

## Week 6

# Virtual Private Network Lab

**Name:Nikhil T M**

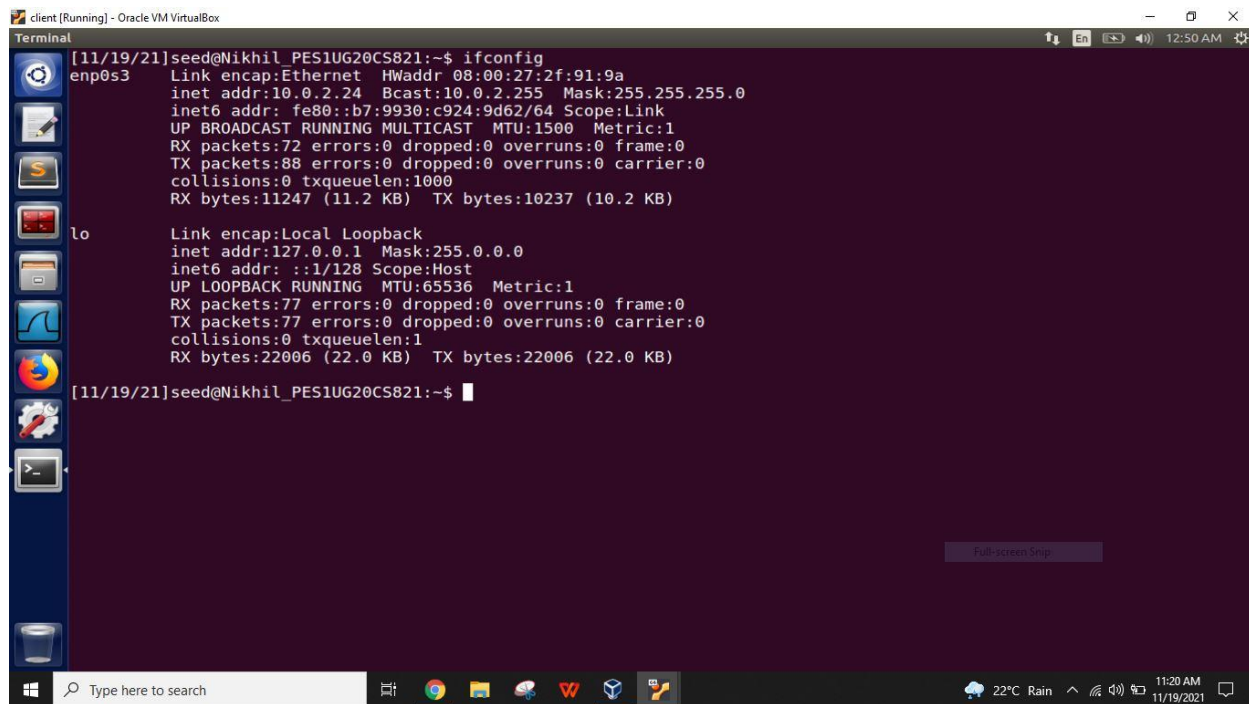
**SRN:PES1UG20CS821**

**Section:F**

### Task 1: VM Setup

**we use 3 VM's client,server and host v**

**VPN client – Adapter 1 – NAT Network**



```
client [Running] - Oracle VM VirtualBox
Terminal
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ ifconfig
enp0s3  Link encap:Ethernet  HWaddr 08:00:27:2f:91:9a
        inet addr:10.0.2.24  Bcast:10.0.2.255  Mask:255.255.255.0
        inet6 addr: fe80::b7:9930:c924:9d62/64 Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:72 errors:0 dropped:0 overruns:0 frame:0
        TX packets:88 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:11247 (11.2 KB)  TX bytes:10237 (10.2 KB)

lo      Link encap:Local Loopback
        inet addr:127.0.0.1  Mask:255.0.0.0
        inet6 addr: ::1/128 Scope:Host
        UP LOOPBACK RUNNING  MTU:65536  Metric:1
        RX packets:77 errors:0 dropped:0 overruns:0 frame:0
        TX packets:77 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1
        RX bytes:22006 (22.0 KB)  TX bytes:22006 (22.0 KB)

[11/19/21]seed@Nikhil_PES1UG20CS821:~$
```

## VPN Server – Adapter 1 – NAT network, Adapter 2 – Internal Network

```
server [Running] - Oracle VM VirtualBox
Terminal
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ ifconfig
enp0s3  Link encap:Ethernet  HWaddr 08:00:27:d3:1d:ae
        inet addr:10.0.2.27  Bcast:10.0.2.255  Mask:255.255.255.0
        inet6 addr: fe80::8c89:bbb1:d7d:69dd/64 Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:63 errors:0 dropped:0 overruns:0 frame:0
        TX packets:106 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:8972 (8.9 KB)  TX bytes:12453 (12.4 KB)

enp0s8  Link encap:Ethernet  HWaddr 08:00:27:10:c5:dd
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:0 errors:0 dropped:0 overruns:0 frame:0
        TX packets:123 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:0 (0.0 B)  TX bytes:20347 (20.3 KB)

lo      Link encap:Local Loopback
        inet addr:127.0.0.1  Mask:255.0.0.0
        inet6 addr: ::1/128 Scope:Host
        UP LOOPBACK RUNNING  MTU:65536  Metric:1
        RX packets:80 errors:0 dropped:0 overruns:0 frame:0
        TX packets:80 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1
        RX bytes:22271 (22.2 KB)  TX bytes:22271 (22.2 KB)

[11/19/21]seed@Nikhil_PES1UG20CS821:~$
```

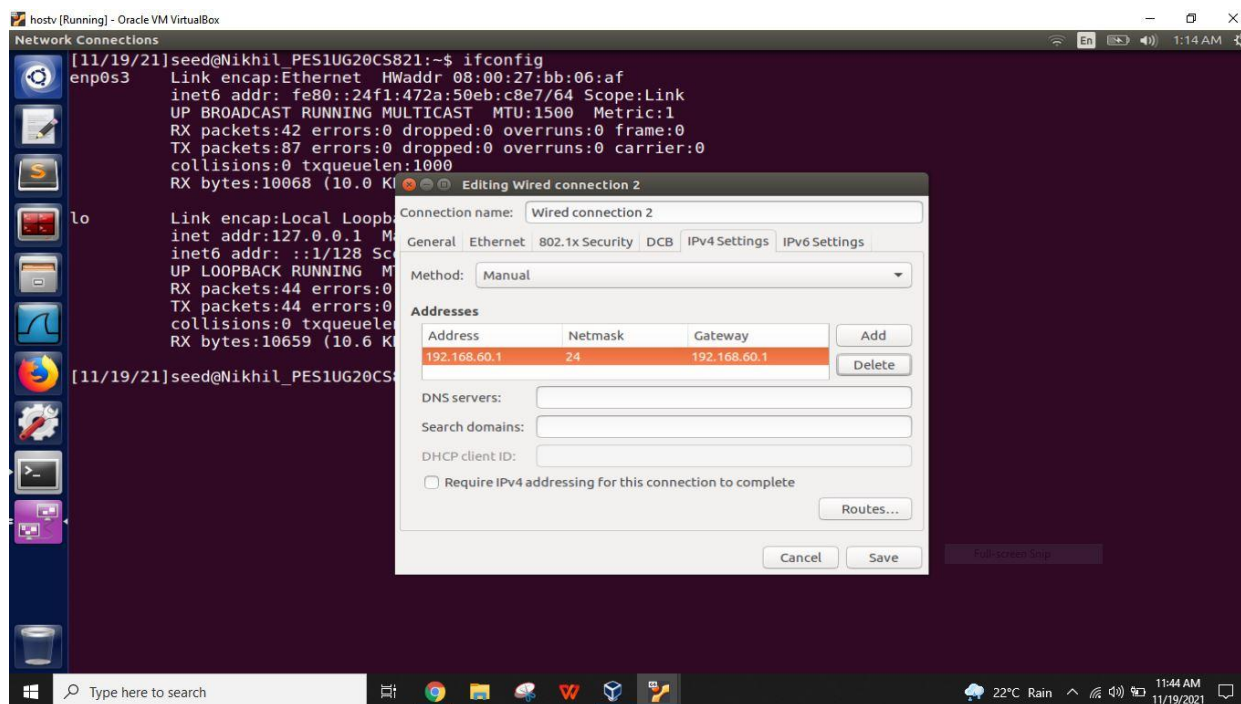
## HOST V – Adapter 1 – Internal Network

```
hostv [Running] - Oracle VM VirtualBox
Terminal
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ ifconfig
enp0s3  Link encap:Ethernet  HWaddr 08:00:27:bb:06:af
        inet6 addr: fe80::24f1:472a:50eb:c8e7/64 Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:42 errors:0 dropped:0 overruns:0 frame:0
        TX packets:87 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:10068 (10.0 KB)  TX bytes:14277 (14.2 KB)

lo      Link encap:Local Loopback
        inet addr:127.0.0.1  Mask:255.0.0.0
        inet6 addr: ::1/128 Scope:Host
        UP LOOPBACK RUNNING  MTU:65536  Metric:1
        RX packets:44 errors:0 dropped:0 overruns:0 frame:0
        TX packets:44 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1
        RX bytes:10659 (10.6 KB)  TX bytes:10659 (10.6 KB)

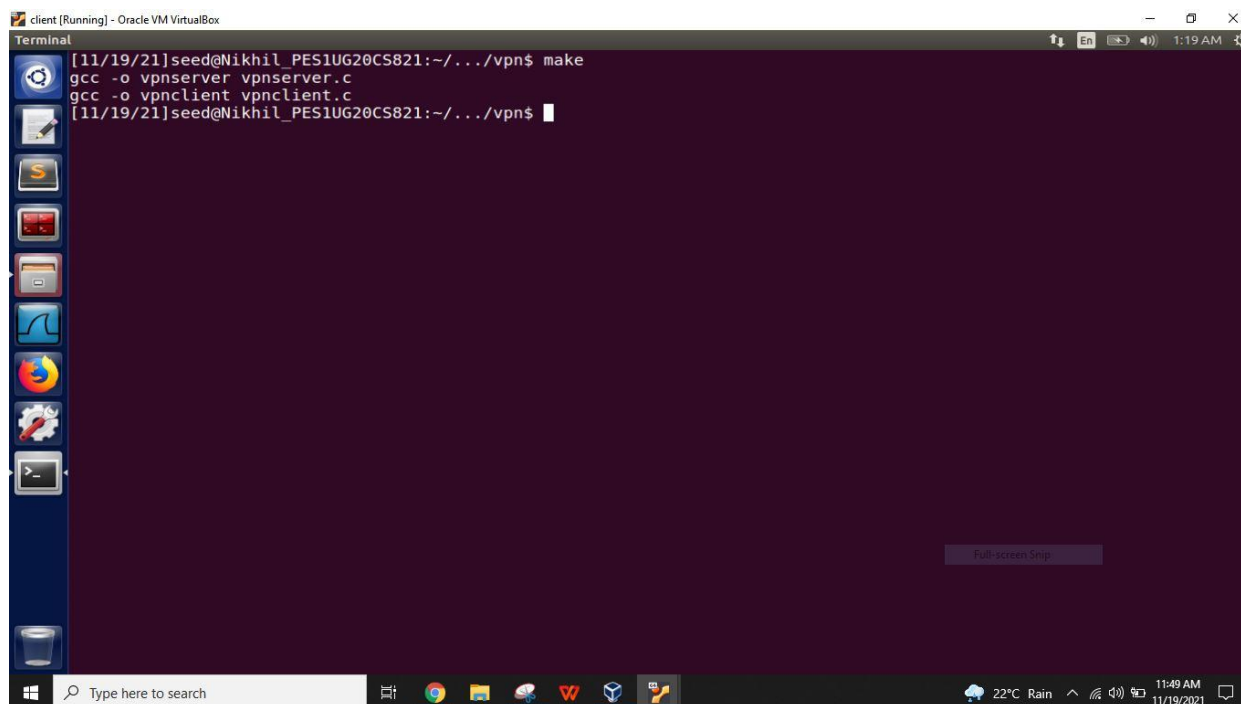
[11/19/21]seed@Nikhil_PES1UG20CS821:~$
```

We add the gateway to the host v VM



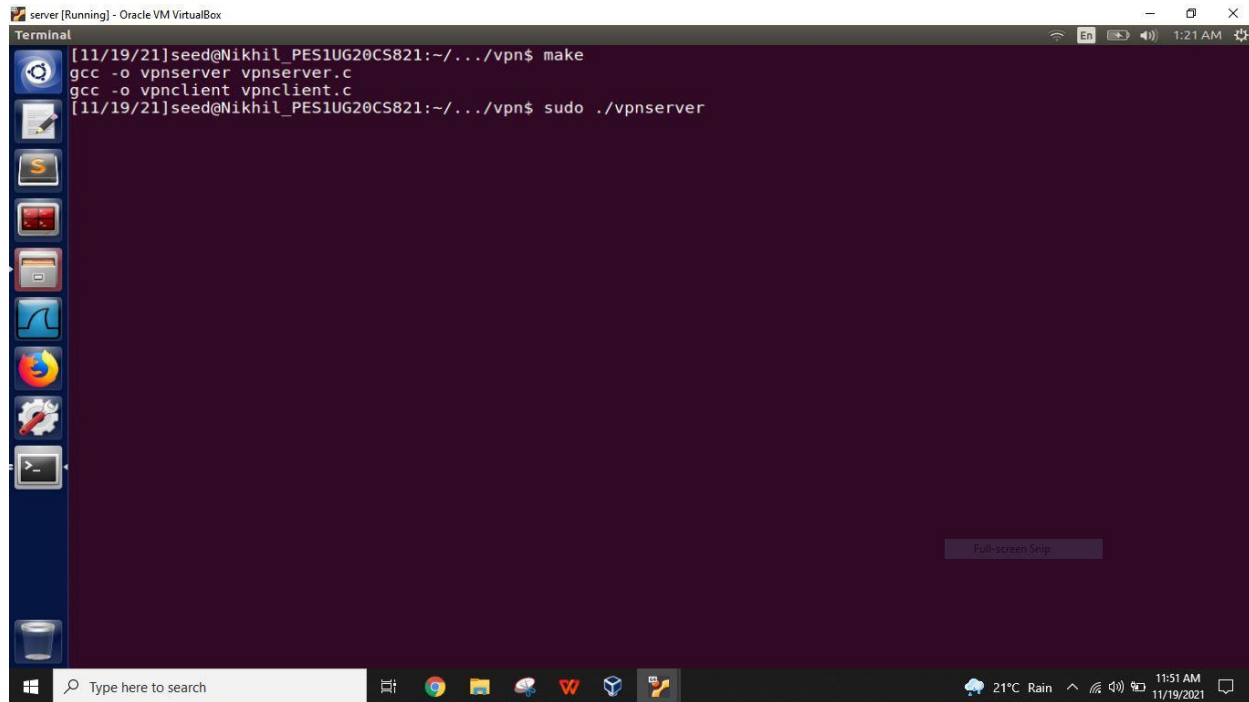
## Task 2: Creating a VPN Tunnel using TUN/TAP

First we build the make file using the command make on both the VM cilent and server



## Step 1: Run VPN server and set it's IP address of the interface – (Run on VPNServer VM)

Next we run the file vpnserver.c in the server VM

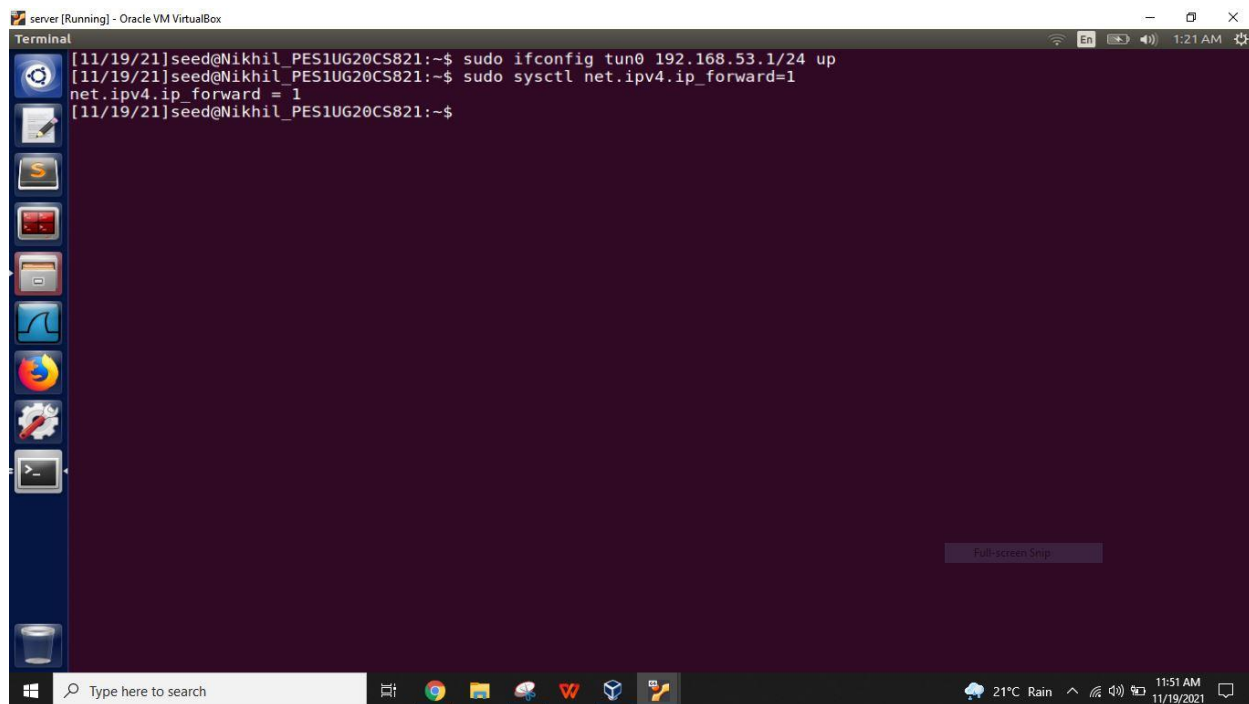


The screenshot shows a terminal window titled "server [Running] - Oracle VM VirtualBox". The terminal output is as follows:

```
[11/19/21]seed@Nikhil_PES1UG20CS821:~/.../vpn$ make
gcc -o vpnserver vpnserver.c
gcc -o vpnclient vpnclient.c
[11/19/21]seed@Nikhil_PES1UG20CS821:~/.../vpn$ sudo ./vpnserver
```

The terminal window has a dark purple background and a sidebar with various application icons. The bottom status bar shows the system clock as 11:51 AM on 11/19/2021 and weather information as 21°C Rain.

Later we add the new interface tun0 and set the ip forwarding



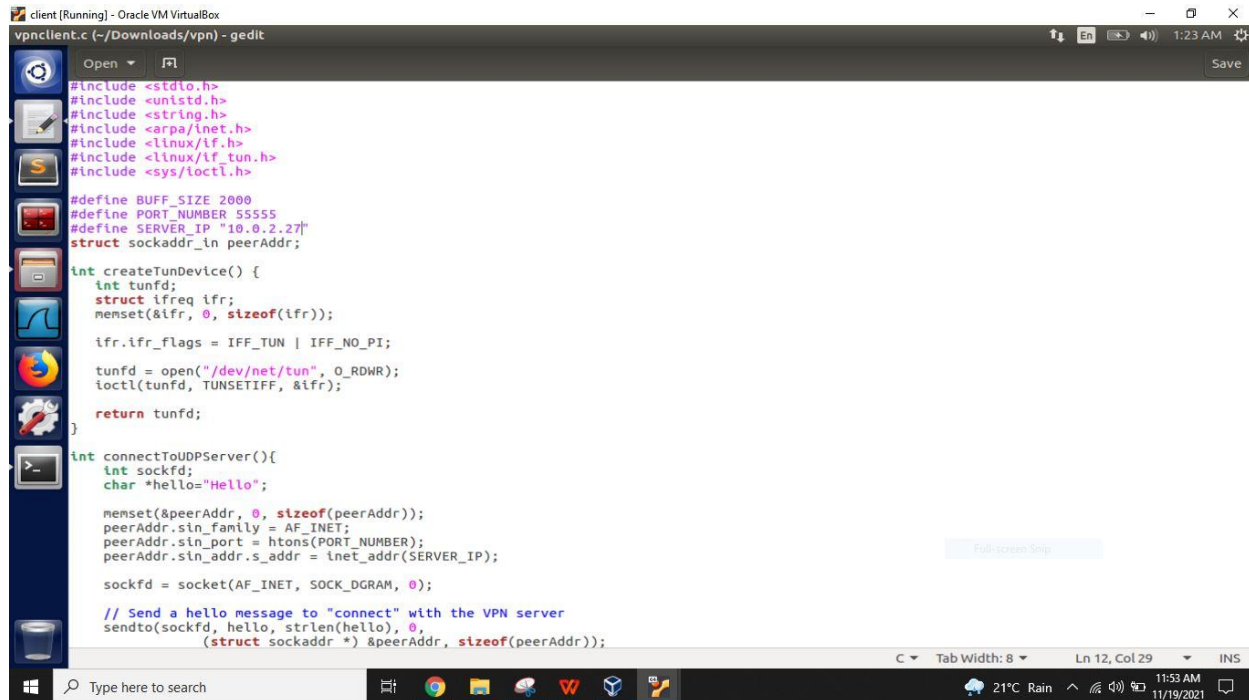
The screenshot shows the same terminal window as before, but with additional commands and output:

```
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ sudo ifconfig tun0 192.168.53.1/24 up
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ sudo sysctl net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
[11/19/21]seed@Nikhil_PES1UG20CS821:~$
```

The terminal window continues to show the same sidebar and status bar as the previous screenshot.

## Step 2: Run VPN Client and set IP address of the interface - (Run on VPNClient VM)

We run the below code in the client VM



```
client [Running] - Oracle VM VirtualBox
vpnclient.c (-/Downloads/vpn) - gedit

#include <stdio.h>
#include <unistd.h>
#include <string.h>
#include <arpa/inet.h>
#include <linux/if.h>
#include <linux/if_tun.h>
#include <sys/ioctl.h>

#define BUFF_SIZE 2000
#define PORT_NUMBER 55555
#define SERVER_IP "10.0.2.27"
struct sockaddr_in peerAddr;

int createTunDevice() {
    int tunfd;
    struct ifreq ifr;
    memset(&ifr, 0, sizeof(ifr));

    ifr.ifr_flags = IFF_TUN | IFF_NO_PI;

    tunfd = open("/dev/net/tun", O_RDWR);
    ioctl(tunfd, TUNSETIFF, &ifr);

    return tunfd;
}

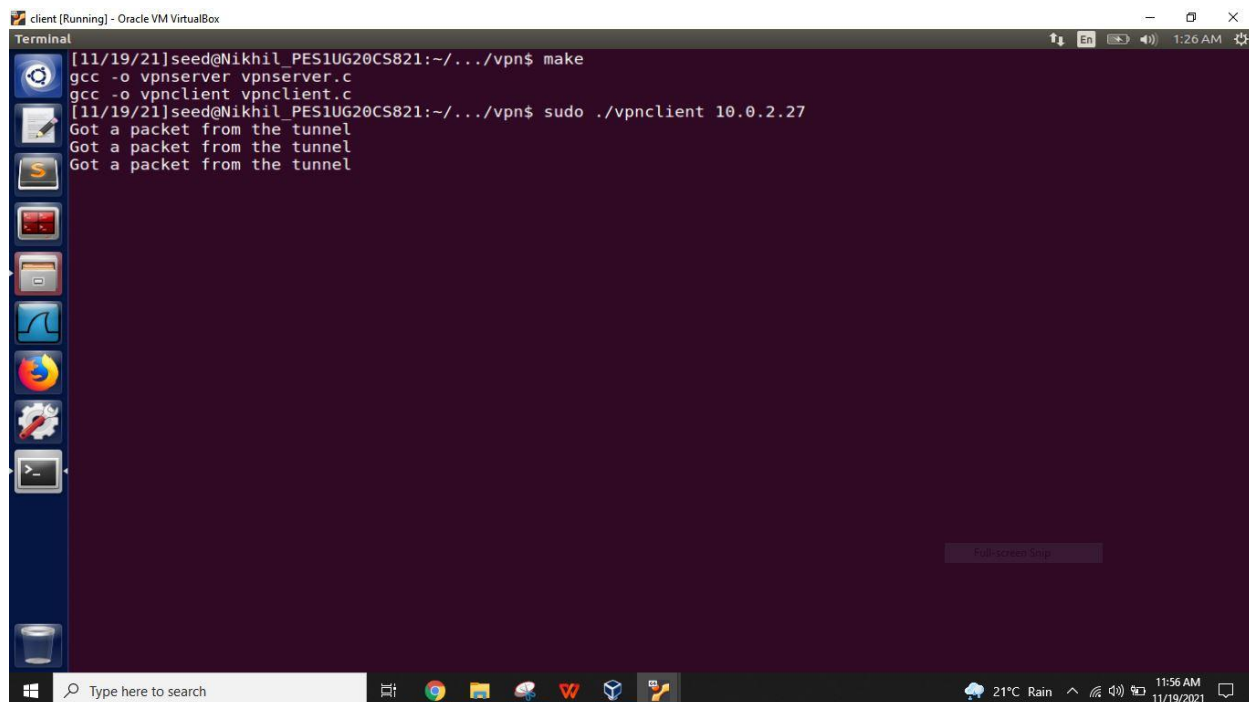
int connectToUDPServer(){
    int sockfd;
    char *hello="Hello";

    memset(&peerAddr, 0, sizeof(peerAddr));
    peerAddr.sin_family = AF_INET;
    peerAddr.sin_port = htons(PORT_NUMBER);
    peerAddr.sin_addr.s_addr = inet_addr(SERVER_IP);

    sockfd = socket(AF_INET, SOCK_DGRAM, 0);

    // Send a hello message to "connect" with the VPN server
    sendto(sockfd, hello, strlen(hello), 0,
           (struct sockaddr *) &peerAddr, sizeof(peerAddr));
}
```

And we try to establish the connection to the server VM by running vpnclient.c file

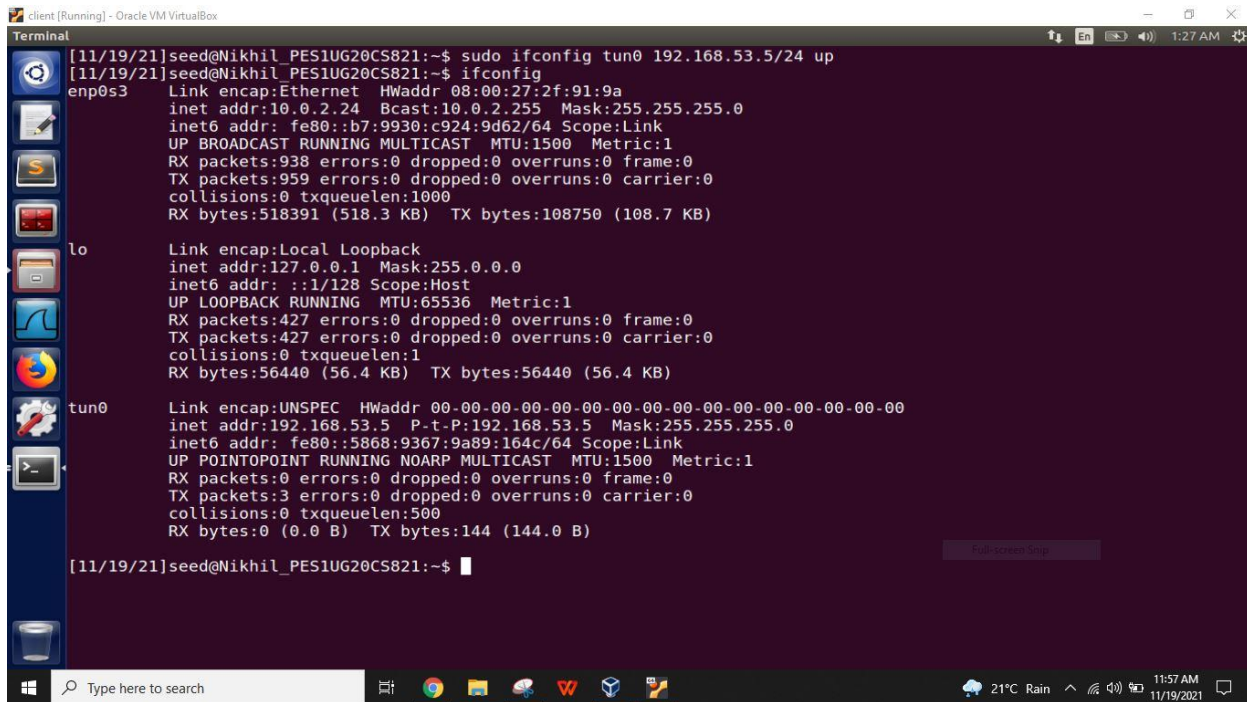


```
client [Running] - Oracle VM VirtualBox
Terminal

[11/19/21]seed@Nikhil_PES1UG20CS821:~/.../vpn$ make
gcc -o vpnserver vpnserver.c
gcc -o vpnclient vpnclient.c
[11/19/21]seed@Nikhil_PES1UG20CS821:~/.../vpn$ sudo ./vpnclient 10.0.2.27
Got a packet from the tunnel
Got a packet from the tunnel
Got a packet from the tunnel
```



And we add new interface tun0 in the client VM and we set the IP forwarding



```
client [Running] - Oracle VM VirtualBox
Terminal
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ sudo ifconfig tun0 192.168.53.5/24 up
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ ifconfig
enp0s3      Link encap:Ethernet  HWaddr 08:00:27:2f:91:9a
            inet addr:10.0.2.24  Bcast:10.0.2.255  Mask:255.255.255.0
            inet6 addr: fe80::b7:9930:c924:9d62/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
            RX packets:938 errors:0 dropped:0 overruns:0 frame:0
            TX packets:959 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1000
            RX bytes:518391 (518.3 KB)  TX bytes:108750 (108.7 KB)

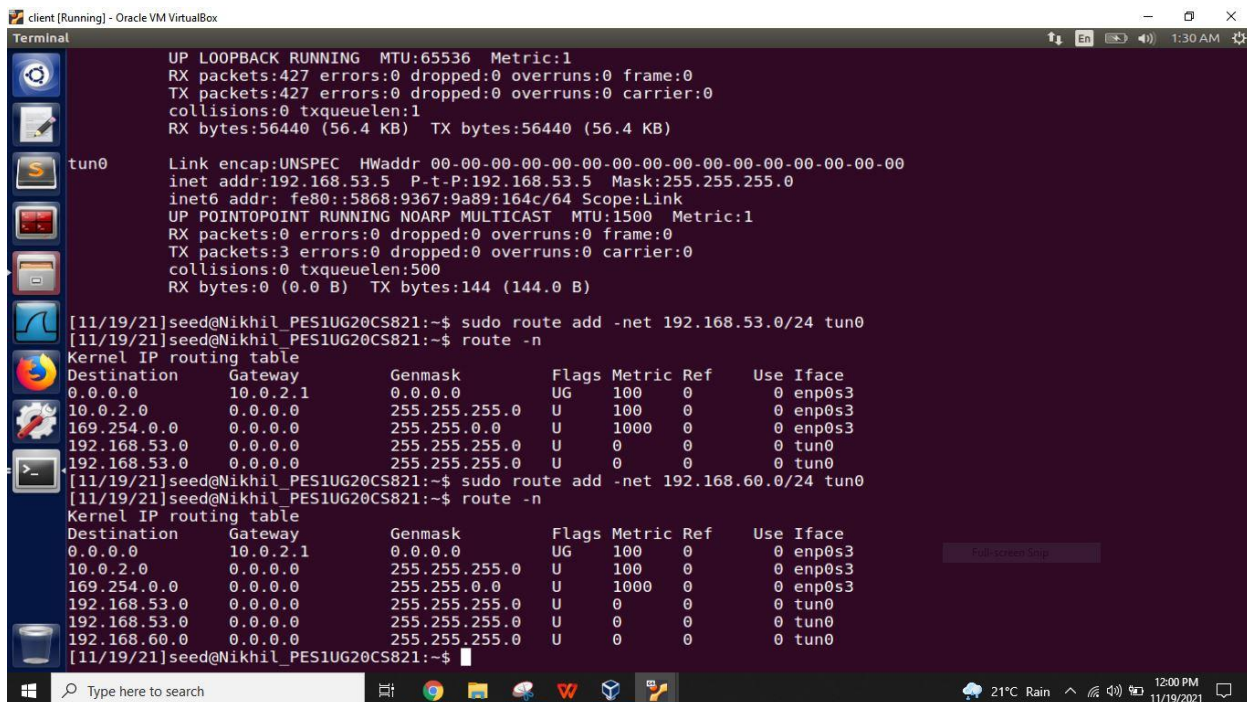
lo          Link encap:Local Loopback
            inet addr:127.0.0.1  Mask:255.0.0.0
            inet6 addr: ::1/128 Scope:Host
            UP LOOPBACK RUNNING  MTU:65536  Metric:1
            RX packets:427 errors:0 dropped:0 overruns:0 frame:0
            TX packets:427 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1
            RX bytes:56440 (56.4 KB)  TX bytes:56440 (56.4 KB)

tun0        Link encap:UNSPEC  HWaddr 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00
            inet addr:192.168.53.5  P-t-P:192.168.53.5  Mask:255.255.255.0
            inet6 addr: fe80::5868:9367:9a89:164c/64 Scope:Link
            UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
            RX packets:0 errors:0 dropped:0 overruns:0 frame:0
            TX packets:3 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:500
            RX bytes:0 (0.0 B)  TX bytes:144 (144.0 B)

[11/19/21]seed@Nikhil_PES1UG20CS821:~$
```

### Step 3: Set up routing on Client and Server VMs

We add routing path to the client VM



```
client [Running] - Oracle VM VirtualBox
Terminal
UP LOOPBACK RUNNING  MTU:65536  Metric:1
RX packets:427 errors:0 dropped:0 overruns:0 frame:0
TX packets:427 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1
RX bytes:56440 (56.4 KB)  TX bytes:56440 (56.4 KB)

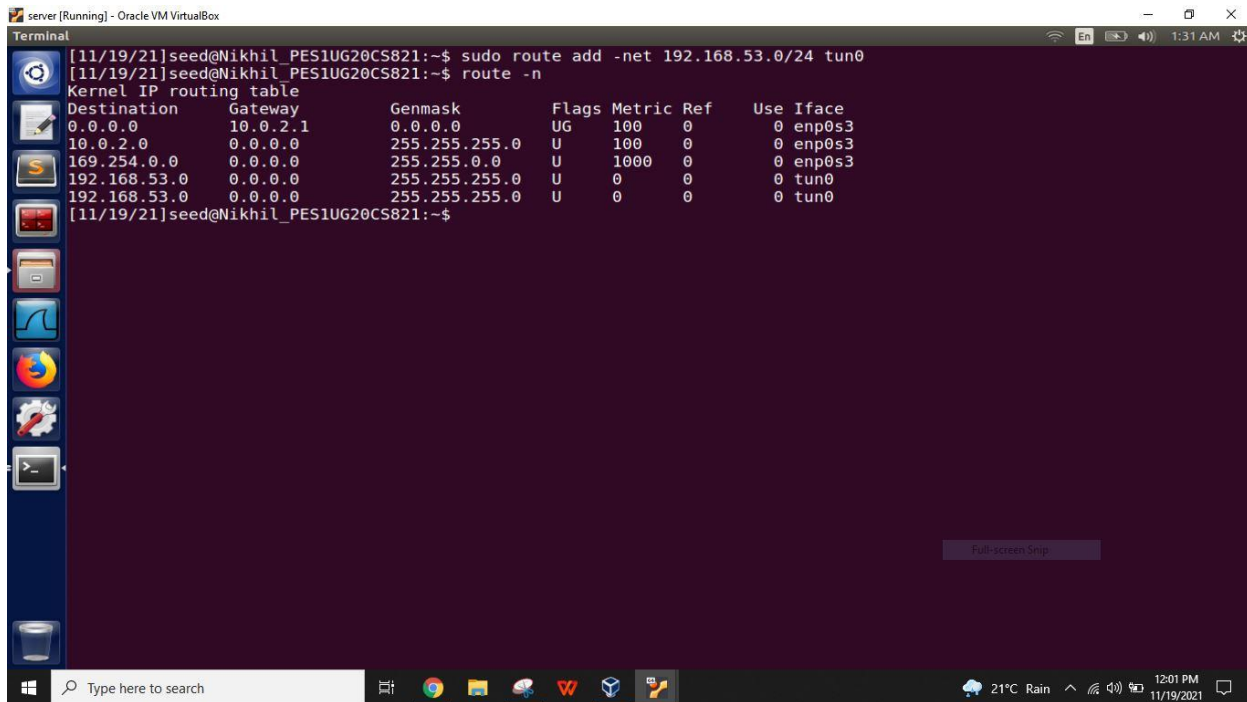
tun0        Link encap:UNSPEC  HWaddr 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00
            inet addr:192.168.53.5  P-t-P:192.168.53.5  Mask:255.255.255.0
            inet6 addr: fe80::5868:9367:9a89:164c/64 Scope:Link
            UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
            RX packets:0 errors:0 dropped:0 overruns:0 frame:0
            TX packets:3 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:500
            RX bytes:0 (0.0 B)  TX bytes:144 (144.0 B)

[11/19/21]seed@Nikhil_PES1UG20CS821:~$ sudo route add -net 192.168.53.0/24 tun0
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         10.0.2.1       0.0.0.0         UG    100    0        0 enp0s3
10.0.2.0        0.0.0.0       255.255.255.0   U     100    0        0 enp0s3
169.254.0.0     0.0.0.0       255.255.255.0   U    1000    0        0 enp0s3
192.168.53.0    0.0.0.0       255.255.255.0   U     0      0        0 tun0
192.168.53.0    0.0.0.0       255.255.255.0   U     0      0        0 tun0

[11/19/21]seed@Nikhil_PES1UG20CS821:~$ sudo route add -net 192.168.60.0/24 tun0
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         10.0.2.1       0.0.0.0         UG    100    0        0 enp0s3
10.0.2.0        0.0.0.0       255.255.255.0   U     100    0        0 enp0s3
169.254.0.0     0.0.0.0       255.255.255.0   U    1000    0        0 enp0s3
192.168.53.0    0.0.0.0       255.255.255.0   U     0      0        0 tun0
192.168.53.0    0.0.0.0       255.255.255.0   U     0      0        0 tun0
192.168.60.0    0.0.0.0       255.255.255.0   U     0      0        0 tun0

[11/19/21]seed@Nikhil_PES1UG20CS821:~$
```

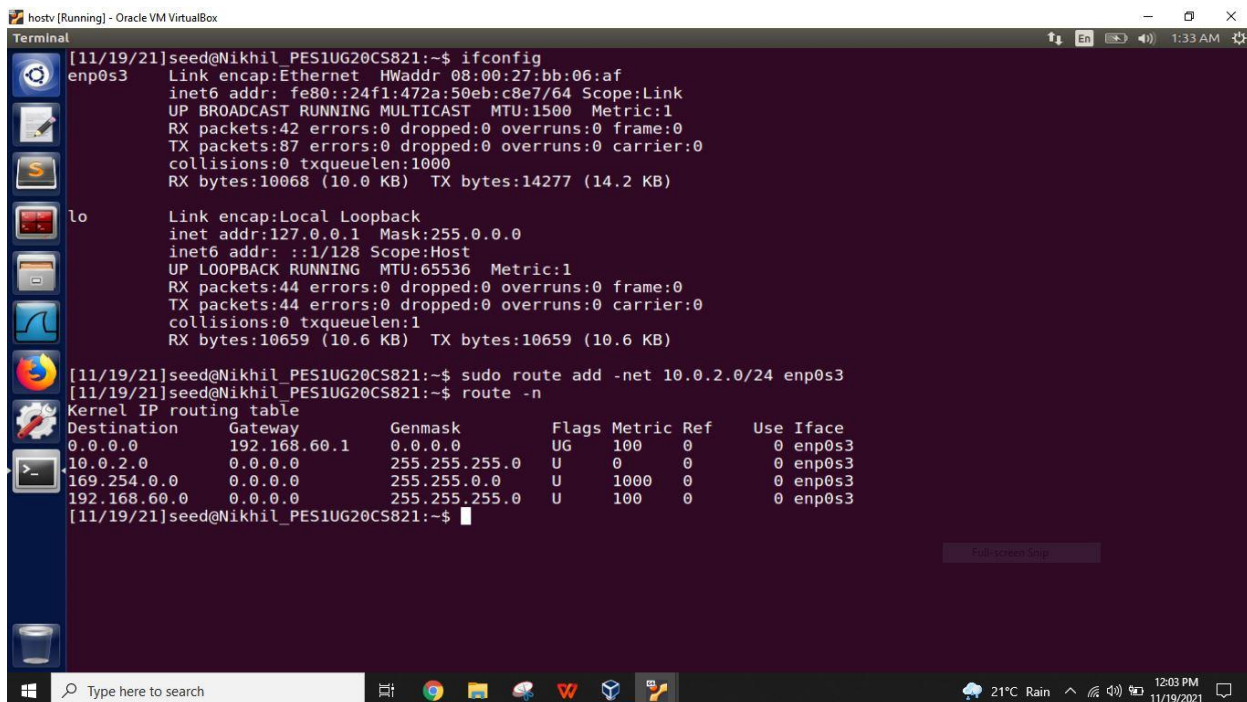
We also add routing path to the server VM



```
server [Running] - Oracle VM VirtualBox
Terminal
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ sudo route add -net 192.168.53.0/24 tun0
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ route -n
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0          10.0.2.1       0.0.0.0         UG    100    0      0 enp0s3
10.0.2.0         0.0.0.0        255.255.255.0   U     100    0      0 enp0s3
169.254.0.0      0.0.0.0        255.255.0.0     U    1000    0      0 enp0s3
192.168.53.0     0.0.0.0        255.255.255.0   U      0      0      0 tun0
192.168.53.0     0.0.0.0        255.255.255.0   U      0      0      0 tun0
[11/19/21]seed@Nikhil_PES1UG20CS821:~$
```

## Step 4: Set up routing on HOST V

At last we add the routing path to the host v



```
hostv [Running] - Oracle VM VirtualBox
Terminal
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ ifconfig
enp0s3      Link encap:Ethernet  HWaddr 08:00:27:bb:06:af
            inet6 addr: fe80::24f1:472a:50eb:c8e7/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
            RX packets:42 errors:0 dropped:0 overruns:0 frame:0
            TX packets:87 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1000
            RX bytes:10068 (10.0 KB)  TX bytes:14277 (14.2 KB)

lo          Link encap:Local Loopback
            inet addr:127.0.0.1  Mask:255.0.0.0
            inet6 addr: ::1/128 Scope:Host
            UP LOOPBACK RUNNING  MTU:65536  Metric:1
            RX packets:44 errors:0 dropped:0 overruns:0 frame:0
            TX packets:44 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1
            RX bytes:10659 (10.6 KB)  TX bytes:10659 (10.6 KB)

[11/19/21]seed@Nikhil_PES1UG20CS821:~$ sudo route add -net 10.0.2.0/24 enp0s3
[11/19/21]seed@Nikhil_PES1UG20CS821:~$ route -n
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0          192.168.60.1   0.0.0.0         UG    100    0      0 enp0s3
10.0.2.0         0.0.0.0        255.255.255.0   U      0      0      0 enp0s3
169.254.0.0      0.0.0.0        255.255.0.0     U    1000    0      0 enp0s3
192.168.60.0     0.0.0.0        255.255.255.0   U     100    0      0 enp0s3
[11/19/21]seed@Nikhil_PES1UG20CS821:~$
```

## Step 5: Test the VPN tunnel

After setting up the VPN tunnel we can see that the packets travel from client to server via host v which acts like the vpn

The image shows a Wireshark network traffic capture window. The top pane displays a list of captured packets. The middle pane shows the details of the selected packet (No. 18), which is an ICMP Echo (ping) request. The bottom pane shows the raw packet data in hexadecimal and ASCII.

No.	Time	Source	Destination	Protocol	Length	Info
1	2021-11-19 01:34:37.5949772	192.168.53.5	192.168.60.101	ICMP	100	Echo (ping) request id=0x0bd7, seq=1/256, t
2	2021-11-19 01:34:37.5950183	10.0.2.24	10.0.2.27	UDP	128	52208 → 55555 Len=84
3	2021-11-19 01:34:38.6052255	192.168.53.5	192.168.60.101	ICMP	100	Echo (ping) request id=0x0bd7, seq=2/512, t
4	2021-11-19 01:34:38.6052939	10.0.2.24	10.0.2.27	UDP	128	52208 → 55555 Len=84
5	2021-11-19 01:34:39.6284262	192.168.53.5	192.168.60.101	ICMP	100	Echo (ping) request id=0x0bd7, seq=3/768, t
6	2021-11-19 01:34:39.6288153	10.0.2.24	10.0.2.27	UDP	128	52208 → 55555 Len=84
7	2021-11-19 01:34:40.6528145	192.168.53.5	192.168.60.101	ICMP	100	Echo (ping) request id=0x0bd7, seq=4/1024, t
8	2021-11-19 01:34:40.6529048	10.0.2.24	10.0.2.27	UDP	128	52208 → 55555 Len=84
9	2021-11-19 01:34:41.0220339	:::1	:::1	UDP	64	51736 → 50035 Len=0
10	2021-11-19 01:34:41.6773870	192.168.53.5	192.168.60.101	ICMP	100	Echo (ping) request id=0x0bd7, seq=5/1280, t
11	2021-11-19 01:34:41.6774218	10.0.2.24	10.0.2.27	UDP	128	52208 → 55555 Len=84
12	2021-11-19 01:34:42.7010338	192.168.53.5	192.168.60.101	ICMP	100	Echo (ping) request id=0x0bd7, seq=6/1536, t
13	2021-11-19 01:34:42.7010782	10.0.2.24	10.0.2.27	UDP	128	52208 → 55555 Len=84
14	2021-11-19 01:34:42.7655545	PcsCompu_2f:91:9a	192.168.60.101	ARP	44	Who has 10.0.2.27? Tell 10.0.2.24
15	2021-11-19 01:34:42.7669229	PcsCompu_d3:1d:ae	192.168.60.101	ARP	62	10.0.2.27 is at 08:00:27:d3:1d:ae
16	2021-11-19 01:34:43.7256254	192.168.53.5	192.168.60.101	ICMP	100	Echo (ping) request id=0x0bd7, seq=7/1792, t
17	2021-11-19 01:34:43.7256651	10.0.2.24	10.0.2.27	UDP	128	52208 → 55555 Len=84
18	2021-11-19 01:34:44.7488540	192.168.53.5	192.168.60.101	ICMP	100	Echo (ping) request id=0x0bd7, seq=8/2048, t

Frame 18: 100 bytes on wire (800 bits), 100 bytes captured (800 bits) on interface 0  
Linux cooked capture  
Internet Protocol Version 4, Src: 192.168.53.5, Dst: 192.168.60.101  
Internet Control Message Protocol

Raw packet data (hex):  
0000 00 04 ff fe 00 00 00 00 00 00 00 00 00 08 00 .....  
0010 45 00 00 54 8c e7 40 00 40 01 bb 06 c0 a8 35 05 E..T..@. @.....5.  
0020 c0 a8 3c 65 08 00 ce 69 0b d7 00 01 7d 45 97 61 ..<e...i .....)E.a  
0030 15 14 09 00 08 09 0a 0b 0c 0d 0e 0f 10 11 12 13 .....  
0040 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 ..... !"#  
0050 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 \$%&'()\*+ ,-. /0123