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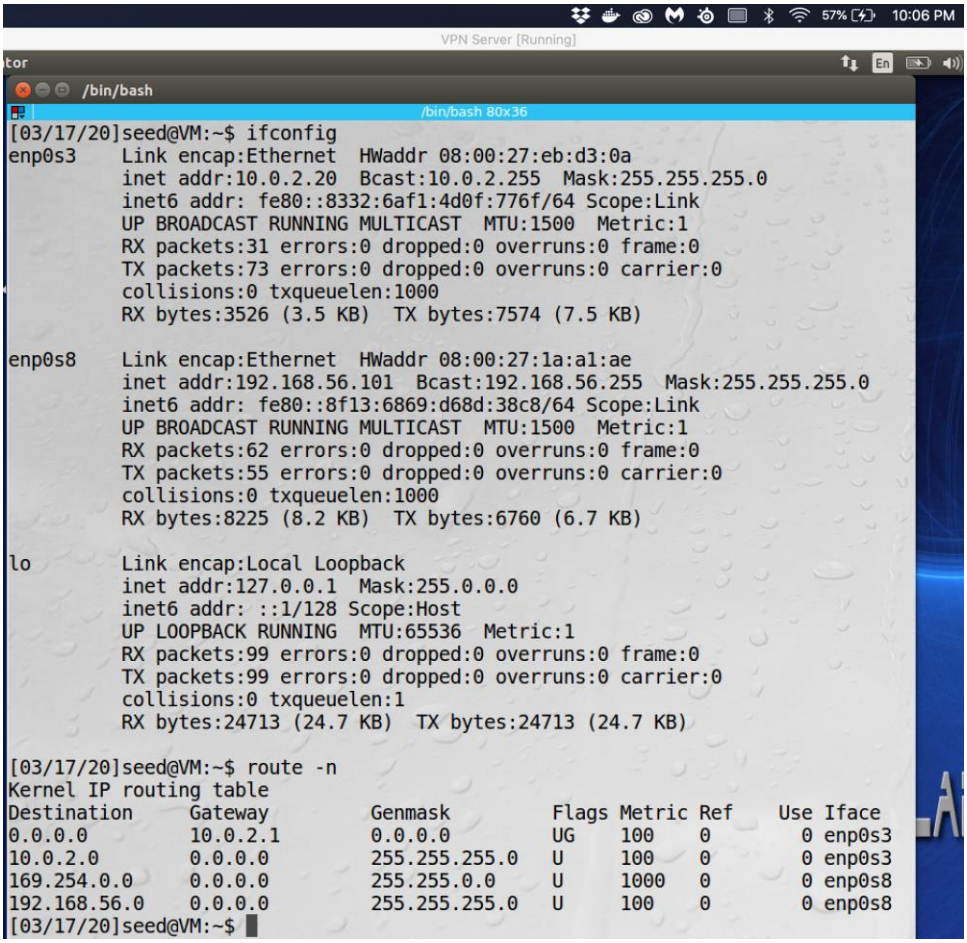
Lab 7

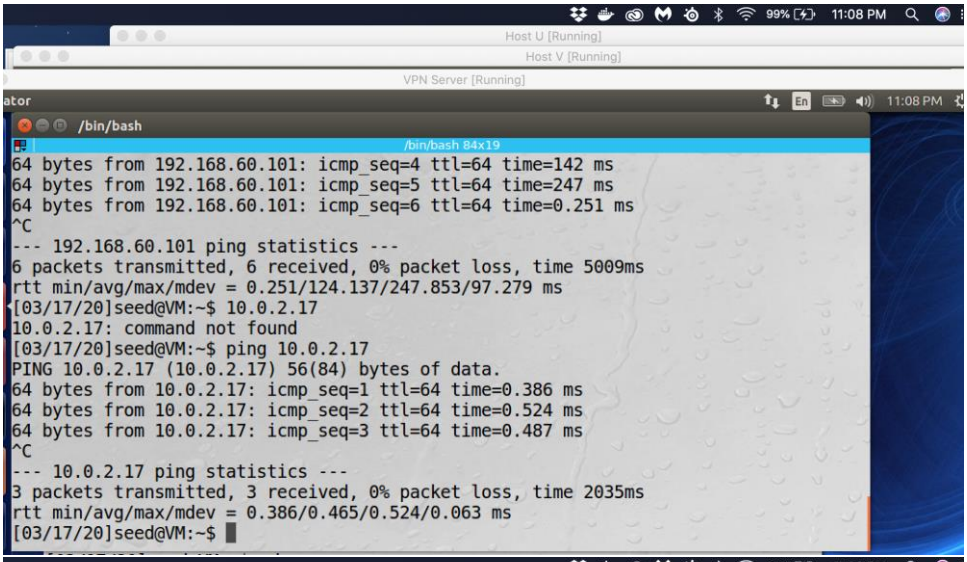
Task 1:

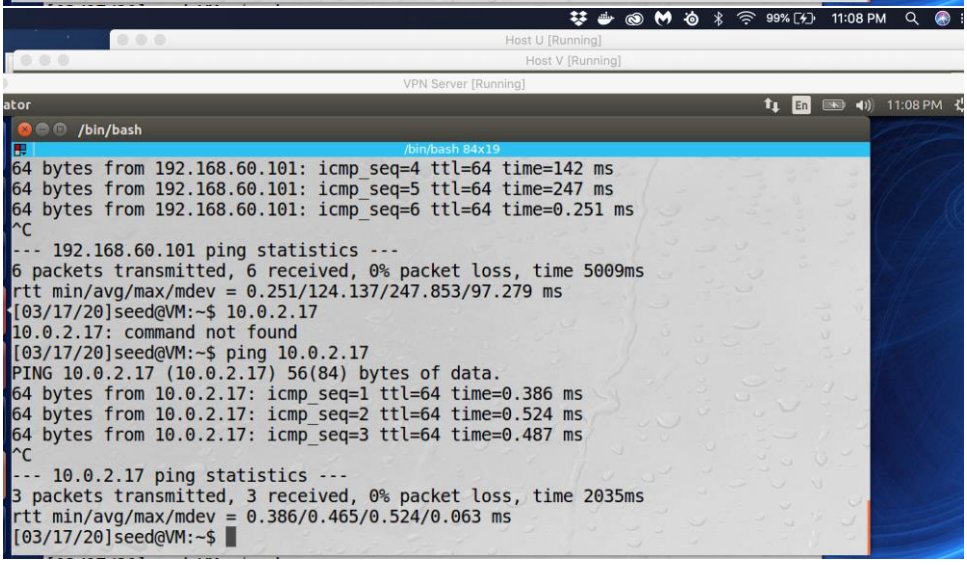
```
          inet addr:10.0.2.17  Bcast:10.0.2.255  Mask:255.255.255.0
          inet6 addr: fe80::c35b:2b21:482:3022/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:63 errors:0 dropped:0 overruns:0 frame:0
          TX packets:61 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:7955 (7.9 KB)  TX bytes:6744 (6.7 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:65 errors:0 dropped:0 overruns:0 frame:0
          TX packets:65 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:21312 (21.3 KB)  TX bytes:21312 (21.3 KB)

[03/17/20]seed@VM:~$ 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
[03/17/20]seed@VM:~$
```

```
panda.bmp                       vpn.zip
pic_original.bmp                words.txt
[03/17/20]seed@VM:~$ sudo ifconfig tun0 192.168.53.1/24 up
SIOCSIFADDR: No such device
tun0: ERROR while getting interface flags: No such device
tun0: ERROR while getting interface flags: No such device
SIOCSIFNETMASK: No such device
[03/17/20]seed@VM:~$ ping 10.0.2.20
PING 10.0.2.20 (10.0.2.20) 56(84) bytes of data.
64 bytes from 10.0.2.20: icmp_seq=1 ttl=64 time=0.363 ms
64 bytes from 10.0.2.20: icmp_seq=2 ttl=64 time=0.768 ms
64 bytes from 10.0.2.20: icmp_seq=3 ttl=64 time=0.781 ms
64 bytes from 10.0.2.20: icmp_seq=4 ttl=64 time=0.527 ms
^C
--- 10.0.2.20 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3055ms
rtt min/avg/max/mdev = 0.363/0.609/0.781/0.177 ms
[03/17/20]seed@VM:~$ ping 192.168.60.6
PING 192.168.60.6 (192.168.60.6) 56(84) bytes of data.

--- 192.168.60.6 ping statistics ---
10 packets transmitted, 0 received, 100% packet loss, time 9206ms

[03/17/20]seed@VM:~$ 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
[03/17/20]seed@VM:~$
```

Observation: Used for following configuration for Host U VM with a VPN Client that has a Nat Network adapter with the following IP 10.0.2.17 . HostU connection to the VPN server is accomplished through the same LAB. HostU can use ping to test the server but now reach the HostV machine. The purpose of this lab is to establish a VPN tunnel through a VPN server to allow HostU to talk to HostV through that tunnel.







Observation: The above screenshot shows how the VPN server is configured with a Nat Network adapter with IP address 10.0.2.20 and VPN Server – Host Only adapter with IP address 192.168.56.101. Through the use of dual adapters there is now a tunnel for HostU and HostV to communicate.

```
          inet addr:192.168.60.6  Bcast:192.168.60.255  Mask:255.255.255.0
          inet6 addr: fe80::d34d:ad2:977d:df1a/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:29 errors:0 dropped:0 overruns:0 frame:0
          TX packets:70 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3564 (3.5 KB)  TX bytes:7006 (7.0 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:53 errors:0 dropped:0 overruns:0 frame:0
          TX packets:53 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:12437 (12.4 KB)  TX bytes:12437 (12.4 KB)

[03/17/20]seed@VM:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         192.168.60.6    0.0.0.0         UG    100    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
[03/17/20]seed@VM:~$
```

```
64 bytes from 192.168.60.1: icmp_seq=41 ttl=64 time=92.6 ms
64 bytes from 192.168.60.1: icmp_seq=42 ttl=64 time=0.325 ms
64 bytes from 192.168.60.1: icmp_seq=43 ttl=64 time=0.338 ms
64 bytes from 192.168.60.1: icmp_seq=44 ttl=64 time=0.436 ms
64 bytes from 192.168.60.1: icmp_seq=45 ttl=64 time=0.439 ms
64 bytes from 192.168.60.1: icmp_seq=46 ttl=64 time=0.363 ms
64 bytes from 192.168.60.1: icmp_seq=47 ttl=64 time=0.297 ms
64 bytes from 192.168.60.1: icmp_seq=48 ttl=64 time=65.1 ms
64 bytes from 192.168.60.1: icmp_seq=49 ttl=64 time=0.304 ms
64 bytes from 192.168.60.1: icmp_seq=50 ttl=64 time=0.360 ms
64 bytes from 192.168.60.1: icmp_seq=51 ttl=64 time=0.264 ms
64 bytes from 192.168.60.1: icmp_seq=52 ttl=64 time=0.288 ms
64 bytes from 192.168.60.1: icmp_seq=53 ttl=64 time=40.7 ms
64 bytes from 192.168.60.1: icmp_seq=54 ttl=64 time=0.267 ms
64 bytes from 192.168.60.1: icmp_seq=55 ttl=64 time=75.8 ms
64 bytes from 192.168.60.1: icmp_seq=56 ttl=64 time=0.306 ms
64 bytes from 192.168.60.1: icmp_seq=57 ttl=64 time=0.347 ms
64 bytes from 192.168.60.1: icmp_seq=58 ttl=64 time=0.285 ms
^C
--- 192.168.60.1 ping statistics ---
58 packets transmitted, 58 received, 0% packet loss, time 58145ms
rtt min/avg/max/mdev = 0.264/51.844/273.926/80.303 ms
[03/17/20]seed@VM:~$ ping 10.0.2.20
PING 10.0.2.20 (10.0.2.20) 56(84) bytes of data.
64 bytes from 10.0.2.20: icmp_seq=1 ttl=64 time=0.369 ms
64 bytes from 10.0.2.20: icmp_seq=2 ttl=64 time=0.568 ms
64 bytes from 10.0.2.20: icmp_seq=3 ttl=64 time=0.685 ms
64 bytes from 10.0.2.20: icmp_seq=4 ttl=64 time=0.698 ms
^C
--- 10.0.2.20 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3055ms
rtt min/avg/max/mdev = 0.369/0.580/0.698/0.131 ms
[03/17/20]seed@VM:~$
```

Observation: HostV is a computer inside the private networks that is configured to have a Host Only adapter with ip address 192.168.60.6

```
PING 10.0.2.17 (10.0.2.17) 56(84) bytes of data.
64 bytes from 10.0.2.17: icmp_seq=1 ttl=64 time=0.386 ms
64 bytes from 10.0.2.17: icmp_seq=2 ttl=64 time=0.524 ms
64 bytes from 10.0.2.17: icmp_seq=3 ttl=64 time=0.487 ms
^C
--- 10.0.2.17 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2035ms
rtt min/avg/max/mdev = 0.386/0.465/0.524/0.063 ms
[03/17/20]seed@VM:~$ sudo ifconfig tun0 192.168.53.1/24 up
[03/17/20]seed@VM:~$ 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
0.0.0.0         192.168.60.1    0.0.0.0         UG    101    0        0 enp0s8
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 enp0s8
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     100    0        0 enp0s8
[03/17/20]seed@VM:~$
```

```
  inflating: vpn/README
  inflating: vpn/vpnclient.c
  inflating: vpn/Makefile
  inflating: vpn/vpnserver.c
[03/17/20]seed@VM:~$ cd vpn
[03/17/20]seed@VM:~/vpn$ make
gcc -o vpnserver vpnserver.c
gcc -o vpnclient vpnclient.c
[03/17/20]seed@VM:~/vpn$ ls
Makefile  README  vpnclient  vpnclient.c  vpnserver  vpnserver.c
[03/17/20]seed@VM:~/vpn$ sudo ./vpnserver
```


```
PING 10.0.2.17 (10.0.2.17) 56(84) bytes of data.
64 bytes from 10.0.2.17: icmp_seq=1 ttl=64 time=0.386 ms
64 bytes from 10.0.2.17: icmp_seq=2 ttl=64 time=0.524 ms
64 bytes from 10.0.2.17: icmp_seq=3 ttl=64 time=0.487 ms
^C
--- 10.0.2.17 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2035ms
rtt min/avg/max/mdev = 0.386/0.465/0.524/0.063 ms
[03/17/20]seed@VM:~$ sudo ifconfig tun0 192.168.53.1/24 up
[03/17/20]seed@VM:~$ 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
0.0.0.0         192.168.60.1    0.0.0.0         UG    101    0        0 enp0s8
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 enp0s8
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     100    0        0 enp0s8
[03/17/20]seed@VM:~$
```

```
  inflating: vpn/README
  inflating: vpn/vpnclient.c
  inflating: vpn/Makefile
  inflating: vpn/vpnserver.c
[03/17/20]seed@VM:~$ cd vpn
[03/17/20]seed@VM:~/vpn$ make
gcc -o vpnserver vpnserver.c
gcc -o vpnclient vpnclient.c
[03/17/20]seed@VM:~/vpn$ ls
Makefile  README  vpnclient  vpnclient.c  vpnserver  vpnserver.c
[03/17/20]seed@VM:~/vpn$ sudo ./vpnserver
```

Observation: The VPN Server is first spun up through the command sudo ./vpnserver. Then I need to configure the tun() interface. The command is sudo ifconfig tun0 (ip address)/24 up. This commands accomplishes assigning the IP address to the tun(), spun up the VPN server, and configured the route through the route table.

```
          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:1149 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1149 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:109904 (109.9 KB)  TX bytes:109904 (109.9 KB)

tun0      Link encap:UNSPEC  HWaddr 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00

          inet addr:192.168.53.1  P-t-P:192.168.53.1  Mask:255.255.255.0
          inet6 addr: fe80::9f02:a812:43b0:6d5c/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:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:500
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

[03/17/20]seed@VM:~$
```

```
  inflating: vpn/README
  inflating: vpn/vpnclient.c
  inflating: vpn/Makefile
  inflating: vpn/vpnserver.c
[03/17/20]seed@VM:~$ cd vpn
[03/17/20]seed@VM:~/vpn$ make
gcc -o vpnserver vpnserver.c
gcc -o vpnclient vpnclient.c
[03/17/20]seed@VM:~/vpn$ ls
Makefile  README  vpnclient  vpnclient.c  vpnserver  vpnserver.c
[03/17/20]seed@VM:~/vpn$ sudo ./vpnserver
```


```
          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:1149 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1149 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:109904 (109.9 KB)  TX bytes:109904 (109.9 KB)

tun0      Link encap:UNSPEC  HWaddr 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00

          inet addr:192.168.53.1  P-t-P:192.168.53.1  Mask:255.255.255.0
          inet6 addr: fe80::9f02:a812:43b0:6d5c/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:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:500
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

[03/17/20]seed@VM:~$
```

```
  inflating: vpn/README
  inflating: vpn/vpnclient.c
  inflating: vpn/Makefile
  inflating: vpn/vpnserver.c
[03/17/20]seed@VM:~$ cd vpn
[03/17/20]seed@VM:~/vpn$ make
gcc -o vpnserver vpnserver.c
gcc -o vpnclient vpnclient.c
[03/17/20]seed@VM:~/vpn$ ls
Makefile  README  vpnclient  vpnclient.c  vpnserver  vpnserver.c
[03/17/20]seed@VM:~/vpn$ sudo ./vpnserver
```

Observation: The above screenshot displays the IP address configured to the tun() interface (ipaddress)

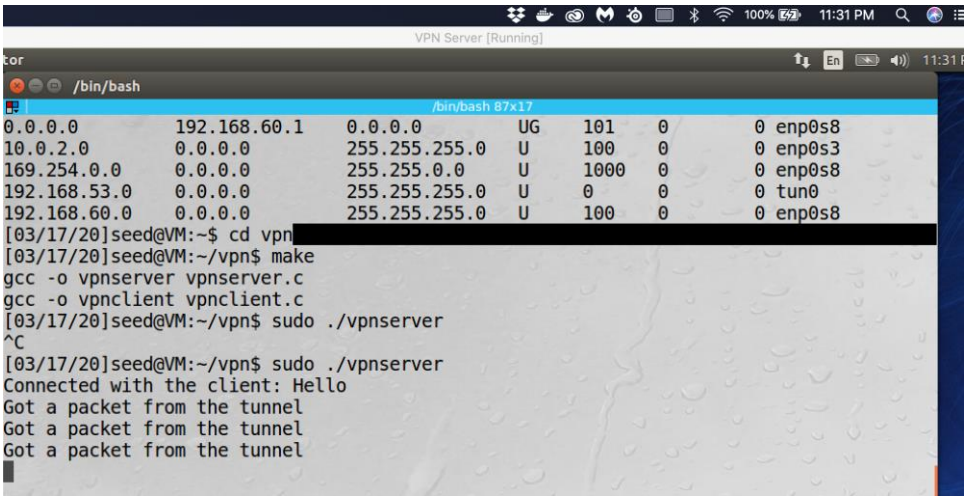
```
/bin/bash 83x30
#include <fcntl.h>
#include <stdio.h>
#include <unistd.h>
#include <string.h>
#include <arpa/inet.h>
#include <linux/if.h>
#include <linux/if_tun.h>
#include <sys/ioctl.h>

#define BUFF_SIZE 2000
#define PORT_NUMBER 55555
#define SERVER_IP "10.0.2.20"
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;
-- INSERT --                                   12,29          Top
```

Observation: The ipaddress is configured in the above screenshot to the IP address that is standing in for the VPN server.

```
/bin/bash 83x19
[03/17/20]seed@VM:~$ ping 192.168.60.6
PING 192.168.60.6 (192.168.60.6) 56(84) bytes of data.

--- 192.168.60.6 ping statistics ---
10 packets transmitted, 0 received, 100% packet loss, time 9206ms

[03/17/20]seed@VM:~$ 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
[03/17/20]seed@VM:~$ vim vpnclient
[03/17/20]seed@VM:~$ cd vpn
[03/17/20]seed@VM:~/vpn$ vim vpnclient
[03/17/20]seed@VM:~/vpn$ ls
Makefile  README  vpnclient  vpnclient.c  vpnserver  vpnserver.c
[03/17/20]seed@VM:~/vpn$ vim vpnclient.c
[03/17/20]seed@VM:~/vpn$ sudo ifconfig tun0 192.168.53.5/24 up
```

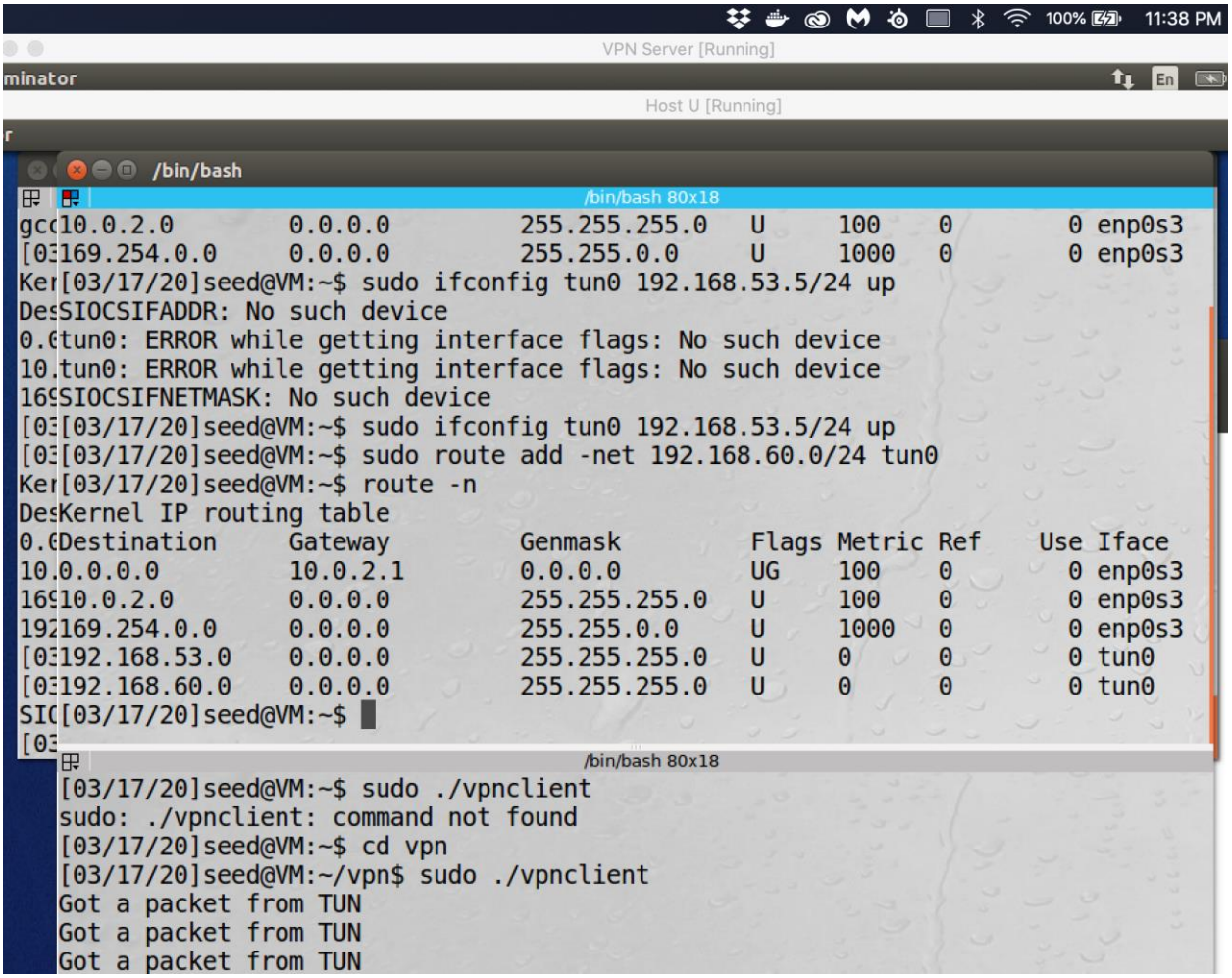
```
/bin/bash 80x24
[03/17/20]seed@VM:~$ cd vpn
[03/17/20]seed@VM:~/vpn$ sudo ./vpnclient
```

Observation: Using the created VPN client we run the vpnclient program through the configured tun() interface using the ipaddress “” for the tun interface to connect through the vpn client. The following command “sudo ifconfig tun0 “”/24 up will route traffic automatically through the vpn tunnel.



Observation: The server program intilizes a TUN interface(tun0) and is in waiting mode for a tunnel connection request from the vpn client. The client program creates the TUN interface(tun0) and forwards a “hello” message to establish the VPN tunnel as shown in the screenshot above. Through this tun0 interface packets will be enable communication through the VPN tunnel.

Step 3: Configuring Routing on the VPN Client and Vpn Server



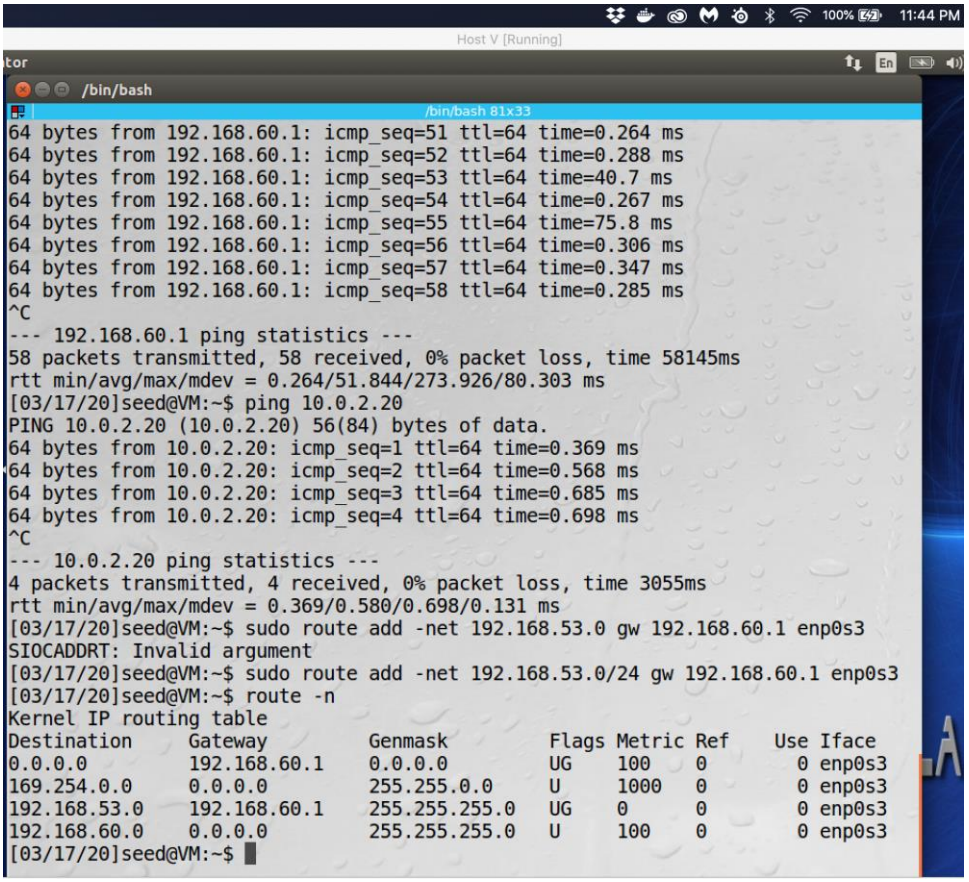
Observation: The route through the tun0 interface is setup with the following command sudo route add –net “ipaddress”/24 tun0. This instructs the VPN Client to forward all traffic from “ipaddress” through the VPN tunnel we just created.

```
[03/18/20]seed@VM:~/vpn$ sudo ifconfig tun0 192.168.59.1/24 up
[03/18/20]seed@VM:~/vpn$ route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         10.0.2.1        0.0.0.0         UG    100    0        0 enp0s3
default         192.168.60.1    0.0.0.0         UG    101    0        0 enp0s8
10.0.2.0        *               255.255.255.0   U     100    0        0 enp0s3
link-local      *               255.255.0.0     U     1000   0        0 enp0s8
192.168.59.0    *               255.255.255.0   U     0      0        0 tun0
192.168.60.0    *               255.255.255.0   U     100    0        0 enp0s8
```

```
[03/18/20]seed@VM:~/vpn$ sudo ifconfig tun0 192.168.59.1/24 up
[03/18/20]seed@VM:~/vpn$ route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         10.0.2.1        0.0.0.0         UG    100    0        0 enp0s3
default         192.168.60.1    0.0.0.0         UG    101    0        0 enp0s8
10.0.2.0        *               255.255.255.0   U     100    0        0 enp0s3
link-local      *               255.255.0.0     U     1000   0        0 enp0s8
192.168.59.0    *               255.255.255.0   U     0      0        0 tun0
192.168.60.0    *               255.255.255.0   U     100    0        0 enp0s8
```

Observation: On the client and server VM's, the traffic flow needs to be done through a routing table entry that all traffic from the "ipaddress"/24 network are to go through the tun0 interface. This entry is put into the routing table automatically when we assigned the ipaddress to the tun0 interface.

Step 4: Configure Routing on Host V



Observation: Any reply packets should now utilize the same VPN tunnel so they are encrypted. This is done by routing all packets for the "ipaddress"/24 network through the VPN tunnel. For HostV, the following command sudo route add –net "ipaddress"/24 gw "ipaddress of gateway" enp0s3. HostV will then connect to the "ipaddress"/24 network via the enp0s3 network interface.

Step 5: Test the VPN tunnel

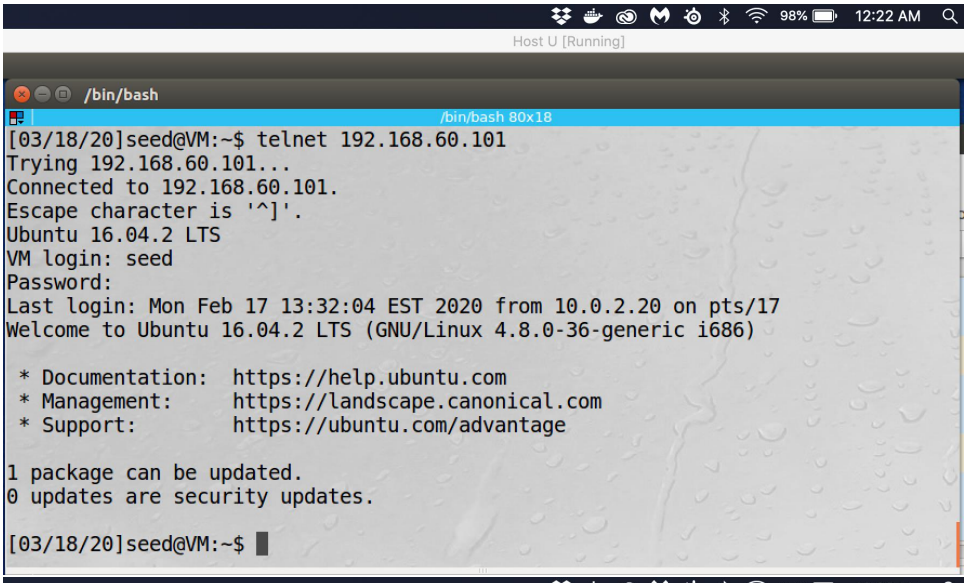
Prior to the configuring of the VPN server there would be no reply from HostV because the tunnel connecting the two VM's is not established yet. Following the VPN being setup now HostU and HostV can communicate to one another through the VPN tunnel.

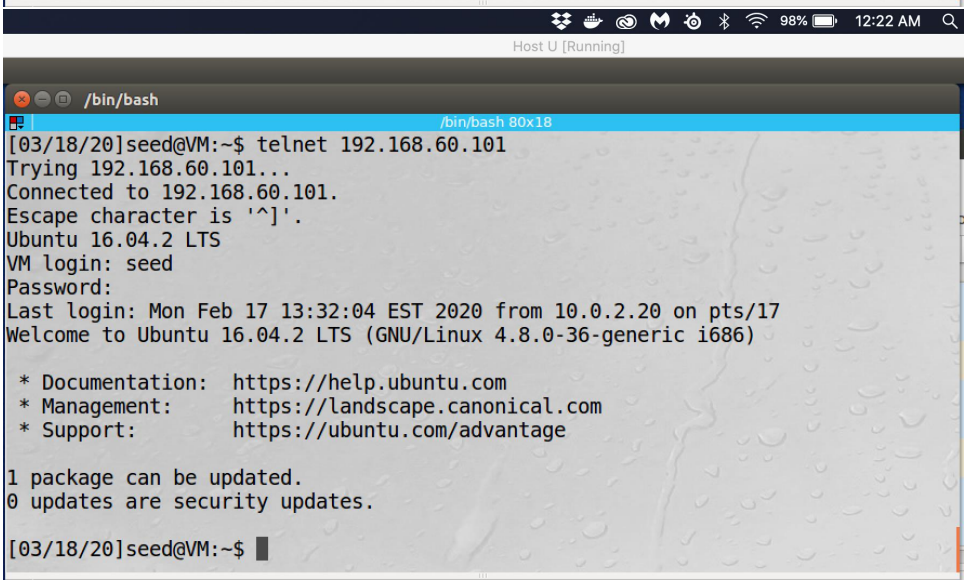
```
[03/17/20]seed@VM:~$ ping 192.168.60.6
PING 192.168.60.6 (192.168.60.6) 56(84) bytes of data.

--- 192.168.60.6 ping statistics ---
10 packets transmitted, 0 received, 100% packet loss, time 9206ms

[03/17/20]seed@VM:~$ 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
[03/17/20]seed@VM:~$ vim vpnclient
[03/17/20]seed@VM:~$ cd vpn
[03/17/20]seed@VM:~/vpn$ vim vpnclient
[03/17/20]seed@VM:~/vpn$ ls
Makefile  README  vpnclient  vpnclient.c  vpnserver  vpnserver.c
[03/17/20]seed@VM:~/vpn$ vim vpnclient.c
[03/17/20]seed@VM:~/vpn$ sudo ifconfig tun0 192.168.53.5/24 up
```

```
[03/17/20]seed@VM:~$ cd vpn
[03/17/20]seed@VM:~/vpn$ sudo ./vpnclient
```

Observation: Pinging HostV from HostU will result in packets being sent over the gateway- host only adapter.

Observation: The screenshot above shows the packets generated when using ping between to test packet receipt on HostV from HostU. The way that our routing table is set up the ICMP packet is routed to the TUN interface, the VPN application then gets the ICMP packet, forwards the packet to the VPN tunnel, stores that inside a UDP packet then sends it towards the VPN server. The reply UDP packet from the VPN server contains the ICMP echo reply packet. The tunnel on the VPN client then receives this UDP packet, extracts the ICMP packet, and sends that to the kernel through the tun0 interface.



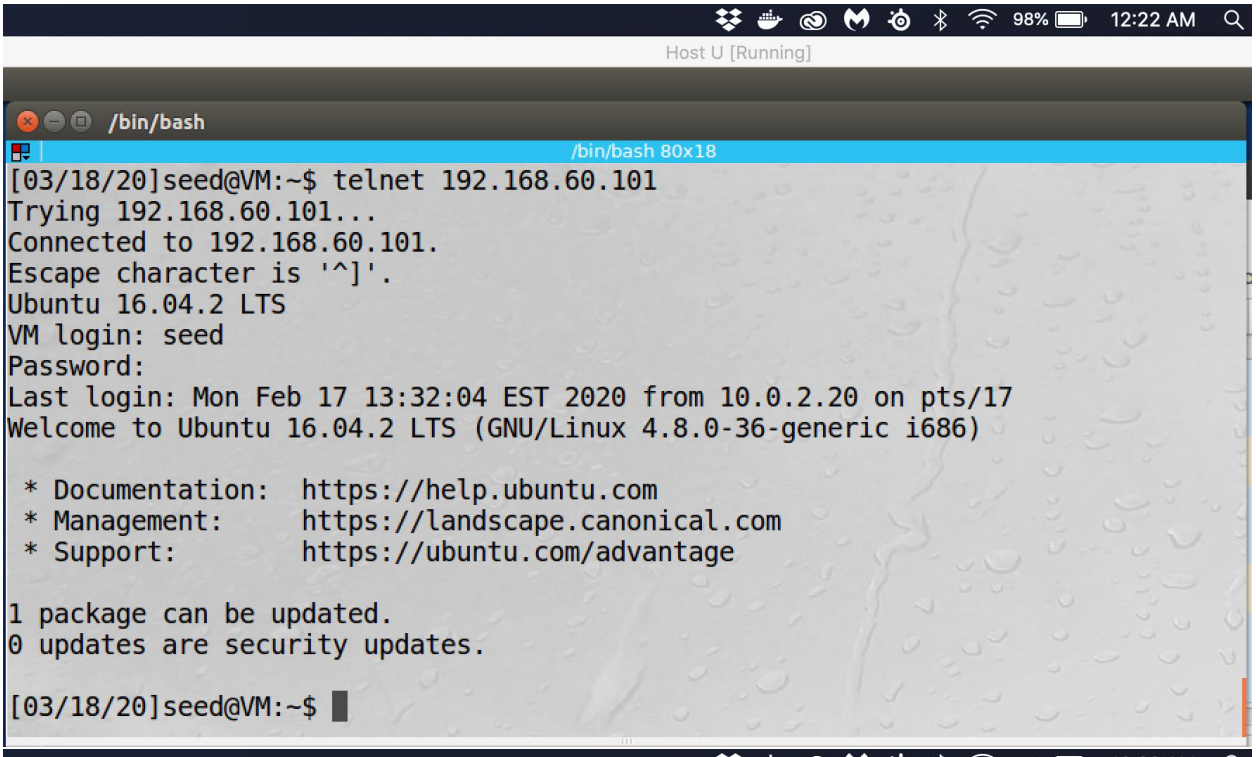


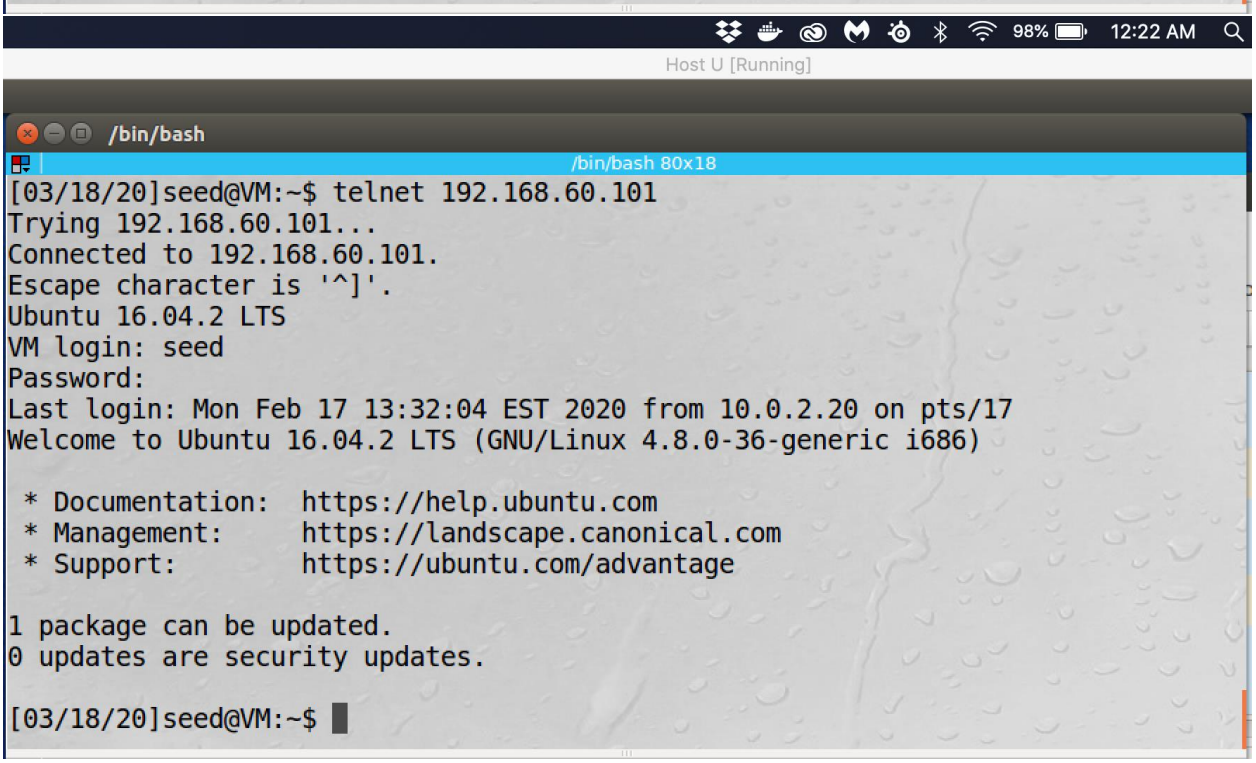
Observation: The screenshot above displays the successful connection to the telnet server on Host V within the private network from HostU that is communicating through the VPN tunnel.

Observation: The screenshot above is the wireshark packet capture file from the successful connection to the telnet server that is initiated on HostV that is contained within the private network from HostU using the VPN tunnel.

Step 6: Testing of breaking the VPN Tunnel

Observation: Connection through telnet from HostV to HostU for this demonstration of breaking the tunnel.

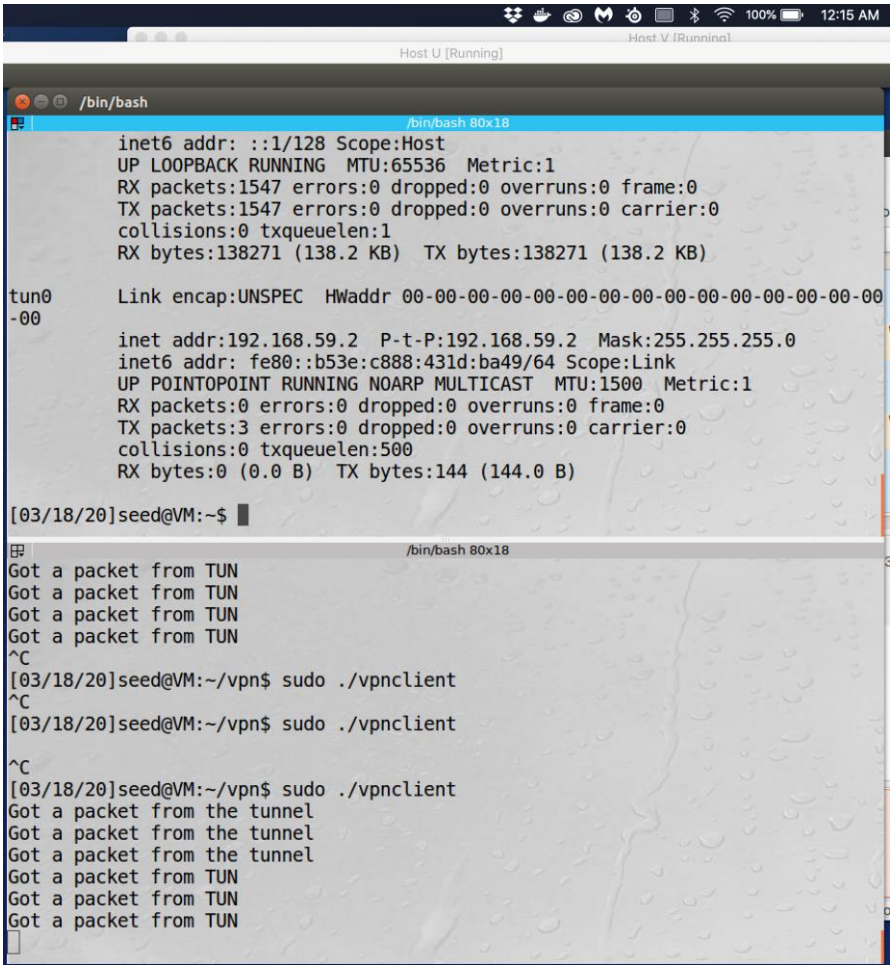




Observation: The above screenshot shows that the VPN tunnel that we have make is broken. Telnet is of course still live but the tunnel with which packets were forwarded is no longer active. This will cause

the packets to keep attempting to send the packets but the result will be that none of the packets will successfully be transmitted through the VPN tunnel.

```
/bin/bash
/bin/bash 80x18
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:1547 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1547 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:138271 (138.2 KB)  TX bytes:138271 (138.2 KB)

tun0      Link encap:UNSPEC  HWaddr 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00
-00
          inet addr:192.168.59.2  P-t-P:192.168.59.2  Mask:255.255.255.0
          inet6 addr: fe80::b53e:c888:431d:ba49/64 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)

[03/18/20]seed@VM:~$
/bin/bash 80x18
Got a packet from TUN
Got a packet from TUN
Got a packet from TUN
Got a packet from TUN
^C
[03/18/20]seed@VM:~/vpn$ sudo ./vpnclient
^C
[03/18/20]seed@VM:~/vpn$ sudo ./vpnclient

^C
[03/18/20]seed@VM:~/vpn$ sudo ./vpnclient
Got a packet from the tunnel
Got a packet from the tunnel
Got a packet from the tunnel
Got a packet from TUN
Got a packet from TUN
Got a packet from TUN
```



Observation: The above screenshot shows that the telnet connection is still active, TCP will keep trying to send packets, but none will be successful because the VPN tunnel is broken. Although all of the information that is typed into the telnet session will be saved in a buffer until the tunnel is reconnecting causing all of the typed information to be sent through from the buffer.

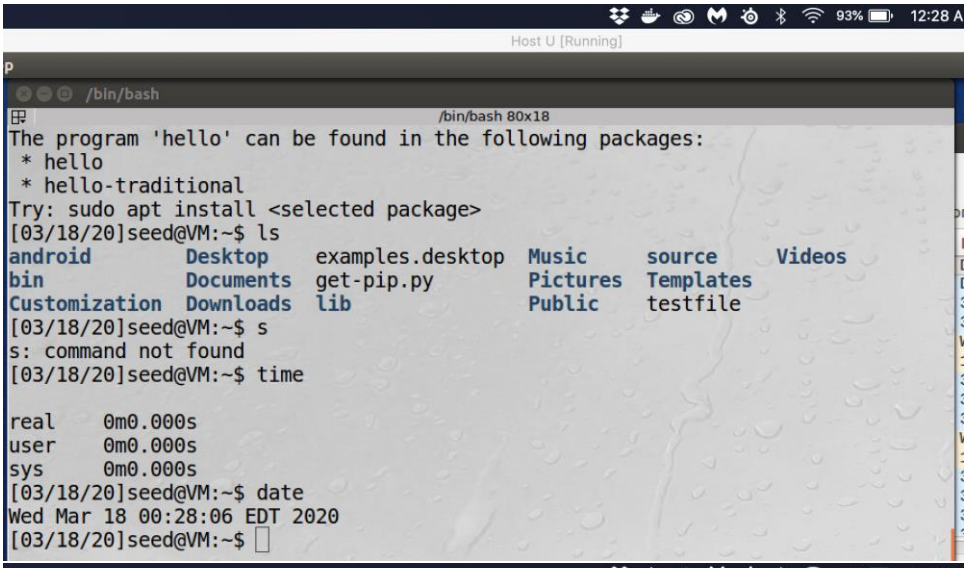
```
4 packets transmitted, 0 received, 100% packet loss, time 3147ms

[03/18/20]seed@VM:~$ sudo route add -net 192.168.60.0/24 tun0
[03/18/20]seed@VM:~$ ping 192.168.60.101
PING 192.168.60.101 (192.168.60.101) 56(84) bytes of data.
64 bytes from 192.168.60.101: icmp_seq=1 ttl=63 time=531 ms

64 bytes from 192.168.60.101: icmp_seq=2 ttl=63 time=19.1 ms
64 bytes from 192.168.60.101: icmp_seq=3 ttl=63 time=494 ms
64 bytes from 192.168.60.101: icmp_seq=4 ttl=63 time=10.9 ms
64 bytes from 192.168.60.101: icmp_seq=5 ttl=63 time=15.0 ms
64 bytes from 192.168.60.101: icmp_seq=6 ttl=63 time=14.3 ms
64 bytes from 192.168.60.101: icmp_seq=7 ttl=63 time=4.66 ms
^C
--- 192.168.60.101 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6276ms
rtt min/avg/max/mdev = 4.660/155.781/531.702/226.264 ms
[03/18/20]seed@VM:~$
```

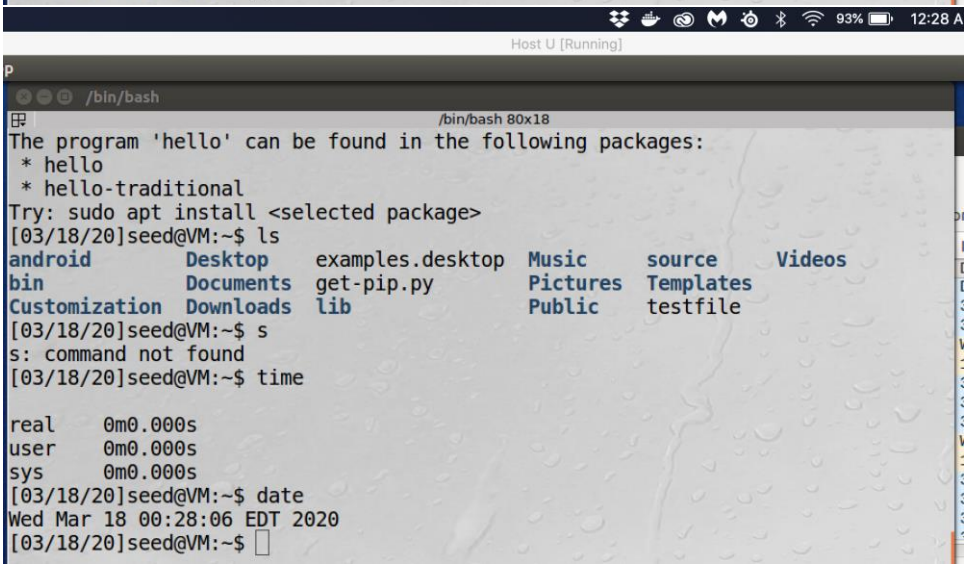
```
Got a packet from TUN
Got a packet from the tunnel
Got a packet from TUN
Got a packet from TUN
Got a packet from the tunnel
Got a packet from TUN
Got a packet from the tunnel
Got a packet from TUN
Got a packet from the tunnel
Got a packet from TUN
Got a packet from the tunnel
Got a packet from TUN
Got a packet from the tunnel
Got a packet from TUN
Got a packet from the tunnel
```

Observation: This shows what happens when the tunnels are reconnected, the VPN server/client are restarted, and then on a second terminal the “ipaddress” is assigned to their tun0 interfaces.

510	2020-03-18 00:18:54.8940516…	192.168.200.1	10.0.2.17	DNS	139	Standard query response 0x4985 No such name
533	2020-03-18 00:19:06.0374330…	10.0.2.20	10.0.2.3	DHCP	342	DHCP Request - Transaction ID 0x338d524b
534	2020-03-18 00:19:06.0412081…	10.0.2.3	255.255.255.255	DHCP	590	DHCP ACK - Transaction ID 0x338d524b
542	2020-03-18 00:20:16.3731842…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
543	2020-03-18 00:20:16.9042756…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
544	2020-03-18 00:20:17.3943374…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
545	2020-03-18 00:20:17.4132667…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
546	2020-03-18 00:20:18.4447321…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
547	2020-03-18 00:20:18.9377087…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
548	2020-03-18 00:20:19.4459354…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
549	2020-03-18 00:20:19.4566981…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
550	2020-03-18 00:20:20.5793513…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
551	2020-03-18 00:20:20.5936663…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
554	2020-03-18 00:20:21.6135249…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
557	2020-03-18 00:20:21.6272643…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
558	2020-03-18 00:20:22.6498432…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
559	2020-03-18 00:20:22.6538858…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
510	2020-03-18 00:18:54.8940516…	192.168.200.1	10.0.2.17	DNS	139	Standard query response 0x4985 No such name
533	2020-03-18 00:19:06.0374330…	10.0.2.20	10.0.2.3	DHCP	342	DHCP Request - Transaction ID 0x338d524b
534	2020-03-18 00:19:06.0412081…	10.0.2.3	255.255.255.255	DHCP	590	DHCP ACK - Transaction ID 0x338d524b
542	2020-03-18 00:20:16.3731842…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
543	2020-03-18 00:20:16.9042756…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
544	2020-03-18 00:20:17.3943374…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
545	2020-03-18 00:20:17.4132667…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
546	2020-03-18 00:20:18.4447321…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
547	2020-03-18 00:20:18.9377087…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
548	2020-03-18 00:20:19.4459354…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
549	2020-03-18 00:20:19.4566981…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
550	2020-03-18 00:20:20.5793513…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
551	2020-03-18 00:20:20.5936663…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
554	2020-03-18 00:20:21.6135249…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
557	2020-03-18 00:20:21.6272643…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84
558	2020-03-18 00:20:22.6498432…	10.0.2.17	10.0.2.20	UDP	126	43872 → 55555 Len=84
559	2020-03-18 00:20:22.6538858…	10.0.2.20	10.0.2.17	UDP	126	55555 → 43872 Len=84

Observation: The wireshark capture shows that all of the packets that were in the buffer were finally sent through.





Observation: The VPN tunnel has been successfully reconnected, all of the commands were placed into a buffer, waiting on them to be sent over the telnet server connection. When telnet reconnects the server will receive the commands in the buffer, echo the commands back to the telnet client, then display them to the terminal window. Because this is a TCP transmission as soon as the VPN tunnel was restablished the buffered commands show up on the client side terminal