

**AIM:** The purpose of this lab is to understand how Ethernet LANs are managed. Initially the functions of Address Resolution Protocol (ARP) are studied. Followed by which experiments for managing Ethernet switches and configuring virtual LANs spanning multiple switches were conducted. Finally, an experiment to configure Inter-VLAN routing were conducted.

**COMPONENTS REQUIRED:**

Components	Quantities
PC	3
Laptop	1
Switch	1
Hub	1
Access Points	1
Cisco Router	1

**EXPERIMENTS:**

**1. Initial topology setup**

The following default topology is setup, in which interface eth1 of each PC and interface eth0 of the laptop are connected to the WB-2 switch. The switch is also connected to the lab common network (LNET port).

PC1 – P122 of Work bench patch panel

PC2 – P222 of Work bench patch panel

PC3 – P322 of Work bench patch panel

PC2 – P422 of Work bench patch panel

Lap – LA112 of Work bench patch panel

**2. IP addressing and ARP**

The experiment gives an idea on how Address Resolution Protocol (ARP) works and how a host delivers IP packets based on their network parameters configuration.

The IP configuration of every PC is monitored using,

**ifconfig eth1**                      %monitor the IP configuration

**route -n**                              %IP routing table is displayed for that PC

```
team12@netlab-wb2pc1:~  
File Edit View Terminal Tabs Help  
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1  
RX packets:440 errors:0 dropped:0 overruns:0 frame:0  
TX packets:6 errors:0 dropped:0 overruns:0 carrier:0  
collisions:0 txqueuelen:1000  
RX bytes:28160 (27.5 KiB) TX bytes:492 (492.0 b)  
Memory:fe9e0000-fea00000  
[team12@netlab-wb2pc1 ~]$ ifconfig eth0  
eth0  
Link encap:Ethernet HWaddr 00:10:18:33:0F:F7  
inet addr:192.168.1.21 Bcast:192.168.1.255 Mask:255.255.255.0  
inet6 addr: fe80::210:18ff:fe33:fff7/64 Scope:Link  
UP BROADCAST MULTICAST MTU:1500 Metric:1  
RX packets:209 errors:0 dropped:0 overruns:0 frame:0  
TX packets:8 errors:0 dropped:0 overruns:0 carrier:0  
collisions:0 txqueuelen:1000  
RX bytes:13376 (13.0 KiB) TX bytes:620 (620.0 b)  
Interrupt:16  
[team12@netlab-wb2pc1 ~]$ ifconfig eth1  
eth1  
Link encap:Ethernet HWaddr 00:1E:4F:C3:07:6A  
inet addr:172.30.2.21 Bcast:172.30.2.255 Mask:255.255.255.0  
inet6 addr: fe80::21e:4fff:fec3:76a/64 Scope:Link  
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1  
RX packets:531 errors:0 dropped:0 overruns:0 frame:0  
TX packets:6 errors:0 dropped:0 overruns:0 carrier:0  
collisions:0 txqueuelen:1000  
RX bytes:33984 (33.1 KiB) TX bytes:492 (492.0 b)  
Memory:fe9e0000-fea00000  
[team12@netlab-wb2pc1 ~]$ clear  
[team12@netlab-wb2pc1 ~]$ ifconfig eth1  
eth1  
Link encap:Ethernet HWaddr 00:1E:4F:C3:07:6A  
inet addr:172.30.2.21 Bcast:172.30.2.255 Mask:255.255.255.0  
inet6 addr: fe80::21e:4fff:fec3:76a/64 Scope:Link  
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1  
RX packets:760 errors:0 dropped:0 overruns:0 frame:0  
TX packets:6 errors:0 dropped:0 overruns:0 carrier:0  
collisions:0 txqueuelen:1000  
RX bytes:48640 (47.5 KiB) TX bytes:492 (492.0 b)  
Memory:fe9e0000-fea00000  
[team12@netlab-wb2pc1 ~]$ route -n  
Kernel IP routing table  
Destination Gateway Genmask Flags Metric Ref Use Iface  
192.168.1.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0  
172.30.2.0 0.0.0.0 255.255.255.0 U 0 0 0 eth1  
192.168.122.0 0.0.0.0 255.255.255.0 U 0 0 0 virbr0  
169.254.0.0 0.0.0.0 255.255.0.0 U 0 0 0 eth1  
0.0.0.0 172.30.2.1 0.0.0.0 UG 0 0 0 eth1  
[team12@netlab-wb2pc1 ~]$
```

Fig 1: PC1 Configuration and Kernel Routing table

### Observations:

The IP routing table for this PC has the destination IP information the corresponding gateway, the general subnet mask, and the Interface to which it is connected,

### Route Determination Process

To determine which routing table entry is used for the forwarding decision, IP uses the following process:

For each entry in a routing table, it performs a bit-wise logical AND between the destination IP address and the network mask. The result is compared with the network ID of the entry for a match.

The list of matching routes is compiled. The route that has the longest match (the route that matched the most number of bits with the destination IP address) is chosen. The longest matching route is the most specific route to the destination IP address.

The result of the route determination process is the choice of a single route in the routing table. The route chosen yields a forwarding IP address (the next hop IP address) and an interface (the port). If the route determination process fails to find a route, IP declares a routing error. For a router, an ICMP Destination Unreachable-Host Unreachable message is sent to the source host.

Here, the destination address 172.30.2.21 that is assigned to the Interface eth1 can be contacted directly via the gateway 172.30.2.1. Since, it belongs to the same network. However, the IP 192.168.1.0 that is assigned to the Interface eth1 requires a router to be forwarded to that network.

```
team12@netlab-wb2pc2:~$ ifconfig eth1
eth1      Link encap:Ethernet  HWaddr 00:1E:4F:C2:FE:96
          inet addr:172.30.2.22  Bcast:172.30.2.255  Mask:255.255.255.0
          inet6 addr: fe80::21e:4fff:fec2:fe96/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:592 errors:0 dropped:0 overruns:0 frame:0
          TX packets:112 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:37888 (37.0 KiB)  TX bytes:7276 (7.1 KiB)
          Memory:fe9e0000-fea00000

[team12@netlab-wb2pc2 ~]$ route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
192.168.1.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0
172.30.2.0 0.0.0.0 255.255.255.0 U 0 0 0 eth1
192.168.122.0 0.0.0.0 255.255.255.0 U 0 0 0 virbr0
169.254.0.0 0.0.0.0 255.255.0.0 U 0 0 0 eth1
0.0.0.0 172.30.2.1 0.0.0.0 UG 0 0 0 eth1
[team12@netlab-wb2pc2 ~]$
```

Fig 2: PC2 Configuration and Kernel Routing table

**Observations:**

The IP routing table for this PC has the destination IP information the corresponding gateway, the general subnet mask, and the Interface to which it is connected,

Here, the destination address 172.30.2.22 that is assigned to the Interface eth1 can be contacted directly via the gateway 172.30.2.1. Since, it belongs to the same network. However, the IP 192.168.1.0 that is assigned to the Interface eth1 requires a router to be forwarded to that network.

```
team12@netlab-wb2pc3:~$ ifconfig eth1
eth1      Link encap:Ethernet  HWaddr 00:1E:4F:C3:00:02
          inet addr:172.30.2.23  Bcast:172.30.2.255  Mask:255.255.255.0
          inet6 addr: fe80::21e:4fff:fec3:2/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:563 errors:0 dropped:0 overruns:0 frame:0
          TX packets:99 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:36032 (35.1 KiB)  TX bytes:6444 (6.2 KiB)
          Memory:fe9e0000-fea00000

[team12@netlab-wb2pc3 ~]$ route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
192.168.1.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0
172.30.2.0 0.0.0.0 255.255.255.0 U 0 0 0 eth1
169.254.0.0 0.0.0.0 255.255.0.0 U 0 0 0 eth1
0.0.0.0 172.30.2.1 0.0.0.0 UG 0 0 0 eth1
[team12@netlab-wb2pc3 ~]$
```

Fig 3: PC3 Configuration and Kernel Routing table

**Observations:**

The IP routing table for this PC has the destination IP information the corresponding gateway, the general subnet mask, and the Interface to which it is connected,

Here, the destination address 172.30.2.23 that is assigned to the Interface eth1 can be contacted directly via the gateway 172.30.2.1. Since, it belongs to the same network. However, the IP 192.168.1.0 that is assigned to the Interface eth1 requires a router to be forwarded to that network.

```

team12@netlab-wb2pc4:~
File Edit View Terminal Tabs Help
[team12@netlab-wb2pc4 ~]$ ifconfig eth1
eth1: error fetching interface information: Device not found
[team12@netlab-wb2pc4 ~]$ ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:1D:09:D4:B3:88
          inet addr:172.30.2.24  Bcast:172.30.2.255  Mask:255.255.255.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
          Interrupt:17

[team12@netlab-wb2pc4 ~]$ clear

[team12@netlab-wb2pc4 ~]$ ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:1D:09:D4:B3:88
          inet addr:172.30.2.24  Bcast:172.30.2.255  Mask:255.255.255.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
          Interrupt:17

[team12@netlab-wb2pc4 ~]$ route -n
Kernel IP routing table
Destination        Gateway           Genmask          Flags Metric Ref    Use Iface
172.30.2.0         0.0.0.0          255.255.255.0    U        0     0        0 eth0
192.168.122.0     0.0.0.0          255.255.255.0    U        0     0        0 virbr0
10.246.60.0        0.0.0.0          255.255.254.0    U        0     0        0 wlan0
169.254.0.0        0.0.0.0          255.255.0.0      U        0     0        0 wlan0
0.0.0.0           10.246.60.1      0.0.0.0          UG       0     0        0 wlan0
[team12@netlab-wb2pc4 ~]$

```

Fig 4: Laptop Configuration and Kernel Routing table

### Observations:

The IP routing table for this PC has the destination IP information the corresponding gateway, the general subnet mask, and the Interface to which it is connected,

Here, the destination address 172.30.2.24 that is assigned to the Interface eth1 can be contacted directly via the gateway 172.30.2.1. Since, it belongs to the same network. However, the IP 192.168.1.0 that is assigned to the Interface eth1 requires a router to be forwarded to that network.

Following this set of analysis, the ARP cache is also verified using the following commands,

**arp -n**                      %displays current content of ARP cache

### Observation:

If the IP address is not found in the ARP table, the PC will then send a broadcast packet to the network using the ARP protocol to ask "who has 172.30.2.24". Because it is a broadcast packet, it is sent to a special MAC address that causes all machines on the network to receive it.

Before broadcast of those packets, when we learn the arp table there would be no resolution for the IP address instead it shows empty, since no ARP request was generated.

Following the arp cache being empty new arp requests are generated using the following command:

**sudo arping [-c N] [-b] -I <interface> <IP address>** %generate arp requests

**Example:**

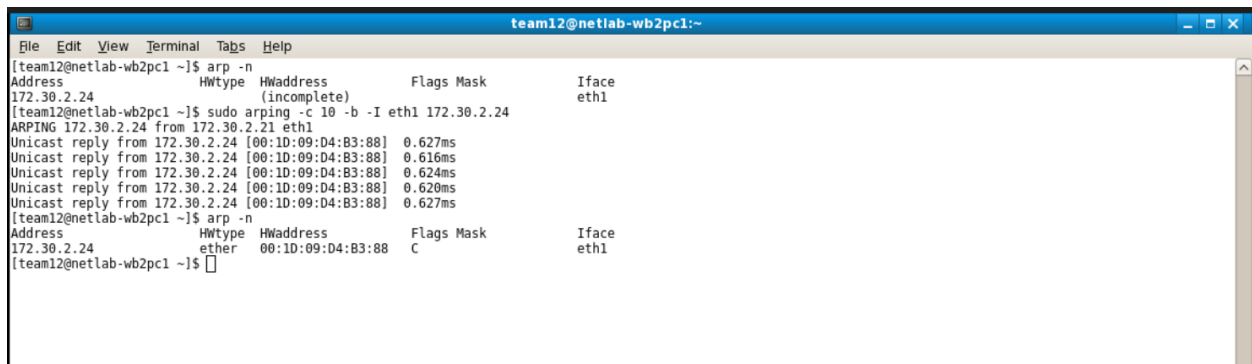
sudo arping -c 50 -b -I eth0 170.30.2.24.

After the ARP requests gets generated the entry in the arp cache is updated with the corresponding Hardware address as shown in Fig 6.



```
team12@netlab-wb2pc2:~  
File Edit View Terminal Tabs Help  
[team12@netlab-wb2pc2 ~]$ arp -n  
Address          HWtype  HWaddress      Flags Mask    Iface  
172.30.2.1        (incomplete)          eth1  
192.168.1.1        (incomplete)          eth0  
[team12@netlab-wb2pc2 ~]$ sudo arping -c 50 -b -I eth0 192.168.1.21  
Password:  
ARPING 192.168.1.21 from 192.168.1.22 eth0  
Sent 50 probes (50 broadcast(s))  
Received 0 response(s)  
[team12@netlab-wb2pc2 ~]$
```

Fig 5: PC2 arp cache content before arping

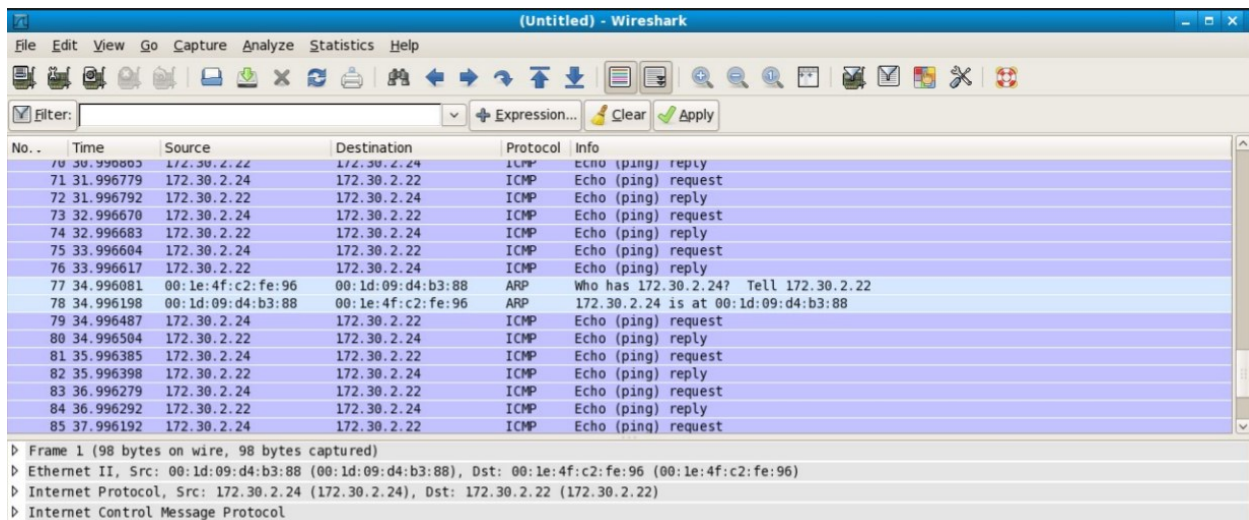


```
team12@netlab-wb2pc1:~  
File Edit View Terminal Tabs Help  
[team12@netlab-wb2pc1 ~]$ arp -n  
Address          HWtype  HWaddress      Flags Mask    Iface  
172.30.2.24        (incomplete)          eth1  
[team12@netlab-wb2pc1 ~]$ sudo arping -c 10 -b -I eth1 172.30.2.24  
ARPING 172.30.2.24 from 172.30.2.21 eth1  
Unicast reply from 172.30.2.24 [00:1D:09:D4:B3:88] 0.627ms  
Unicast reply from 172.30.2.24 [00:1D:09:D4:B3:88] 0.616ms  
Unicast reply from 172.30.2.24 [00:1D:09:D4:B3:88] 0.624ms  
Unicast reply from 172.30.2.24 [00:1D:09:D4:B3:88] 0.620ms  
Unicast reply from 172.30.2.24 [00:1D:09:D4:B3:88] 0.627ms  
[team12@netlab-wb2pc1 ~]$ arp -n  
Address          HWtype  HWaddress      Flags Mask    Iface  
172.30.2.24        ether    00:1D:09:D4:B3:88  C             eth1  
[team12@netlab-wb2pc1 ~]$
```

Fig 6: PC1 arp cache content before and after arping

After working with generating arp requests, the ARP packets are captured using the IP packet monitoring tool Wireshark.

In a different PC, the wireshark terminal is opened and the arp request packets are captured within the network and outside the network.

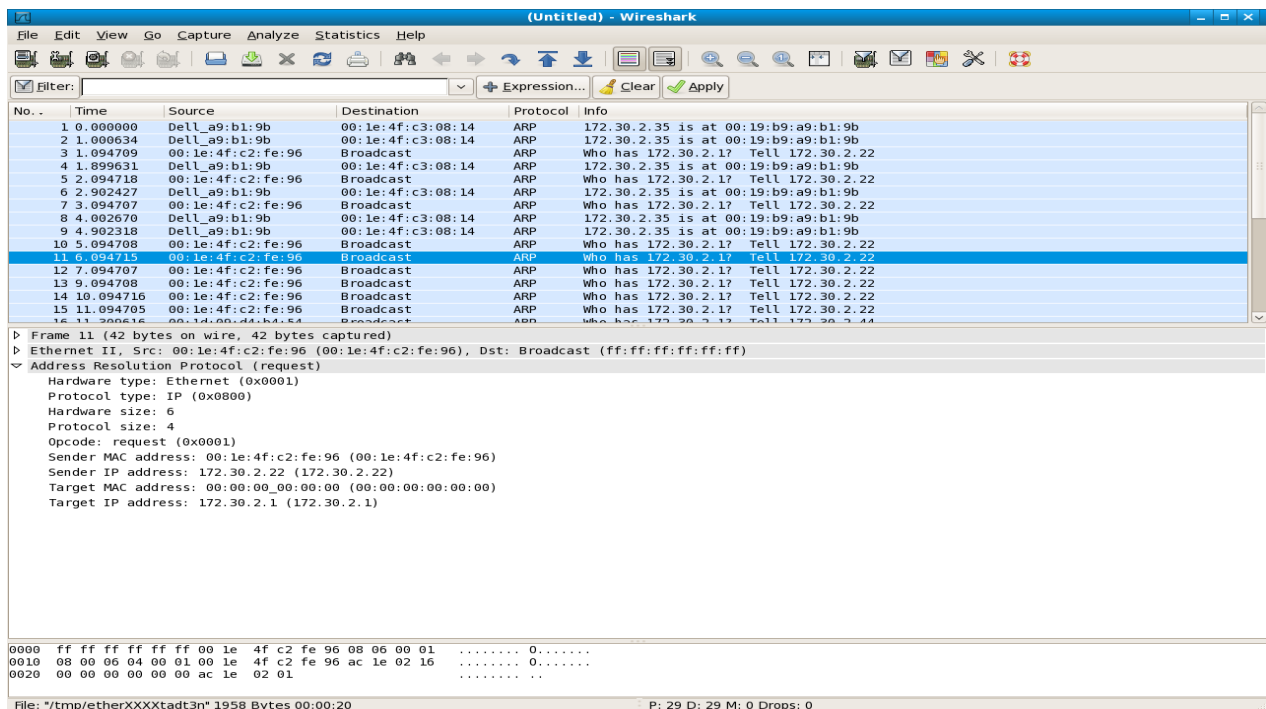


The screenshot shows a Wireshark capture of ICMP Echo (ping) requests and replies between two hosts on the same network. The packet list shows a sequence of requests and replies. The packet details pane shows the Ethernet II, Internet Protocol, and Internet Control Message Protocol layers for a selected packet.

No.	Time	Source	Destination	Protocol	Info
70	30.996803	172.30.2.22	172.30.2.24	ICMP	Echo (ping) reply
71	31.996779	172.30.2.24	172.30.2.22	ICMP	Echo (ping) request
72	31.996792	172.30.2.22	172.30.2.24	ICMP	Echo (ping) reply
73	32.996670	172.30.2.24	172.30.2.22	ICMP	Echo (ping) request
74	32.996683	172.30.2.22	172.30.2.24	ICMP	Echo (ping) reply
75	33.996604	172.30.2.24	172.30.2.22	ICMP	Echo (ping) request
76	33.996617	172.30.2.22	172.30.2.24	ICMP	Echo (ping) reply
77	34.996081	00:1e:4f:c2:fe:96	00:1d:09:d4:b3:88	ARP	Who has 172.30.2.24? Tell 172.30.2.22
78	34.996198	00:1d:09:d4:b3:88	00:1e:4f:c2:fe:96	ARP	172.30.2.24 is at 00:1d:09:d4:b3:88
79	34.996487	172.30.2.24	172.30.2.22	ICMP	Echo (ping) request
80	34.996504	172.30.2.22	172.30.2.24	ICMP	Echo (ping) reply
81	35.996385	172.30.2.24	172.30.2.22	ICMP	Echo (ping) request
82	35.996398	172.30.2.22	172.30.2.24	ICMP	Echo (ping) reply
83	36.996279	172.30.2.24	172.30.2.22	ICMP	Echo (ping) request
84	36.996292	172.30.2.22	172.30.2.24	ICMP	Echo (ping) reply
85	37.996192	172.30.2.24	172.30.2.22	ICMP	Echo (ping) request

Frame 1 (98 bytes on wire, 98 bytes captured)  
 Ethernet II, Src: 00:1d:09:d4:b3:88 (00:1d:09:d4:b3:88), Dst: 00:1e:4f:c2:fe:96 (00:1e:4f:c2:fe:96)  
 Internet Protocol, Src: 172.30.2.24 (172.30.2.24), Dst: 172.30.2.22 (172.30.2.22)  
 Internet Control Message Protocol

Fig 6: *Wireshark ping capture same network*



The screenshot shows a Wireshark capture of ARP requests and replies. The packet list shows a sequence of ARP requests and replies. The packet details pane shows the Ethernet II, Address Resolution Protocol, and Internet Protocol layers for a selected packet. The packet bytes pane shows the raw data of the selected packet.

No.	Time	Source	Destination	Protocol	Info
1	0.000000	Dell_a9:b1:9b	00:1e:4f:c3:08:14	ARP	172.30.2.35 is at 00:19:b9:a9:b1:9b
2	1.000634	Dell_a9:b1:9b	00:1e:4f:c3:08:14	ARP	172.30.2.35 is at 00:19:b9:a9:b1:9b
3	1.094709	00:1e:4f:c2:fe:96	Broadcast	ARP	Who has 172.30.2.1? Tell 172.30.2.22
4	1.899631	Dell_a9:b1:9b	00:1e:4f:c3:08:14	ARP	172.30.2.35 is at 00:19:b9:a9:b1:9b
5	2.094718	00:1e:4f:c2:fe:96	Broadcast	ARP	Who has 172.30.2.1? Tell 172.30.2.22
6	2.902427	Dell_a9:b1:9b	00:1e:4f:c3:08:14	ARP	172.30.2.35 is at 00:19:b9:a9:b1:9b
7	3.094707	00:1e:4f:c2:fe:96	Broadcast	ARP	Who has 172.30.2.1? Tell 172.30.2.22
8	4.002670	Dell_a9:b1:9b	00:1e:4f:c3:08:14	ARP	172.30.2.35 is at 00:19:b9:a9:b1:9b
9	4.902318	Dell_a9:b1:9b	00:1e:4f:c3:08:14	ARP	172.30.2.35 is at 00:19:b9:a9:b1:9b
10	5.094708	00:1e:4f:c2:fe:96	Broadcast	ARP	Who has 172.30.2.1? Tell 172.30.2.22
11	6.094715	00:1e:4f:c2:fe:96	Broadcast	ARP	Who has 172.30.2.1? Tell 172.30.2.22
12	7.094707	00:1e:4f:c2:fe:96	Broadcast	ARP	Who has 172.30.2.1? Tell 172.30.2.22
13	9.094708	00:1e:4f:c2:fe:96	Broadcast	ARP	Who has 172.30.2.1? Tell 172.30.2.22
14	10.094716	00:1e:4f:c2:fe:96	Broadcast	ARP	Who has 172.30.2.1? Tell 172.30.2.22
15	11.094705	00:1e:4f:c2:fe:96	Broadcast	ARP	Who has 172.30.2.1? Tell 172.30.2.22
16	11.300616	00:1d:09:d4:b3:88	Broadcast	ARP	Who has 172.30.2.1? Tell 172.30.2.22

Frame 11 (42 bytes on wire, 42 bytes captured)  
 Ethernet II, Src: 00:1e:4f:c2:fe:96 (00:1e:4f:c2:fe:96), Dst: Broadcast (ff:ff:ff:ff:ff:ff)  
 Address Resolution Protocol (request)  
 Hardware type: Ethernet (0x0001)  
 Protocol type: IP (0x0800)  
 Hardware size: 6  
 Protocol size: 4  
 Opcode: request (0x0001)  
 Sender MAC address: 00:1e:4f:c2:fe:96 (00:1e:4f:c2:fe:96)  
 Sender IP address: 172.30.2.22 (172.30.2.22)  
 Target MAC address: 00:00:00:00:00:00 (00:00:00:00:00:00)  
 Target IP address: 172.30.2.1 (172.30.2.1)

0000 ff ff ff ff ff ff ff ff 4f c2 fe 96 08 06 00 01 ..... 0.....  
 0010 08 00 06 04 00 01 00 1e 4f c2 fe 96 ac 1e 02 16 ..... 0.....  
 0020 00 00 00 00 00 00 ac 1e 02 01 ..... ..

File: "tmp/etherXXXXtadt3n" 1958 Bytes 00:00:20 P: 29 D: 29 M: 0 Drops: 0

Fig 6: *Wireshark arp capture same network*

## Observations:

When the arp packets are generated it is broadcasted to all the PC's connected to the network to find the Hardware Address of that address

In the target, MAC address field the default address is set to 0 in the beginning and then once the Arp cache is updated the MAC ID is updated.

When the ping requests are generated to an external IP address then there exists the error that destination is unreachable and this causes the arp request table to be empty. Since there exists no route to the destined IP address 136.142.116.1

This experiment is followed by creating port based Virtual LAN's for isolating traffic.

A new VLAN is created and few ports are added to these VLAN's, these ports are tagged and then a trunk port is created which is a member to all the VLAN's and the traffic is monitored.

The initial settings for creating, adding ports and tagging of the ports are all done through the management interface of the workbench:

***To create VLAN:***

VLAN Membership → Create VLAN option → specify the VLAN ID to be created. (2 & 3)

***To add a port to a VLAN:***

VLAN Membership → select the desired VLAN ID and click on Apply Changes → check the box corresponding to the port to be assigned to the VLAN → choose U for untagged port (one click) and T for IEEE 802.1Q tagged port (2 clicks) → click on Apply Changes

Then the ports 12 and 14 were added to VLAN2 and the ports 16 and 18 were added to VLAN3 and they are used as untagged ports. Additional port 19 is added to both the VLAN and then it is tagged with the IEEE 802.1Q. This port is used as a trunk port.

***To set PVID for a port:***

VLAN Port Settings → select the port → set the PVID value → Apply Changes

PowerConnect 2724

172.30.2.25
VLAN Membership

Switch Status  
IP Addressing  
Interface Configuration  
Jumbo Frames  
**VLAN Membership**  
VLAN Port Settings  
LAG Membership  
File Download  
Local User Database  
Integrated Cable Test  
Optical Transceiver  
Port Mirroring  
Storm Control  
CoS Settings  
CoS to Queue  
DSCP to Queue  
RMON Statistics  
Reset

VLAN Membership

Print Refresh

Select VLAN ID 2 Create VLAN (2-4094)

Remove VLAN

Ports

Static	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Current													U	U						T				

LAGs

Static	1	2	3	4	5	6
Current						

Not Member  
U Untag egress packets  
T Tag egress packets

Fig 7: VLAN 2 Membership

PowerConnect 2724

172.30.2.25
VLAN Membership

Switch Status  
IP Addressing  
Interface Configuration  
Jumbo Frames  
**VLAN Membership**  
VLAN Port Settings  
LAG Membership  
File Download  
Local User Database  
Integrated Cable Test  
Optical Transceiver  
Port Mirroring  
Storm Control  
CoS Settings  
CoS to Queue  
DSCP to Queue  
RMON Statistics  
Reset

VLAN Membership

Print Refresh

Select VLAN ID 3 Create VLAN (2-4094)

Remove VLAN

Ports

Static	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Current																U			U	T				

LAGs

Static	1	2	3	4	5	6
Current						

Not Member  
U Untag egress packets  
T Tag egress packets

Fig 8: VLAN 3 Membership




Dell OpenManage Switch Administrator

Support

Help

About

Log Out



PowerConnect 2724

172.30.2.25

VLAN Port Settings

Switch Status

IP Addressing

Interface Configur

Jumbo Frames

VLAN Membership

VLAN Port Settings

LAG Membership

File Download

Local User Datab

Integrated Cable T

Optical Transceive

Port Mirroring

Storm Control

CoS Settings

CoS to Queue

DSCP to Queue

RMON Statistics

Reset

Interface	PVID	Frame Type	Ingress Filtering
Port 1	1	Admit All	Enable
Port 2	1	Admit All	Enable
Port 3	1	Admit All	Enable
Port 4	1	Admit All	Enable
Port 5	1	Admit All	Enable
Port 6	1	Admit All	Enable
Port 7	1	Admit All	Enable
Port 8	1	Admit All	Enable
Port 9	1	Admit All	Enable
Port 10	1	Admit All	Enable
Port 11	1	Admit All	Enable
Port 12	2	Admit All	Enable
Port 13	1	Admit All	Enable
Port 14	2	Admit All	Enable
Port 15	1	Admit All	Enable
Port 16	3	Admit All	Enable
Port 17	1	Admit All	Enable
Port 18	3	Admit All	Enable
Port 19	2	Admit All	Enable
Port 20	1	Admit All	Enable
Port 21	1000	Admit All	Enable
Port 22	1000	Admit All	Enable
Port 23	1000	Admit All	Enable
Port 24	1000	Admit All	Enable

Fig 9: VLAN Membership

interface eth0 of the PC's and laptops are connected to untagged ports as follows:

→ PC112 and PC212 to VLAN2

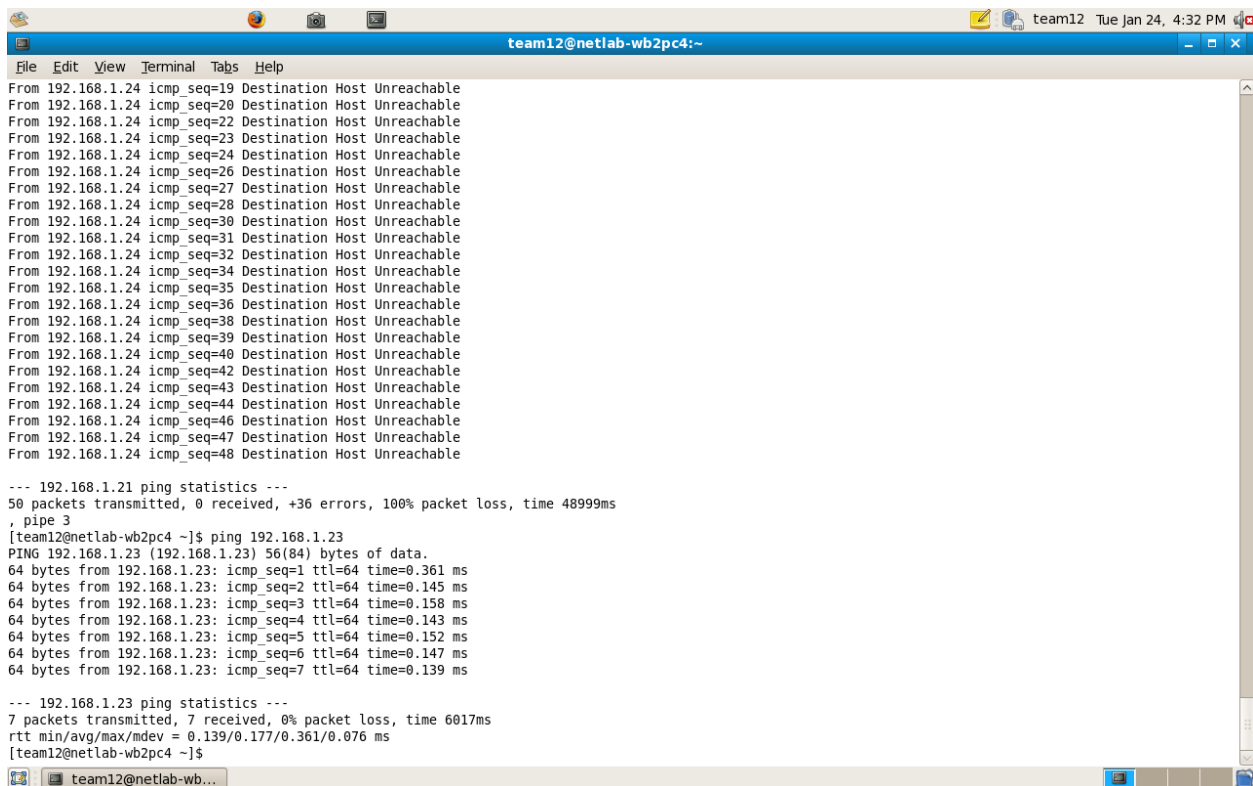
→ PC312 and LA112 to VLAN3

→ The IP address of the laptop NIC is set to 192.168.1.24/24 .

Connectivity of PCs to the laptop is checked over the 192.168.1.0/24 network and the following results were observed.

### Observations:

When the ping command was executed the members of VLAN2 could ping among themselves. However, members of different VLAN were not able to ping. Since they belong to different subnets they were not able to ping



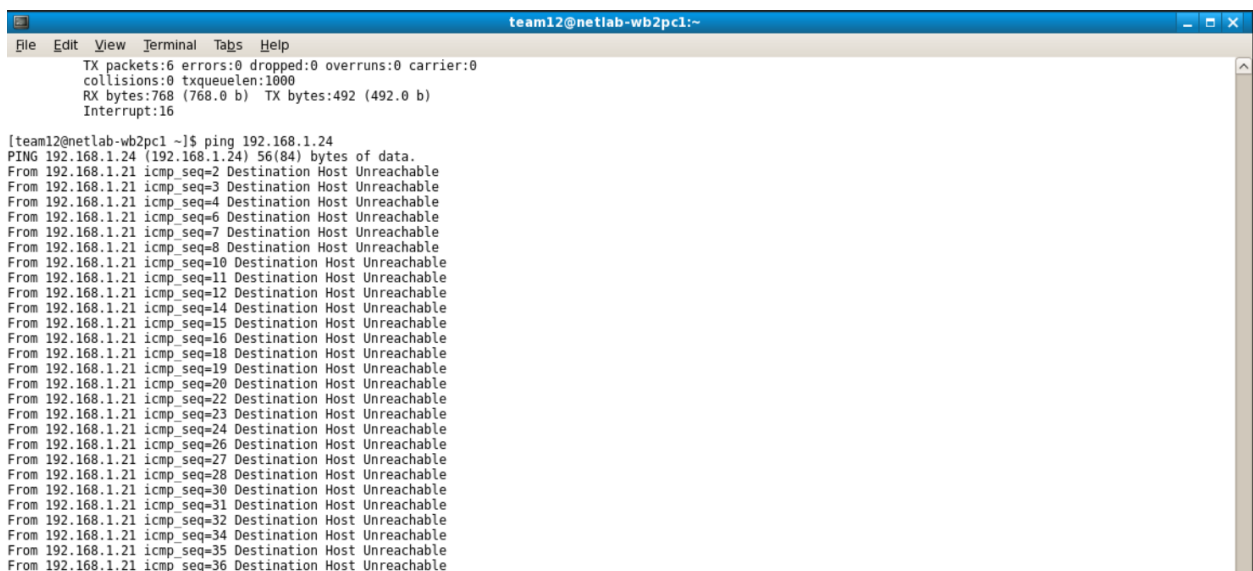
The screenshot shows a terminal window titled "team12@netlab-wb2pc4:~". The terminal output displays a series of ping attempts from 192.168.1.24 to 192.168.1.23. Each attempt results in "Destination Host Unreachable". Following these, a ping statistics summary is shown for 192.168.1.21, indicating 50 packets transmitted, 0 received, and a 100% packet loss. Then, a successful ping is performed from 192.168.1.23 to 192.168.1.23, showing 7 packets transmitted and received with 0% packet loss. The terminal window includes standard menu options like File, Edit, View, Terminal, Tabs, and Help.

```
File Edit View Terminal Tabs Help
From 192.168.1.24 icmp_seq=19 Destination Host Unreachable
From 192.168.1.24 icmp_seq=20 Destination Host Unreachable
From 192.168.1.24 icmp_seq=22 Destination Host Unreachable
From 192.168.1.24 icmp_seq=23 Destination Host Unreachable
From 192.168.1.24 icmp_seq=24 Destination Host Unreachable
From 192.168.1.24 icmp_seq=26 Destination Host Unreachable
From 192.168.1.24 icmp_seq=27 Destination Host Unreachable
From 192.168.1.24 icmp_seq=28 Destination Host Unreachable
From 192.168.1.24 icmp_seq=30 Destination Host Unreachable
From 192.168.1.24 icmp_seq=31 Destination Host Unreachable
From 192.168.1.24 icmp_seq=32 Destination Host Unreachable
From 192.168.1.24 icmp_seq=34 Destination Host Unreachable
From 192.168.1.24 icmp_seq=35 Destination Host Unreachable
From 192.168.1.24 icmp_seq=36 Destination Host Unreachable
From 192.168.1.24 icmp_seq=38 Destination Host Unreachable
From 192.168.1.24 icmp_seq=39 Destination Host Unreachable
From 192.168.1.24 icmp_seq=40 Destination Host Unreachable
From 192.168.1.24 icmp_seq=42 Destination Host Unreachable
From 192.168.1.24 icmp_seq=43 Destination Host Unreachable
From 192.168.1.24 icmp_seq=44 Destination Host Unreachable
From 192.168.1.24 icmp_seq=46 Destination Host Unreachable
From 192.168.1.24 icmp_seq=47 Destination Host Unreachable
From 192.168.1.24 icmp_seq=48 Destination Host Unreachable

--- 192.168.1.21 ping statistics ---
50 packets transmitted, 0 received, +36 errors, 100% packet loss, time 48999ms
, pipe 3
[team12@netlab-wb2pc4 ~]$ ping 192.168.1.23
PING 192.168.1.23 (192.168.1.23) 56(84) bytes of data.
64 bytes from 192.168.1.23: icmp_seq=1 ttl=64 time=0.361 ms
64 bytes from 192.168.1.23: icmp_seq=2 ttl=64 time=0.145 ms
64 bytes from 192.168.1.23: icmp_seq=3 ttl=64 time=0.158 ms
64 bytes from 192.168.1.23: icmp_seq=4 ttl=64 time=0.143 ms
64 bytes from 192.168.1.23: icmp_seq=5 ttl=64 time=0.152 ms
64 bytes from 192.168.1.23: icmp_seq=6 ttl=64 time=0.147 ms
64 bytes from 192.168.1.23: icmp_seq=7 ttl=64 time=0.139 ms

--- 192.168.1.23 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6017ms
rtt min/avg/max/mdev = 0.139/0.177/0.361/0.076 ms
[team12@netlab-wb2pc4 ~]$
```

Fig 10: *Ping within VLAN*



The screenshot shows a terminal window titled "team12@netlab-wb2pc1:~". The terminal output displays network statistics: TX packets:6, errors:0, dropped:0, overruns:0, carrier:0, collisions:0, txqueuelen:1000, RX bytes:768 (768.0 b), TX bytes:492 (492.0 b), and Interrupt:16. Then, a ping command is executed from 192.168.1.24 to 192.168.1.21. The results show 36 consecutive "Destination Host Unreachable" messages, indicating a complete failure to reach the destination outside the VLAN. The terminal window includes standard menu options like File, Edit, View, Terminal, Tabs, and Help.

```
File Edit View Terminal Tabs Help
TX packets:6 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:768 (768.0 b) TX bytes:492 (492.0 b)
Interrupt:16

[team12@netlab-wb2pc1 ~]$ ping 192.168.1.21
PING 192.168.1.21 (192.168.1.21) 56(84) bytes of data.
From 192.168.1.21 icmp_seq=2 Destination Host Unreachable
From 192.168.1.21 icmp_seq=3 Destination Host Unreachable
From 192.168.1.21 icmp_seq=4 Destination Host Unreachable
From 192.168.1.21 icmp_seq=6 Destination Host Unreachable
From 192.168.1.21 icmp_seq=7 Destination Host Unreachable
From 192.168.1.21 icmp_seq=8 Destination Host Unreachable
From 192.168.1.21 icmp_seq=10 Destination Host Unreachable
From 192.168.1.21 icmp_seq=11 Destination Host Unreachable
From 192.168.1.21 icmp_seq=12 Destination Host Unreachable
From 192.168.1.21 icmp_seq=14 Destination Host Unreachable
From 192.168.1.21 icmp_seq=15 Destination Host Unreachable
From 192.168.1.21 icmp_seq=16 Destination Host Unreachable
From 192.168.1.21 icmp_seq=18 Destination Host Unreachable
From 192.168.1.21 icmp_seq=19 Destination Host Unreachable
From 192.168.1.21 icmp_seq=20 Destination Host Unreachable
From 192.168.1.21 icmp_seq=22 Destination Host Unreachable
From 192.168.1.21 icmp_seq=23 Destination Host Unreachable
From 192.168.1.21 icmp_seq=24 Destination Host Unreachable
From 192.168.1.21 icmp_seq=26 Destination Host Unreachable
From 192.168.1.21 icmp_seq=27 Destination Host Unreachable
From 192.168.1.21 icmp_seq=28 Destination Host Unreachable
From 192.168.1.21 icmp_seq=30 Destination Host Unreachable
From 192.168.1.21 icmp_seq=31 Destination Host Unreachable
From 192.168.1.21 icmp_seq=32 Destination Host Unreachable
From 192.168.1.21 icmp_seq=34 Destination Host Unreachable
From 192.168.1.21 icmp_seq=35 Destination Host Unreachable
From 192.168.1.21 icmp_seq=36 Destination Host Unreachable
```

Fig 11: *Ping outside VLAN*

To make VLAN's to work together the trunk configuration is done and then network setup is created as follows



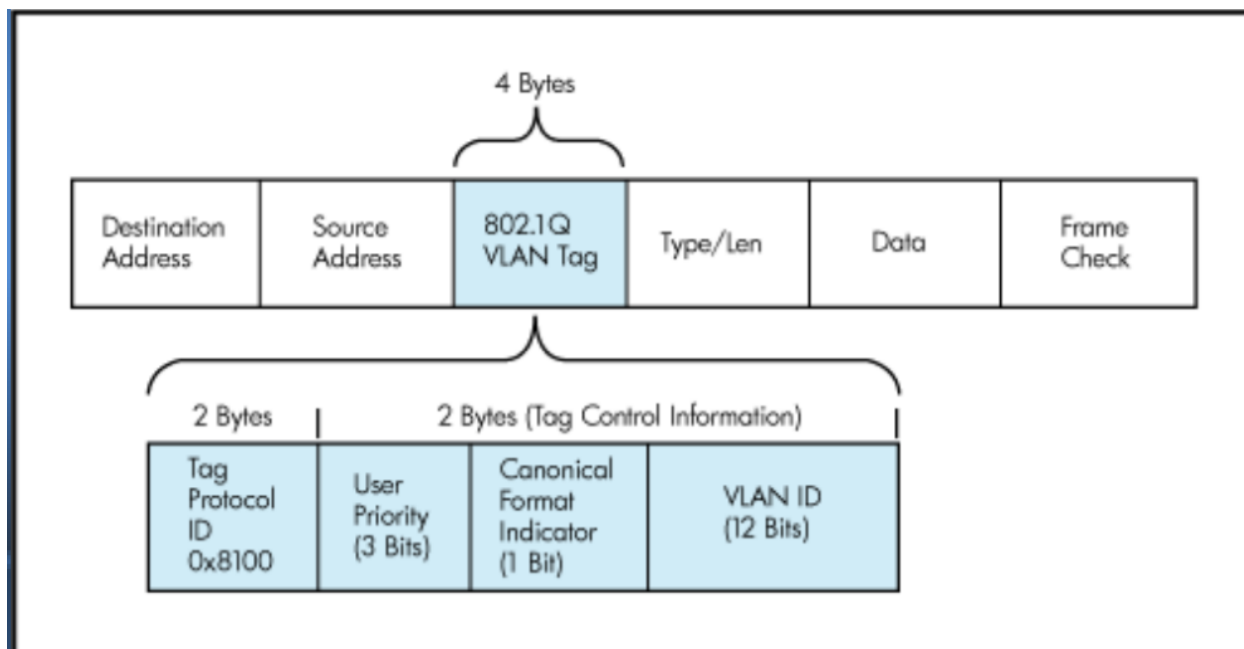


Fig 14: *VLAN packet*

(Untitled) - Wireshark

File Edit View Go Capture Analyze Statistics Help

Filter:  Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Info
248	199.305375	00:1d:09:d4:b3:88	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.24
249	199.777342	Broadcast_33:0f:75	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.22
250	200.305307	00:1d:09:d4:b3:88	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.24
251	201.305299	00:1d:09:d4:b3:88	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.24
252	201.777477	Broadcast_33:0f:75	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.22
253	202.777551	Broadcast_33:0f:75	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.22
254	203.305240	00:1d:09:d4:b3:88	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.24
255	203.777610	Broadcast_33:0f:75	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.22
256	204.305191	00:1d:09:d4:b3:88	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.24
257	205.305167	00:1d:09:d4:b3:88	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.24
258	205.777754	Broadcast_33:0f:75	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.22
259	206.777829	Broadcast_33:0f:75	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.22
260	207.777880	Broadcast_33:0f:75	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.22
261	209.778017	Broadcast_33:0f:75	Broadcast	ARP	Who has 192.168.1.1? Tell 192.168.1.22

Frame 250 (64 bytes on wire, 64 bytes captured)

Ethernet II, Src: 00:1d:09:d4:b3:88 (00:1d:09:d4:b3:88), Dst: Broadcast (ff:ff:ff:ff:ff:ff)

802.1Q Virtual LAN

000. .... = Priority: 0  
 ...0 .... = CFI: 0  
 ... 0000 0000 0011 = ID: 3  
 Type: ARP (0x0806)  
 Trailer: 00

Address Resolution Protocol (request)

Hardware type: Ethernet (0x0001)  
 Protocol type: IP (0x0800)  
 Hardware size: 6  
 Protocol size: 4  
 Opcode: request (0x0001)  
 Sender MAC address: 00:1d:09:d4:b3:88 (00:1d:09:d4:b3:88)  
 Sender IP address: 192.168.1.24 (192.168.1.24)  
 Target MAC address: 00:00:00:00:00:00 (00:00:00:00:00:00)  
 Target IP address: 192.168.1.1 (192.168.1.1)

0000 ff ff ff ff ff ff 00 1d 09 d4 b3 88 81 00 00 03 .....  
 0010 08 06 00 01 08 00 06 04 00 01 00 1d 09 d4 b3 88 .....  
 0020 c0 a8 01 18 00 00 00 00 00 00 c0 a8 01 01 00 00 .....  
 0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

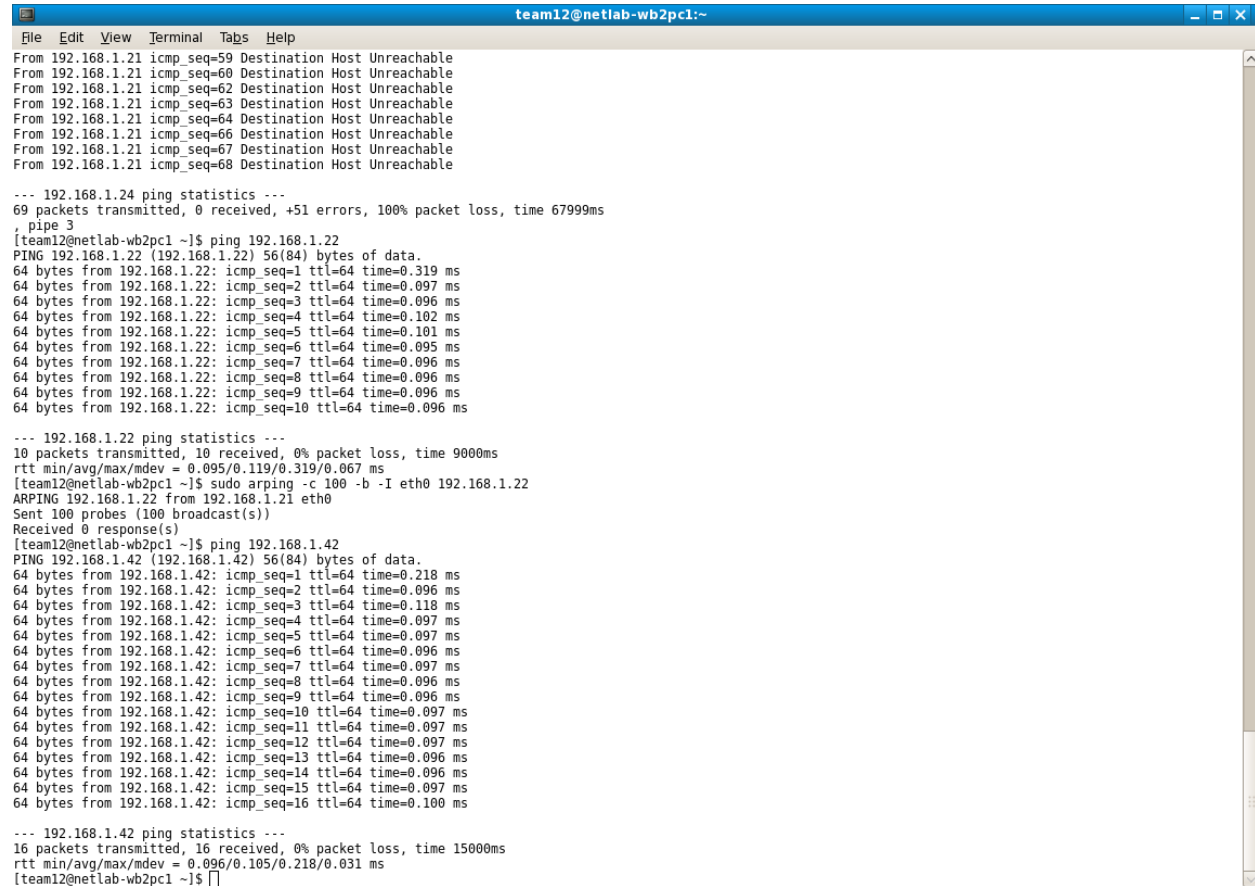
File: "/tmp/etherXXXXFF21lu" 19 KB 00:03:51 P: 278 D: 278 M: 0 Drops: 0

Fig 15: *ARP request VLAN3 packet*

## Observations:

- A networking standard written by the IEEE 802.1 workgroup allowing multiple bridged networks to transparently share the same physical link without leakage of information between networks.

802.1Q- Allows multiple VLANs to span multiple switches



```
team12@netlab-wb2pc1:~  
File Edit View Terminal Tabs Help  
From 192.168.1.21 icmp_seq=59 Destination Host Unreachable  
From 192.168.1.21 icmp_seq=60 Destination Host Unreachable  
From 192.168.1.21 icmp_seq=62 Destination Host Unreachable  
From 192.168.1.21 icmp_seq=63 Destination Host Unreachable  
From 192.168.1.21 icmp_seq=64 Destination Host Unreachable  
From 192.168.1.21 icmp_seq=66 Destination Host Unreachable  
From 192.168.1.21 icmp_seq=67 Destination Host Unreachable  
From 192.168.1.21 icmp_seq=68 Destination Host Unreachable  
  
--- 192.168.1.24 ping statistics ---  
69 packets transmitted, 0 received, +51 errors, 100% packet loss, time 67999ms  
, pipe 3  
[team12@netlab-wb2pc1 ~]$ ping 192.168.1.22  
PING 192.168.1.22 (192.168.1.22) 56(84) bytes of data:  
64 bytes from 192.168.1.22: icmp_seq=1 ttl=64 time=0.319 ms  
64 bytes from 192.168.1.22: icmp_seq=2 ttl=64 time=0.097 ms  
64 bytes from 192.168.1.22: icmp_seq=3 ttl=64 time=0.096 ms  
64 bytes from 192.168.1.22: icmp_seq=4 ttl=64 time=0.102 ms  
64 bytes from 192.168.1.22: icmp_seq=5 ttl=64 time=0.101 ms  
64 bytes from 192.168.1.22: icmp_seq=6 ttl=64 time=0.095 ms  
64 bytes from 192.168.1.22: icmp_seq=7 ttl=64 time=0.096 ms  
64 bytes from 192.168.1.22: icmp_seq=8 ttl=64 time=0.096 ms  
64 bytes from 192.168.1.22: icmp_seq=9 ttl=64 time=0.096 ms  
64 bytes from 192.168.1.22: icmp_seq=10 ttl=64 time=0.096 ms  
  
--- 192.168.1.22 ping statistics ---  
10 packets transmitted, 10 received, 0% packet loss, time 9000ms  
rtt min/avg/max/mdev = 0.095/0.119/0.319/0.067 ms  
[team12@netlab-wb2pc1 ~]$ sudo arping -c 100 -b -I eth0 192.168.1.22  
ARPING 192.168.1.22 from 192.168.1.21 eth0  
Sent 100 probes (100 broadcast(s))  
Received 0 response(s)  
[team12@netlab-wb2pc1 ~]$ ping 192.168.1.42  
PING 192.168.1.42 (192.168.1.42) 56(84) bytes of data:  
64 bytes from 192.168.1.42: icmp_seq=1 ttl=64 time=0.218 ms  
64 bytes from 192.168.1.42: icmp_seq=2 ttl=64 time=0.096 ms  
64 bytes from 192.168.1.42: icmp_seq=3 ttl=64 time=0.118 ms  
64 bytes from 192.168.1.42: icmp_seq=4 ttl=64 time=0.097 ms  
64 bytes from 192.168.1.42: icmp_seq=5 ttl=64 time=0.097 ms  
64 bytes from 192.168.1.42: icmp_seq=6 ttl=64 time=0.096 ms  
64 bytes from 192.168.1.42: icmp_seq=7 ttl=64 time=0.097 ms  
64 bytes from 192.168.1.42: icmp_seq=8 ttl=64 time=0.096 ms  
64 bytes from 192.168.1.42: icmp_seq=9 ttl=64 time=0.096 ms  
64 bytes from 192.168.1.42: icmp_seq=10 ttl=64 time=0.097 ms  
64 bytes from 192.168.1.42: icmp_seq=11 ttl=64 time=0.097 ms  
64 bytes from 192.168.1.42: icmp_seq=12 ttl=64 time=0.097 ms  
64 bytes from 192.168.1.42: icmp_seq=13 ttl=64 time=0.096 ms  
64 bytes from 192.168.1.42: icmp_seq=14 ttl=64 time=0.096 ms  
64 bytes from 192.168.1.42: icmp_seq=15 ttl=64 time=0.097 ms  
64 bytes from 192.168.1.42: icmp_seq=16 ttl=64 time=0.100 ms  
  
--- 192.168.1.42 ping statistics ---  
16 packets transmitted, 16 received, 0% packet loss, time 15000ms  
rtt min/avg/max/mdev = 0.096/0.105/0.218/0.031 ms  
[team12@netlab-wb2pc1 ~]$
```

Fig 16: Ping same VLAN across workbench

```
team12@netlab-wb2pc4:~  
File Edit View Terminal Tabs Help  
From 192.168.1.24 icmp_seq=10 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=11 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=12 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=14 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=15 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=16 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=18 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=19 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=20 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=22 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=23 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=24 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=26 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=27 Destination Host Unreachable  
From 192.168.1.24 icmp_seq=28 Destination Host Unreachable  
  
--- 192.168.1.42 ping statistics ---  
28 packets transmitted, 0 received, +21 errors, 100% packet loss, time 26999ms  
 , pipe 3  
[team12@netlab-wb2pc4 ~]$ ping 192.168.1.43  
PING 192.168.1.43 (192.168.1.43) 56(84) bytes of data.  
64 bytes from 192.168.1.43: icmp_seq=1 ttl=64 time=0.821 ms  
64 bytes from 192.168.1.43: icmp_seq=2 ttl=64 time=0.158 ms  
64 bytes from 192.168.1.43: icmp_seq=3 ttl=64 time=0.169 ms  
64 bytes from 192.168.1.43: icmp_seq=4 ttl=64 time=0.160 ms  
64 bytes from 192.168.1.43: icmp_seq=5 ttl=64 time=0.160 ms  
64 bytes from 192.168.1.43: icmp_seq=6 ttl=64 time=0.145 ms  
64 bytes from 192.168.1.43: icmp_seq=7 ttl=64 time=0.155 ms  
64 bytes from 192.168.1.43: icmp_seq=8 ttl=64 time=0.157 ms  
64 bytes from 192.168.1.43: icmp_seq=9 ttl=64 time=0.164 ms  
64 bytes from 192.168.1.43: icmp_seq=10 ttl=64 time=0.162 ms  
64 bytes from 192.168.1.43: icmp_seq=11 ttl=64 time=0.164 ms  
64 bytes from 192.168.1.43: icmp_seq=12 ttl=64 time=0.162 ms  
64 bytes from 192.168.1.43: icmp_seq=13 ttl=64 time=0.156 ms  
64 bytes from 192.168.1.43: icmp_seq=14 ttl=64 time=0.156 ms  
64 bytes from 192.168.1.43: icmp_seq=15 ttl=64 time=0.166 ms  
  
--- 192.168.1.43 ping statistics ---  
15 packets transmitted, 15 received, 0% packet loss, time 14000ms  
rtt min/avg/max/mdev = 0.145/0.203/0.821/0.165 ms  
[team12@netlab-wb2pc4 ~]$
```

Fig 16: Ping same VLAN across workbench

**Observation:**

When ping is done from same VLAN the two switches can communicate effectively that the tagged port is used for spanning multiple trees.

**Simple routing configuration**

**Aim:**

To interconnect two LANs using a router and assign different IP network for the two VLAN for doing a route between them

**Components Used:**

Components	Quantities
PC	2
Switch	1
Router	1

**Network diagram:**

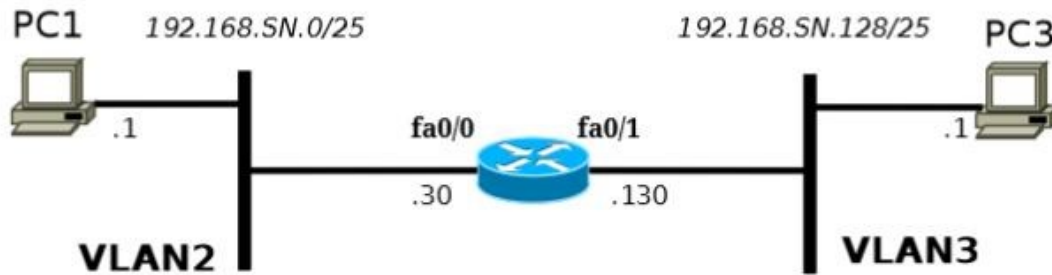
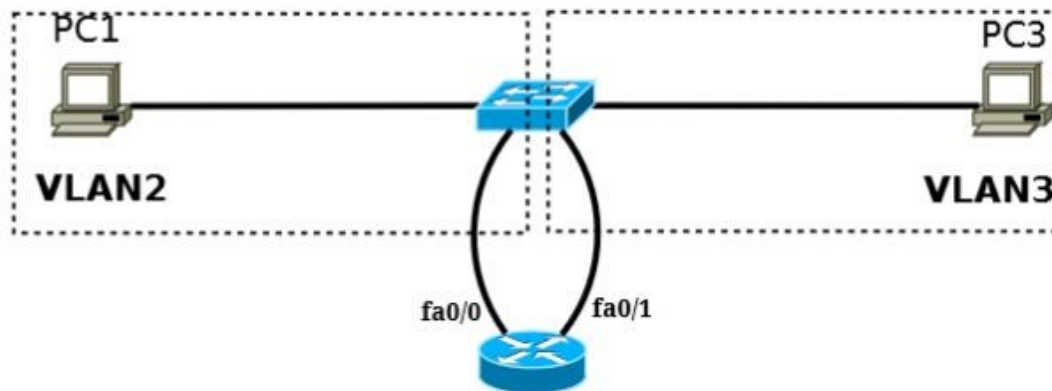


Figure 2: Logical topology for routing between VLANs



### Setup:

VLAN1 has PC1 and VLAN3 has PC3. A switch is connected between these two PC's and a router is also interconnected

such that fa0/0 and fa0/1 are supported

### Process:

**ifconfig** command is used to configure the IP address of PC1 to 192.168.12.1/25 and PC3 to 192.168.12.129/25 and the two VLAN ports are connected which are available after disconnecting them from the workbench router. Now VLAN2 is in network 192.168.12.0/25 and VLAN3 is in network 192.168.12.128/25 and the router needs to be configured.

The IP addresses to the two router interfaces facing VLAN2 and VLAN3 are 192.168.12.30/25 and 192.168.12.130 respectively. Using some commands, the IP address to these router interfaces are configured which is shown below,

```
team12@netlab-wb2pc1:~  
File Edit View Terminal Tabs Help  
Password:  
Password:  
Password:  
  
Welcome to the SecureLinux Console Manager  
Model Number: SLC16  
For a list of commands, type 'help'.  
  
[mgmtswitch]> connect direct deviceport R1M2  
Connecting to Device Port R1M2.  
Connected to port 3. Escape sequence is ESC A  
  
R1WB2>enable  
R1WB2#show ip interface brief  
Interface IP-Address OK? Method Status Prot  
FastEthernet0/0 unassigned YES NVRAM up up  
FastEthernet0/1 unassigned YES NVRAM up up  
FastEthernet0/0/0 unassigned YES NVRAM up down  
  
R1WB2#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
R1WB2(config)#interface fa 0/0  
R1WB2(config-if)#ip address 192.168.12.30/25  
^  
% Invalid input detected at '^' marker.  
  
R1WB2(config-if)#ip address 192.168.12.30 255.255.255.1  
Bad mask 0xFFFFF01 for address 192.168.12.30  
R1WB2(config-if)#ip address 192.168.12.30 255.255.255.128  
R1WB2(config-if)#exit  
R1WB2(config)#^Z  
R1WB2#  
*Jan 25 00:24:15.696: %SYS-5-CONFIG_I: Configured from console by console^Z  
R1WB2#^Z  
R1WB2#^Z  
R1WB2#^Z  
R1WB2#^Z  
R1WB2#^Z  
R1WB2#^Z  
R1WB2#^Z  
R1WB2#^Z  
R1WB2#^Z  
R1WB2#^Z  
R1WB2#shutdown  
Translating "shutdown"  
  
Translating "shutdown"  
  
% Bad IP address or host name
```

**Fig 4.5.1 IP address configuration to router interface using PC1**

Once the IP address is assigned, then the command **sudo route add default gw <routerIP>** is executed in both the VLAN



```
team12@netlab-wb2pc1:~  
File Edit View Terminal Tabs Help  
  
R1WB2 con0 is now available  
  
Press RETURN to get started.  
  
Returning to command line  
[mgmtswitch]> exit  
Unknown parameter: 'exit'  
[mgmtswitch]> logout  
Logging out...  
Connection to 192.168.1.250 closed by remote host.  
Connection to 192.168.1.250 closed.  
[team12@netlab-wb2pc1 ~]$ sudo route add default gw 192.168.12.30  
[team12@netlab-wb2pc1 ~]$ ping 192.168.12.129  
PING 192.168.12.129 (192.168.12.129) 56(84) bytes of data.  
64 bytes from 192.168.12.129: icmp_seq=1 ttl=63 time=6.40 ms  
64 bytes from 192.168.12.129: icmp_seq=2 ttl=63 time=0.237 ms  
64 bytes from 192.168.12.129: icmp_seq=3 ttl=63 time=0.245 ms  
64 bytes from 192.168.12.129: icmp_seq=4 ttl=63 time=0.236 ms  
64 bytes from 192.168.12.129: icmp_seq=5 ttl=63 time=0.243 ms  
64 bytes from 192.168.12.129: icmp_seq=6 ttl=63 time=0.241 ms  
64 bytes from 192.168.12.129: icmp_seq=7 ttl=63 time=0.237 ms  
64 bytes from 192.168.12.129: icmp_seq=8 ttl=63 time=0.239 ms  
64 bytes from 192.168.12.129: icmp_seq=9 ttl=63 time=0.242 ms  
--- 192.168.12.129 ping statistics ---  
9 packets transmitted, 9 received, 0% packet loss, time 7999ms  
rtt min/avg/max/mdev = 0.236/0.925/6.405/1.937 ms  
[team12@netlab-wb2pc1 ~]$
```

Fig 4.5.2 IP address configuration to router interface (contd) and pinging to PC3

```
Applications Places System team12@netlab-wb2pc1:~  
Tue Jan 24, 7:44 PM team12  
team12@netlab-wb2pc3:~  
File Edit View Terminal Tabs Help  
[team12@netlab-wb2pc3 ~]$ sudo ifconfig eth1 up  
[team12@netlab-wb2pc3 ~]$ ifconfig eth1  
eth1      Link encap:Ethernet  HWaddr 00:1E:4F:C3:00:02  
          inet addr:172.30.2.23  Bcast:172.30.2.255  Mask:255.255.255.0  
          inet6 addr: fe80::21e:4fff:fec3:2/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:4142 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:536 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:272726 (266.3 KiB)  TX bytes:42050 (41.0 KiB)  
          Memory:fe9e0000-fea00000  
  
[team12@netlab-wb2pc3 ~]$ sudo ifconfig eth1 192.168.1.23/24  
[team12@netlab-wb2pc3 ~]$ ssh -l team2 192.168.1.250  
Password:  
  
Welcome to the SecureLinux Console Manager  
Model Number: SLC16  
For a list of commands, type 'help'.  
  
[mgmtswitch]> enable  
Unknown parameter: 'enable'  
[mgmtswitch]> connect direct deviceport R1M2  
Connecting to DMZ.  
connected to port 3. Escape sequence is ESC A  
  
R1WB2>  
R1WB2>  
R1WB2>  
R1WB2>  
R1WB2>enable  
R1WB2#sh ip int br  
Interface IP-Address OK? Method Status Prot  
oc01 192.168.12.30 YES manual up up  
FastEthernet0/0 unassigned YES NVRAM up up  
FastEthernet0/1 unassigned YES NVRAM up up  
FastEthernet0/0/0 unassigned YES NVRAM up down  
  
R1WB2#conf t  
Enter configuration commands, one per line. End with CNTL/Z.  
R1WB2(config)#int fa0/1  
R1WB2(config-if)#ip address 192.168.12.130 255.255.255.128  
R1WB2(config-if)#exit  
R1WB2(config)#^Z  
R1WB2#  
*Jan 25 00:41:18.120: %SYS-5-CONFIG_I: Configured from console by console  
  
Returning to command line  
[mgmtswitch]> logout  
Logging out...  
Connection to 192.168.1.250 closed by remote host.  
team12@netlab-wb2...
```

Fig 4.5.3 IP address configuration to router interface using PC3

```

Applications Places System Tue Jan 24, 7:45 PM team12
team12@netlab-wb2pc3:~
File Edit View Terminal Tabs Help
Model Number: SLC16
For a list of commands, type 'help'.

[mgmtswitch]> enable
Unknown parameter: 'enable'
[mgmtswitch]> connect direct deviceport R1M2
Connecting to Device Port R1M2.
Connected to port 3. Escape sequence is ESC A

R1WB2>
R1WB2>
R1WB2>
R1WB2>enable
R1WB2#sh ip int br
Interface IP-Address OK? Method Status Prot
oCol
FastEthernet0/0 192.168.12.30 YES manual up
FastEthernet0/1 unassigned YES NVRAM up
FastEthernet0/0/0 unassigned YES NVRAM up down

R1WB2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1WB2(config)#int fa0/1
R1WB2(config-if)#ip address 192.168.12.130 255.255.255.128
R1WB2(config-if)#exit
R1WB2(config)#^Z
R1WB2#
*Jan 25 00:41:18.120: %SYS-5-CONFIG_I: Configured from console by console

Returning to command line
[mgmtswitch]> logout
Logging out...

Connection to 192.168.1.250 closed by remote host.
Connection to 192.168.1.250 closed.
[team12@netlab-wb2pc3 ~]$ sudo route add default gw 192.168.12.128
SIOCADDRT: No such process
[team12@netlab-wb2pc3 ~]$ sudo route add default gw 192.168.12.130
[team12@netlab-wb2pc3 ~]$ ping 192.168.12.1
PING 192.168.12.1 (192.168.12.1) 56(84) bytes of data.
64 bytes from 192.168.12.1: icmp_seq=1 ttl=63 time=0.265 ms
64 bytes from 192.168.12.1: icmp_seq=2 ttl=63 time=0.247 ms
64 bytes from 192.168.12.1: icmp_seq=3 ttl=63 time=0.250 ms
64 bytes from 192.168.12.1: icmp_seq=4 ttl=63 time=0.239 ms
64 bytes from 192.168.12.1: icmp_seq=5 ttl=63 time=0.240 ms
64 bytes from 192.168.12.1: icmp_seq=6 ttl=63 time=0.257 ms

--- 192.168.12.1 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 4999ms
rtt min/avg/max/mdev = 0.239/0.249/0.265/0.020 ms
[team12@netlab-wb2pc3 ~]$

```

**Fig 4.5.4 IP address configuration to router interface (contd) and pinging to PC1**

Ping function and trace route command is performed between both PC's

## Inter-VLAN routing configuration

### Aim:

To configure a scalable solution for inter-VLAN routing by using a single router interface and a single switch port to interconnect multiple VLAN

### Components Used:

Components	Quantities
PC	2
Switch	1
Router	1

### Setup:

The tagged port is connected to interface fa0/0 of the router and the interface fa0/1 is disconnected.

### Process:

Interface fa0/1 is shut down using the command **interface fa0/1 shut down** and the IP address of fa0/0 is removed using **interface fa0/0 no ip address** . Then the following commands are executed to create two sub interfaces for two VLANs and for assigning IP address.

**interface fa0/0.2**

**Encapsulation dot 1Q 2**

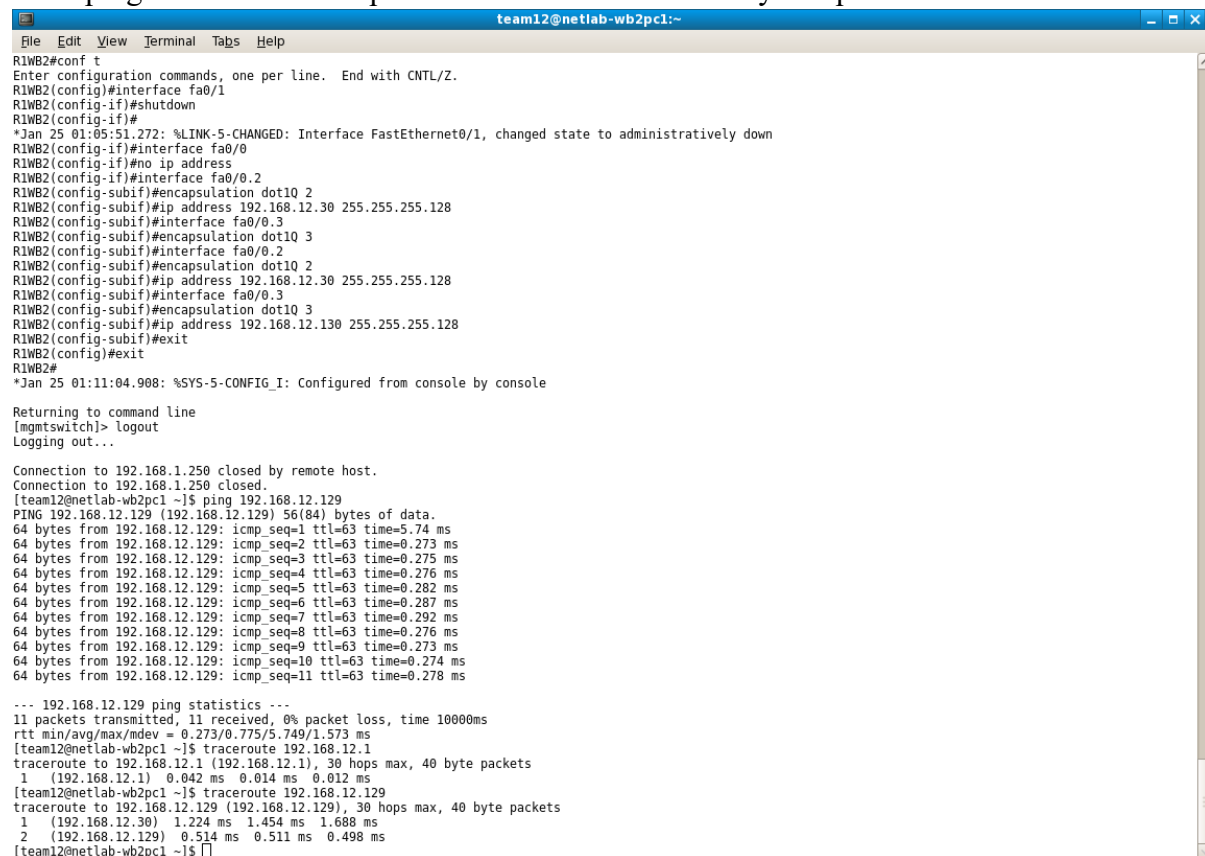
**ip address 192.168.12.30 255.255.255.128**

**interface fa0/0.3**

**Encapsulation dot 1Q 3**

**ip address 192.168.12.130 255.255.255.128**

Then ping and traceroute is performed to check connectivity and path between the two hosts.

A screenshot of a terminal window titled 'team12@netlab-wb2pc1:~'. The terminal shows a series of commands and their outputs. First, the user enters 'R1WB2#conf t' to enter configuration mode. They then shut down interface fa0/1, remove the IP address from fa0/0, and create two sub-interfaces: fa0/0.2 and fa0/0.3. Each sub-interface is configured with 'encapsulation dot1Q' and an IP address (192.168.12.30 for .2 and 192.168.12.130 for .3). After exiting configuration mode, the user logs out. The terminal then shows a ping command from 192.168.12.129 to 192.168.12.129, which succeeds with 11 packets. Finally, a traceroute is performed from 192.168.12.129 to 192.168.12.129, showing a path of two hops.

```
R1WB2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1WB2(config)#interface fa0/1
R1WB2(config-if)#shut down
R1WB2(config-if)#
*Jan 25 01:05:51.272: %LINK-5-CHANGED: Interface FastEthernet0/1, changed state to administratively down
R1WB2(config-if)#interface fa0/0
R1WB2(config-if)#no ip address
R1WB2(config-if)#interface fa0/0.2
R1WB2(config-subif)#encapsulation dot1Q 2
R1WB2(config-subif)#ip address 192.168.12.30 255.255.255.128
R1WB2(config-subif)#interface fa0/0.3
R1WB2(config-subif)#encapsulation dot1Q 3
R1WB2(config-subif)#interface fa0/0.2
R1WB2(config-subif)#encapsulation dot1Q 2
R1WB2(config-subif)#ip address 192.168.12.30 255.255.255.128
R1WB2(config-subif)#interface fa0/0.3
R1WB2(config-subif)#encapsulation dot1Q 3
R1WB2(config-subif)#ip address 192.168.12.130 255.255.255.128
R1WB2(config-subif)#exit
R1WB2(config)#exit
R1WB2#
*Jan 25 01:11:04.908: %SYS-5-CONFIG_I: Configured from console by console

Returning to command line
[mgmtswitch]> logout
Logging out...

Connection to 192.168.1.250 closed by remote host.
Connection to 192.168.1.250 closed.
[team12@netlab-wb2pc1 ~]$ ping 192.168.12.129
PING 192.168.12.129 (192.168.12.129) 56(84) bytes of data.
64 bytes from 192.168.12.129: icmp_seq=1 ttl=63 time=5.74 ms
64 bytes from 192.168.12.129: icmp_seq=2 ttl=63 time=0.273 ms
64 bytes from 192.168.12.129: icmp_seq=3 ttl=63 time=0.275 ms
64 bytes from 192.168.12.129: icmp_seq=4 ttl=63 time=0.276 ms
64 bytes from 192.168.12.129: icmp_seq=5 ttl=63 time=0.282 ms
64 bytes from 192.168.12.129: icmp_seq=6 ttl=63 time=0.287 ms
64 bytes from 192.168.12.129: icmp_seq=7 ttl=63 time=0.292 ms
64 bytes from 192.168.12.129: icmp_seq=8 ttl=63 time=0.276 ms
64 bytes from 192.168.12.129: icmp_seq=9 ttl=63 time=0.273 ms
64 bytes from 192.168.12.129: icmp_seq=10 ttl=63 time=0.274 ms
64 bytes from 192.168.12.129: icmp_seq=11 ttl=63 time=0.278 ms
--- 192.168.12.129 ping statistics ---
11 packets transmitted, 11 received, 0% packet loss, time 10000ms
rtt min/avg/max/mdev = 0.273/0.775/5.749/1.573 ms
[team12@netlab-wb2pc1 ~]$ traceroute 192.168.12.1
traceroute to 192.168.12.1 (192.168.12.1), 30 hops max, 40 byte packets
 1 (192.168.12.1) 0.042 ms 0.014 ms 0.012 ms
[team12@netlab-wb2pc1 ~]$ traceroute 192.168.12.129
traceroute to 192.168.12.129 (192.168.12.129), 30 hops max, 40 byte packets
 1 (192.168.12.30) 1.224 ms 1.454 ms 1.688 ms
 2 (192.168.12.129) 0.514 ms 0.511 ms 0.498 ms
[team12@netlab-wb2pc1 ~]$
```

**Fig 4.6.1 Ping & trace route from PC1**

```
team12@netlab-wb2pc3:~  
File Edit View Terminal Tabs Help  
64 bytes from 192.168.12.1: icmp_seq=238 ttl=63 time=0.268 ms  
64 bytes from 192.168.12.1: icmp_seq=239 ttl=63 time=0.286 ms  
64 bytes from 192.168.12.1: icmp_seq=240 ttl=63 time=0.316 ms  
64 bytes from 192.168.12.1: icmp_seq=241 ttl=63 time=0.275 ms  
64 bytes from 192.168.12.1: icmp_seq=242 ttl=63 time=0.267 ms  
64 bytes from 192.168.12.1: icmp_seq=243 ttl=63 time=0.271 ms  
64 bytes from 192.168.12.1: icmp_seq=244 ttl=63 time=0.339 ms  
64 bytes from 192.168.12.1: icmp_seq=245 ttl=63 time=0.270 ms  
64 bytes from 192.168.12.1: icmp_seq=246 ttl=63 time=0.267 ms  
64 bytes from 192.168.12.1: icmp_seq=247 ttl=63 time=0.273 ms  
64 bytes from 192.168.12.1: icmp_seq=248 ttl=63 time=0.266 ms  
64 bytes from 192.168.12.1: icmp_seq=249 ttl=63 time=0.271 ms  
64 bytes from 192.168.12.1: icmp_seq=250 ttl=63 time=0.268 ms  
64 bytes from 192.168.12.1: icmp_seq=251 ttl=63 time=0.284 ms  
64 bytes from 192.168.12.1: icmp_seq=252 ttl=63 time=0.266 ms  
64 bytes from 192.168.12.1: icmp_seq=253 ttl=63 time=0.268 ms  
64 bytes from 192.168.12.1: icmp_seq=254 ttl=63 time=0.273 ms  
64 bytes from 192.168.12.1: icmp_seq=255 ttl=63 time=0.276 ms  
64 bytes from 192.168.12.1: icmp_seq=256 ttl=63 time=0.269 ms  
64 bytes from 192.168.12.1: icmp_seq=257 ttl=63 time=0.264 ms  
64 bytes from 192.168.12.1: icmp_seq=258 ttl=63 time=0.286 ms  
64 bytes from 192.168.12.1: icmp_seq=259 ttl=63 time=0.275 ms  
64 bytes from 192.168.12.1: icmp_seq=260 ttl=63 time=0.265 ms  
64 bytes from 192.168.12.1: icmp_seq=261 ttl=63 time=0.274 ms  
64 bytes from 192.168.12.1: icmp_seq=262 ttl=63 time=0.269 ms  
64 bytes from 192.168.12.1: icmp_seq=263 ttl=63 time=0.275 ms  
64 bytes from 192.168.12.1: icmp_seq=264 ttl=63 time=0.273 ms  
64 bytes from 192.168.12.1: icmp_seq=265 ttl=63 time=0.277 ms  
64 bytes from 192.168.12.1: icmp_seq=266 ttl=63 time=0.272 ms  
  
--- 192.168.12.1 ping statistics ---  
266 packets transmitted, 266 received, 0% packet loss, time 264998ms  
rtt min/avg/max/mdev = 0.237/0.275/0.339/0.015 ms  
[team12@netlab-wb2pc3 ~]$ ping 192.168.12.1  
PING 192.168.12.1 (192.168.12.1) 56(84) bytes of data:  
64 bytes from 192.168.12.1: icmp_seq=1 ttl=63 time=0.304 ms  
64 bytes from 192.168.12.1: icmp_seq=2 ttl=63 time=0.273 ms  
64 bytes from 192.168.12.1: icmp_seq=3 ttl=63 time=0.273 ms  
64 bytes from 192.168.12.1: icmp_seq=4 ttl=63 time=0.270 ms  
64 bytes from 192.168.12.1: icmp_seq=5 ttl=63 time=0.275 ms  
64 bytes from 192.168.12.1: icmp_seq=6 ttl=63 time=0.253 ms  
64 bytes from 192.168.12.1: icmp_seq=7 ttl=63 time=0.291 ms  
64 bytes from 192.168.12.1: icmp_seq=8 ttl=63 time=0.283 ms  
64 bytes from 192.168.12.1: icmp_seq=9 ttl=63 time=0.264 ms  
64 bytes from 192.168.12.1: icmp_seq=10 ttl=63 time=0.273 ms  
  
--- 192.168.12.1 ping statistics ---  
10 packets transmitted, 10 received, 0% packet loss, time 8999ms  
rtt min/avg/max/mdev = 0.253/0.275/0.304/0.026 ms  
[team12@netlab-wb2pc3 ~]$ traceroute 192.168.12.1  
traceroute to 192.168.12.1 (192.168.12.1), 30 hops max, 40 byte packets  
1 (192.168.12.130) 1.203 ms 1.463 ms 1.971 ms  
2 (192.168.12.1) 0.512 ms 0.506 ms 0.496 ms  
[team12@netlab-wb2pc3 ~]$
```

**Fig 4.6.2 Ping & trace route from PC3**

Then the original switch configuration is done by removing VLAN2 and VLAN3. Even the original VPID is restored as shown below,

Dell - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://172.30.2.25/index.htm

Release Notes Fedora Project Red Hat Free Content

Dell OpenManage Switch Administrator Support Help About Log Out

**DELL** PowerConnect 2724

172.30.2.25 VLAN Port Settings

Apply Changes

Interface	PVID	Frame Type	Ingress Filtering
Port 1	1	Admit All	Enable
Port 2	1	Admit All	Enable
Port 3	1	Admit All	Enable
Port 4	1	Admit All	Enable
Port 5	1	Admit All	Enable
Port 6	1	Admit All	Enable
Port 7	1	Admit All	Enable
Port 8	1	Admit All	Enable
Port 9	1	Admit All	Enable
Port 10	1	Admit All	Enable
Port 11	1	Admit All	Enable
Port 12	1	Admit All	Enable
Port 13	1	Admit All	Enable
Port 14	1	Admit All	Enable
Port 15	1	Admit All	Enable
Port 16	1	Admit All	Enable
Port 17	1	Admit All	Enable
Port 18	1	Admit All	Enable
Port 19	1	Admit All	Enable
Port 20	1	Admit All	Enable
Port 21	1000	Admit All	Enable
Port 22	1000	Admit All	Enable
Port 23	1000	Admit All	Enable
Port 24	1000	Admit All	Enable
Lag 1	1	Admit All	Enable
Lag 2	1	Admit All	Enable

Done

**Fig 4.6.3 Restored PVID**