IP LAB ASSIGNMENT

The topology configured among the four PC's is :

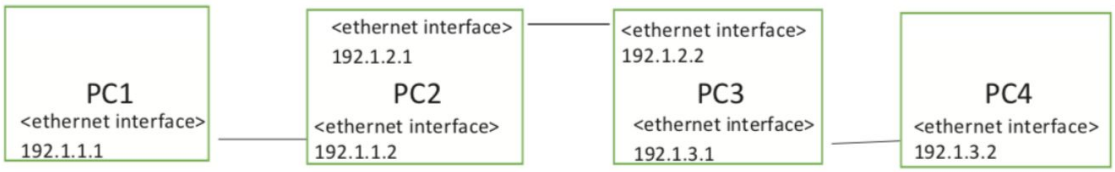


Figure 1: Network topology

1. Assign proper IP addresses to the interfaces of the PCs in the topology of Figure1.

   The IP addresses are assigned as per figure1
   For PC1:

```
root@PC1:~# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1
    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
5: eth0@if6: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default
    link/ether 02:42:ac:11:00:02 brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 172.17.0.2/16 brd 172.17.255.255 scope global eth0
       valid_lft forever preferred_lft forever
14: eth2@if13: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether b6:90:4d:73:68:75 brd ff:ff:ff:ff:ff:ff link-netnsid 1
    inet 192.1.1.1/24 scope global eth2
       valid_lft forever preferred_lft forever
root@PC1:~#
```

   For PC2:

```
root@PC2:~# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1
    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
7: eth0@if8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default
    link/ether 02:42:ac:11:00:03 brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 172.17.0.3/16 brd 172.17.255.255 scope global eth0
       valid_lft forever preferred_lft forever
13: eth1@if14: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether 1a:24:e8:71:92:b5 brd ff:ff:ff:ff:ff:ff link-netnsid 1
    inet 192.1.1.2/24 scope global eth1
       valid_lft forever preferred_lft forever
16: eth3@if15: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether 22:0b:98:b4:af:c7 brd ff:ff:ff:ff:ff:ff link-netnsid 2
    inet 192.1.2.1/24 scope global eth3
       valid_lft forever preferred_lft forever
root@PC2:~#
```

For PC3:

```
root@PC3:~# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1
    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
9: eth0@if10: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default
    link/ether 02:42:ac:11:00:04 brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 172.17.0.4/16 brd 172.17.255.255 scope global eth0
       valid_lft forever preferred_lft forever
15: eth2@if16: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether ce:bc:ff:27:4a:d6 brd ff:ff:ff:ff:ff:ff link-netnsid 1
    inet 192.1.2.2/24 scope global eth2
       valid_lft forever preferred_lft forever
18: eth4@if17: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether e6:8f:1f:92:19:06 brd ff:ff:ff:ff:ff:ff link-netnsid 2
    inet 192.1.3.1/24 scope global eth4
       valid_lft forever preferred_lft forever
root@PC3:~#
```

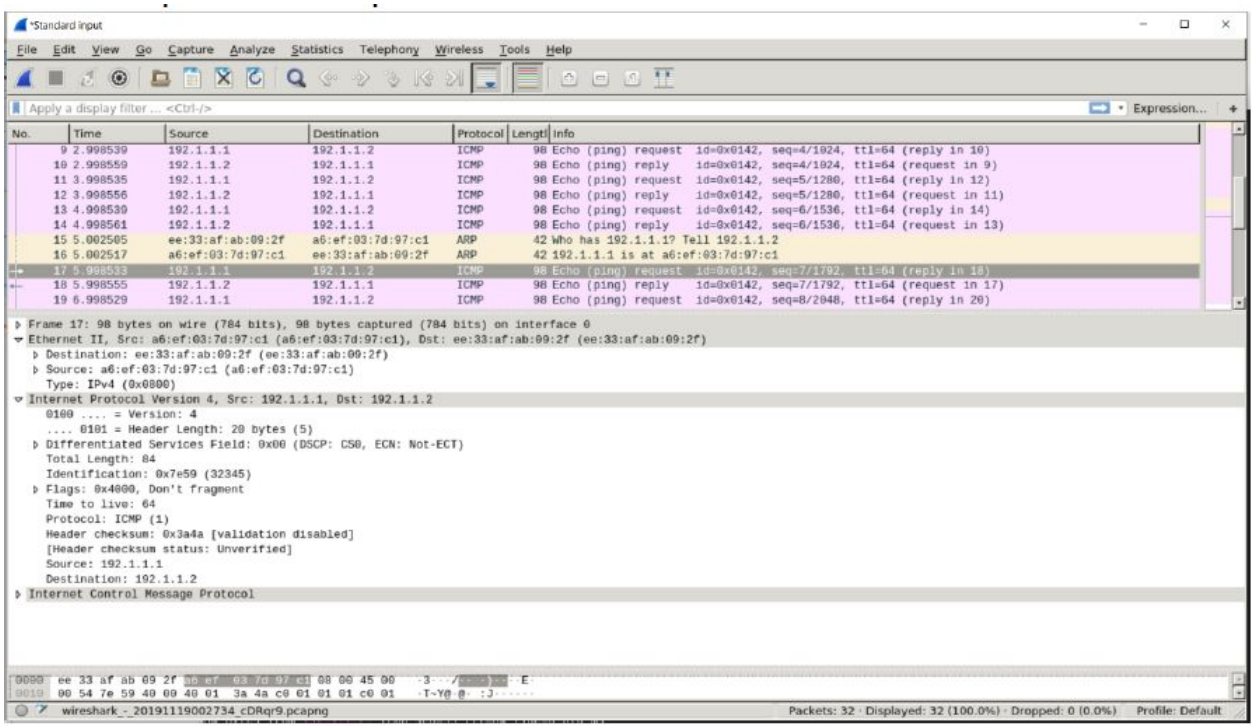
For PC4:

```
root@PC4:~# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1
    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
11: eth0@if12: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default
    link/ether 02:42:ac:11:00:05 brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 172.17.0.5/16 brd 172.17.255.255 scope global eth0
       valid_lft forever preferred_lft forever
17: eth3@if18: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether 6a:a9:ca:ad:a8:8a brd ff:ff:ff:ff:ff:ff link-netnsid 1
    inet 192.1.3.2/24 scope global eth3
       valid_lft forever preferred_lft forever
root@PC4:~#
```

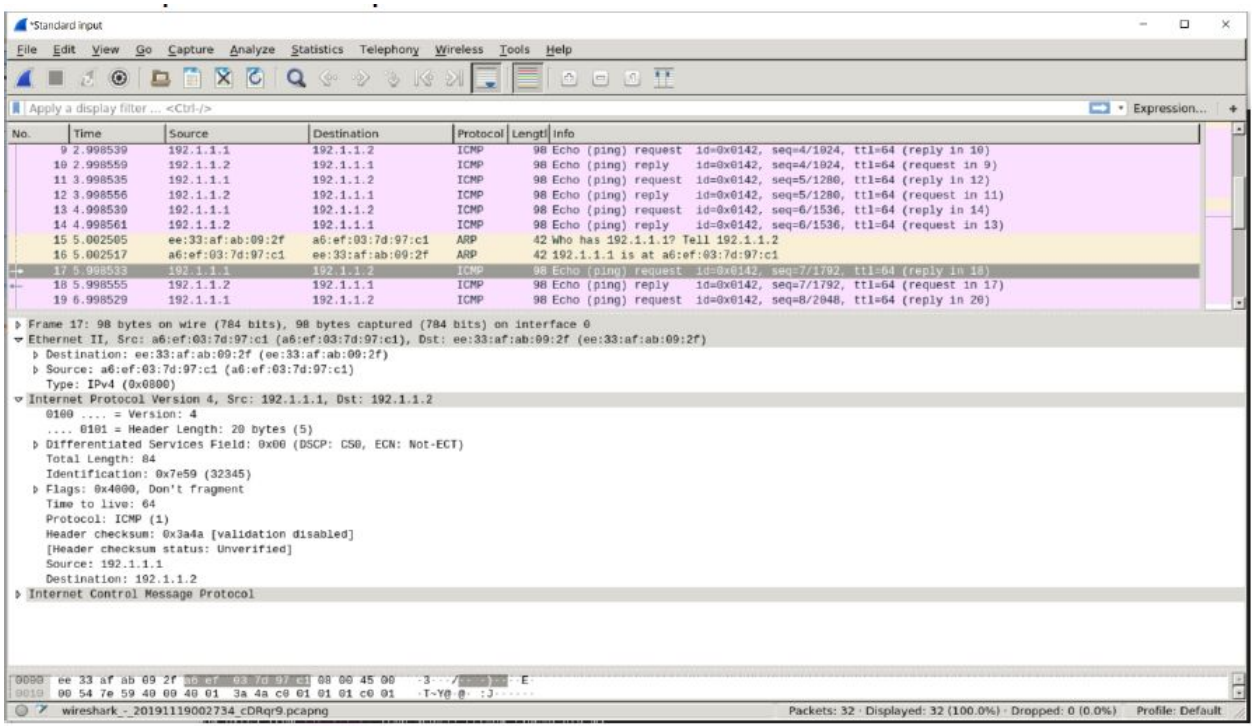
2. Run Wireshark on each PC and make sure that it works properly; if there is a problem you may consult the setup document.

Ans: Wireshark is working properly on all the PC's.

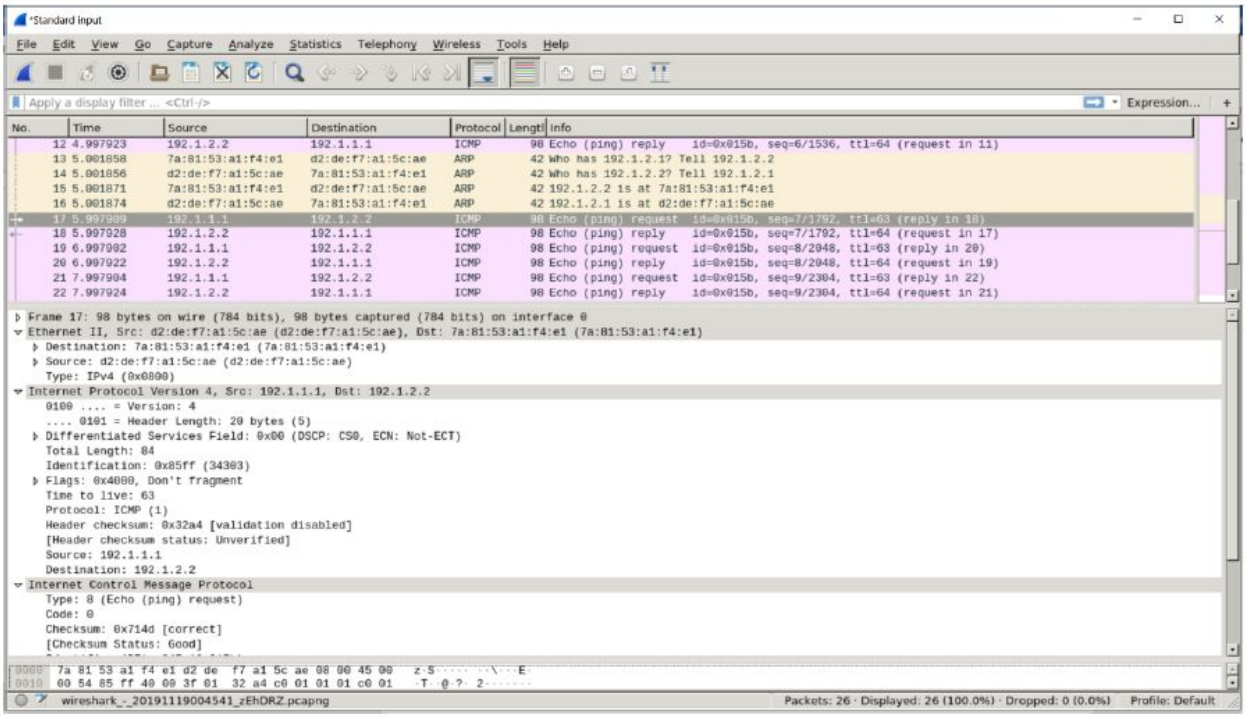
Wireshark capture of ICMP request on eth1 of PC2



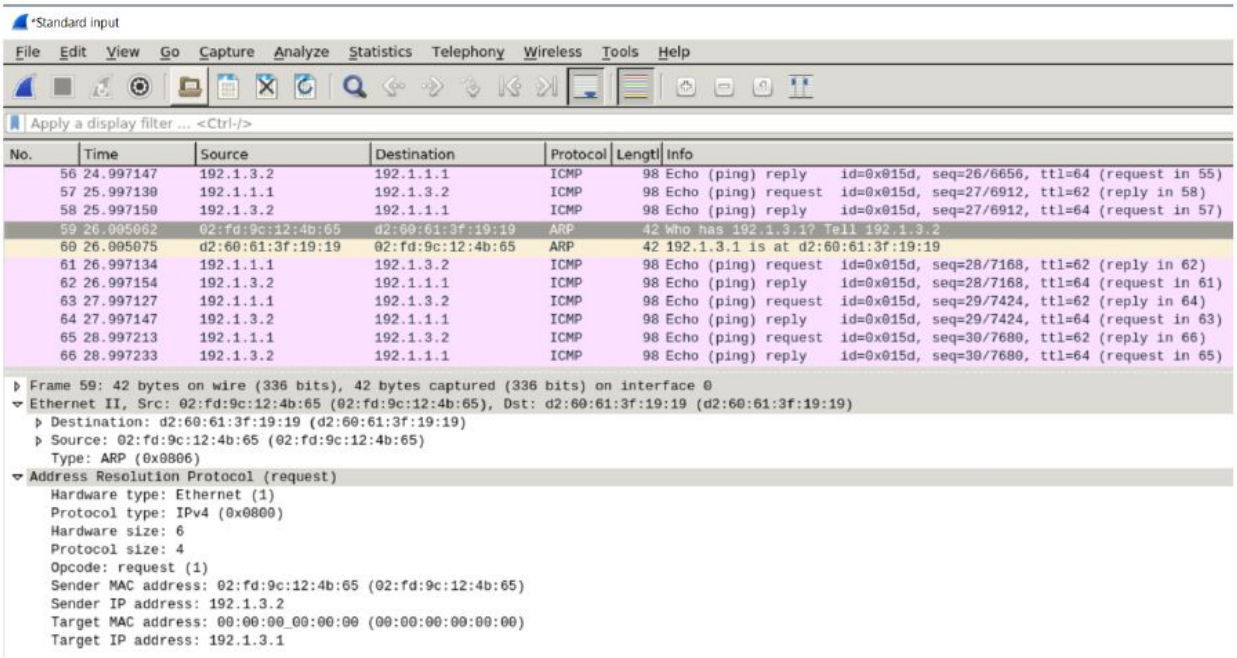
Wireshark capture of ARP packet on eth3 of PC2



Wireshark capture of ICMP request packet on eth2 of PC3



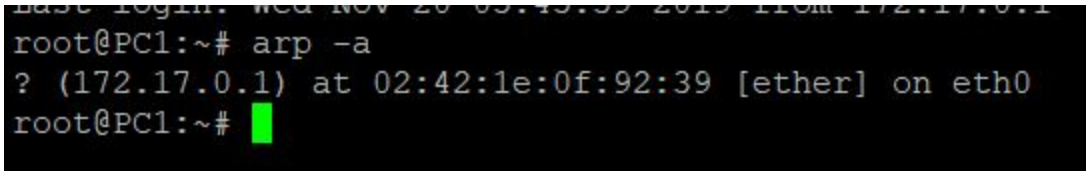
Wireshark capture of ARP packet on eth3 of PC4



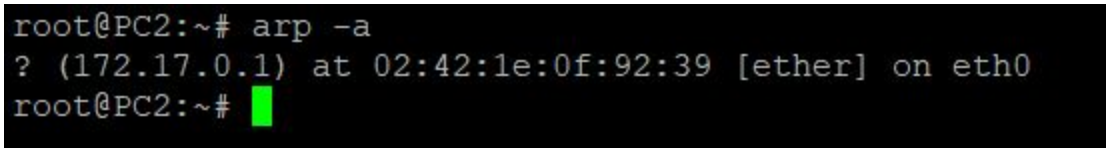
3. Examine the ARP table of each PC.

Ans:

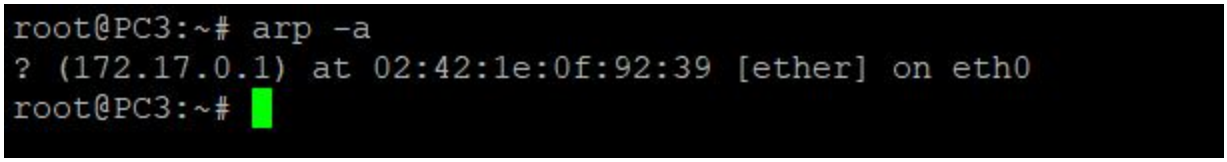
For PC1:



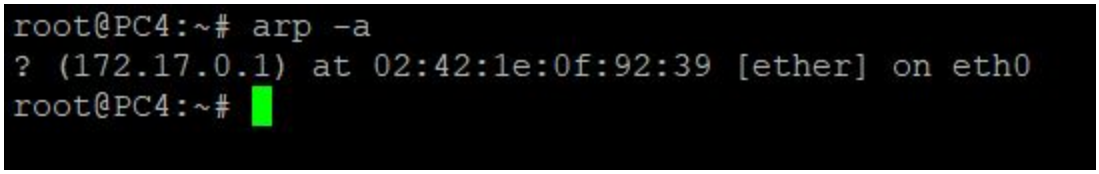
For PC2:



For PC3:



For PC4;



4. Examine the routing table of each PC.

Ans:

For PC1:

```
root@PC1:~# ip route show
default via 172.17.0.1 dev eth0
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.2
192.1.1.0/24 dev eth2 proto kernel scope link src 192.1.1.1
root@PC1:~#
```

For PC2:

```
root@PC2:~# ip route show
default via 172.17.0.1 dev eth0
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.3
192.1.1.0/24 dev eth1 proto kernel scope link src 192.1.1.2
192.1.2.0/24 dev eth3 proto kernel scope link src 192.1.2.1
root@PC2:~#
```

For PC3:

```
root@PC3:~# ip route show
default via 172.17.0.1 dev eth0
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.4
192.1.2.0/24 dev eth2 proto kernel scope link src 192.1.2.2
192.1.3.0/24 dev eth4 proto kernel scope link src 192.1.3.1
root@PC3:~#
```

For PC4:

```
root@PC4:~# ip route show
default via 172.17.0.1 dev eth0
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.5
192.1.3.0/24 dev eth3 proto kernel scope link src 192.1.3.2
root@PC4:~#
```

5.Ping PC2, PC3 and PC4 from PC1

Ans:

Ping from PC1 to PC2

The Ping was successful.

```
root@PC1:~# ping 192.1.1.2
PING 192.1.1.2 (192.1.1.2) 56(84) bytes of data.
64 bytes from 192.1.1.2: icmp_seq=1 ttl=64 time=0.126 ms
64 bytes from 192.1.1.2: icmp_seq=2 ttl=64 time=0.054 ms
^C
--- 192.1.1.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 999ms
rtt min/avg/max/mdev = 0.054/0.090/0.126/0.036 ms
root@PC1:~#
```

Ping from PC1 to PC3

The destination host is unreachable

```
root@PC1:~#
root@PC1:~# ping 192.1.2.2
PING 192.1.2.2 (192.1.2.2) 56(84) bytes of data.
From 128.109.191.97 icmp_seq=2 Destination Net Unreachable
^C
--- 192.1.2.2 ping statistics ---
3 packets transmitted, 0 received, +1 errors, 100% packet loss, time 2008ms

root@PC1:~#
```

Ping from PC1 to PC4:

The ping is not successful

```
root@PC1:~# ping 192.1.3.3
PING 192.1.3.3 (192.1.3.3) 56(84) bytes of data.
^C
--- 192.1.3.3 ping statistics ---
4 packets transmitted, 0 received, 100% packet loss, time 3023ms

root@PC1:~#
```

6.Examine the ARP table of each PC
Ans:

In PC1

```
root@PC1:~# arp -a
? (192.1.1.2) at 1a:24:e8:71:92:b5 [ether] on eth2
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC1:~#
```

In PC2:

```
root@PC2:~# arp -a
? (192.1.1.1) at b6:90:4d:73:68:75 [ether] on eth1
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC2:~#
```

In PC3:

```
root@PC3:~# arp -a
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC3:~#
```

In PC4:

```
root@PC4:~# arp -a
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC4:~#
```

7. Add routes at PC2 and PC3 to allow packets to be forwarded along the path from PC1 to PC4.

Ans:

For PC1:

```
root@PC1:~# ip route add 192.1.3.0/24 via 192.1.1.2 dev eth2
root@PC1:~#
root@PC1:~# ip route add 192.1.2.0/24 via 192.1.1.2 dev eth2
```

```
root@PC1:~# ip route show
default via 172.17.0.1 dev eth0
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.2
192.1.1.0/24 dev eth2 proto kernel scope link src 192.1.1.1
192.1.2.0/24 via 192.1.1.2 dev eth2
192.1.3.0/24 via 192.1.1.2 dev eth2
root@PC1:~#
```

For PC2:

```
root@PC2:~#
root@PC2:~# ip route add 192.1.3.0/24 via 192.1.2.2 dev eth3
root@PC2:~# ip route show
default via 172.17.0.1 dev eth0
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.3
192.1.1.0/24 dev eth1 proto kernel scope link src 192.1.1.2
192.1.2.0/24 dev eth3 proto kernel scope link src 192.1.2.1
192.1.3.0/24 via 192.1.2.2 dev eth3
root@PC2:~#
```

For PC3:

```
root@PC3:~#
root@PC3:~# ip route add 192.1.1.0/24 via 192.1.2.1 dev eth2
root@PC3:~#
root@PC3:~# ip route show
default via 172.17.0.1 dev eth0
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.4
192.1.1.0/24 via 192.1.2.1 dev eth2
192.1.2.0/24 dev eth2 proto kernel scope link src 192.1.2.2
192.1.3.0/24 dev eth4 proto kernel scope link src 192.1.3.1
root@PC3:~#
```

For PC4:

```
root@PC4:~#
root@PC4:~# ip route add 192.1.2.0/24 via 192.1.3.1 dev eth3
root@PC4:~# ip route add 192.1.1.0/24 via 192.1.3.1 dev eth3
root@PC4:~#
root@PC4:~# ip route show
default via 172.17.0.1 dev eth0
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.5
192.1.1.0/24 via 192.1.3.1 dev eth3
192.1.2.0/24 via 192.1.3.1 dev eth3
192.1.3.0/24 dev eth3 proto kernel scope link src 192.1.3.2
root@PC4:~#
```

8. Make sure forwarding is turned “on” at each PC
Ans:

For PC1:

```
root@PC1:~# cat /proc/sys/net/ipv4/ip_forward
1
root@PC1:~#
```

For PC2:

```
root@PC2:~#  cat /proc/sys/net/ipv4/ip_forward
1
root@PC2:~#
```

For PC3:

```
root@PC3:~# cat /proc/sys/net/ipv4/ip_forward
1
root@PC3:~#
```

For PC4:

```
root@PC4:~# cat /proc/sys/net/ipv4/ip_forward
1
root@PC4:~#
```

9. Ping PC2, PC3 and PC4 from PC1.

Ans:

When PC2 was pinged from PC1

```
root@PC1:~# ping 192.1.1.2
PING 192.1.1.2 (192.1.1.2) 56(84) bytes of data.
64 bytes from 192.1.1.2: icmp_seq=1 ttl=64 time=1.21 ms
64 bytes from 192.1.1.2: icmp_seq=2 ttl=64 time=0.061 ms
64 bytes from 192.1.1.2: icmp_seq=3 ttl=64 time=0.059 ms
^C
--- 192.1.1.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2000ms
rtt min/avg/max/mdev = 0.059/0.444/1.214/0.544 ms
root@PC1:~#
```

When PC3 was pinged from PC1

```
root@PC1:~# ping 192.1.2.2
PING 192.1.2.2 (192.1.2.2) 56(84) bytes of data.
64 bytes from 192.1.2.2: icmp_seq=1 ttl=63 time=0.159 ms
64 bytes from 192.1.2.2: icmp_seq=2 ttl=63 time=0.066 ms
64 bytes from 192.1.2.2: icmp_seq=3 ttl=63 time=0.070 ms
64 bytes from 192.1.2.2: icmp_seq=4 ttl=63 time=0.069 ms
^C
--- 192.1.2.2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 2997ms
rtt min/avg/max/mdev = 0.066/0.091/0.159/0.039 ms
root@PC1:~#
```

When PC4 was pinged from PC1:

```
root@PC1:~# ping 192.1.3.2
PING 192.1.3.2 (192.1.3.2) 56(84) bytes of data.
64 bytes from 192.1.3.2: icmp_seq=1 ttl=62 time=2.09 ms
64 bytes from 192.1.3.2: icmp_seq=2 ttl=62 time=0.084 ms
64 bytes from 192.1.3.2: icmp_seq=3 ttl=62 time=0.084 ms
^C
--- 192.1.3.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2000ms
rtt min/avg/max/mdev = 0.084/0.754/2.096/0.948 ms
root@PC1:~#
```

10. Examine the ARP table of each PC.

Ans:

For PC1:

```
root@PC1:~# arp -a
? (192.1.1.2) at 1a:24:e8:71:92:b5 [ether] on eth2
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC1:~#
```

For PC2:

```
root@PC2:~# arp -a
? (192.1.1.1) at b6:90:4d:73:68:75 [ether] on eth1
? (192.1.2.2) at ce:bc:ff:27:4a:d6 [ether] on eth3
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC2:~#
```

For PC3:

```
root@PC3:~# arp -a
? (192.1.3.2) at 6a:a9:ca:ad:a8:8a [ether] on eth4
? (192.1.2.1) at 22:0b:98:b4:af:c7 [ether] on eth2
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC3:~#
```

For PC4:

```
root@PC4:~# arp -a
? (192.1.3.1) at e6:8f:1f:92:19:06 [ether] on eth3
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC4:~#
```

11. Clear the ARP table on all PCs, run wireshark on each PC, and repeat Steps 3-6.
Ans:

For PC1

```
root@PC1:~# ip -s -s neigh flush all
192.1.1.2 dev eth2 lladdr 1a:24:e8:71:92:b5 used 660/657/641 probes 1 STALE
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 6/0/5 probes 0 REACHABLE

*** Round 1, deleting 2 entries ***
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 0/0/0 probes 4 REACHABLE

*** Round 2, deleting 1 entries ***
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 0/0/0 probes 4 REACHABLE

*** Round 3, deleting 1 entries ***
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 0/0/0 probes 4 REACHABLE

*** Round 4, deleting 1 entries ***
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 0/0/0 probes 4 REACHABLE

*** Round 5, deleting 1 entries ***
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 0/0/0 probes 4 REACHABLE

*** Round 6, deleting 1 entries ***
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 0/0/0 probes 4 REACHABLE

*** Round 7, deleting 1 entries ***
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 0/0/0 probes 4 REACHABLE

*** Round 8, deleting 1 entries ***
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 0/0/0 probes 4 REACHABLE

*** Round 9, deleting 1 entries ***
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 0/0/0 probes 4 REACHABLE

*** Round 10, deleting 1 entries ***
*** Flush not complete bailing out after 10 rounds
root@PC1:~# arp -a
? (192.1.1.2) at <incomplete> on eth2
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC1:~#
```

For PC2

```
root@PC2:~#
root@PC2:~# ip -s -s neigh flush all
192.1.1.1 dev eth1 lladdr b6:90:4d:73:68:75 used 605/602/584 probes 1 STALE
192.1.2.2 dev eth3 lladdr ce:bc:ff:27:4a:d6 used 605/602/574 probes 1 STALE
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 13/3/12 probes 0 REACHABLE

*** Round 1, deleting 3 entries ***
*** Flush is complete after 1 round ***
root@PC2:~#
root@PC2:~# arp -a
? (192.1.1.1) at <incomplete> on eth1
? (192.1.2.2) at <incomplete> on eth3
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC2:~#
```

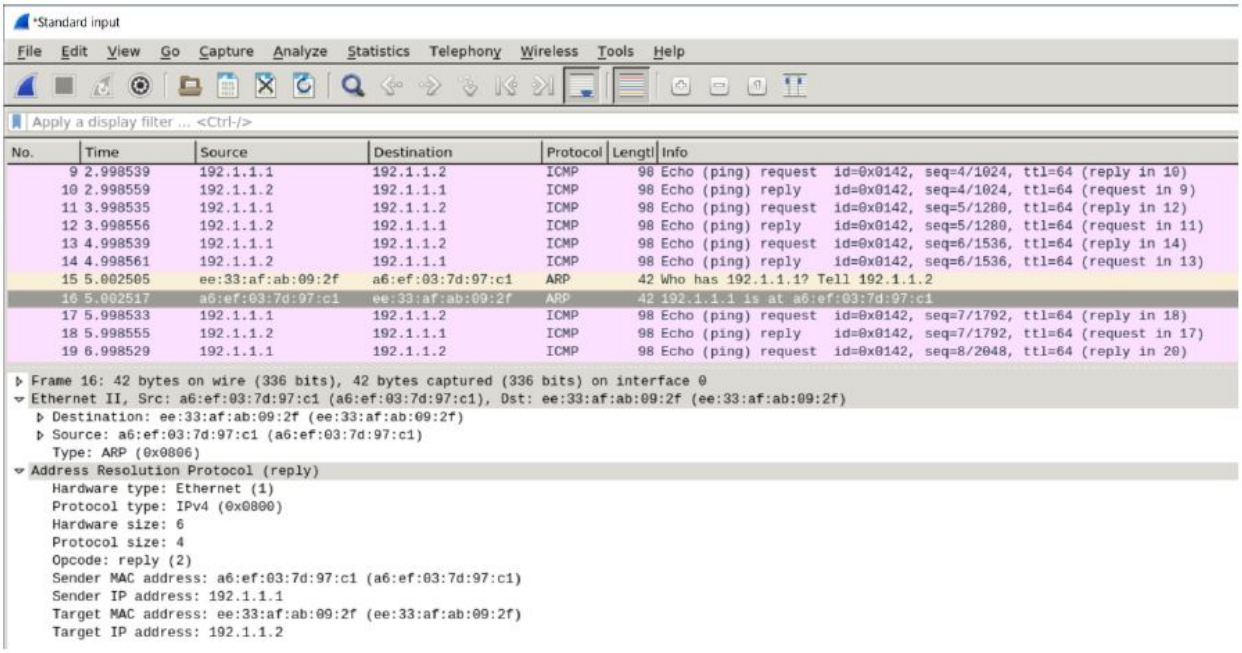
For PC3

```
root@PC3:~# ip -s -s neigh flush all
192.1.3.2 dev eth4 lladdr 6a:a9:ca:ad:a8:8a used 543/543/525 probes 4 STALE
192.1.2.1 dev eth2 lladdr 22:0b:98:b4:af:c7 used 541/538/502 probes 1 STALE
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 16/1/12 probes 1 REACHABLE

*** Round 1, deleting 3 entries ***
*** Flush is complete after 1 round ***
root@PC3:~#
root@PC3:~# arp - s
-: Unknown host
root@PC3:~# arp -a
? (192.1.3.2) at <incomplete> on eth4
? (192.1.2.1) at <incomplete> on eth2
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC3:~#
```

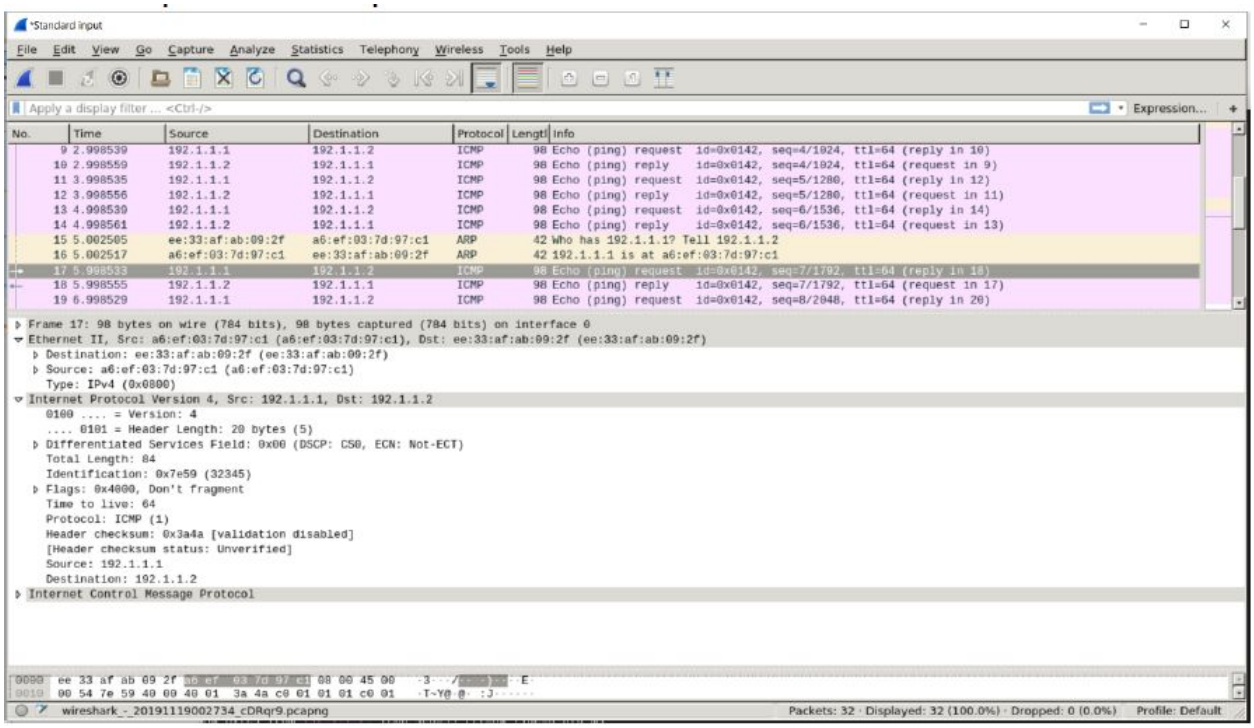
For PC4

```
root@PC4:~#
root@PC4:~# ip -s -s neigh flush all
192.1.3.1 dev eth3 lladdr e6:8f:1f:92:19:06 used 463/460/428 probes 1 STALE
172.17.0.1 dev eth0 lladdr 02:42:1e:0f:92:39 ref 1 used 7/1/7 probes 1 REACHABLE

*** Round 1, deleting 2 entries ***
*** Flush is complete after 1 round ***
root@PC4:~# arp -a
? (192.1.3.1) at <incomplete> on eth3
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC4:~#
```

Wireshark Capture of ARP packet at eth1 of PC2



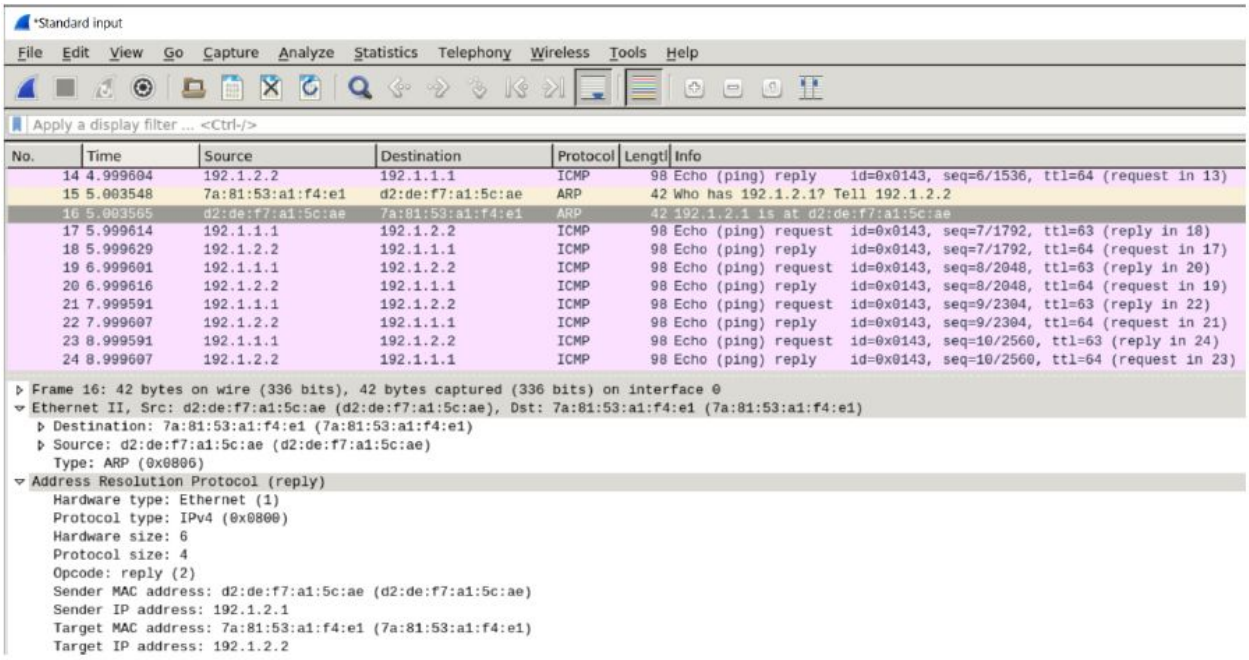
Wireshark capture of ICMP request on eth1 of PC2



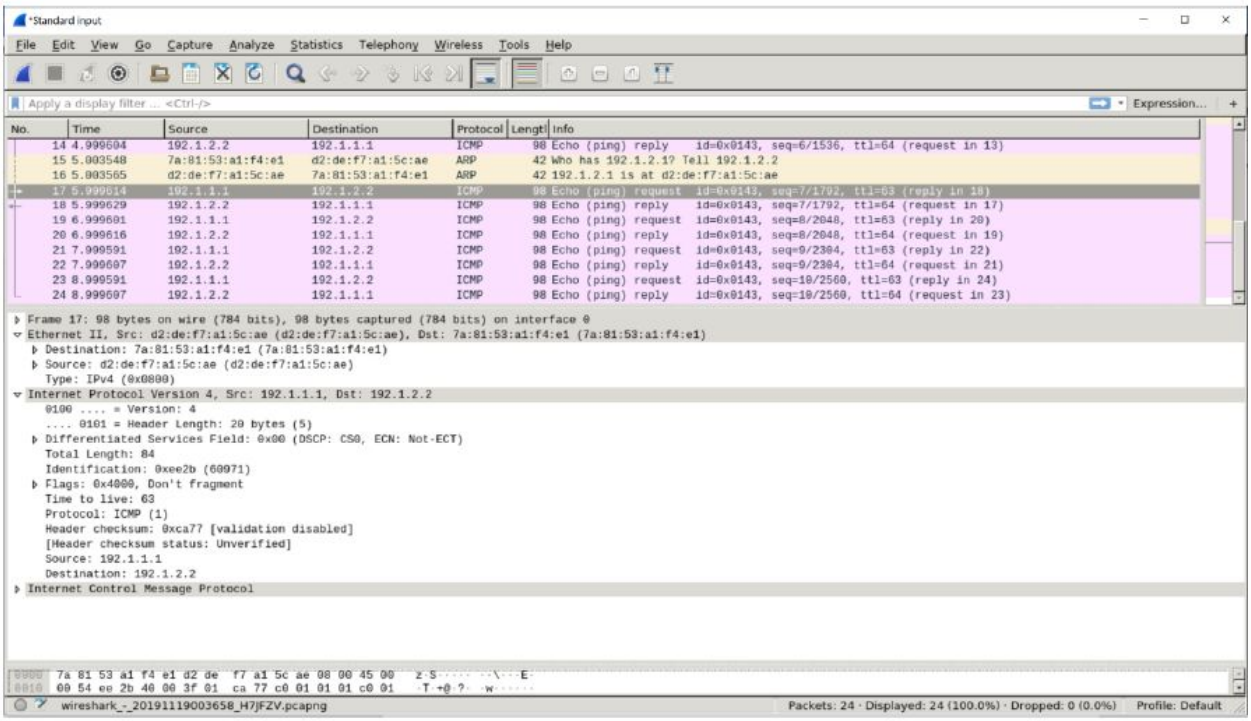
When PC3 is pinged from PC1

```
root@PC1:~#
root@PC1:~# ping 192.1.2.2
PING 192.1.2.2 (192.1.2.2) 56(84) bytes of data.
64 bytes from 192.1.2.2: icmp_seq=1 ttl=63 time=0.231 ms
64 bytes from 192.1.2.2: icmp_seq=2 ttl=63 time=0.072 ms
64 bytes from 192.1.2.2: icmp_seq=3 ttl=63 time=0.068 ms
64 bytes from 192.1.2.2: icmp_seq=4 ttl=63 time=0.080 ms
^C
--- 192.1.2.2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 2997ms
rtt min/avg/max/mdev = 0.068/0.112/0.231/0.069 ms
root@PC1:~#
```

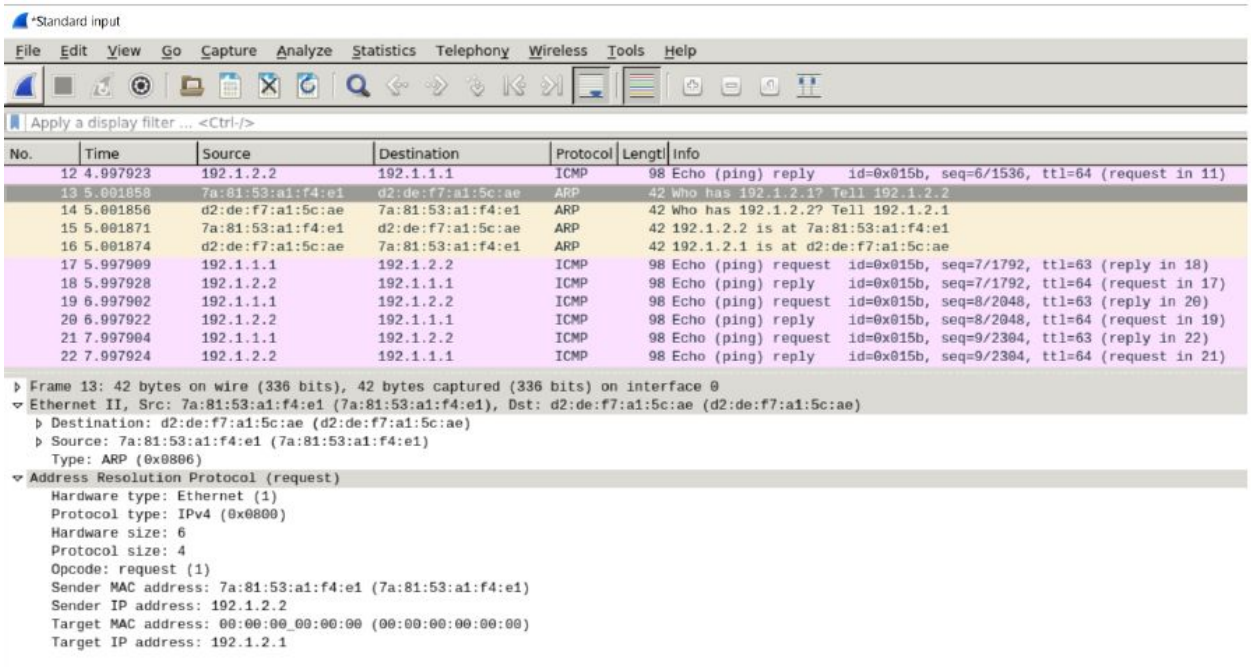
Wireshark capture of ARP packet on eth3 of PC2



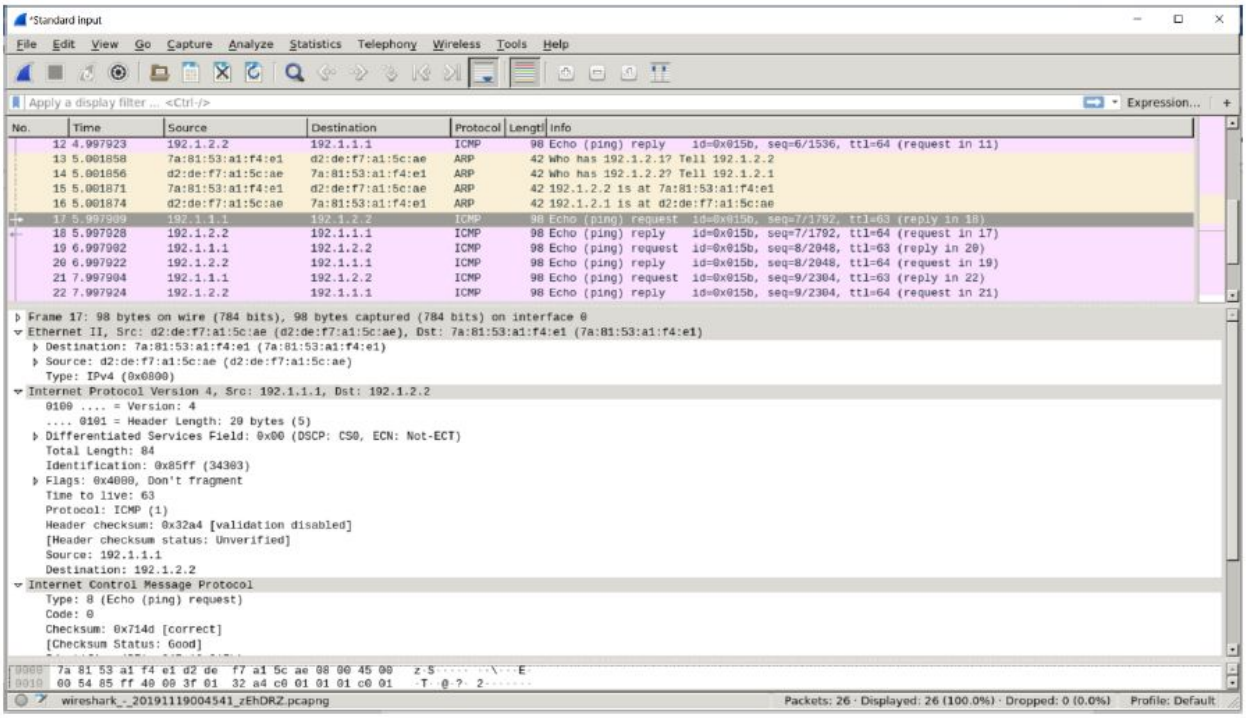
Wireshark capture of ICMP request packet on eth3 of PC2



Wireshark capture of ARP packet on eth2 of PC3



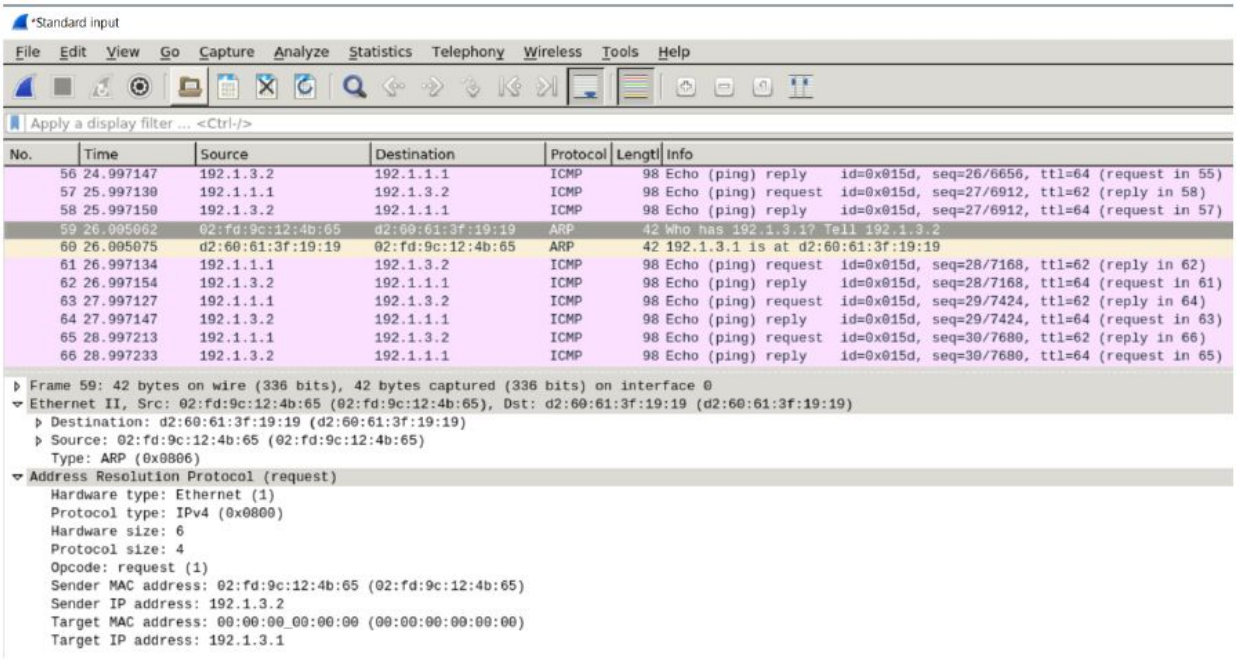
Wireshark capture of ICMP request packet on eth2 of PC3



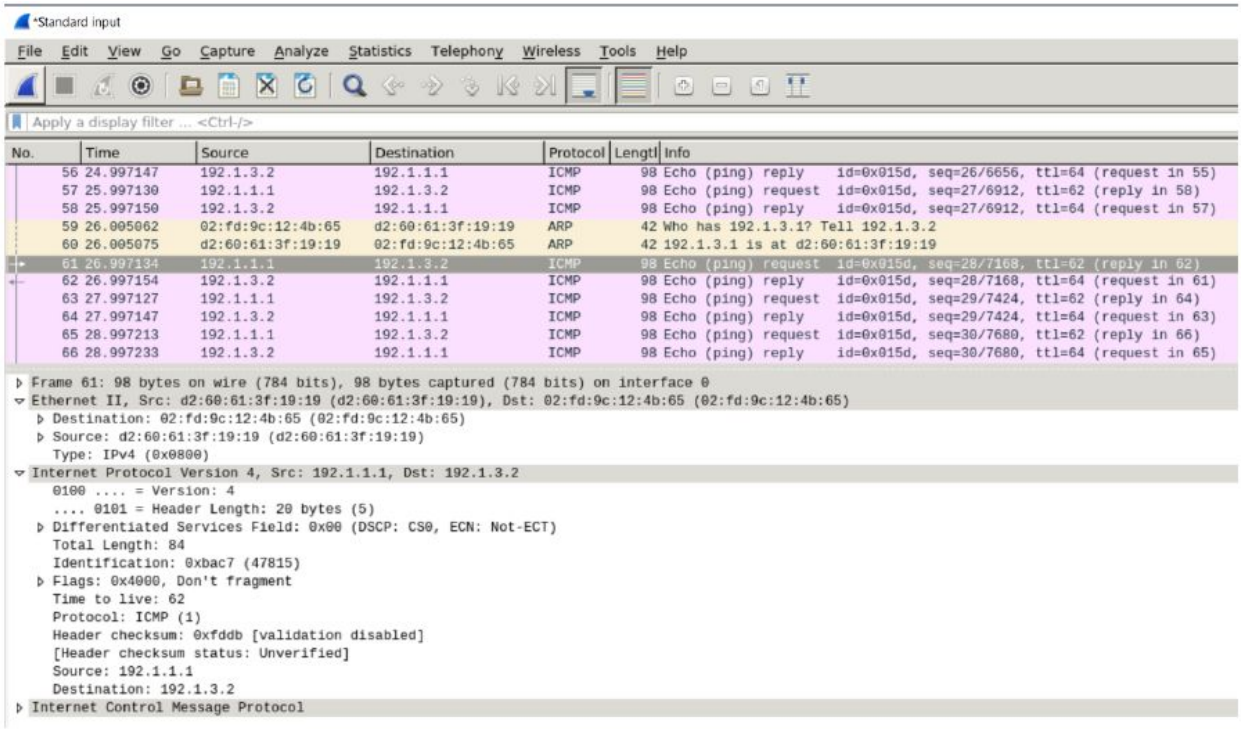
When PC4 is pinged from PC1

```
root@PC1:~# ping 192.1.3.2
PING 192.1.3.2 (192.1.3.2) 56(84) bytes of data.
64 bytes from 192.1.3.2: icmp_seq=1 ttl=62 time=0.258 ms
64 bytes from 192.1.3.2: icmp_seq=2 ttl=62 time=0.086 ms
64 bytes from 192.1.3.2: icmp_seq=3 ttl=62 time=0.085 ms
64 bytes from 192.1.3.2: icmp_seq=4 ttl=62 time=0.116 ms
64 bytes from 192.1.3.2: icmp_seq=5 ttl=62 time=0.097 ms
^C
--- 192.1.3.2 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4000ms
rtt min/avg/max/mdev = 0.085/0.128/0.258/0.066 ms
root@PC1:~#
```

Wireshark capture of ARP packet on eth3 of PC4



Wireshark capture of ICMP request packet on eth3 of PC4



Arp table of PC1

```
root@PC1:~# arp -a
? (192.1.1.2) at 1a:24:e8:71:92:b5 [ether] on eth2
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC1:~#
```

Arp table of PC2

```
root@PC2:~# arp -a
? (192.1.1.1) at b6:90:4d:73:68:75 [ether] on eth1
? (192.1.2.2) at ce:bc:ff:27:4a:d6 [ether] on eth3
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC2:~#
```

Arp table of PC3

```
root@PC3:~# arp -a
? (192.1.3.2) at 6a:a9:ca:ad:a8:8a [ether] on eth4
? (192.1.2.1) at 22:0b:98:b4:af:c7 [ether] on eth2
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC3:~#
```

Arp table of PC4

```
root@PC4:~# arp -a
? (192.1.3.1) at e6:8f:1f:92:19:06 [ether] on eth3
? (172.17.0.1) at 02:42:1e:0f:92:39 [ether] on eth0
root@PC4:~#
```

12. From PC1, change its default gateway to 192.1.1.2 (PC2), run “curl www.ncsu.edu”, and observe the Wireshark output

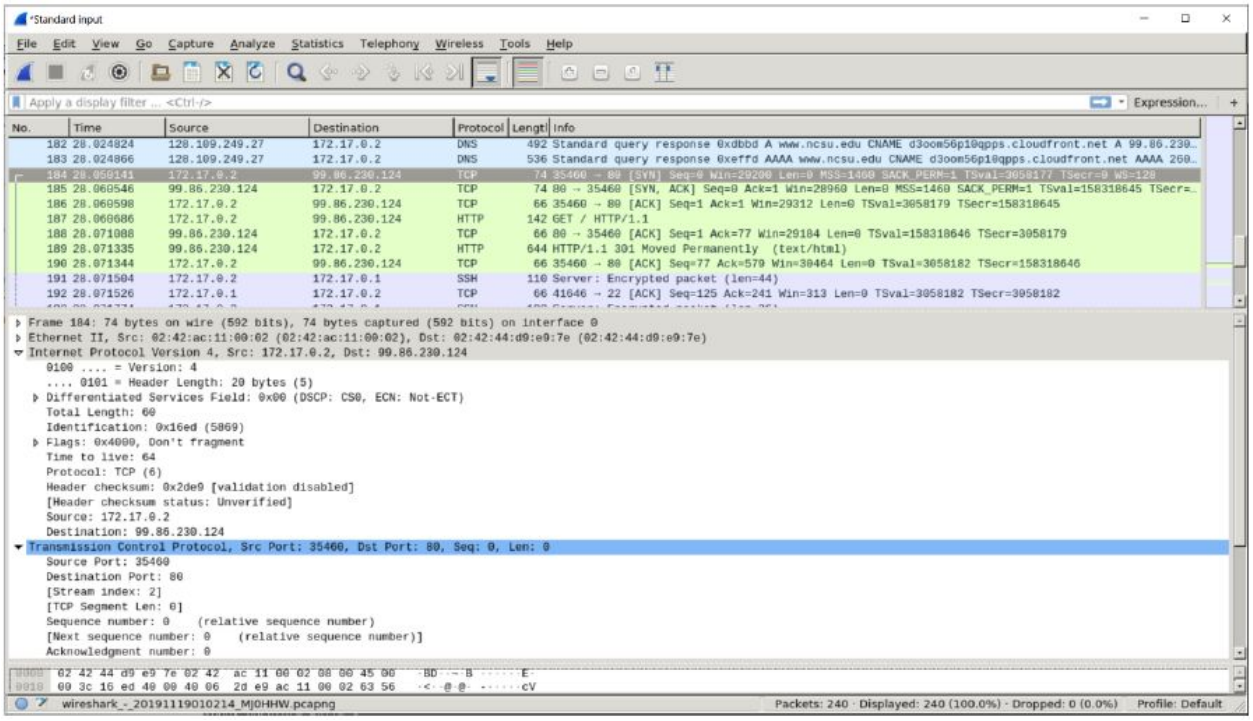
Ans: The routes initially

```
root@PC1:~# ip r
default via 172.17.0.1 dev eth0
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.2
192.1.1.0/24 dev eth2 proto kernel scope link src 192.1.1.1
192.1.2.0/24 via 192.1.1.2 dev eth2
192.1.3.0/24 via 192.1.1.2 dev eth2
```

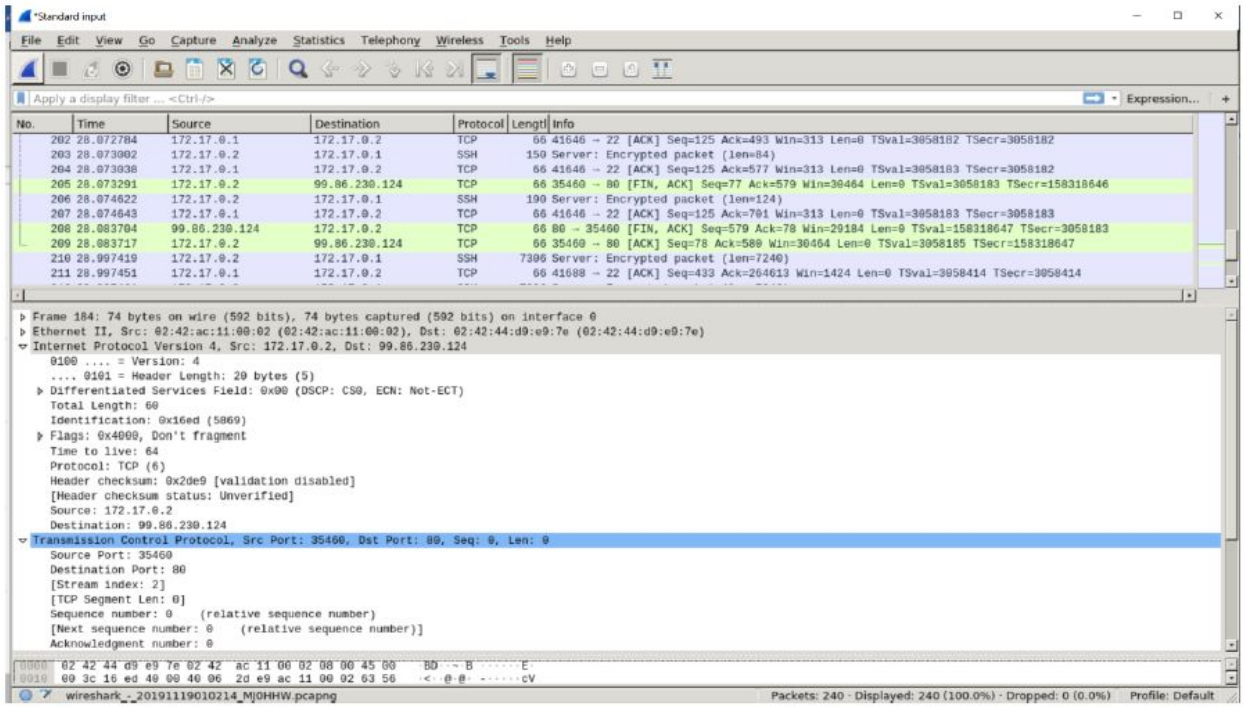
When curl www.ncsu.edu is run initially

```
root@PC1:~# curl www.ncsu.edu
<html>
<head><title>301 Moved Permanently</title></head>
<body bgcolor="white">
<center><h1>301 Moved Permanently</h1></center>
<hr><center>CloudFront</center>
</body>
</html>
root@PC1:~#
```

Wireshark captures at eth0 of PC1



We can see the TCP SYN, SYN ACK and ACK packets for setting up the TCP connection between PC1 and the server of NCSU.



We can see the TCP FIN, FIN ACK and ACK packets for closing the TCP connection between PC1 and NCSU server.
The routes after deleting the default gateway

```
root@PC1:~# ip r
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.2
192.1.1.0/24 dev eth2 proto kernel scope link src 192.1.1.1
192.1.2.0/24 via 192.1.1.2 dev eth2
192.1.3.0/24 via 192.1.1.2 dev eth2
root@PC1:~#
```

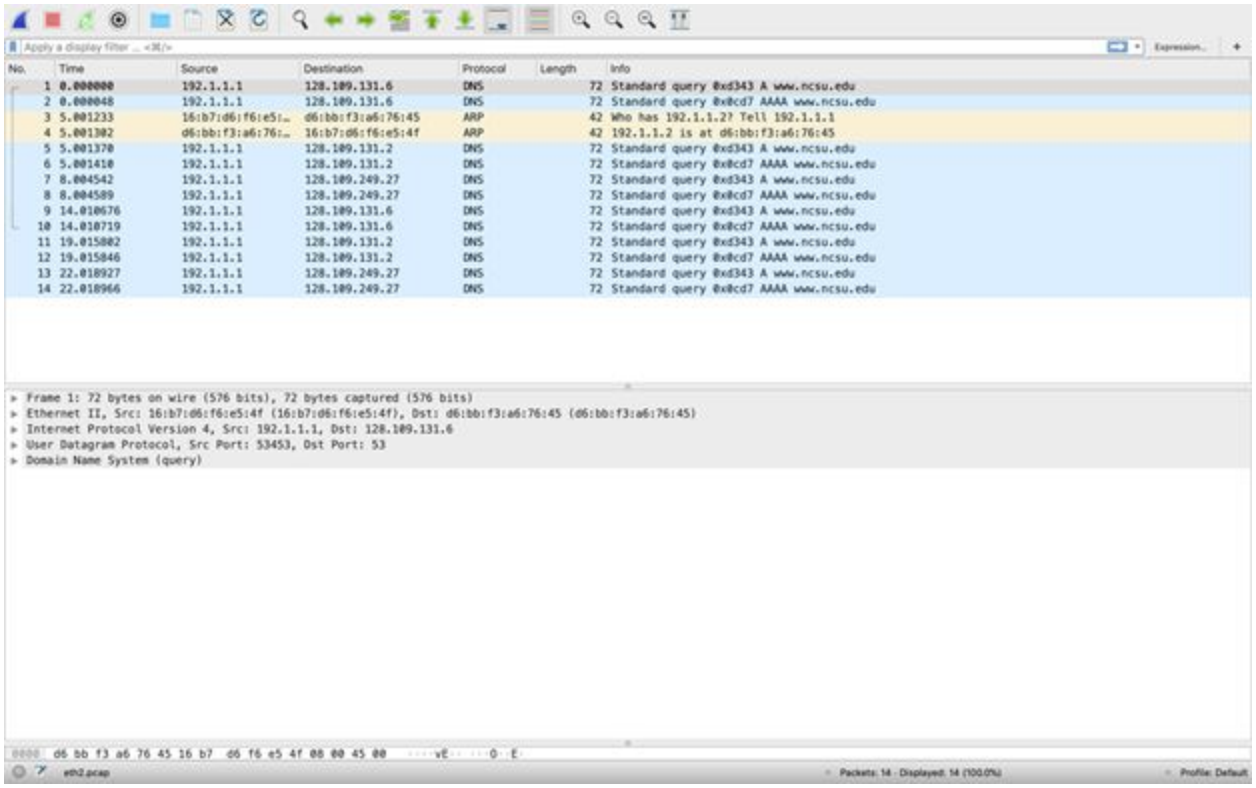
After adding the gateway via 192.1.1.2

```
root@PC1:~# ip route add default via 192.1.1.2
root@PC1:~#
root@PC1:~#
root@PC1:~# ip route show
default via 192.1.1.2 dev eth2
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.2
192.1.1.0/24 dev eth2 proto kernel scope link src 192.1.1.1
192.1.2.0/24 via 192.1.1.2 dev eth2
192.1.3.0/24 via 192.1.1.2 dev eth2
root@PC1:~#
```

When curl www.ncsu.edu is run later

```
root@PC1:~# curl www.ncsu.edu
curl: (6) Could not resolve host: www.ncsu.edu
root@PC1:~#
```

Caputre at eth2 of PC1



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.1.1.1	128.109.131.6	DNS	72	Standard query 0xd343 A www.ncsu.edu
2	0.000048	192.1.1.1	128.109.131.6	DNS	72	Standard query 0x0cd7 AAAA www.ncsu.edu
3	5.001233	16:b7:d6:f6:e5:…	d6:bb:f3:a6:76:45	ARP	42	Who has 192.1.1.2? Tell 192.1.1.1
4	5.001302	d6:bb:f3:a6:76:…	16:b7:d6:f6:e5:4f	ARP	42	192.1.1.2 is at d6:bb:f3:a6:76:45
5	5.001370	192.1.1.1	128.109.131.2	DNS	72	Standard query 0xd343 A www.ncsu.edu
6	5.001410	192.1.1.1	128.109.131.2	DNS	72	Standard query 0x0cd7 AAAA www.ncsu.edu
7	8.004542	192.1.1.1	128.109.249.27	DNS	72	Standard query 0xd343 A www.ncsu.edu
8	8.004589	192.1.1.1	128.109.249.27	DNS	72	Standard query 0x0cd7 AAAA www.ncsu.edu
9	14.010676	192.1.1.1	128.109.131.6	DNS	72	Standard query 0xd343 A www.ncsu.edu
10	14.010719	192.1.1.1	128.109.131.6	DNS	72	Standard query 0x0cd7 AAAA www.ncsu.edu
11	19.015802	192.1.1.1	128.109.131.2	DNS	72	Standard query 0xd343 A www.ncsu.edu
12	19.015846	192.1.1.1	128.109.131.2	DNS	72	Standard query 0x0cd7 AAAA www.ncsu.edu
13	22.018927	192.1.1.1	128.109.249.27	DNS	72	Standard query 0xd343 A www.ncsu.edu
14	22.018966	192.1.1.1	128.109.249.27	DNS	72	Standard query 0x0cd7 AAAA www.ncsu.edu

Wireshark Capture at eth2 of the interface shows the DNS Query and Arp Request being sent but is unsuccessful in setting up a TCP connection between PC1 and NCSU server