

QUESTION 1:

CPU/Memory requirement for 500 Mbps, 1000 Mbps, and 5000 Mbps throughput for CSR routers

500 Mbps 1 vCPU/4gb



1000Mbps 1,2 vcpu/4GB 2vcpu for AX

5000Mbps 1,2 & 8vCPU/4GB 1 for IPbase, 2for security and for all features 8gb

List three features of CSR for each of the following: a) Networking, b)Security, c) Management

a) Virtual-machine creation and deployment

Provisioning and management

RESTful application programming interfaces

b) VPN: IPsec VPN, DMVPN, Easy VPN, FlexVPN, and GetVPN

Firewall: ZBFW

Access control: ACL, AAA, RADIUS, and TACACS+

c) Routing: BGP, OSPF, EIGRP

Hybrid cloud connectivity:OTV, VPLS, and Ethernet over MPLS (EoMPLS)

Application visibility, performance monitoring, and control: QoS and AVC

What would be per year cost to use two 1000 Mbps CSR in Amazon cloud

for the following package,Cisco Cloud Services Router (CSR) 1000V - Security Technology Package
it costs around 12,264\$ for a year.

QUESTION 2:

1 VM Ip address and mac address :

```

New Session - root@localhost:~ - Xshell 6 (Free for Home/School)
File Edit View Tools Tab Window Help
ssh://ece792*****@152.14.83.153:22
To add the current session, click on the left arrow button.

Session Manager  1 New Session  2 New Session  3 New Session
All Sessions  New Session

ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ 
ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ 
ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ 
ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ 
ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ virsh net-list --all
Name          State   Autostart Persistent
default       active  no      yes
ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ virsh domifaddr 4
Name    MAC address   Protocol Address
vnet0  52:54:00:b5:13:32  ipv4    192.168.130.124/24
ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ ssh root@192.168.130.124
root@192.168.130.124's password:
Last login: Fri Oct 12 21:42:56 2018 from gateway
[root@localhost ~]# ifconfig
.bash: ifconfig: command not found
[root@localhost ~]# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 52:54:00:b5:13:32 brd ff:ff:ff:ff:ff:ff
    inet 192.168.130.124/24 brd 192.168.130.255 scope global noprefixroute dynamic eth0
        valid_lft 2891sec preferred_lft 2891sec
    inet6 fe80::65f1:fcff:fa34:7d44/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
[root@localhost ~]#

```

New Session Properties

Name	Value
Name	Ne...
Type	Ses...
Host	152...
Port	22
Protocol	SSH

ssh://ece792@152.14.83.153:22

Type here to search

11:53 PM 10/12/2018

Hypervisor Ip address and Mac address :

As default gateway is connected through ens 3

The Ip address and mac address of ens3 – 192.168.122.66

HWaddr 52:54:00:a7:51:7a

```
All Sessions
e792@152.148.3.153:22 ~ % sudo ip route del default via 192.168.123.1
RTNETLINK answers: Operation not permitted

[sudo] password for e792:
e792@e792:~ % sudo ip route del default via 192.168.123.1
[sudo] password for e792:
e792@e792:~ % sudo ip route del default via 192.168.123.1
[sudo] password for e792:
e792@e792:~ % ifconfig
ens3      Link encap:Ethernet Hwaddr 52:54:00:47:51:7a
          inet addr:192.168.122.66 Bcast:192.168.122.255 Mask:255.255.255.0
          inet6 addr: fe80::3d0f:be0d:9afb:72c9/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
            RX packets:1370015 errors:0 dropped:97 overruns:0 frame:0
            TX packets:660133 errors:0 dropped:0 overruns:0 carrier:0
            collisions:3429000 txqueuelen:1000
            RX bytes:1355250753 (1.3 GB) TX bytes:671397142 (671.3 MB)

ens4      Link encap:Ethernet Hwaddr 52:54:00:85:49:7f
          inet6 addr: fe80::35aa:8d94:a14c:417d/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
            RX packets:174150 errors:0 dropped:0 overruns:0 frame:0
            TX packets:177717 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1000
            RX bytes:40662699 (40.0 MB) TX bytes:32373596 (32.3 MB)

ens5      Link encap:Ethernet Hwaddr 52:54:00:99:48:a2
          inet6 addr: fe80::748a:2d1e:3b82:eb7f/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
            RX packets:47572 errors:0 dropped:0 overruns:0 frame:0
            TX packets:111132 errors:0 dropped:0 overruns:0 carrier:0
            collisions:493686 txqueuelen:1000
            RX bytes:3715246 (3.7 MB) TX bytes:7911723 (7.9 MB)

Session Properties
Value ^ Ne... Ses... 152... 22 vnl SSH to Link encap:Local Loopback
e792@152.148.3.153:22 ~ %
```

(2) the tuples captured at the VM interface and the Hypervisor interface are different

(srcIP, Dest IP, srcMAC and dest MAC)

Tuples Virtual Machine side(eth0)

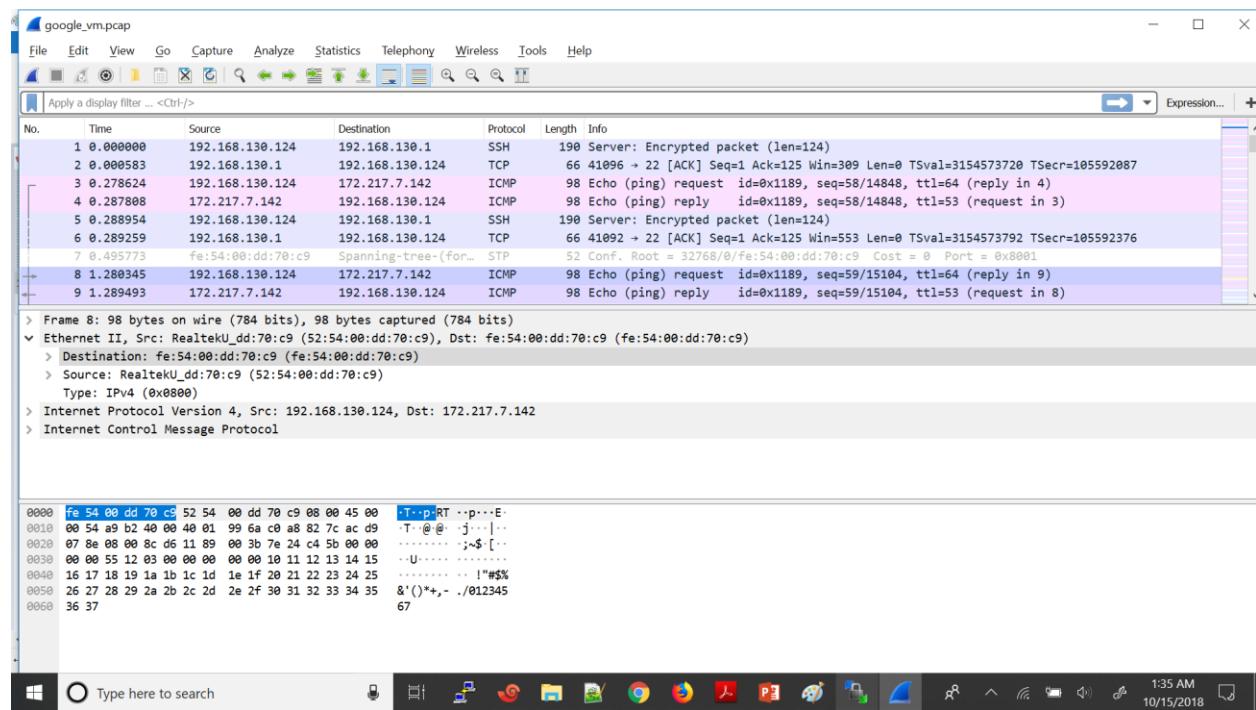
(192.168.130.124 172.217.7.142 52:54:00:dd:70:c9 fe:54:00:dd:70:c9)

The source mac address will be the mac address of eth0 and destination mac address will be the mac address of virbr0 interface (default gateway for VM) which will be obtained from arp request and response.

Source IP address will be of the – eth0 interface

Destination IP address will be of google server .

Packet capture at the VM interface :



Tuples for packet leaving from Hypervisor side (ens3)

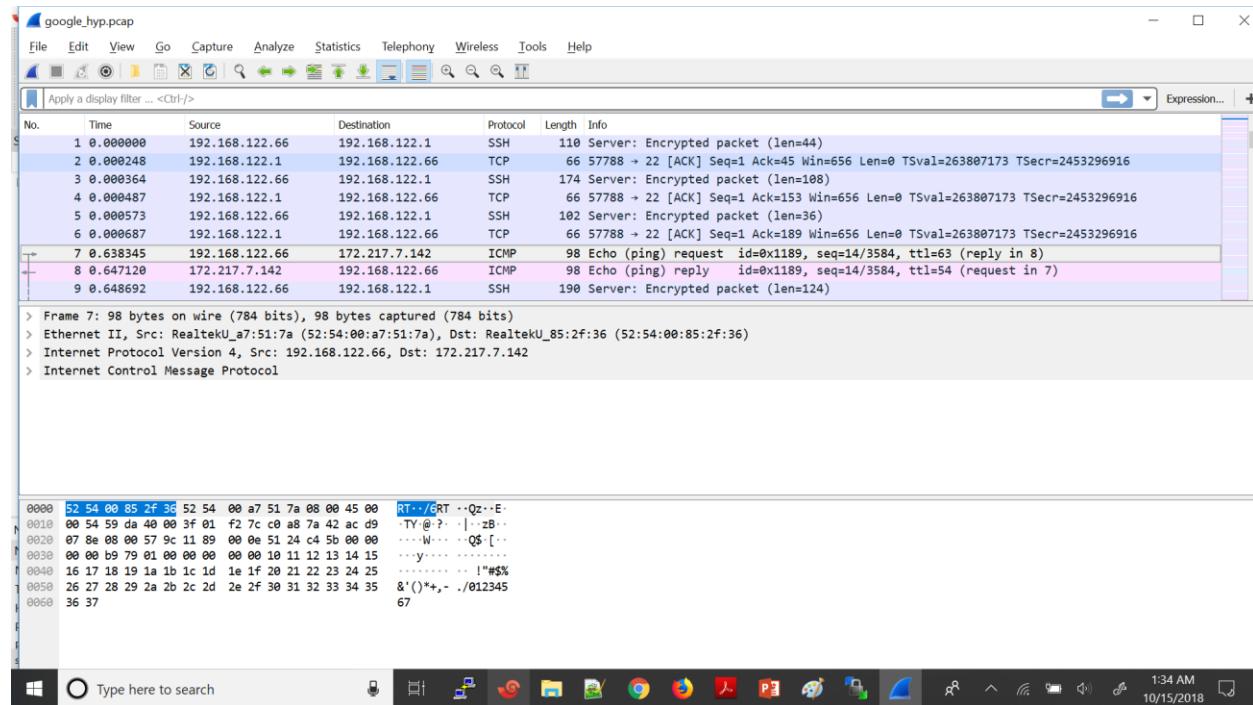
(192.168.122.66 172.217.7.142 52:54:00:a7:51:7a 52:54:00:85:2f:36)

Here the source ip will be the source ip of ens 3 and destination ip address will be of google.com

The source ip address will be the ip address of the ens3 interface and destination mac address will be the next hop (default gateway) mac address



Packet capture at the Hypervisor interface :



QUESTION 3:

(a) Network addition in I2 mode :

The network 200208720NW2 has been added in the Host in the bridge mode :

BY creating the sw1 bridge and defining a 200208720NW2 network in bridge mode using the sw1 bridge

(b) The interface eth2 in 200202780NW2 has been added to 200208720VM1 using the cli

```
virsh attach-interface --domain 200208720VM1 --type network --source 200208720NW2 --model virtio -  
-config -live
```

```
^C25 packets captured
25 packets received by filter
0 packets dropped by kernel
root@ece792-Standard-PC-1440FX-PIIX-1996:/etc/ansible#
root@ece792-Standard-PC-1440FX-PIIX-1996:/etc/ansible#
root@ece792-Standard-PC-1440FX-PIIX-1996:/etc/ansible# virsh domiflist 12
Interface Type Source Model MAC
-----
vnet0 network default virtio 52:54:00:dd:70:c9
vnet1 bridge experiment_brid virtio 52:54:00:dd:70:00
vnet10 bridge experiment_brid virtio 52:54:00:51:e4:10
vnet12 bridge diff_bridge virtio 52:54:00:f1:c0:75
root@ece792-Standard-PC-1440FX-PIIX-1996:/etc/ansible# (srcIP, Dest IP, srcMAC and dest
> MAC)"^C
root@ece792-Standard-PC-1440FX-PIIX-1996:/etc/ansible#
```

(c) The VM “200208720lab2VM2” has been created using the cloning command

```
sudo virt-clone --original 200208720VM1 --name 200208720lab2VM2 --auto-clone
```

It has been cloned from the 200208720VM1

The screenshot shows a Windows desktop environment with a Session Manager window open. The window lists several terminal sessions, including:

```
25 packets received by filter
0 packets dropped by kernel
root@ece792-Standard-PC-i440FX-PIIX-1996:/etc/ansible#
root@ece792-Standard-PC-i440FX-PIIX-1996:/etc/ansible#
root@ece792-Standard-PC-i440FX-PIIX-1996:/etc/ansible# virsh domiflist 12
Interface Type Source Model MAC
vnet0 network default virtio 52:54:00:dd:70:c9
vnet1 bridge 200208720VM2 virtio 52:54:00:dd:70:00
vnet10 bridge experiment_brid virtio 52:54:00:51:e4:10
vnet12 bridge diff_bridge virtio 52:54:00:f1:c0:75

root@ece792-Standard-PC-i440FX-PIIX-1996:/etc/ansible# (srcIP, Dest IP, srcMAC and dest
> MAC)^C
root@ece792-Standard-PC-i440FX-PIIX-1996:/etc/ansible#
root@ece792-Standard-PC-i440FX-PIIX-1996:/etc/ansible#
root@ece792-Standard-PC-i440FX-PIIX-1996:/etc/ansible# virsh list --all
Id Name State
12 200208720VM1 running
13 200208720lab2VM2 running
18 VM3 running
24 VM_script1 running
25 VM_script2 running

root@ece792-Standard-PC-i440FX-PIIX-1996:/etc/ansible#
```

A "New Session Properties" dialog is visible on the left side of the window, showing fields for Name, Value, Type, Host, Port, and Protocol (set to SSH). The session list at the bottom of the window shows 4 sessions.

(d)

Listing the ip and mac adrees of all the VM

The 200208720VM1 interfaces and mac address details

New Session - root@localhost:~ - Xshell 6 (Free for Home/School)

```

File Edit View Tools Tab Window Help
+ ssh://eco792*****@152.14.83.153:22
To add the current session, click on the left arrow button.

Session Manager 4 x 1 New Session 2 New Session 3 New Session 4 New Session +
All Sessions New Session
[bash: brctl: command not found
[root@localhost ~]# net stat -r
[bash: net: command not found
[root@localhost ~]# netstat -r
Kernel IP routing table
Destination Gateway Genmask Flags MSS Window Irtt Iface
default gateway 0.0.0.0 UG 0 0 0 eth0
10.0.0.0 0.0.0.0 255.255.255.0 U 0 0 0 eth1
20.0.0.0 0.0.0.0 255.255.255.0 U 0 0 0 eth2
192.168.130.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0
[root@localhost ~]# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
        inet 127.0.0.1/8 scope host lo
            valid_lft forever preferred_lft forever
            inet6 ::1/128 scope host
                valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 52:54:00:dd:70:c9 brd ff:ff:ff:ff:ff:ff
        inet 192.168.130.124/24 brd 192.168.130.255 scope global noprefixroute dynamic eth0
            valid_lft 2797sec preferred_lft 2797sec
            inet6 fe80::5054:ff:fe70:c9ff/64 scope link noprefixroute
                valid_lft forever preferred_lft forever
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 52:54:00:dd:70:00 brd ff:ff:ff:ff:ff:ff
        inet 10.0.0.2/24 scope global eth1
            valid_lft forever preferred_lft forever
4: eth2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 52:54:00:dd:70:10 brd ff:ff:ff:ff:ff:ff
        inet 20.0.0.1/24 scope global eth2
            valid_lft forever preferred_lft forever
5: eth3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 52:54:00:f1:c0:75 brd ff:ff:ff:ff:ff:ff
        inet 192.168.130.1/24 brd 192.168.130.255 scope global noprefixroute dynamic eth3
            valid_lft 2797sec preferred_lft 2797sec
[root@localhost ~]#

```

New Session Properties

Name	Value
Name	Ne...
Type	Ses...
Host	152...
Port	22
Protocol	SSH

ssh://eco792@152.14.83.153:22

Type here to search [File] [Edit] [Tools] [Tab] [Window] [Help]

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The VM 2 : 200208720lab2VM2 Mac addresses and the details

New Session - root@localhost:~ - Xshell 6 (Free for Home/School)

```

File Edit View Tools Tab Window Help
+ ssh://eco792*****@152.14.83.153:22
To add the current session, click on the left arrow button.

Session Manager 4 x 1 New Session 2 New Session 3 New Session 4 New Session +
All Sessions New Session
[lo: flags=73 mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
        loop txqueuelen 1000 (Local Loopback)
        RX packets 247 bytes 27272 (26.6 KiB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 247 bytes 27272 (26.6 KiB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
[root@localhost ~]#
[root@localhost ~]# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
        inet 127.0.0.1/8 scope host lo
            valid_lft forever preferred_lft forever
            inet6 ::1/128 scope host
                valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 52:54:00:f4:e7:07 brd ff:ff:ff:ff:ff:ff
        inet 192.168.130.77/24 brd 192.168.130.255 scope global noprefixroute dynamic eth0
            valid_lft 3173sec preferred_lft 3173sec
            inet6 fe80::8b25:60f1:fcac:1b0d/64 scope link noprefixroute
                valid_lft forever preferred_lft forever
            inet6 fe80::65f1:fcff:fa34:7d44/64 scope link tentative noprefixroute dadfailed
                valid_lft forever preferred_lft forever
4: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 52:54:00:32:63:0d brd ff:ff:ff:ff:ff:ff
        inet 10.0.0.1/24 scope global eth1
            valid_lft forever preferred_lft forever
3: eth2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 52:54:00:9f:53:bd brd ff:ff:ff:ff:ff:ff
        inet 20.0.0.1/24 scope global eth2
            valid_lft forever preferred_lft forever

```

New Session Properties

Name	Value
Name	Ne...
Type	Ses...
Host	152...
Port	22
Protocol	SSH

ssh://eco792@152.14.83.153:22

Type here to search [File] [Edit] [Tools] [Tab] [Window] [Help]

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Part -5 :

When we ping from one Vm1 (10.0.0.2) to Vm2 (10.0.0.1)

The ip address of VM1 -10.0.0.2

The ip address of Vm2 – 10.0.0.1

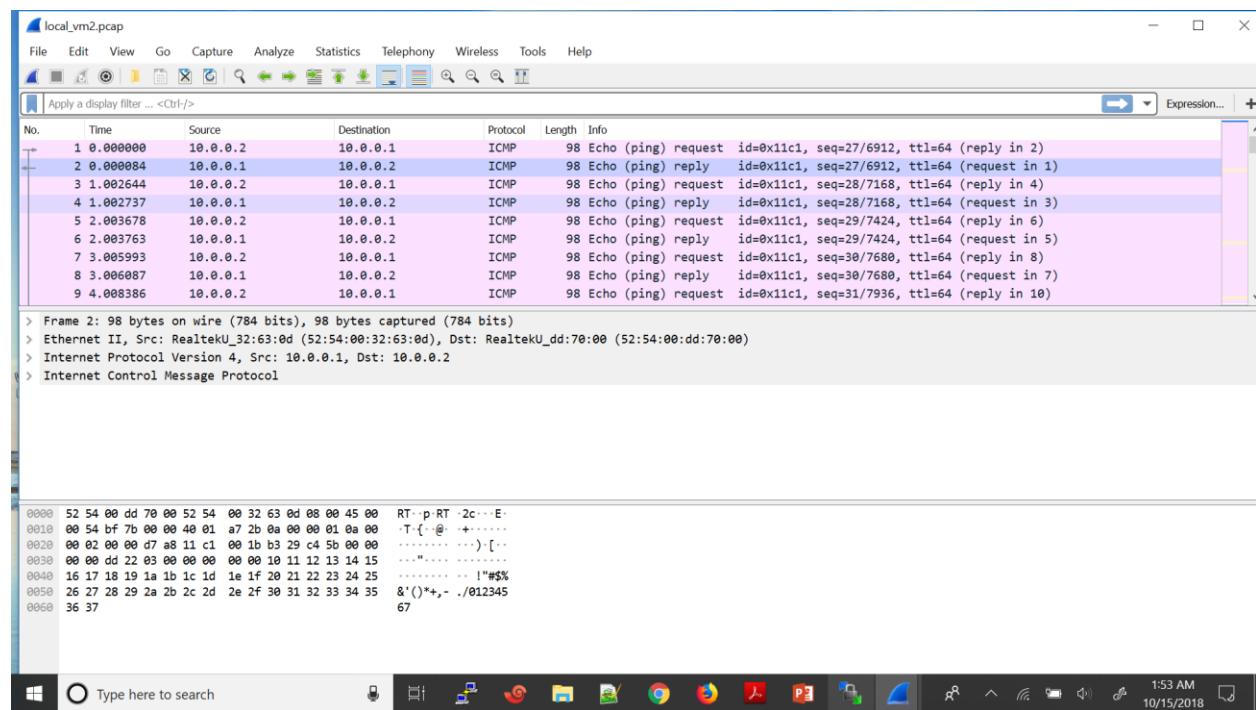
Here is the tuple at the VM1 side :

(10.0.0.2 10.0.0.1 52:54:00:32:63:0d 52:54:00:dd:70:00)

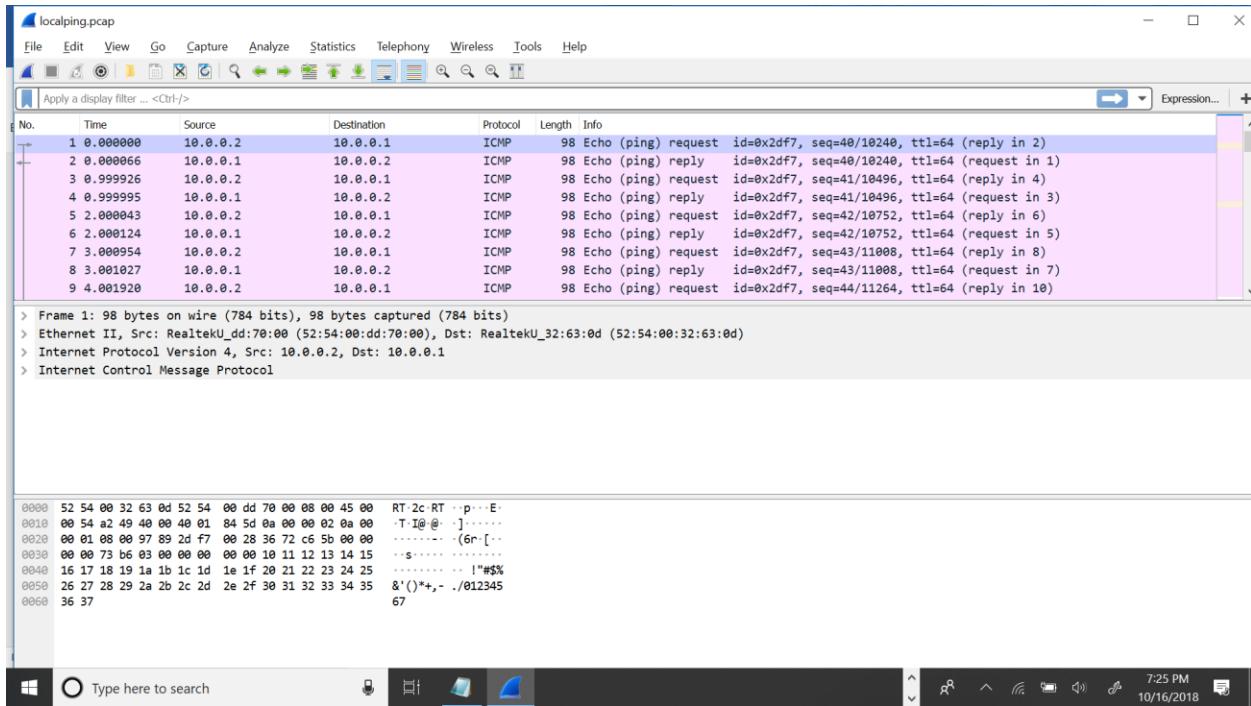
The tuple at the VM2 side is

(10.0.0.2 10.0.0.1 52:54:00:32:63:0d 52:54:00:dd:70:00)

Both must be the same as It is L2 connectivity the packet leaving from the First VM must be forwarded to the other VM



The packets captured on the other vm interface are also same



Source IP and destination IP and the Mac address are same

If there would have been any routers then the packets sent and received would have different tuples

As there is only bridge between these two VMs which doesn't encapsulate or decapsulate as it just forwards or broadcasts based on the MAC table so the tuples obtained on both the interfaces are same.

QUESTION 4: please refer the folder q4 
QUESTION 2: please refer the folder q5 

QUESTION 6:

A distributed switch like vDS can allow different hosts to use the switch unlike the Vswitches that are designed to support only one host. VDS also has features like Net flow and port mirror.

- 1) Port mirror is a feature that allows debugging issues in virtual infrastructures
- 2) VDS can be used for blocking a virtual machine port
- 3) Net Flow helps to measure different application flows and their performance. This can help in planning the resources for different applications.
- 4) Virtual distributed switch automates the virtual machine monitoring.
- 5) Eliminates the per-host configuration for each vsphere host.
- 6) Virtual distributed switch provides centralized provisioning and monitoring.

Question 7:

1st part : Two VMS connected to the same bridge

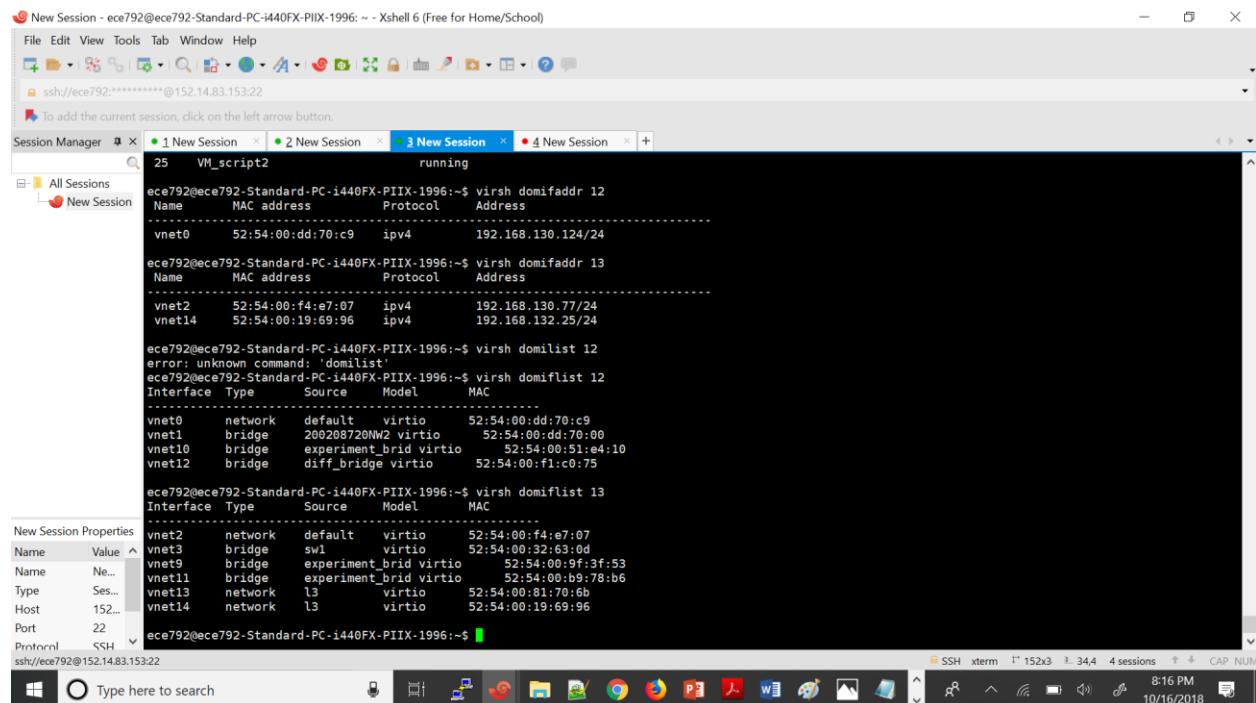
Same mac different ip :

Both have the same mac address :52:54:00:9f:3f:53

Pinging 20.0.0.2 (eth2 interface)from 20.0.0.1 (eth2 interface)

Eth2(20.0.0.2) -----vnet10 (experiment_bridg)

Eth2(20.0.0.1) ----- vnet9 (experiment_brid)



The screenshot shows the Xshell 6 application window with four sessions listed in the Session Manager:

- Session 1: VM_script2 (running)
- Session 2: New Session
- Session 3: New Session
- Session 4: New Session

The terminal window displays the following command-line session:

```
ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ virsh domifaddr 12
Name      MAC address      Protocol      Address
vnet0     52:54:00:dd:70:c9    ipv4        192.168.130.124/24

ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ virsh domifaddr 13
Name      MAC address      Protocol      Address
vnet2     52:54:00:f4:e7:07    ipv4        192.168.130.77/24
vnet14    52:54:00:19:69:96    ipv4        192.168.132.25/24

ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ virsh domiflist 12
error: unknown command: 'domiflist'
ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ virsh domiflist 12
Interface  Type   Source   Model   MAC
vnet0      network default   virtio   52:54:00:dd:70:c9
vnet1      bridge  200208720NM2 virtio   52:54:00:dd:70:00
vnet10     bridge  experiment_brid virtio   52:54:00:51:e4:10
vnet12     bridge  diff_bridge virtio   52:54:00:f1:c0:75

ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$ virsh domiflist 13
Interface  Type   Source   Model   MAC
vnet2      network default   virtio   52:54:00:f4:e7:07
vnet3      bridge  sv1      virtio   52:54:00:32:63:0d
vnet9      bridge  experiment_brid virtio   52:54:00:9f:3f:53
vnet11     bridge  experiment_brid virtio   52:54:00:b9:78:b6
vnet13     network l3       virtio   52:54:00:81:70:6b
vnet14    network l3       virtio   52:54:00:19:69:96

ece792@ece792-Standard-PC-i440FX-PIIX-1996:~$
```

The bottom status bar shows the session is SSH, the terminal size is 152x3, the CPU usage is 34.4, there are 4 sessions, and the date/time is 8:16 PM on 10/16/2018.

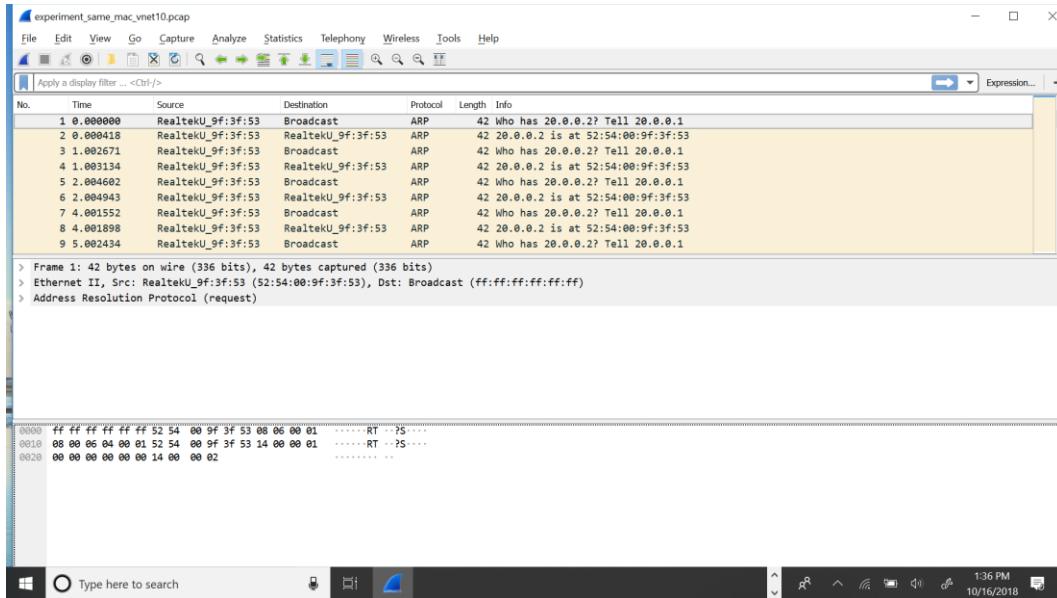
Eth2

Both have the same mac address :

Arp request is reaching the bridge(vnet10) and also the other VM (eth2) interface (10.0.0.2) other 20.0.0.2 interface is replying back to the arp request to the switch(Vnet9).

The arp reply from (20.0.0.2) is not reaching the vnet9 interface so the ping between the 20.0.0.2 and

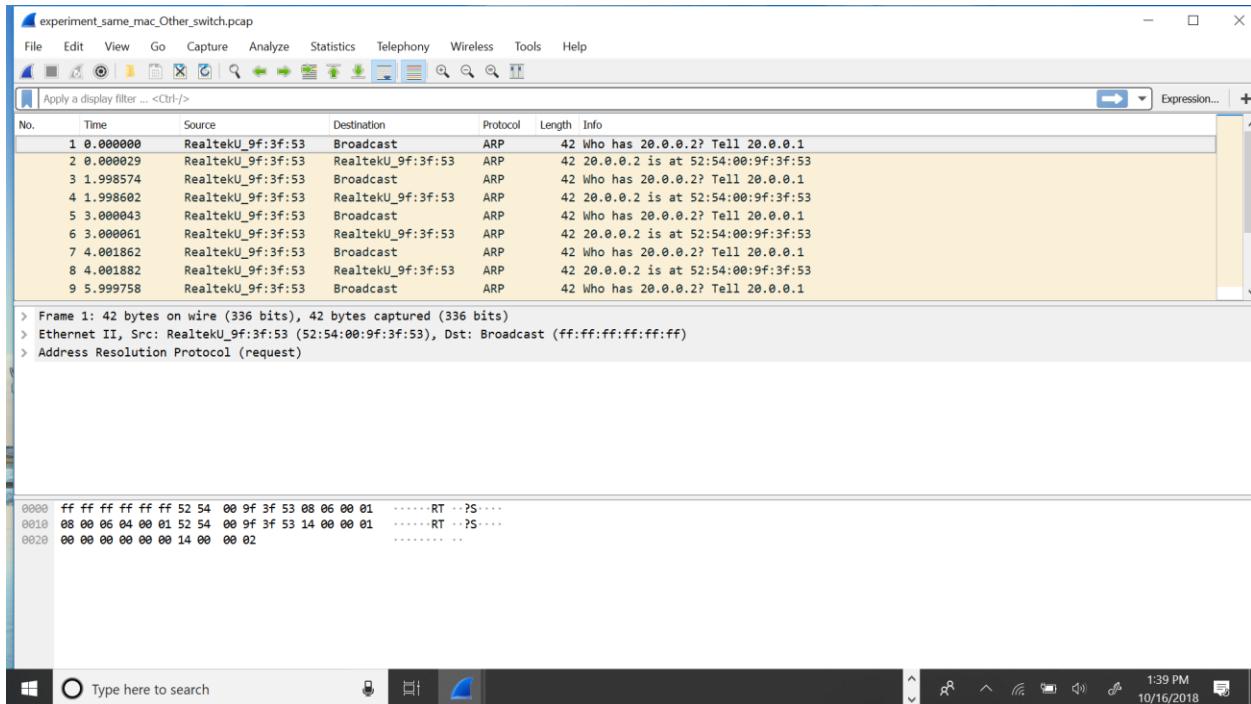
Packet capture at vnet9 interface (connected to 20.0.0.1) interface



The packet capture at the Vnet10 interface (interface connected to 20.0.0.2) interface .

It is replying back to bridge with an arp reply but the source and destination are on the same interface

Vnet10. So the switch is not forwarding the packet to the vnet9 interface as this previous entry has been overridden by the arp reply from 10.0.0.2

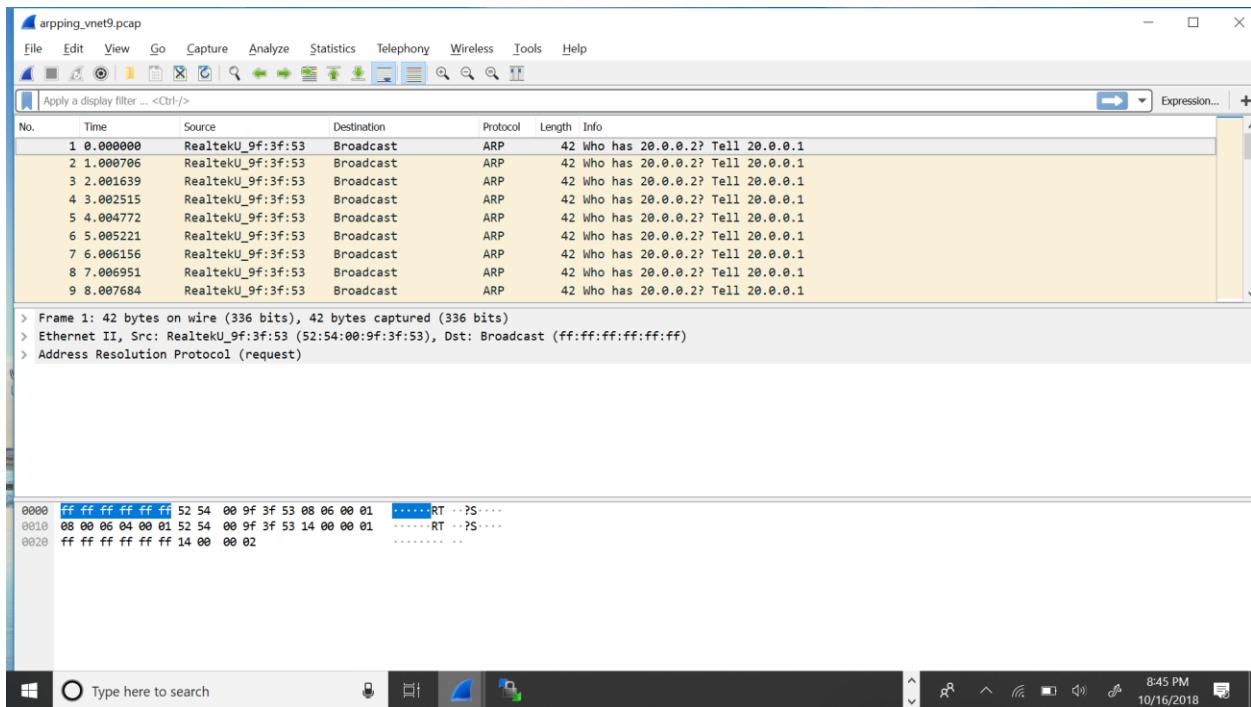


Same Ip address but different mac address but connected to the same bridge :

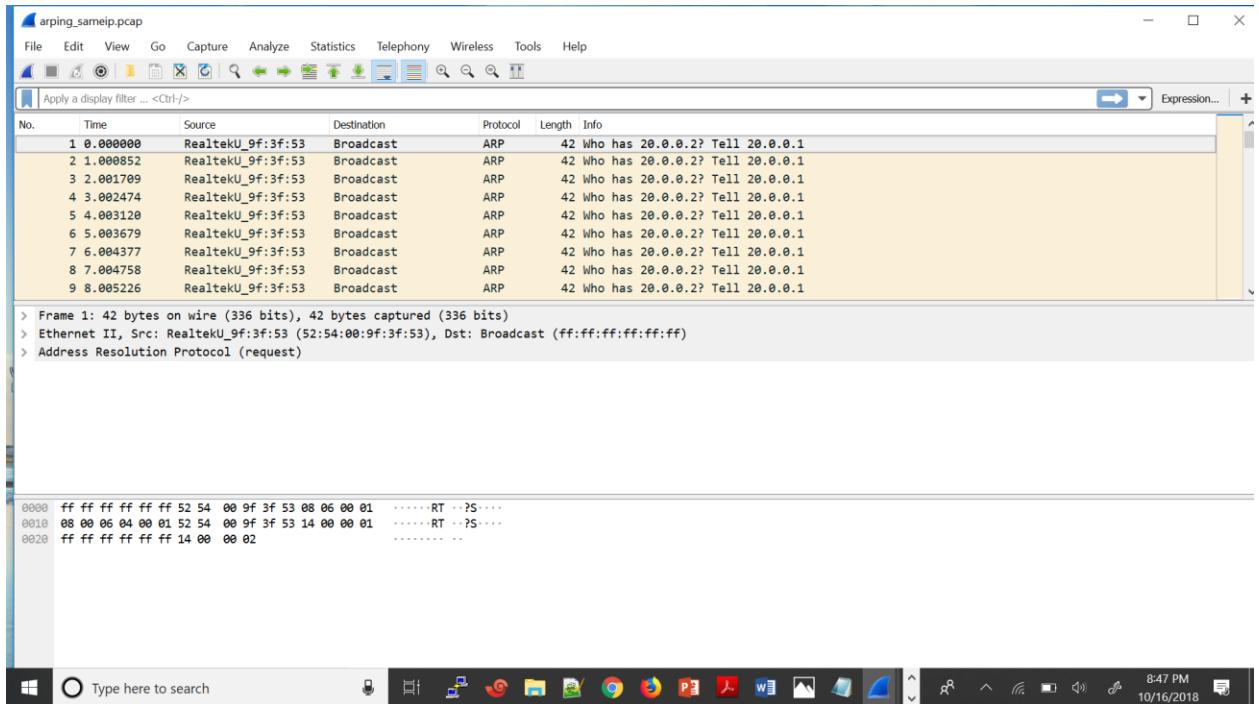
When the following command is executed

Arping _I eth2 20.0.0.2

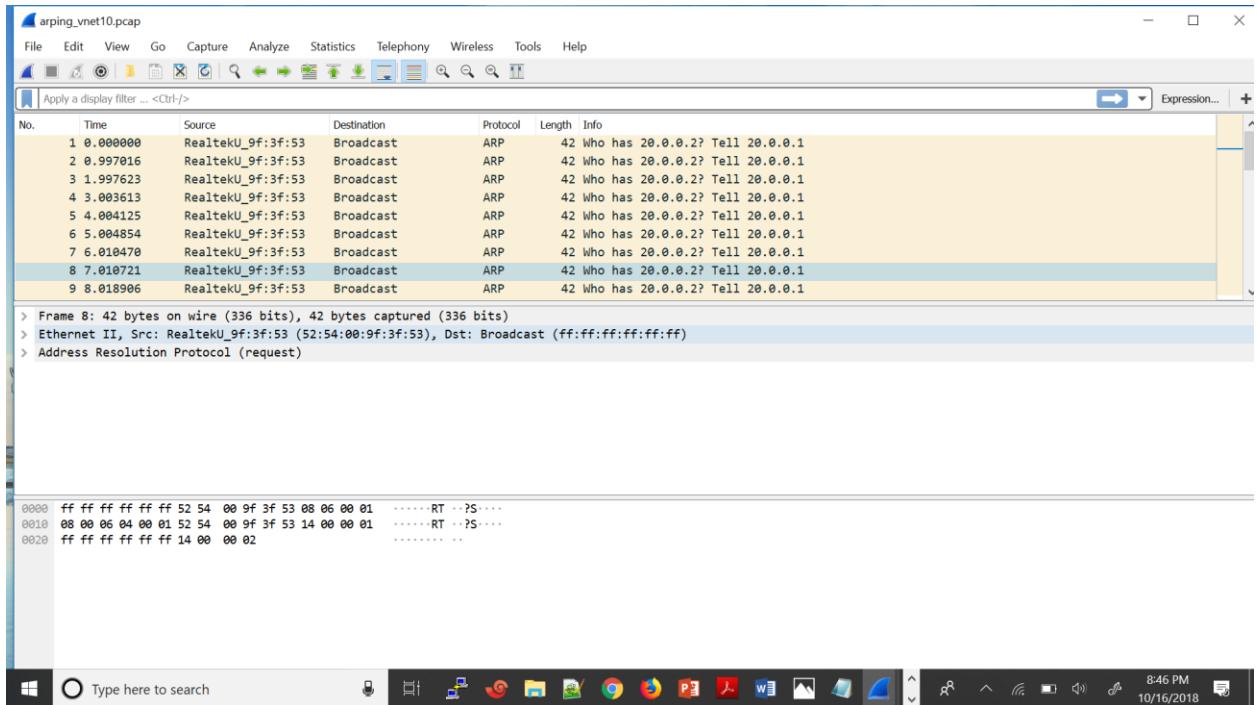
Here is the snapshot of the packet capture at the vnet 9 interface(connected to VM1):



The snapshot of the packet capture at the VM2 interface(eth2) 20.0.0.1 .its receiving the arp request but not replying back.



The packet capture at the vnet10 interface connected to the bridge (connected to VM2) :



As the VM2 is not replying back to the Vm1 arp request so the arp process is not successful .

Part 2 : Two VMs connected to two different bridges

- (a) Same mac address and different ip addresses

If we ping from one vm to other vm the packets wont be reaching the other VM

As the two bridges aren't interconnected so the packet will come to the bridge and it doesn't have any path for further to proceed as it is only connected to the VM



So the data path for this is [VM (eth3) ---- Bridge(vnet10)] as there are no interconnections to this bridge.

- (b) same ip address but different mac address

Ping is successful

In this case when both the VM are having the same Ip address ping is successful but it is not reaching to the other VM packets , ie it is self pinging (packets are travelling through the loopback interface and reaching the same VM) self pinging.

Part 3. Two VMS connected to different L3 bridges but having the same mac address:

The topology is

200208720NW2 (eth4)(192.168.134.152) interface ----- vnet 15 l3_net2 bridge(Routed)

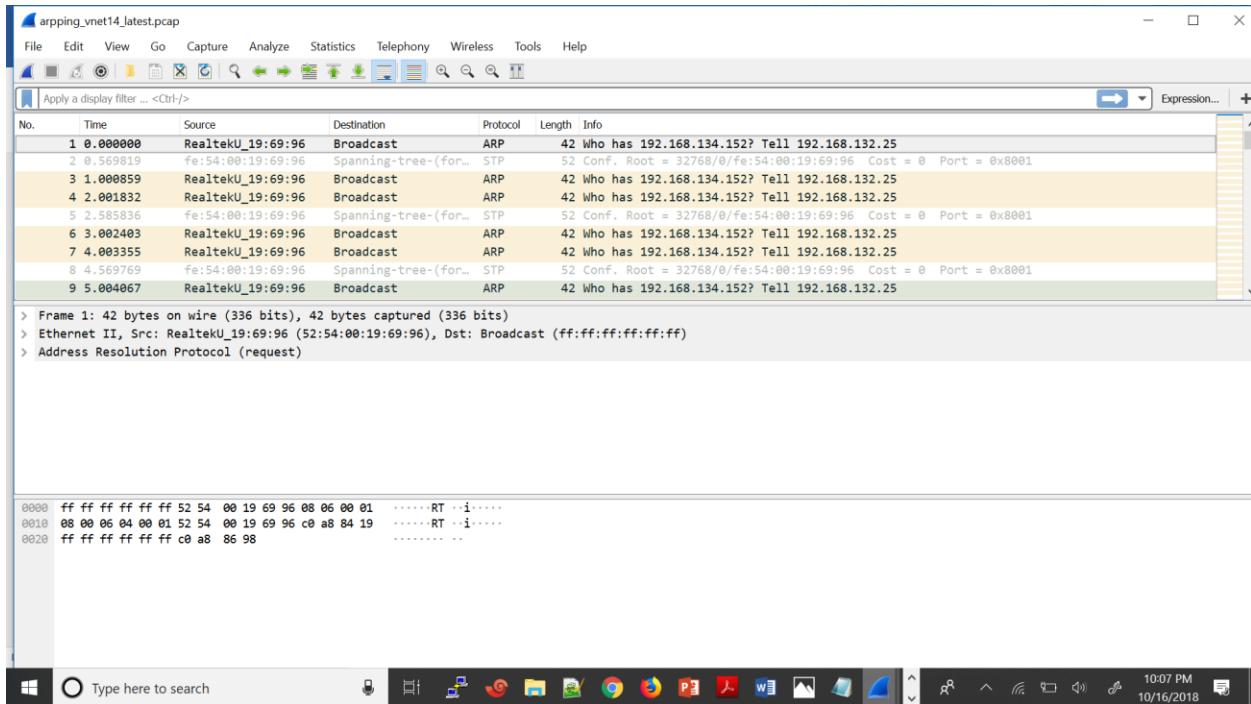
200208720lab2VM2(eth 5) (192.168.132.25)interface ---- vnet14 l3bridge (Routed)

By doing Arp -l eth5 192.168.134.152



The packets are reaching the vnet 14 interface but not reaching the vnet 15 interface as there is no connection between the two routed bridges so the arp process is not successful

Packet capture at vnet 14 interface:



Packet capture at vnet15 interface :

No packet is reaching here from the other l3 bridge to here

