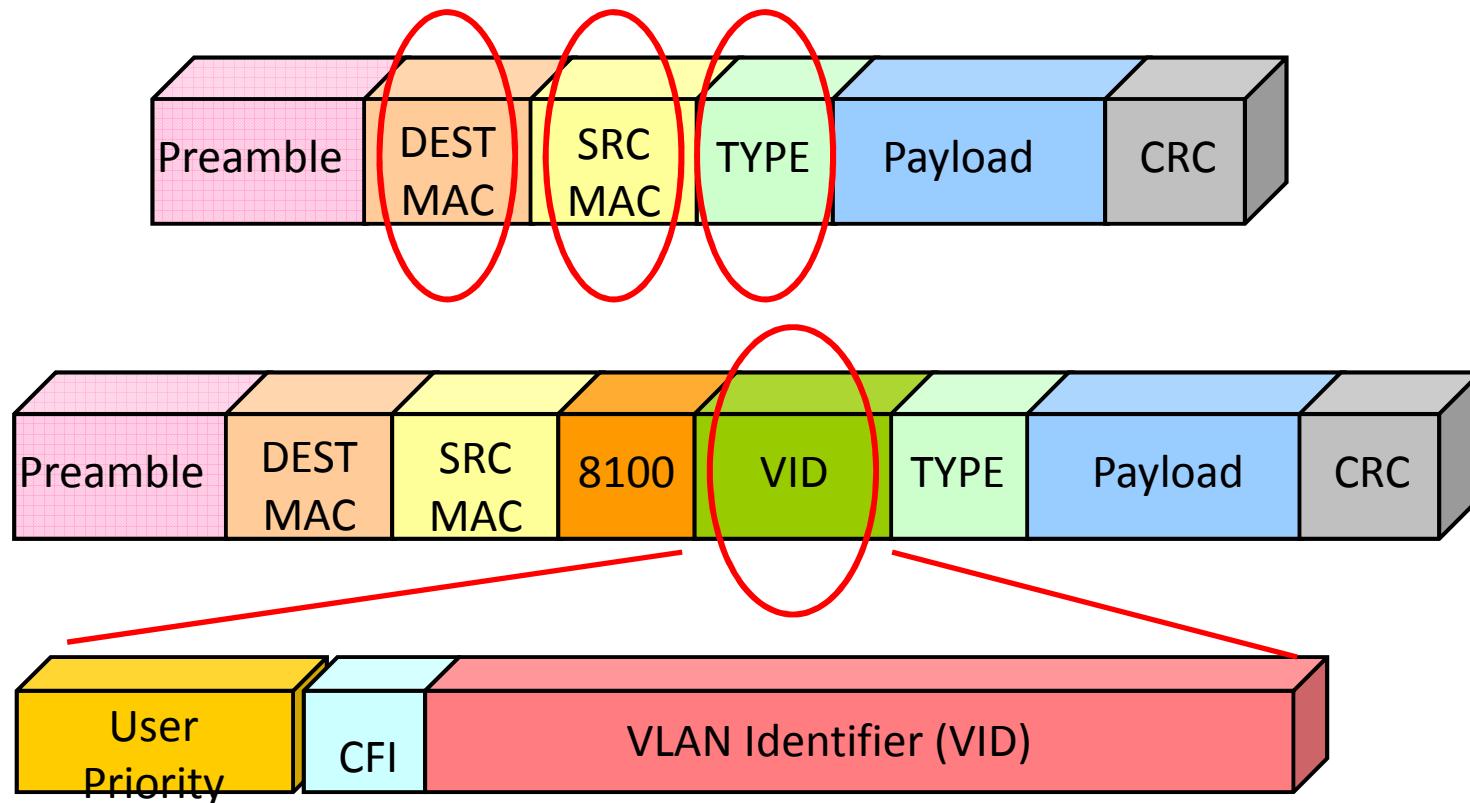
ACL Flow



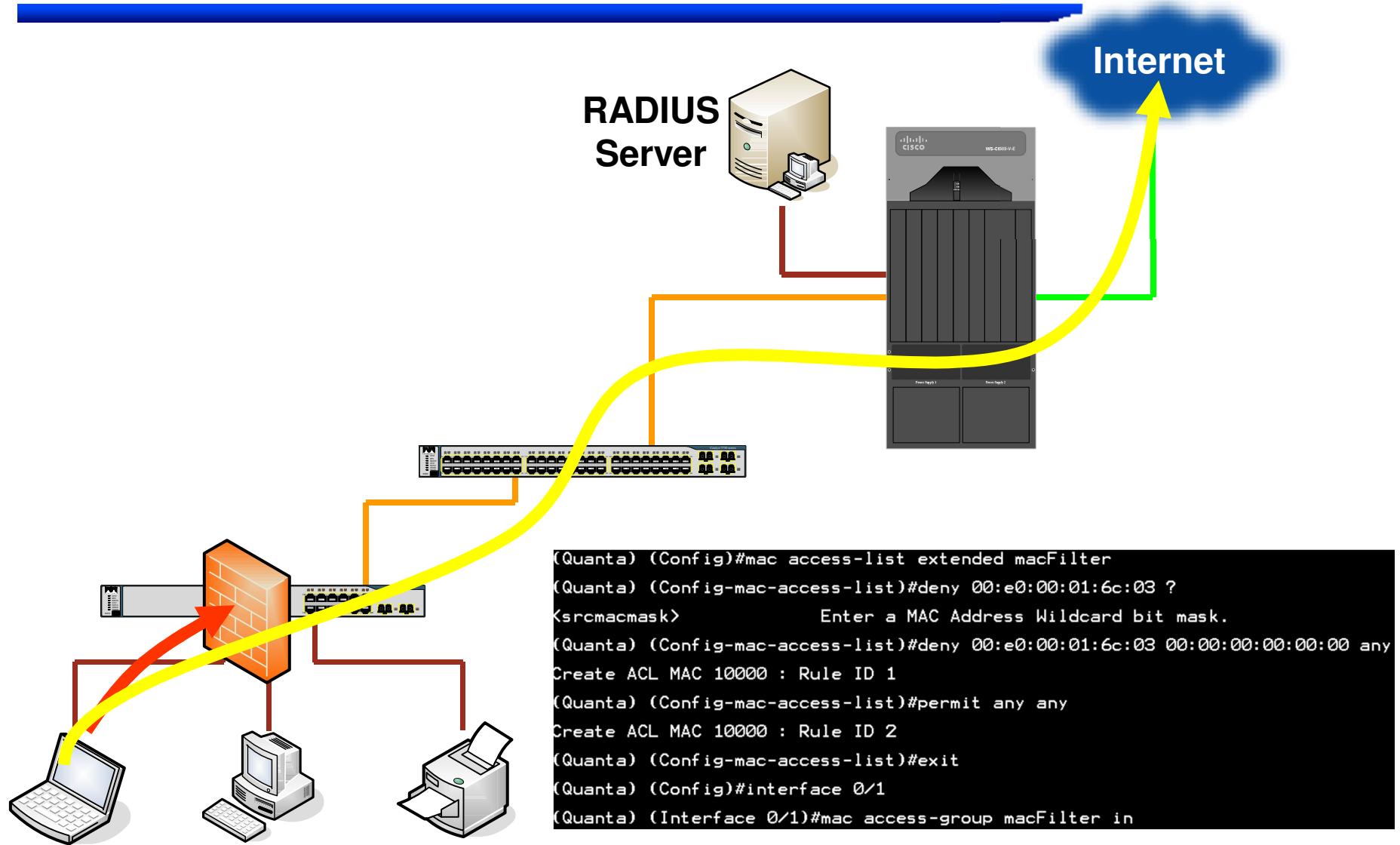
MAC ACL

- MAC Access Control List

- Source/ Destination MAC and bitmask
- User Priority/ Vid/ Ether-type and bitmask



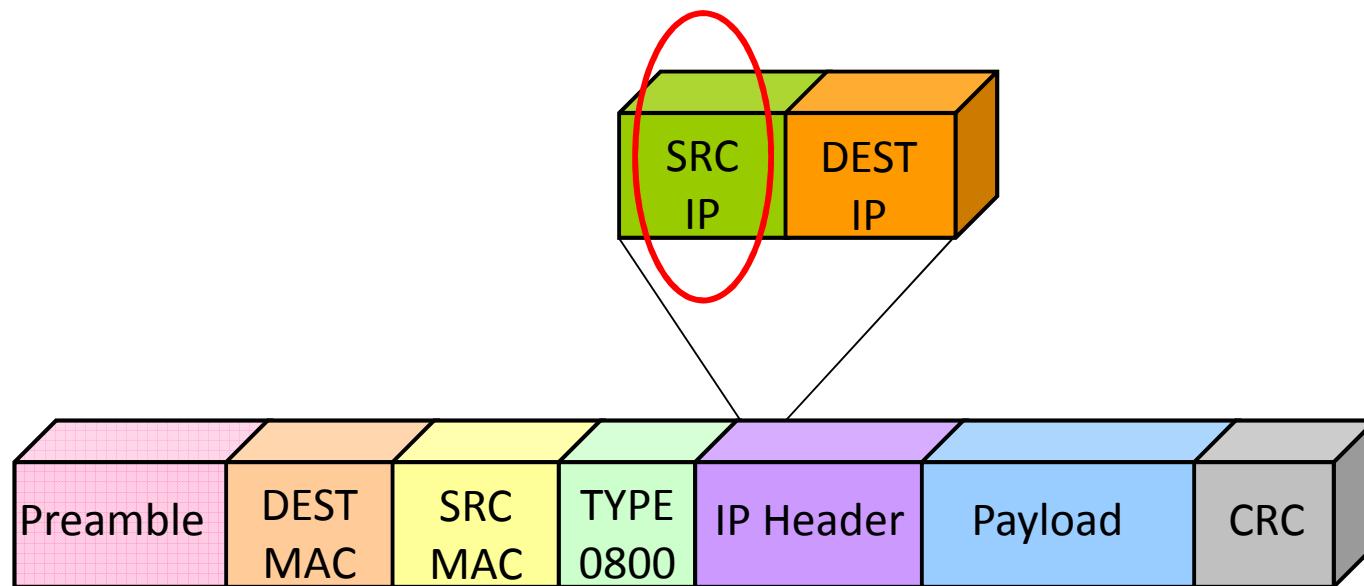
MAC ACL



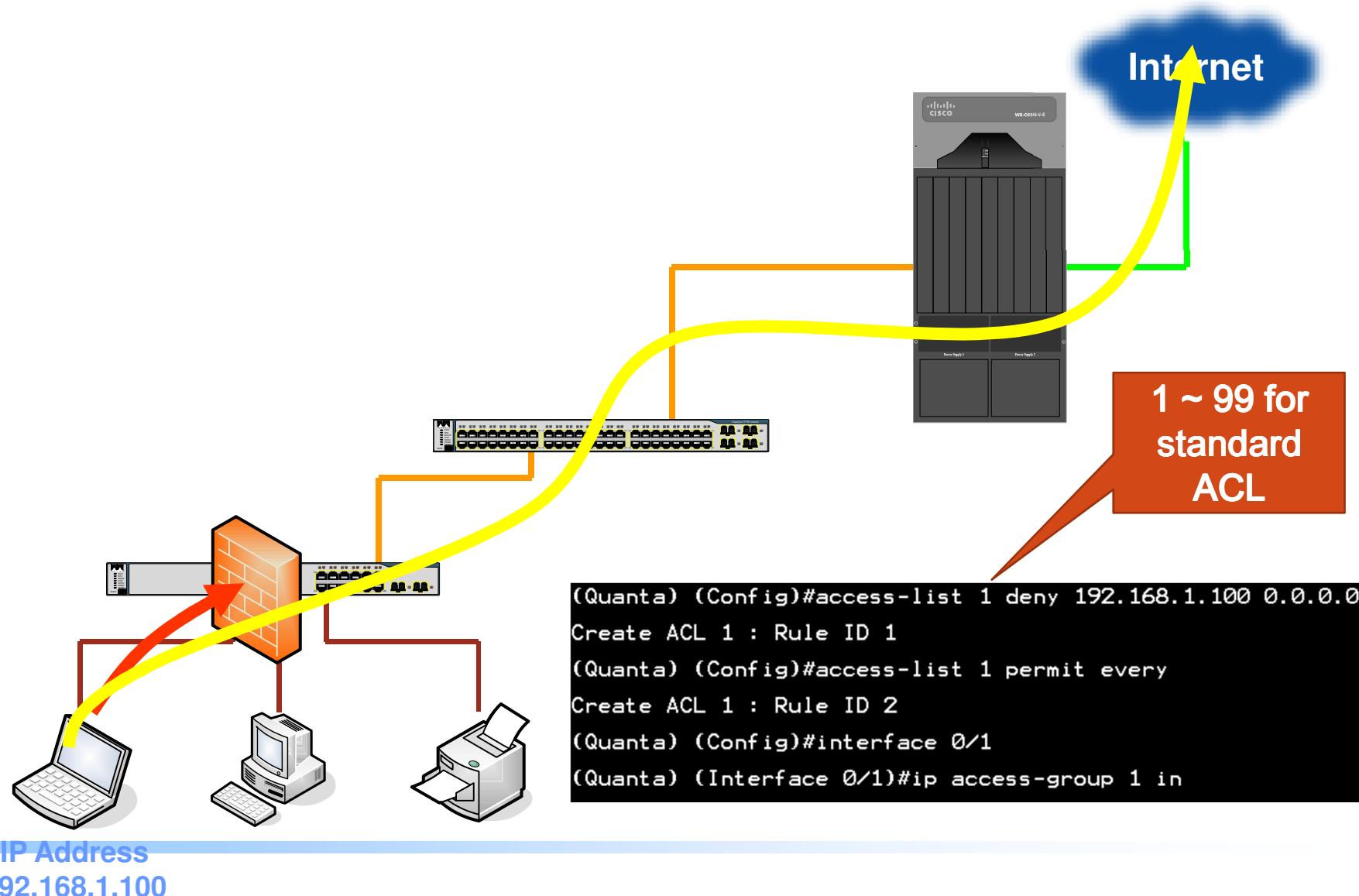
MAC Address
00e0:0001:6c03

IP Standard ACL

- IP Standard Access Control List
 - source IP and subnet Mask



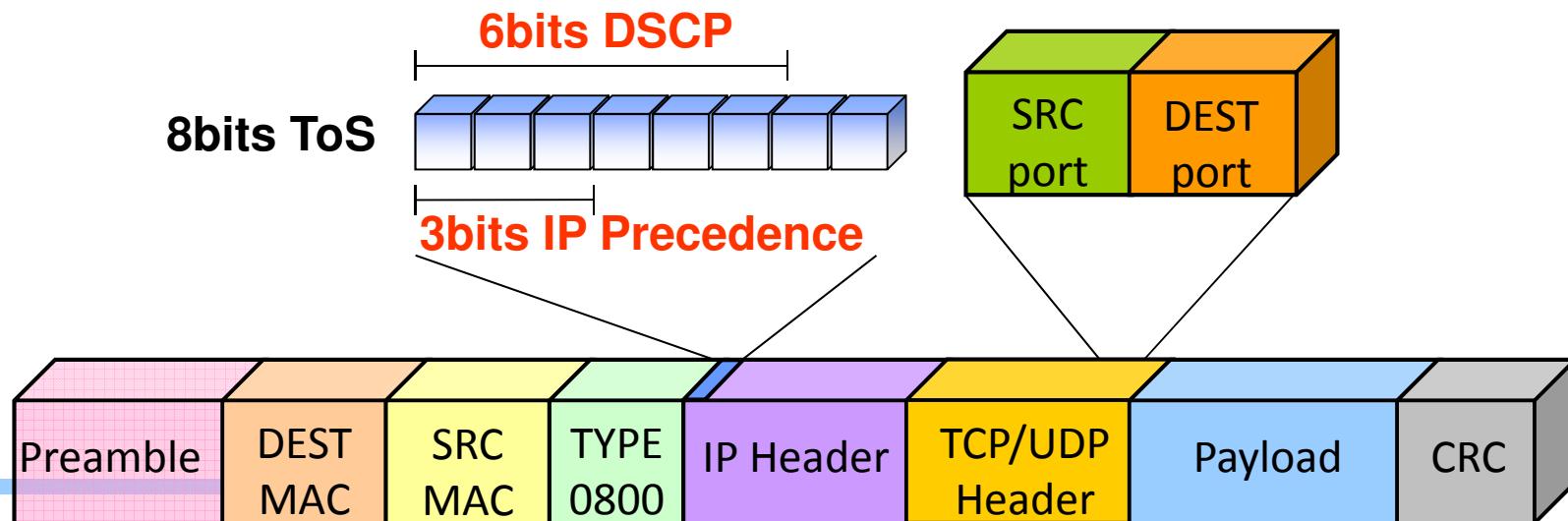
IP Standard ACL



IP Extended ACL

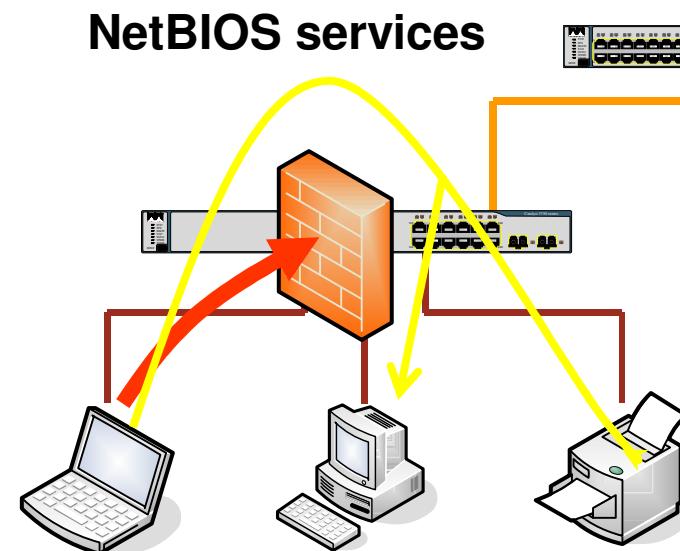
IP extended Access Control List

- ▶ Source/Destination IP and subnet mask
- ▶ Service Type: ToS, Precedence bits, DSCP and bit mask
- ▶ Protocol number: TCP/UDP/Others
- ▶ Source/Destination port number and bit mask
- ▶ Control code and bit mask

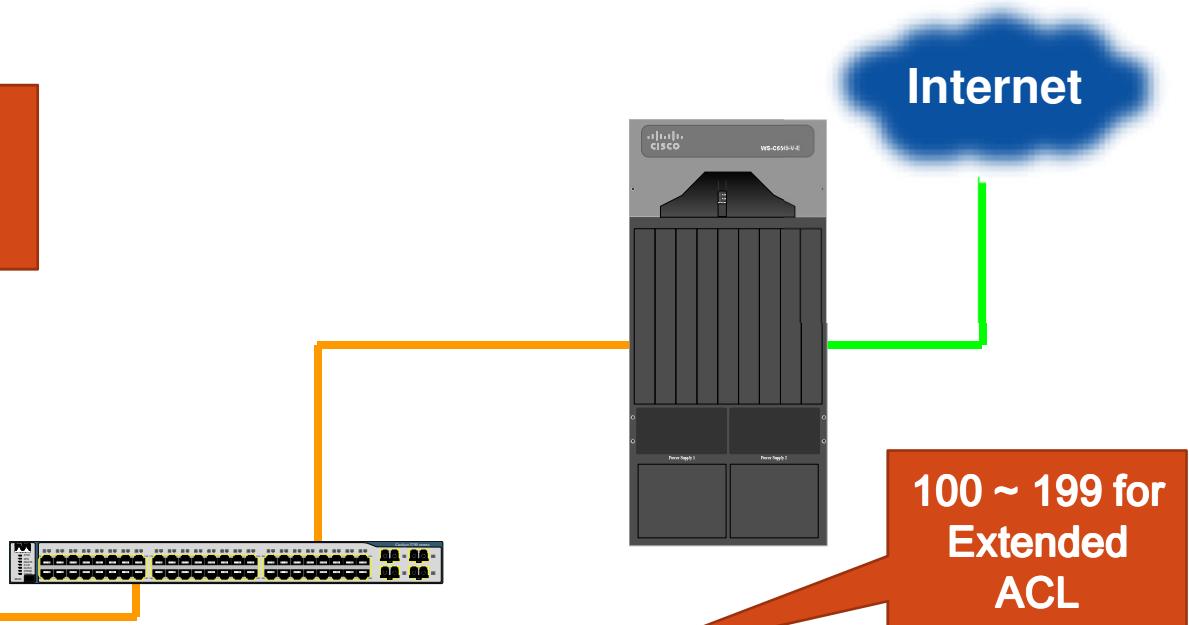


IP extended ACL

UDP Port 137 name service
UDP port 138 datagram service
TCP port 139 session service



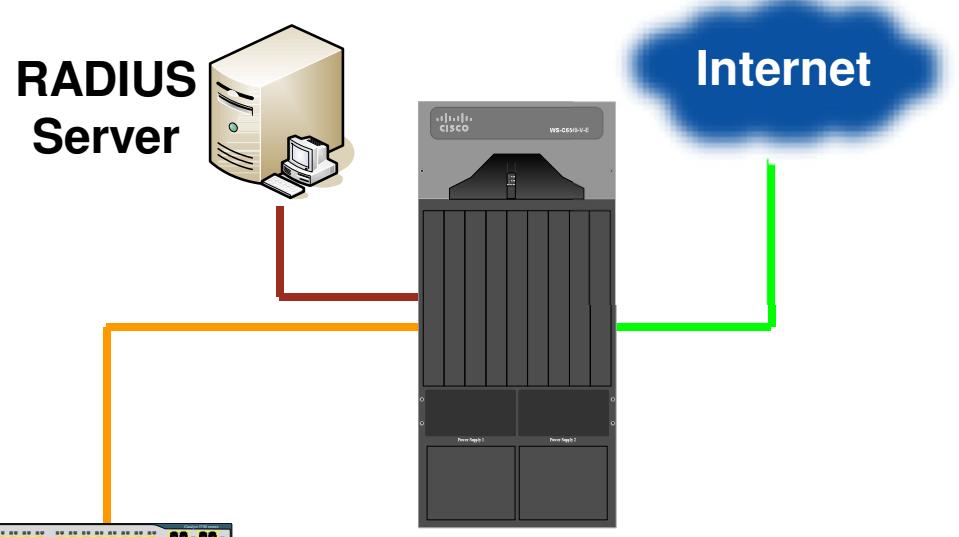
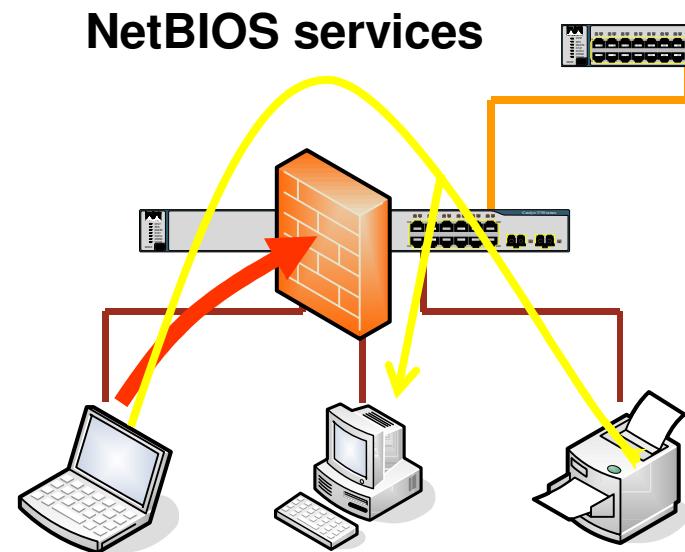
IP Address
192.168.1.100



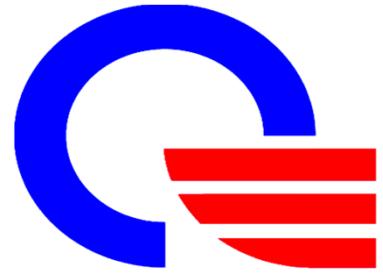
```
(Quanta) (Config)#access-list 100 deny udp 192.168.1.100 0.0.0.0 any eq 137
Create ACL 100 : Rule ID 1
(Quanta) (Config)#access-list 100 deny udp 192.168.1.100 0.0.0.0 any eq 138
Create ACL 100 : Rule ID 2
(Quanta) (Config)#access-list 100 deny tcp 192.168.1.100 0.0.0.0 any eq 139
Create ACL 100 : Rule ID 3
(Quanta) (Config)#access-list 100 permit every
Create ACL 100 : Rule ID 4
(Quanta) (Config)#interface 0/1
(Quanta) (Interface 0/1)#ip access-group 100 in
```

Name based ACL

UDP Port 137 name service
UDP port 138 datagram service
TCP port 139 session service



```
(Quanta) (Config)#ip access-list denyNetbios
(Quanta) (Config-ipv4-acl)#deny udp 192.168.1.100 0.0.0.0 any eq 137
Create ACL 1000 : Rule ID 1
(Quanta) (Config-ipv4-acl)#deny udp 192.168.1.100 0.0.0.0 any eq 138
Create ACL 1000 : Rule ID 2
(Quanta) (Config-ipv4-acl)#deny tcp 192.168.1.100 0.0.0.0 any eq 139
Create ACL 1000 : Rule ID 3
(Quanta) (Config-ipv4-acl)#permit every
Create ACL 1000 : Rule ID 4
(Quanta) (Config-ipv4-acl)#exit
(Quanta) (Config)#interface 0/1
(Quanta) (Interface 0/1)#ip access-group denyNetbios in
```

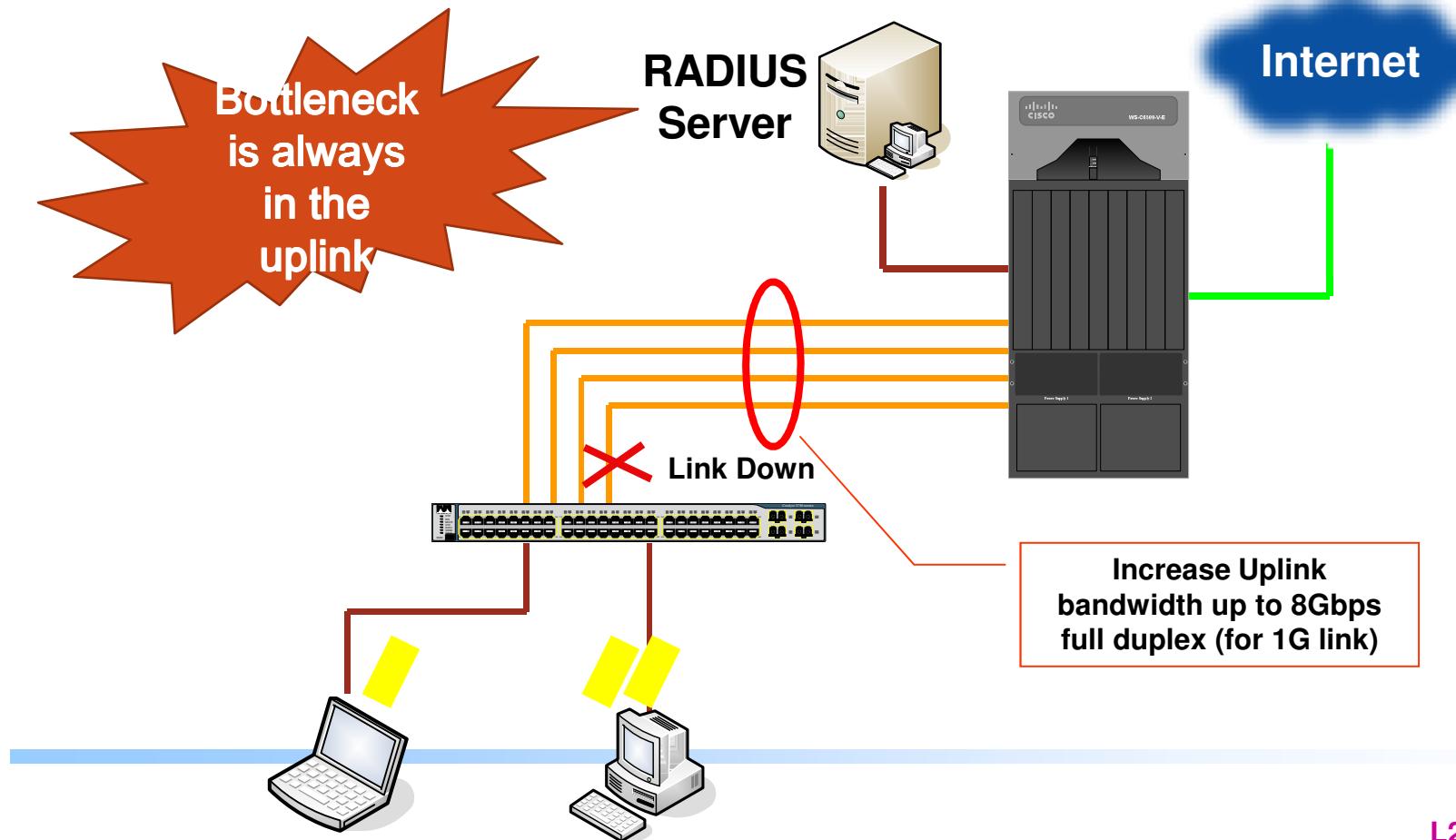


Introduction of Port Trunk



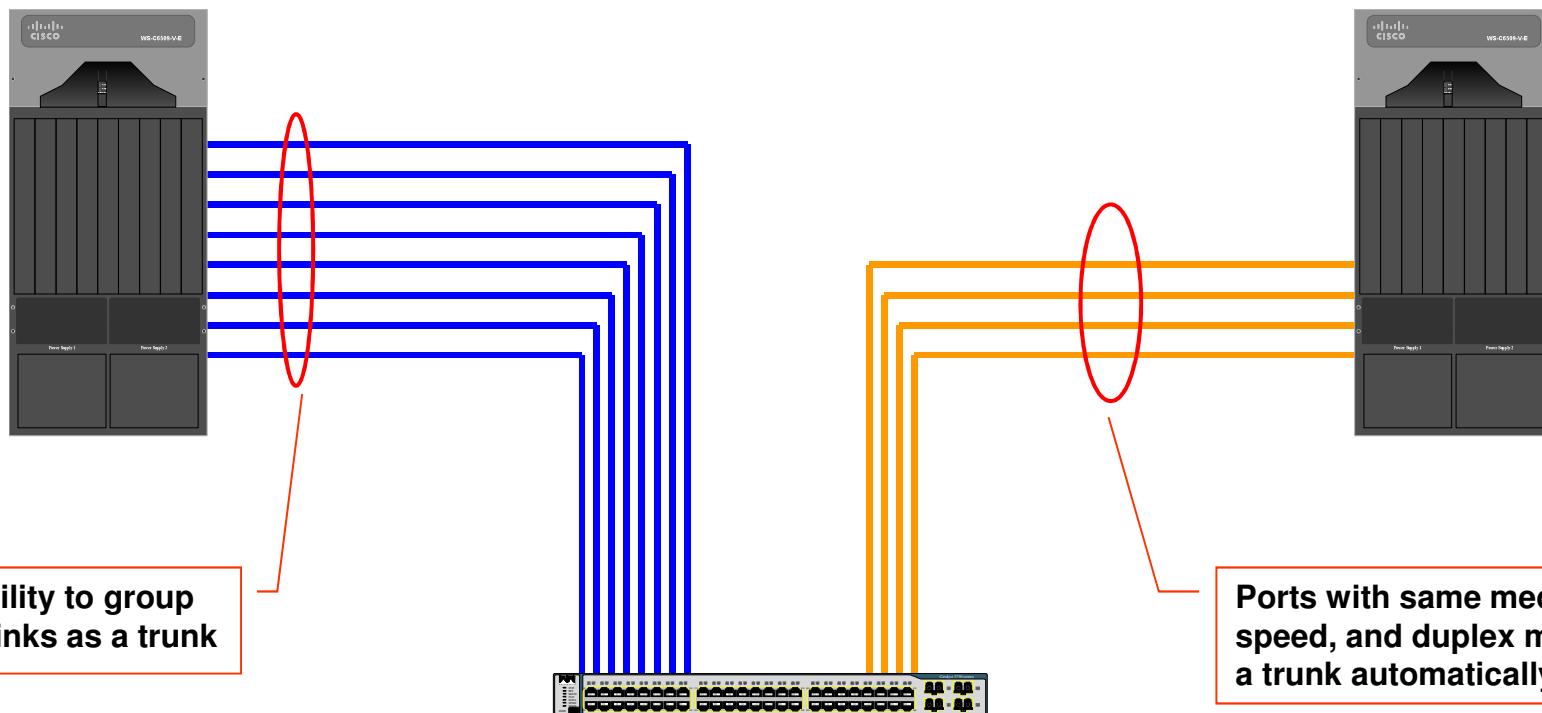
Port Trunk

- Groups physical links together as a single logical link to provide bigger uplink bandwidth
- Traffic load balancing and protection against link failure



802.3ad LACP (Link Aggregation Control Protocol)

- Protocol for automatically and dynamically groups physical link of the same media type and speed together



Configuration of LACP

```
(Quanta) #conf
(Quanta) (Config)#
(Quanta) (Config)#port-channel Trunk_RD_SALES
Interface 1/1 created for port-channel Trunk_RD_SALES
(Quanta) (Config)#
(Quanta) (Config)#do show port-channel brief
Logical Port-Channel Name Link State Trap
Interface           Flag
----- -----
1/1                Trunk_RD_SALES Down     Enabled
                                         Type   Mbr Ports Active Ports
                                         Dynamic
(Quanta) (Config)#interface range 0/18 , 0/20
(Quanta) (if-range)#channel-group 1/1
(Quanta) (if-range)#
(Quanta) (if-range)#
(Quanta) (if-range)#do show port-channel brief
Logical Port-Channel Name Link State Trap
Interface           Flag
----- -----
1/1                Trunk_RD_SALES Up      Enabled
                                         Type   Mbr Ports Active Ports
                                         Dynamic 0/18,0/20 0/18,0/20
```

Default LACP is enable

Use show port-channel brief to
get the logical port name

Configuration of Static Trunk

```
(Quanta) (if-range)#do show port-channel brief  
  
Logical Port-Channel Name Link State Trap Type Mbr Ports Active Ports  
Interface ----- ----- ----- Flag -----  
1/1 Trunk_RD_SALES Up Enabled Dynamic 0/18,0/20 0/18,0/20  
  
(Quanta) (if-range)#  
(Quanta) (if-range)#  
(Quanta) (if-range)#  
(Quanta) (if-range)#interface 1/1  
  
(Quanta) (Interface 1/1) staticcapability  
  
(Quanta) (Interface 1/1)#do show port-channel brief  
  
Logical Port-Channel Name Link State Trap Type Mbr Ports Active Ports  
Interface ----- ----- ----- Flag -----  
1/1 Trunk_RD_SALES Up Enabled Static 0/18,0/20 0/18,0/20
```

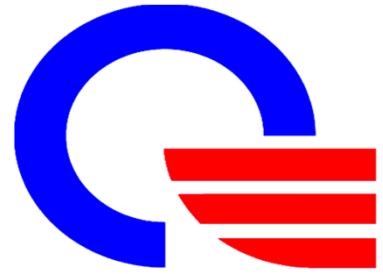
If link partner does not support LACP, then set the trunk to be static trunk!

Load Balance Algorithm

- Switch transmit received data to the member ports of port channel based on specific algorithm
- The default algorithm is src-dst-mac.
 - Use “show port-channel PORT_CHANNEL_ID” to display the current load balance option
- User can change the load balance mode by using the following command.

```
(Quanta) (Config)#port-channel p1
Interface 1/1 created for port-channel p1
(Quanta) (Config)#interface 1/1
(Quanta) (Interface 1/1)#port-?
port-backup          port-security
(Quanta) (Interface 1/1)#load-balance ?
dst-ip               Dest IP and Dest TCP/UDP Port fields
dst-mac              Dest MAC, VLAN, EType, incoming port
src-dst-ip           Src/Dest IP and TCP/UDP Port fields
src-dst-mac          Src/Dest MAC, VLAN, EType, incoming port
src-ip               Src IP and Src TCP/UDP Port fields
src-mac              Src MAC, VLAN, EType, incoming port
```

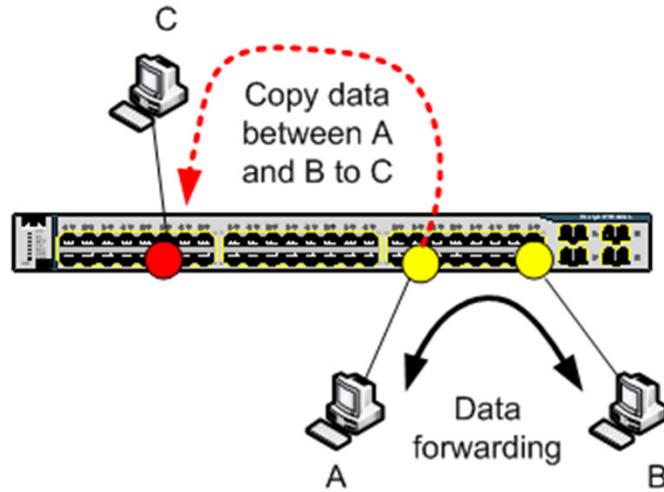
Default
src-dst-ip



Management Utilities



Port mirror



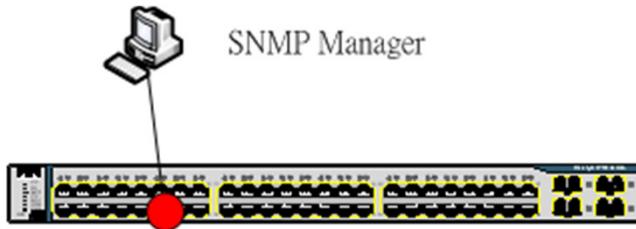
```
(LB9_2) #show port-monitor session 1
Session ID Admin Mode Dest. Port Source Port Type
----- -----
1 Disable

(LB9_2) #
(LB9_2) #
(LB9_2) #
(LB9_2) #conf

(LB9_2) (Config)#port-monitor session 1 destination interface 0/2
(LB9_2) (Config)#port-monitor session 1 source interface 0/48
(LB9_2) (Config)#port-monitor session 1 mode
(LB9_2) (Config)#
(LB9_2) (Config)#do show port-monitor session
Session ID Admin Mode Dest. Port Source Port Type
----- -----
1 Enable 0/48 0/2 Rx,Tx
2 Disable
3 Disable
4 Disable
```

- Switch forward frames base on MAC address table. Switch will not flood the frames to all ports except for unknown, multicast , and broadcast frame.
- If you want to capture the frames for specific port, you can use port mirror.

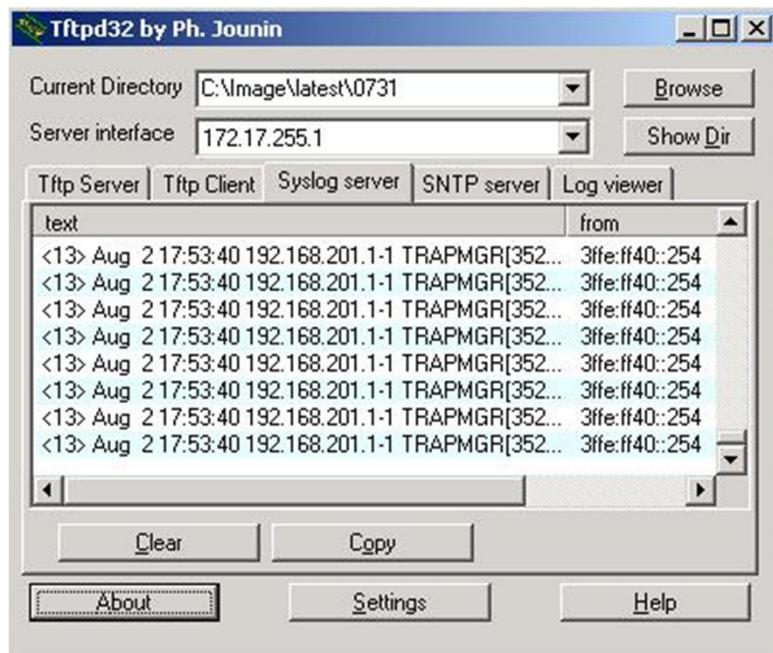
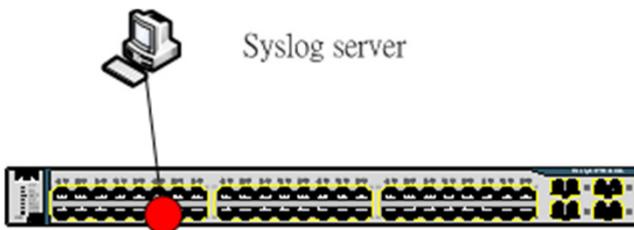
Logging to SNMP Manager



```
(LB9_2) (Config)#snmptrap LB9A_2 ipaddr 192.168.1.1
Snmptrap added!
(LB9_2) (Config)#do show snmptrap
  SNMP Trap Name      IP Address      Port      SNMP Version      Status
-----  -----  -----  -----  -----
LB9A_2          192.168.1.1      162      snmpv2      Enable
```

- You can log the system events to the remote PC through SNMP protocol.

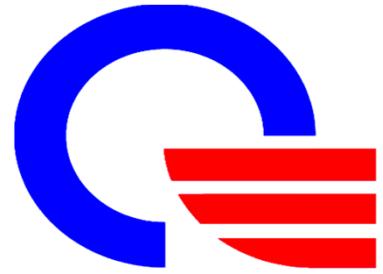
Logging to Syslog



```
(LB9_2) (Config)#logging host 192.168.1.1 ipv4
(LB9_2) (Config)#logging syslog
(LB9_2) (Config)#do show logging host
Index IP Address/Hostname Severity Port Status
1 192.168.1.1 critical 514 Active
```

```
(LB9_2) (Config)#logging host 192.168.1.2 ipv4 514 debug
(LB9_2) (Config)#do show logging host
Index IP Address/Hostname Severity Port Status
1 192.168.1.1 critical 514 Active
2 192.168.1.2 debug 514 Active
```

- You can log the system events to the remote PC through syslog protocol.

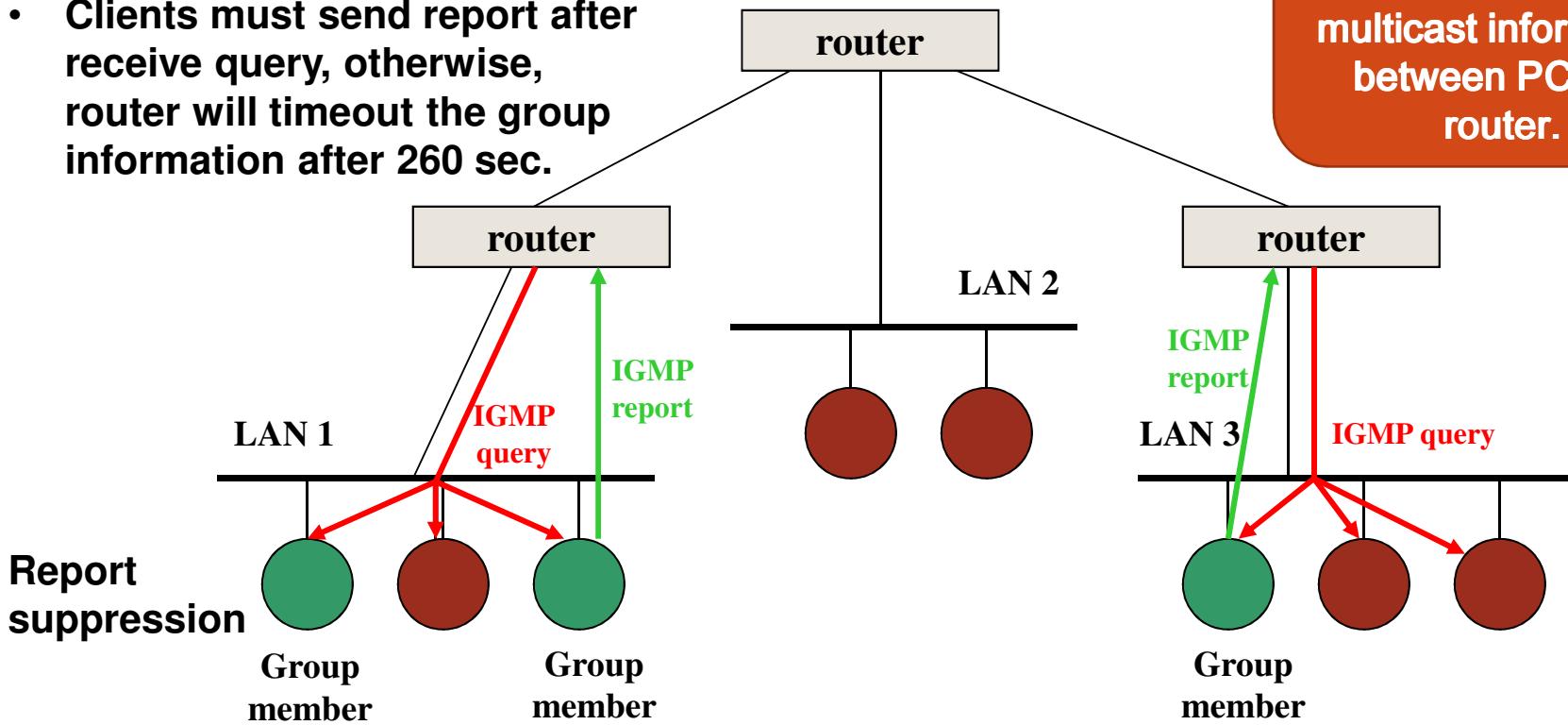


IGMP Snooping



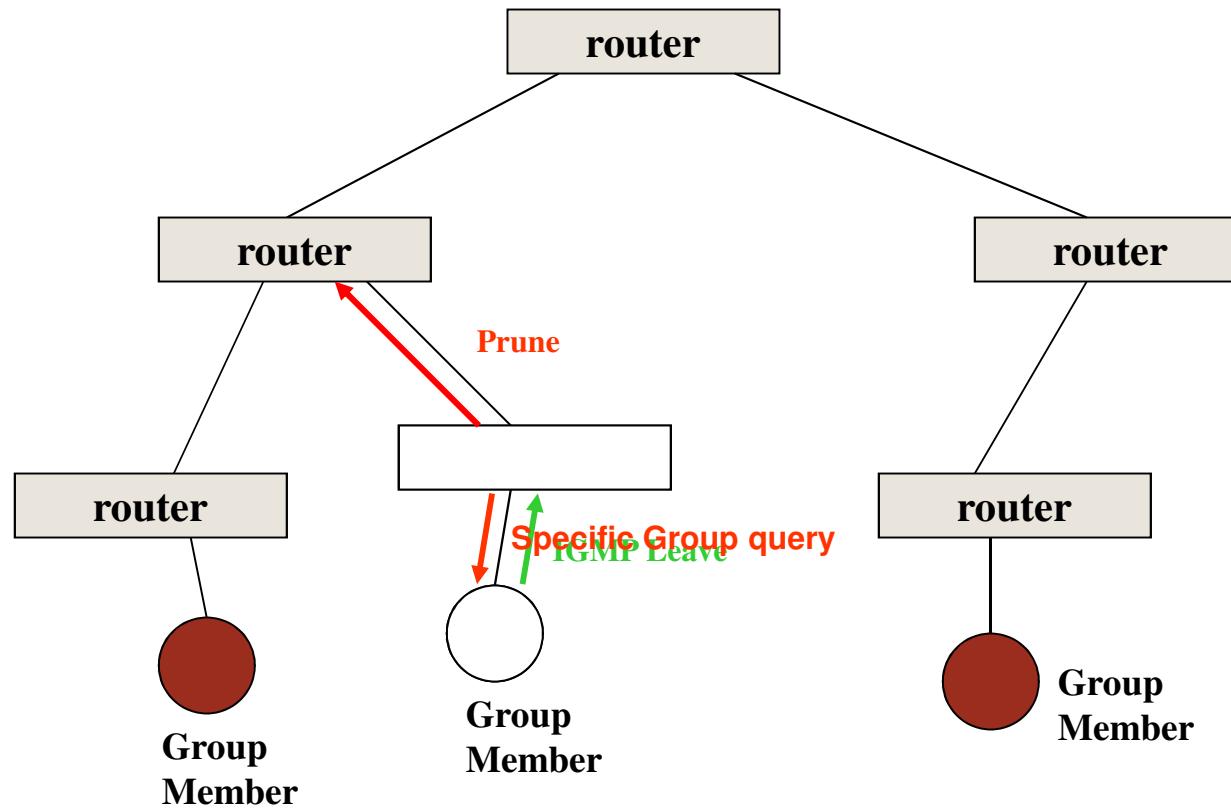
IGMP Behavior -- Join

- Router sends IGMP query every 125 sec to maintain the group information
- Clients must send report after receive query, otherwise, router will timeout the group information after 260 sec.



PC can sends the unsolicited report without query at the very beginning. After that, sends report only when receive the query packet.

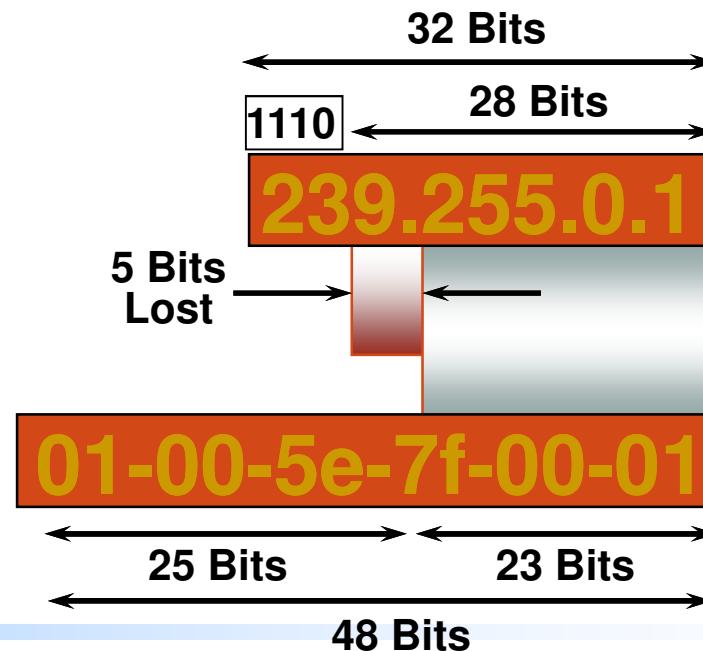
IGMP v2 - Pruning



Multicast Addressing

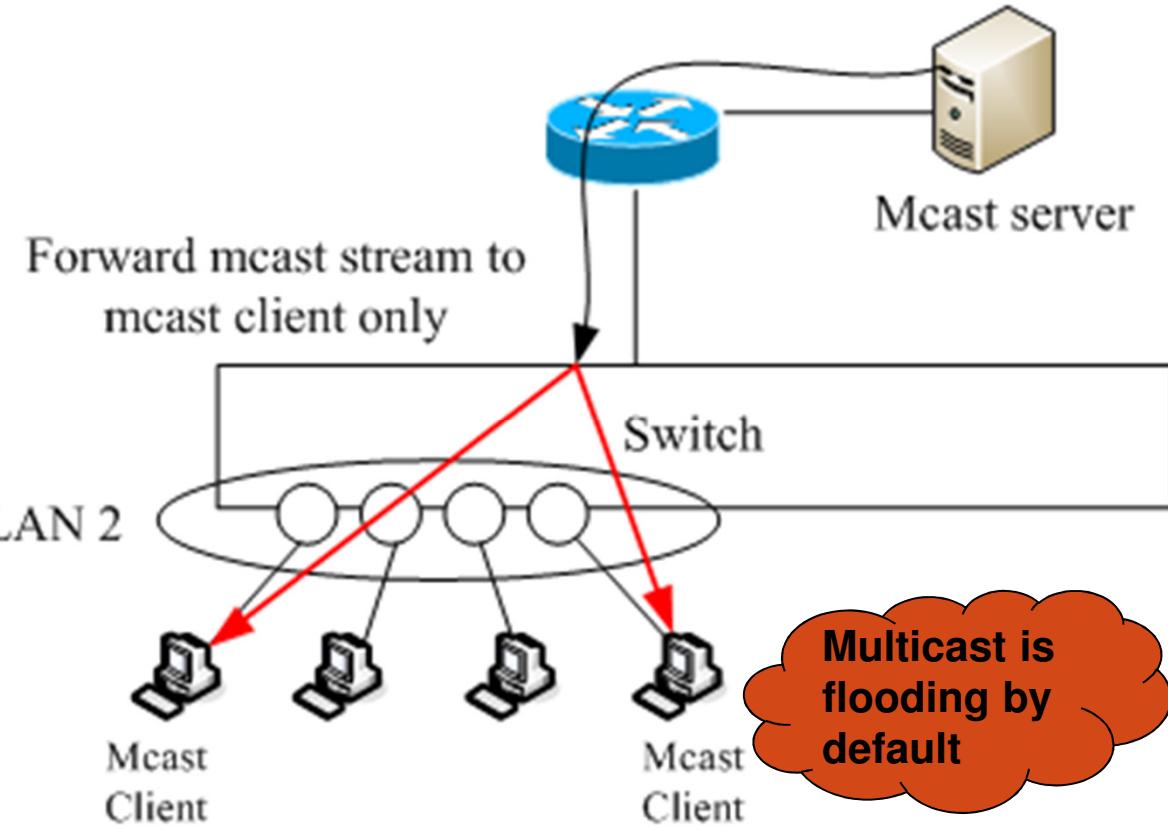
- Multicast address range is 224.0.0.0 ~ 239.255.255.255 (Class D address)
- When you sends unicast packet say to 192.168.1.1, We can use ARP to get the DA for 192.168.1.1.
- But for multicast, there is no such mechanism, the multicast to mac address mapping is through the following mechanism.

IP Multicast MAC Address Mapping



IGMP Snooping

IGMP is a layer 3 protocol. The layer 2 switch should not care about IGMP. But due to the multicast flooding issue, the layer 2 switch starts to watch the layer 3 protocol and record who want to receive the mcast data



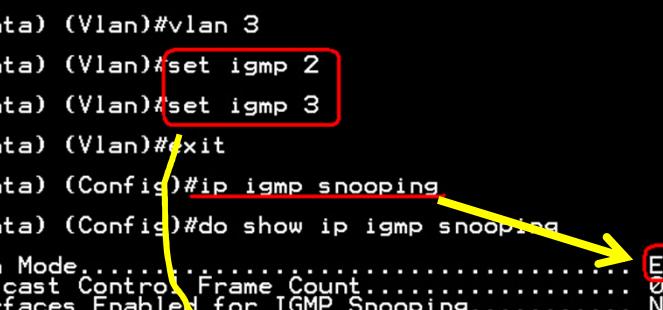
- By default, switch floods received mcast streams.
 - Non mcast clients will receive this mcast packets!
- Through IGMP Snooping operation, only mcast clients will receive mcast traffic.

IGMP Snooping

- IGMP is a layer 3 protocol. The layer 2 switch should not care about IGMP. But due to the multicast flooding issue, the layer 2 switch starts to watch the layer 3 protocol.
- The switch records where the report comes from and delete that entry if client leave the group or the entry timeout due to no report (260 sec).
- For ex:
 - If client sends the report to 239.1.1.1 from port 1, then switch can learn 01:00:5e:01:01:01 from port 1.
 - Next time, when switch receives packets with DA set to 01:00:5e:01:01:01 , it only sends to port 1. other ports will not receive this multicast stream.

IGMP Snooping Per VLAN

- Globally enable IGMP Snooping
 - Ip igmp snooping
 - Enable igmp snooping per VLAN
 - Vlan data
 - ✓ Vlan X
 - ✓ Set igmp X
 - Use “Show ip igmp snooping” to check which VLAN has been enabled IGMP snooping.

```
(Quanta) (Config)#vlan data
(Quanta) (Vlan)#vlan 2
(Quanta) (Vlan)#vlan 3
(Quanta) (Vlan)#set igmp 2
(Quanta) (Vlan)#set igmp 3
(Quanta) (Vlan)#exit
(Quanta) (Config)#ip igmp snooping
(Quanta) (Config)#do show ip igmp snooping
Admin Mode.....
Multicast Control Frame Count.....
Interfaces Enabled for IGMP Snooping.....
Vlans enabled for IGMP snooping.....

```

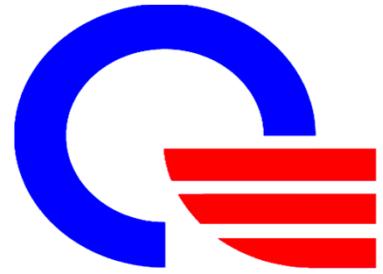
IGMP Snooping Querier

- If there is no mcast router in the network, then one of the switches should enable IGMP snooping querier.
 - If there is no querier, then switch can't maintain mcast client information.
- Quanta switch supports version 1 and 2 for querier.

Configure IGMP Snooping Querier

- Global Querier Address
 - Enable snooping querier
 - ✓ Ip igmp snooping querier
 - Set the querier address (this address will be shared for all VLANs)
 - ✓ Ip igmp snooping querier address X.X.X.X
 - This address may not be the management IP address.
 - Enable querier on VLAN
 - ✓ Ip igmp snooping querier vlan X
- Per VLAN Querier Address
 - Enable snooping querier
 - ✓ Ip igmp snooping querier
 - Set the querier address for specific VLAN
 - ✓ Ip igmp snooping querier vlan X address X.X.X.X
 - Enable querier on VLAN
 - ✓ Ip igmp snooping querier vlan X

```
(Quanta) (Config)#ip igmp snooping querier
(Quanta) (Config)#ip igmp snooping querier address 192.168.1.254
(Quanta) (Config)#ip igmp snooping querier vlan 2
(Quanta) (Config)#ip igmp snooping querier vlan 3
(Quanta) (Config)#do show ip igmp snooping querier
Global IGMP Snooping querier status
-----
IGMP Snooping Querier Mode.....: Enable
Querier Address.....: 192.168.1.254
IGMP Version.....: 2
Querier Query Interval.....: 60
Querier Expiry Interval.....: 60
(Quanta) (Config)#do show ip igmp snooping querier detail
```



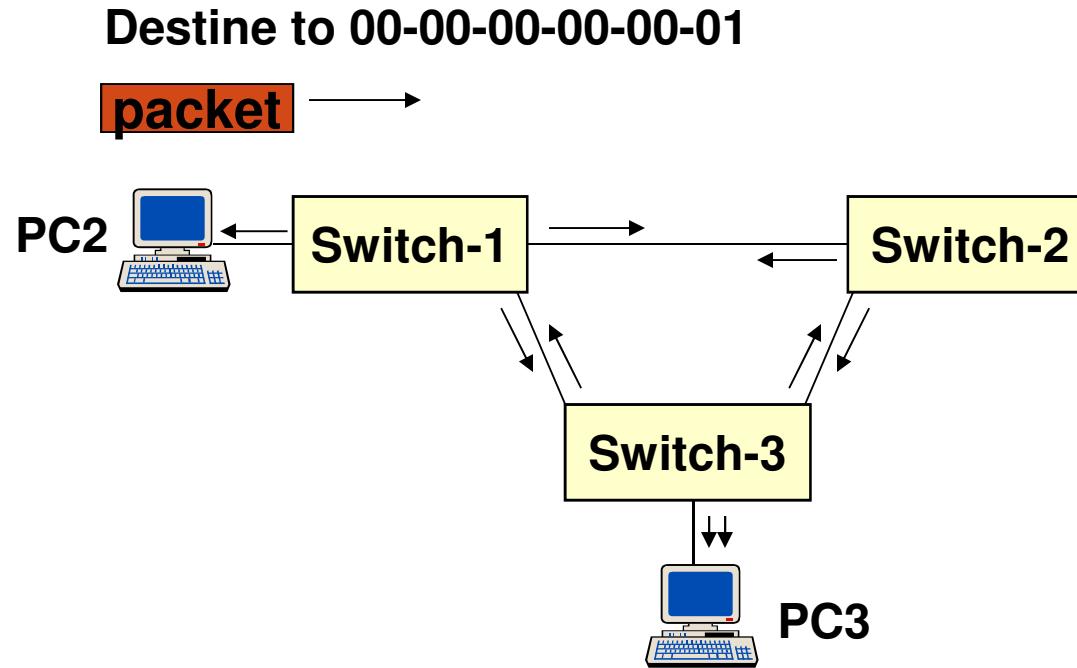
Introduction of Spanning Tree – RSTP



Spanning Tree

- ❑ Purpose: To maintain loop-free topologies in a redundant Layer 2 network
- ❑ Provides path recovery services to increase the network availability
- ❑ Many enhancements for scalability and availability improvements
 - RSTP and MSTP

What Happens without Spanning Tree

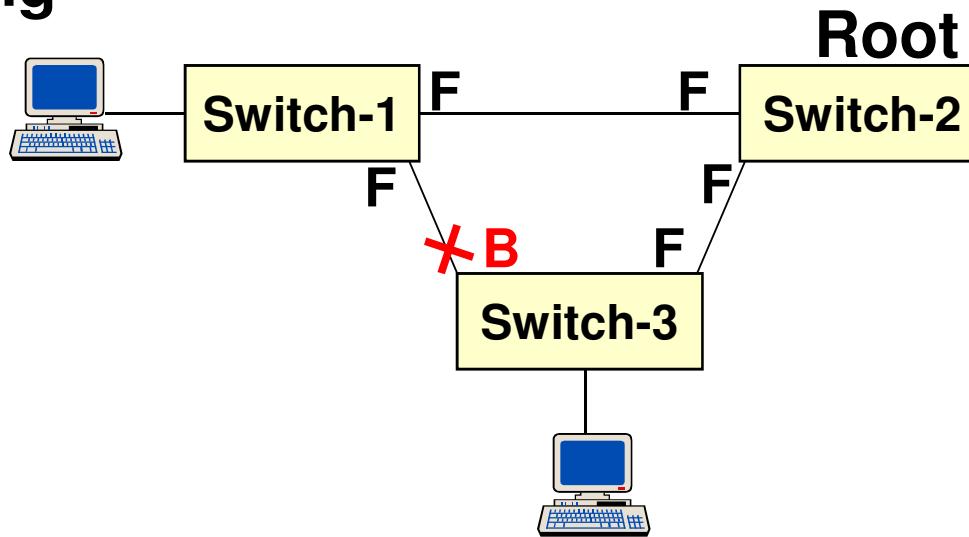


- Unknown unicast, multicast or broadcast frames would flood to all the ports
- Flood would become the storm !

Spanning Tree basic

F: forwarding

B: blocking

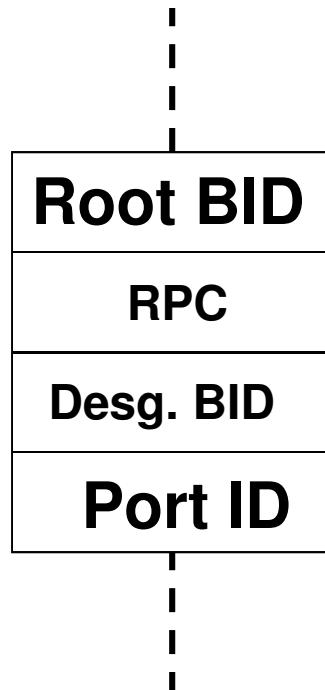


- A switch is selected as root
 - A tree-like loop free topology is established
-

Bridge Protocol Data Unit

❑ BPDU

- Switch use BPDU to convey spanning tree information between them.



Who is the root bridge?

How far away is the root bridge ?

What is the BID of the bridge that sent this BPDU?

What port on the sending bridge did this BPDU come from ?

Spanning tree operation cont'

□ Bridge ID

- 8 bytes field consisting of 2 byte bridge priority and 6 byte switch MAC address
- When compare two bridge IDs, compare priority first then MAC address. The lower value is always preferred.

Root election
needs compare
the Bridge ID

**0001:00-00-00-00-01 is better than
1000:00-00-00-00-02**

**2 bytes
priority**

**6 bytes
MAC address**

Default priority
is 32768

Spanning tree operation cont'

□ Path cost

- A cost to cross a link.

Link speed 愈
快，cost 愈小。

□ Root Path Cost (RPC)

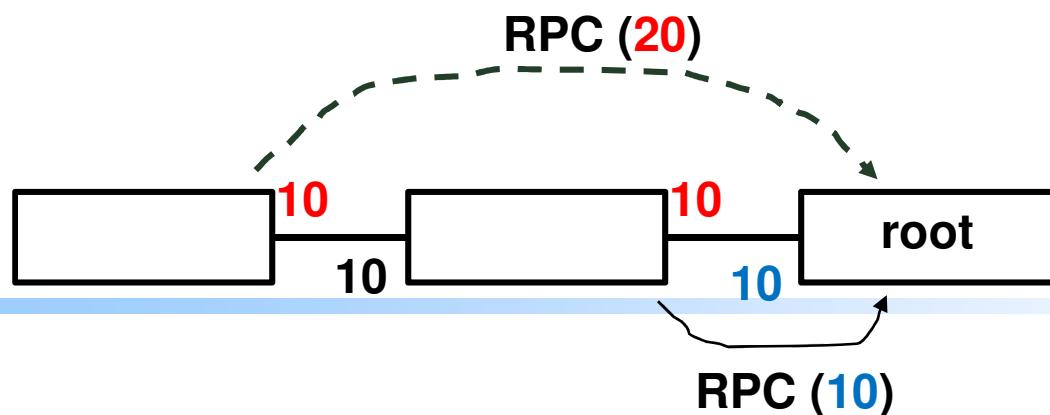
- The cumulative cost of all network links to the root bridge.

□ Port ID

- 1 byte port priority + 1 byte port no.
- The lower port ID is preferred over higher port ID

| | |
|-------------------------|--------------------|
| Port Priority 1 byte | Port No. 1 byte |
|-------------------------|--------------------|

Default port
priority is
128

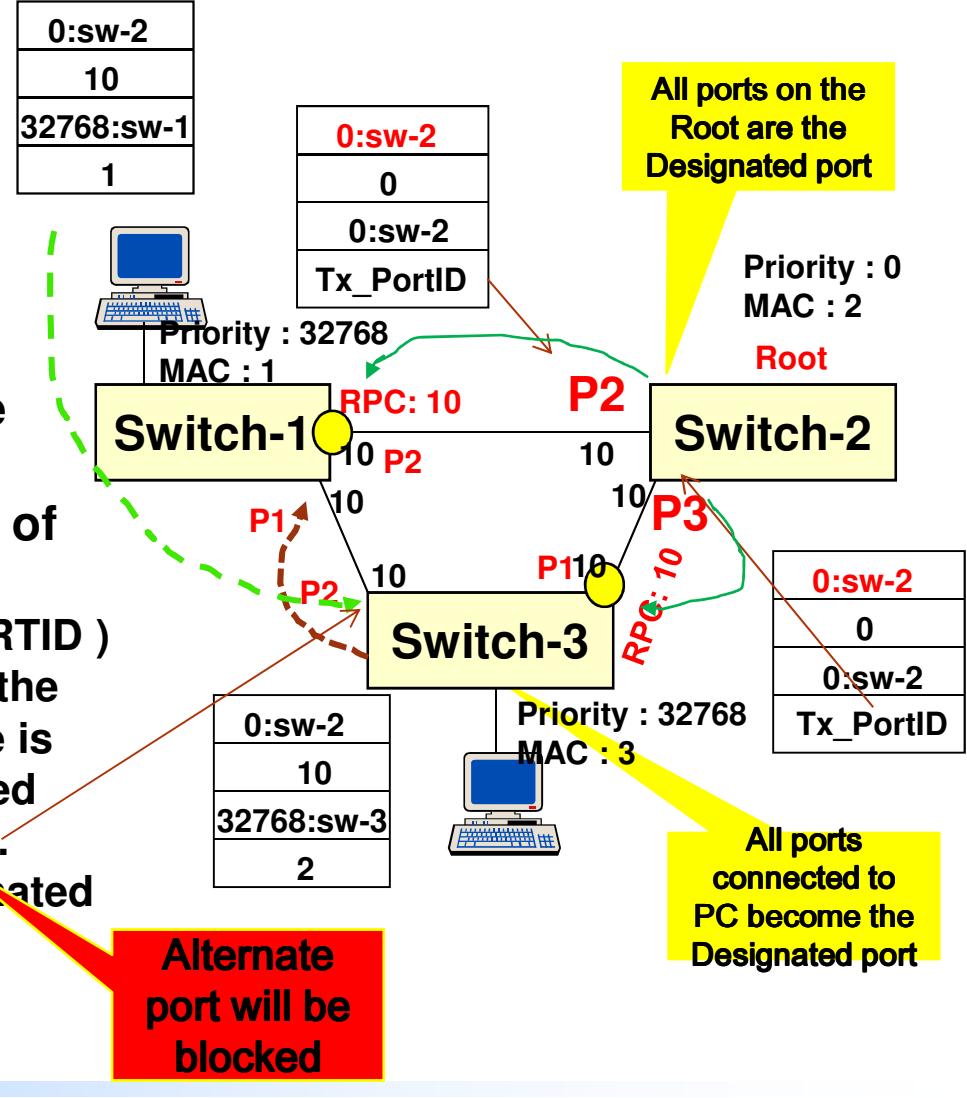


Identify the Blocking Port

1. Write down the bridge ID and path cost
2. Choose the root
 - with the least BID (switch-2)
3. Choose the **root port**
 - Calculate uplink RPC
 - The least one would become root port
4. Calculate the first 4 components of the designated priority
 - (Root_Bid, RPC, myBid, tx_PORTID)
5. Compare the designated priority for the inter switch link port whose port role is not determined. The worse designated priority would become **alternate port**.
6. All other ports would become designated ports (Not complete right!)

Designated port will be in forwarding

Alternate port will be blocked

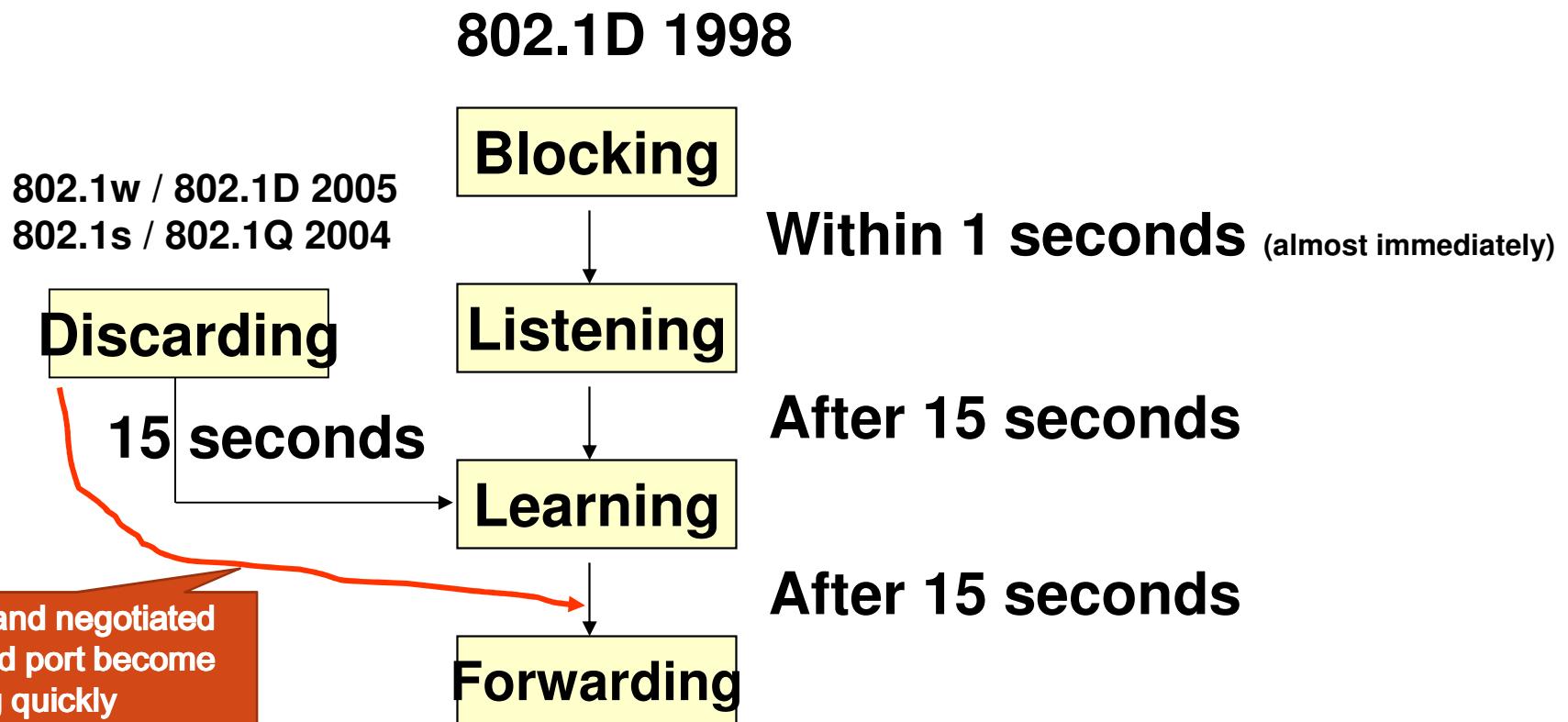


RSTP (Rapid Spanning-Tree Protocol)

- RSTP provides rapid convergence of the spanning tree in less than 1 second.
- Provides rapid recovery of connectivity following the failure of a Bridge, Bridge Ports, or a LAN.
- A new Root Port can transit rapidly to the Forwarding Port State.
- The use of explicit acknowledgements between Bridges allow Designated Ports to transit rapidly to the Forwarding Port State.
- RSTP allows Bridge Ports connected to a LAN segment that is at the edge of the Bridged LAN to be configured to transit directly to Forwarding State

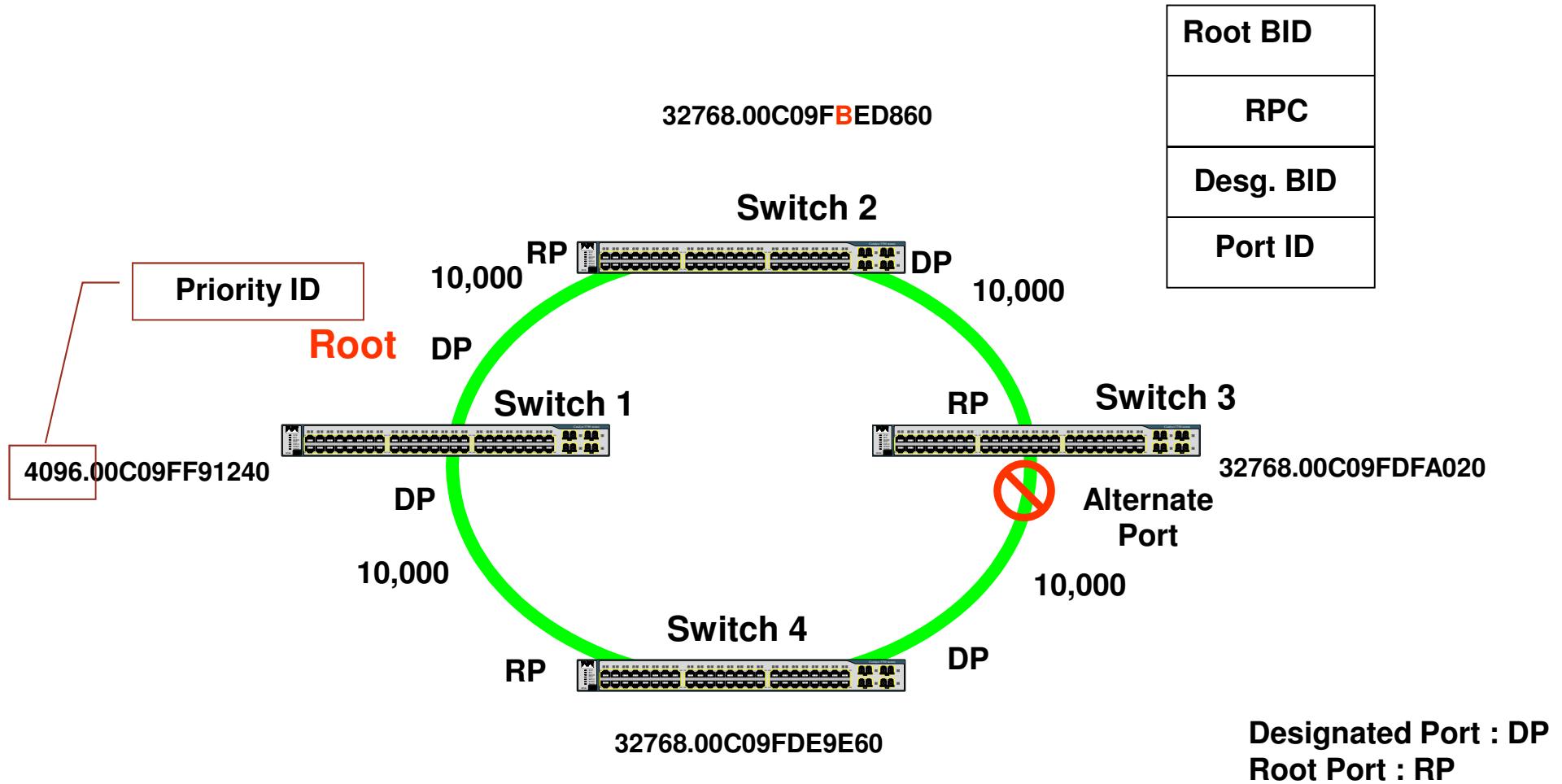
Edge port and
only PC port can
be configured as
edge port

Port state

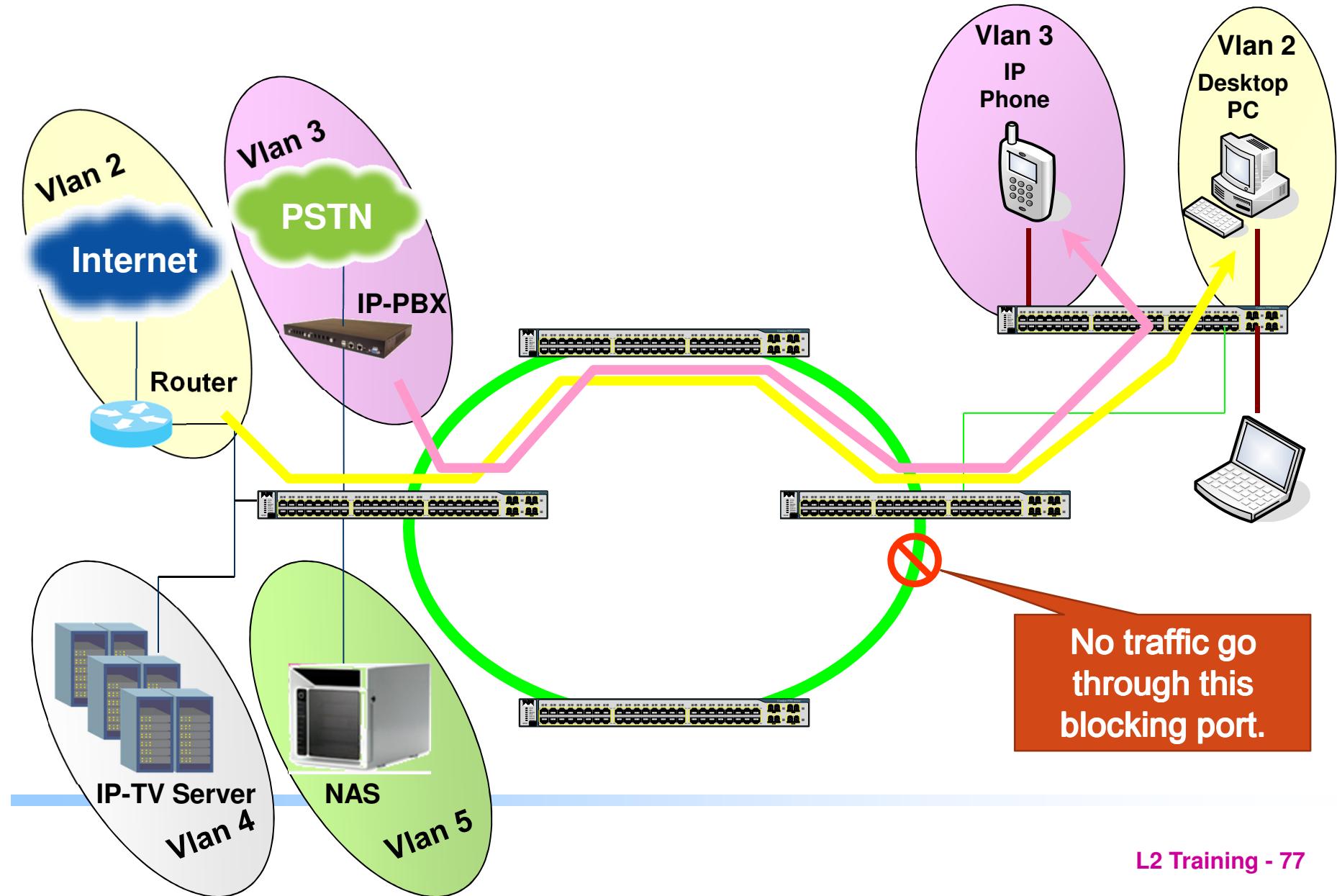


- Normal port needs 30 sec to become forwarding
- Edge port can become forwarding within 1 sec.
 - Auto Edge need 3 sec to become forwarding.

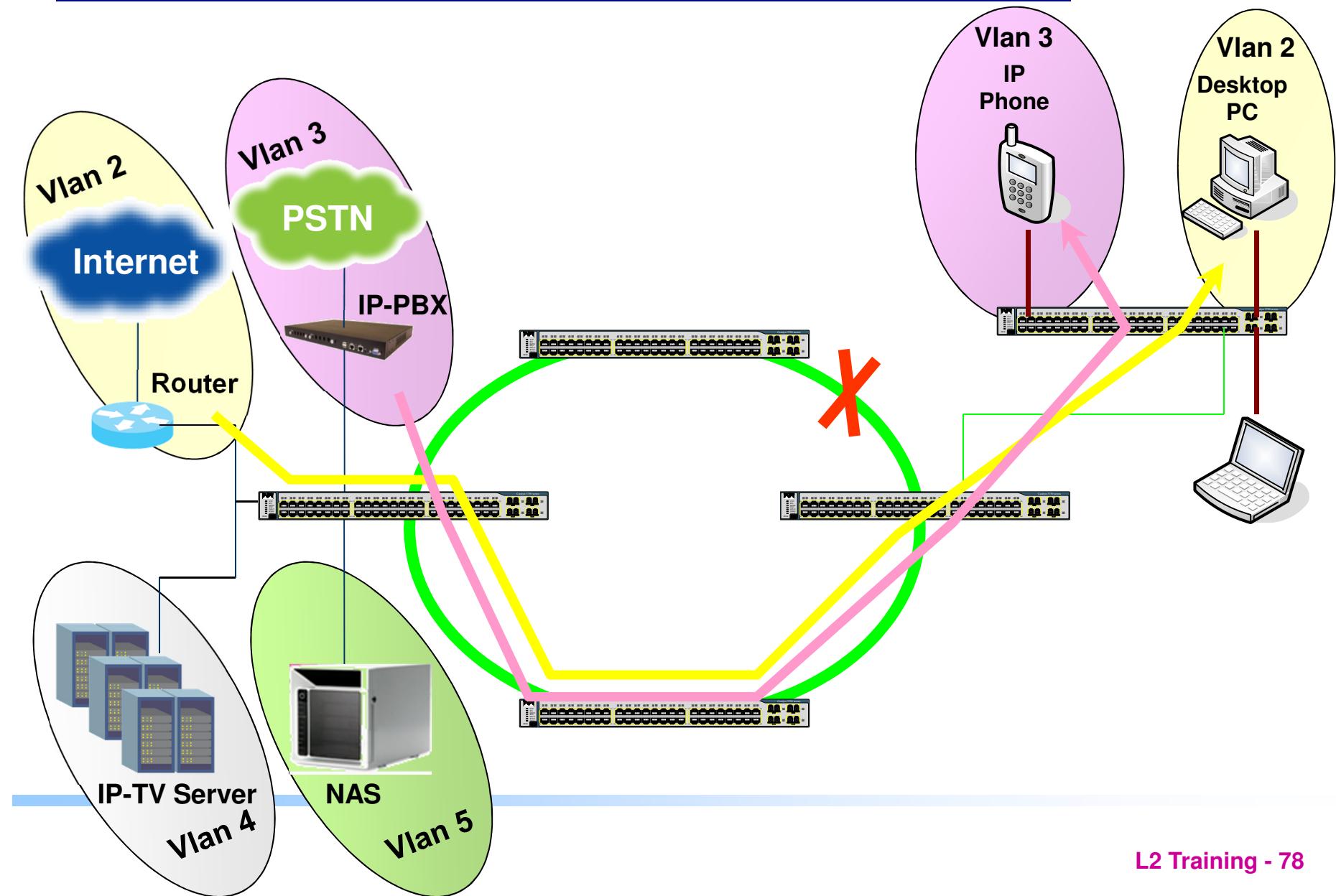
Another example

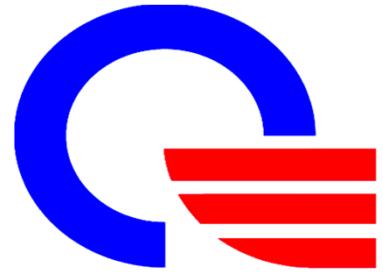


RSTP - Prevent Looping



RSTP - Redundant Path





RSTP Configuration

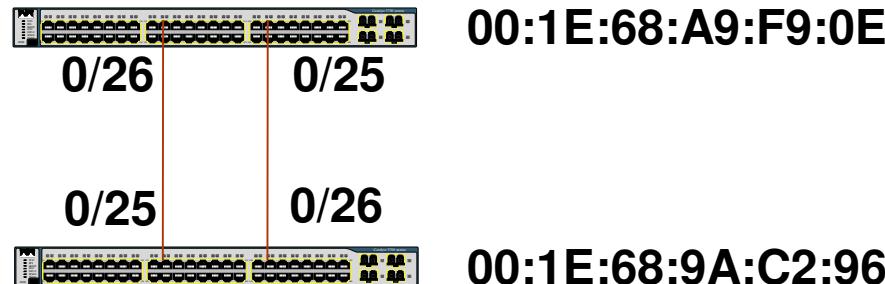


Configure RSTP

```
(Quanta) (Config)#spanning-tree  
(Quanta) (Config)#spanning-tree mode rstp  
(Quanta) (Config)#spanning-tree mst priority 0 4096  
{Quanta} {Config)#interface range 0/25 - 0/26  
{Quanta} {if-range}#spanning-tree port mode
```

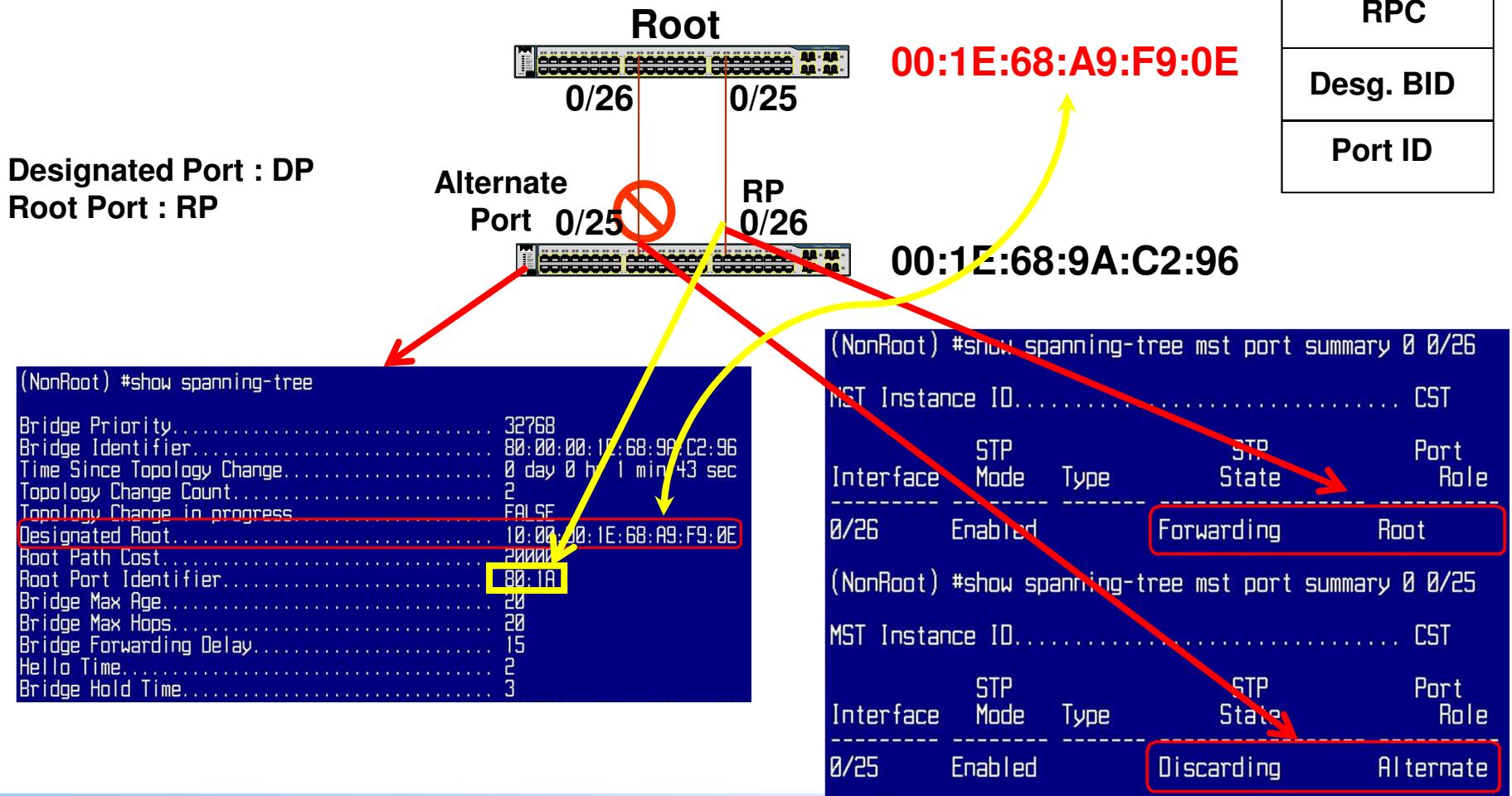
**RSTP is simulated by MSTP.
That's why RSTP use MSTP
command.**

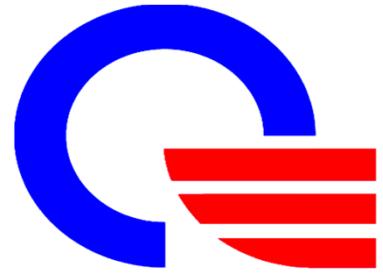
**RSTP is almost same as MSTP
instance 0**



```
(Quanta) (Config)#spanning-tree  
(Quanta) (Config)#spanning-tree mode rstp  
{Quanta} {Config)#interface range 0/25 - 0/26  
{Quanta} {if-range}#spanning-tree port mode
```

Display RSTP Status





Introduction of Spanning Tree – MSTP



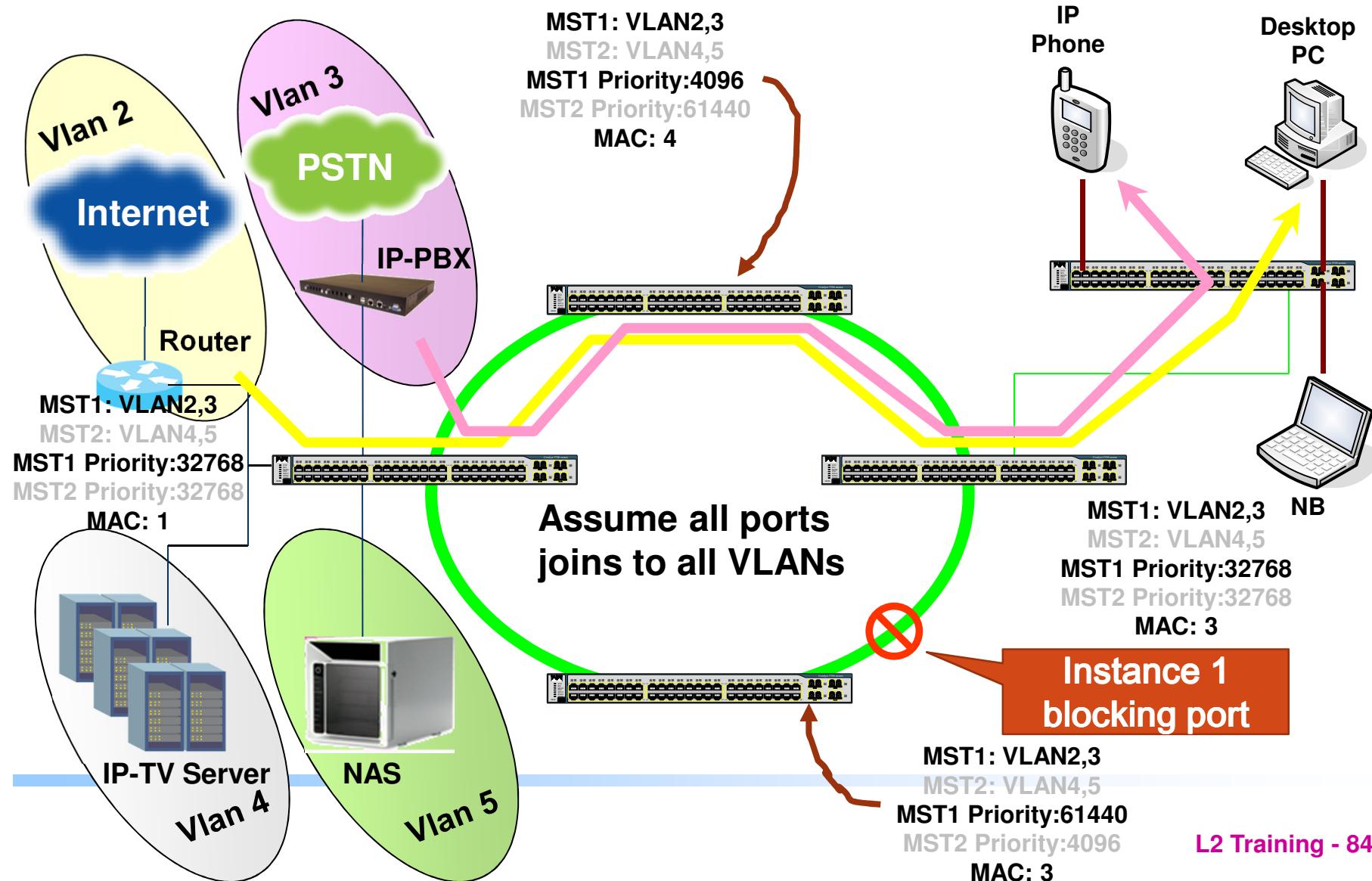
MSTP

● Behaviors

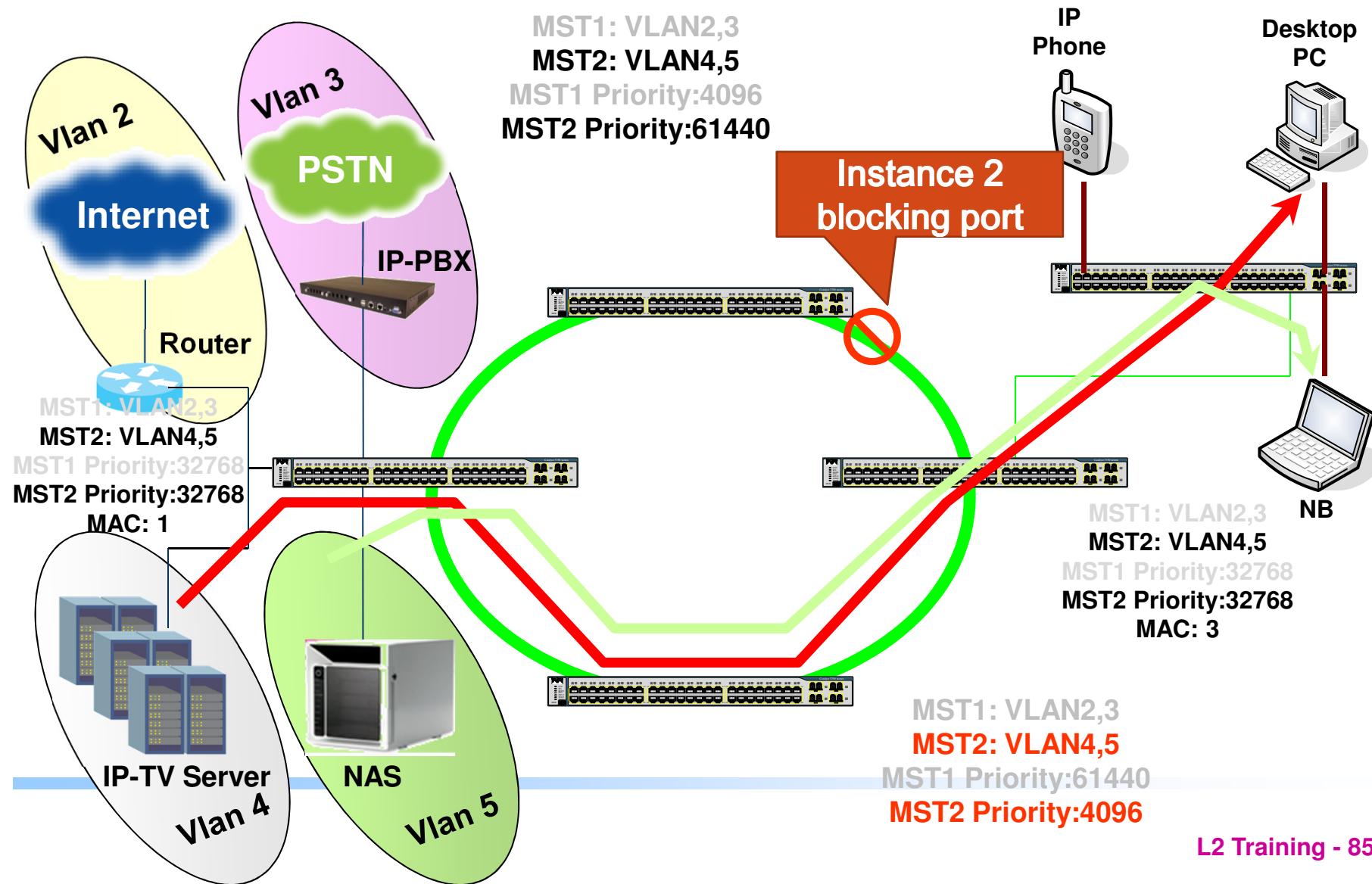
- MSTP uses RSTP for rapid convergence to provide loop-free network and redundant path
- MSTP enables VLANs to be grouped into a spanning-tree instance, with each instance having a spanning-tree topology, provides multiple forwarding paths for data traffic and enables load balancing

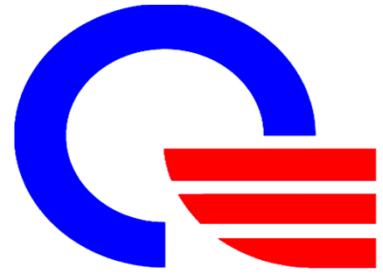
一次只算一個instance的spanning tree state
1.將加入該instance的所有vlan的所有port標出來
2.每個instance都有自己的priority，link cost
3.接下來使用如RSTP的方法找出哪個PORT該被BLOCK
4.其它的instance 依樣畫葫蘆

MSTP - Multiple Spanning-Tree Protocol



MSTP - Load Balance





MSTP Configuration



Configure MSTP

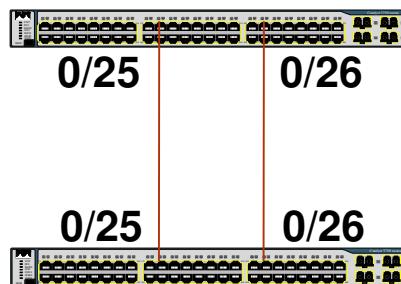
```
(CST-ROOT) (Config)#vlan data  
(CST-ROOT) (Vlan)#vlan 2  
(CST-ROOT) (Vlan)#exit  
(CST-ROOT) (Config)#spanning-tree  
(CST-ROOT) (Config)#spanning-tree mode mstp  
(CST-ROOT) (Config)#spanning-tree configuration name MST_Region_1  
(CST-ROOT) (Config)#spanning-tree mst instance 1  
(CST-ROOT) (Config)#spanning-tree mst vlan 1 2  
(CST-ROOT) (Config)#spanning-tree mst priority 0 4096
```

By default all VLANs are in instance 0; when Vlan add to other instance , then that vlan will be auto removed from instance 0

```
(Config)#vlan data  
(Vlan)#vlan 2  
(Vlan)#exit  
(Config)#spanning-tree  
(Config)#spanning-tree mode mstp  
(Config)#spanning-tree configuration name MST_Region_1  
(Config)#spanning-tree mst instance 1  
(Config)#spanning-tree mst vlan 1 2  
(Config)#spanning-tree mst priority 1 4096
```

```
{Config)#interface range 0/25 - 0/26  
{if-range}#spanning-tree port mode  
{if-range}#  
{if-range}#switchport allowed vlan add 2  
{if-range}#switchport tagging 2
```

MST 0
Root



00:1E:68:A9:F9:0E

00:1E:68:9A:C2:96

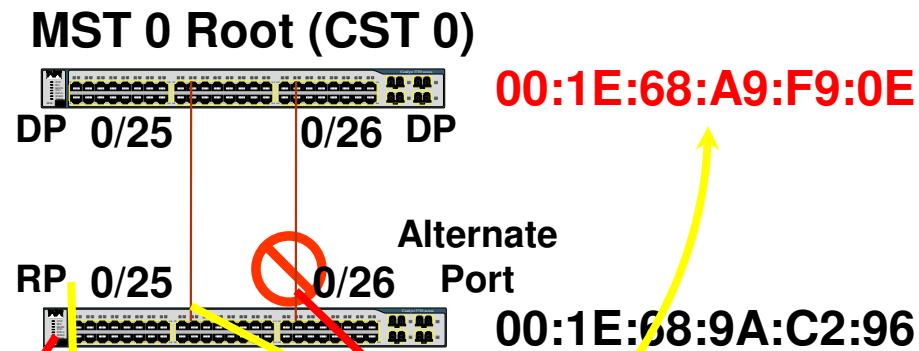
```
{Config)#interface range 0/25 - 0/26  
{if-range}#spanning-tree port mode  
{if-range}#  
{if-range}#switchport allowed vlan add 2  
{if-range}#switchport tagging 2
```

```
(Interface 0/26)#spanning-tree mst 1 port-priority 0
```

MST 1
Root

Display Instance 0 Status

Designated Port : DP
Root Port : RP



```
(MST_ROOT) #show spanning-tree mst detailed 0
MST Instance ID..... 0
MST Bridge Priority..... 32768
MST Bridge Identifier..... 80:00:00:1E:68:9A:C2:96
Time Since Topology Change..... 0 day 0 hr 3 min 54 sec
Topology Change Count..... 2
Topology Change in progress..... FALSE
Designated Root..... 10:00:00:1E:68:A9:F9:0E
Root Path Cost..... 0
Root Port Identifier..... 80:19
```

| MST Instance ID | STP Mode | Type | STP State | Port Role |
|-----------------|----------|------------|-----------|-----------|
| 0/25 | Enabled | Forwarding | Root | |
| 0/26 | Enabled | Discarding | Alternate | |

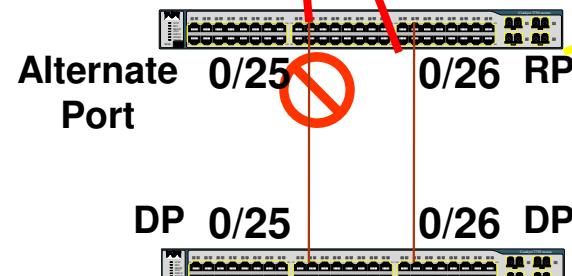
Display Instance 1 Status

```
(CST-ROOT) #show spanning-tree mst port summary 1 0/25
MST Instance ID..... 1
Interface STP Mode Type STP State Port Role
----- -----
0/25 Enabled Discarding Alternate
```

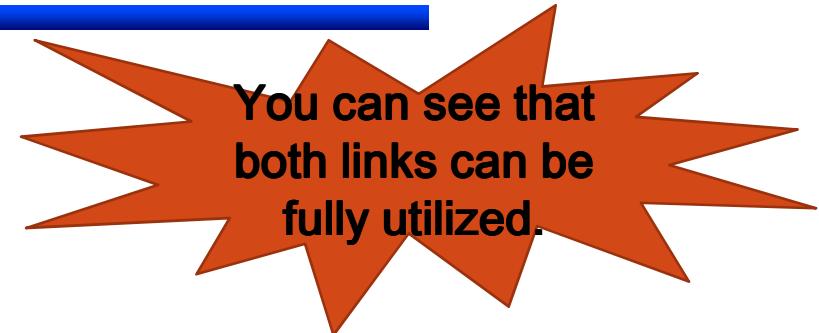


```
(CST-ROOT) #show spanning-tree mst port summary 1 0/26
MST Instance ID..... 1
Interface STP Mode Type STP State Port Role
----- -----
0/26 Enabled Forwarding Root
```

Designated Port : DP
Root Port : RP



MST 1 Root



```
(CST-ROOT) #show spanning-tree mst detailed 1
MST Instance ID..... 1
MST Bridge Priority..... 32768
MST Bridge Identifier..... 80:01:00:1E:68:A9:F9:0E
Time Since Topology Change..... 0 day 0 hr 8 min 11 sec
Topology Change Count..... 4
Topology Change in progress..... FALSE
Designated Root..... 10:01:00:1E:68:9A:C2:96
Root Path Cost..... 20000
Root Port Identifier..... 80:1A
```

00:1E:68:A9:F9:0E

00:1E:68:9A:C2:96

| |
|-----------|
| Root BID |
| RPC |
| Desg. BID |
| Port ID |