COMPUTER NETWORKS (CSE232) Assignment 2

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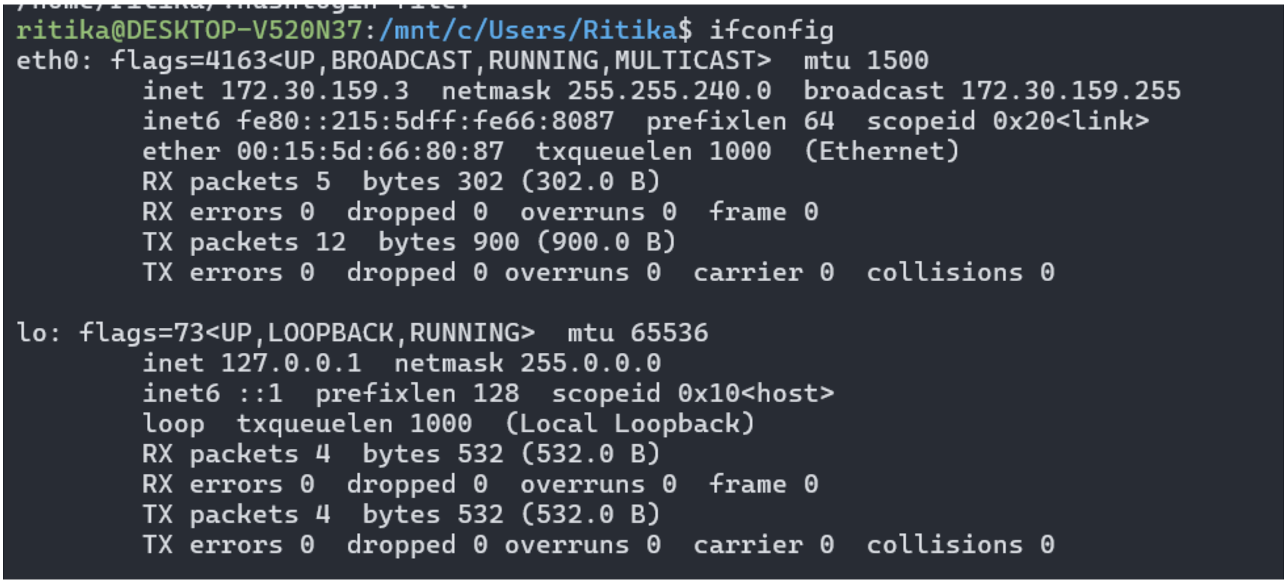
Linux Command Line Utilities

1. `iconfig` command:

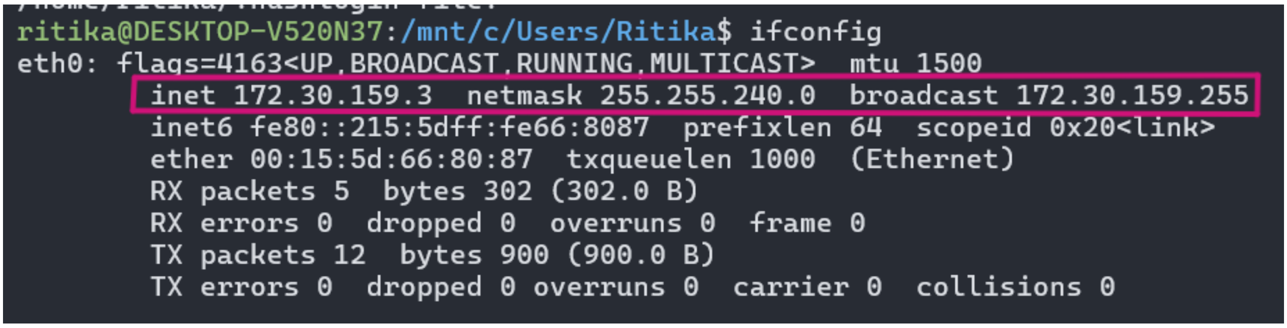
`ifconfig` is used to configure network interfaces in Unix and Linux operating systems. It is used to view and change the configuration of the network interfaces on system. `ipconfig` for Windows.

1. Using `ifconfig` on my device outputs the following:



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.30.159.3  netmask 255.255.240.0  broadcast 172.30.159.255
        inet6 fe80::215:5dff:fe66:8087  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:66:80:87  txqueuelen 1000  (Ethernet)
        RX packets 5  bytes 302 (302.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 12  bytes 900 (900.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  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 4  bytes 532 (532.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 4  bytes 532 (532.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

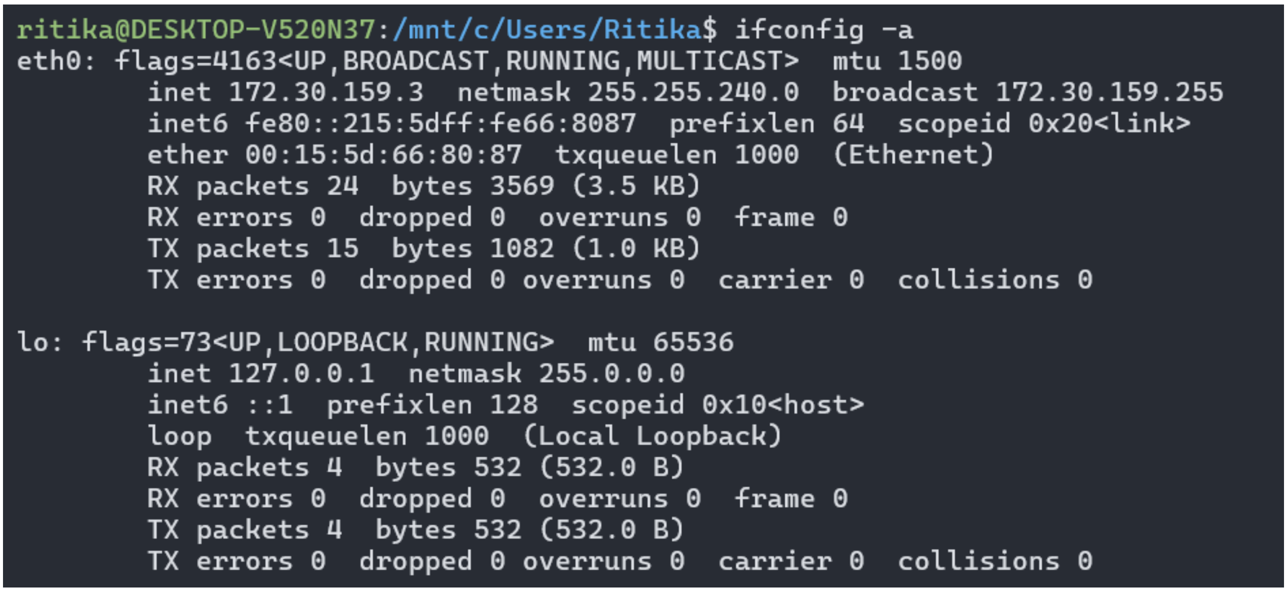
   `eth0` is the primary WiFi interface on my device.



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.30.159.3  netmask 255.255.240.0  broadcast 172.30.159.255
        inet6 fe80::215:5dff:fe66:8087  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:66:80:87  txqueuelen 1000  (Ethernet)
        RX packets 5  bytes 302 (302.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 12  bytes 900 (900.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

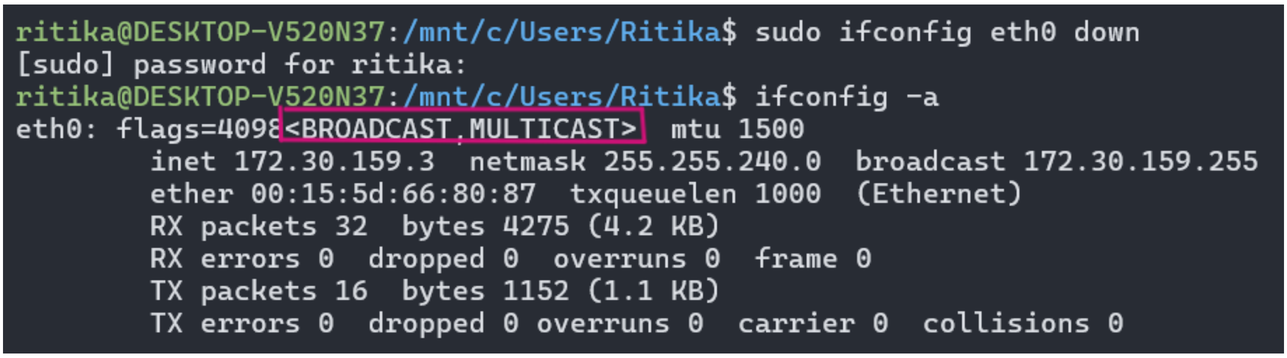
   The rectangle highlights the `ipv4` address of the `eth0` network interface which is `172.30.159.31`. (Note: I am using the college WiFi)

2. `ifconfig -a` command is used to display all interfaces even if they are down.



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ifconfig -a
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.30.159.3  netmask 255.255.240.0  broadcast 172.30.159.255
        inet6 fe80::215:5dff:fe66:8087  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:66:80:87  txqueuelen 1000  (Ethernet)
        RX packets 24  bytes 3569 (3.5 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 15  bytes 1082 (1.0 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  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 4  bytes 532 (532.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 4  bytes 532 (532.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

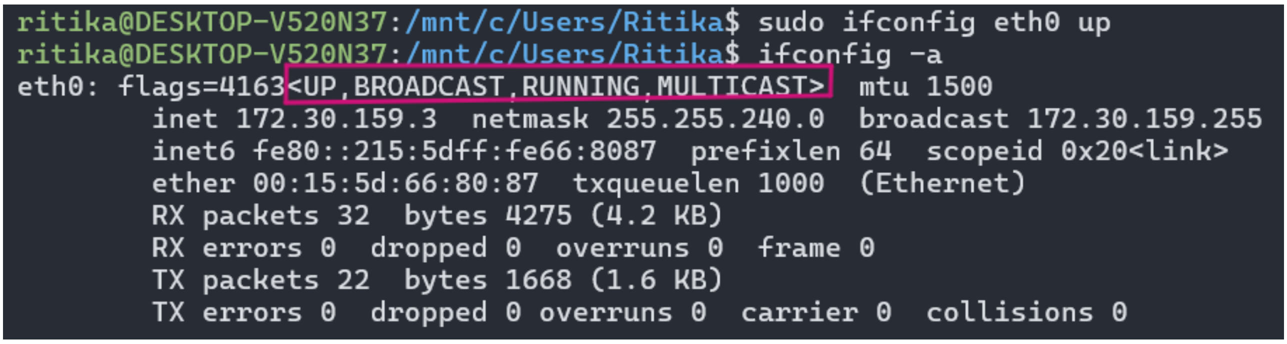
3. Now we will down `eth0`using the command `sudo ifconfig eth0 down` and use `ifconfig -a` to check if the interface is down.



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ sudo ifconfig eth0 down
[sudo] password for ritika:
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ifconfig -a
eth0: flags=4098<BROADCAST,MULTICAST>  mtu 1500
        inet 172.30.159.3  netmask 255.255.240.0  broadcast 172.30.159.255
        ether 00:15:5d:66:80:87  txqueuelen 1000  (Ethernet)
        RX packets 32  bytes 4275 (4.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 16  bytes 1152 (1.1 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Notice how `UP, RUNNING` is not displayed for `eth0` anymore.

4. Now we will bring `eth0` back up using the command `sudo ifconfig eth0 up` and use `ifconfig -a` to check if the interface is up.

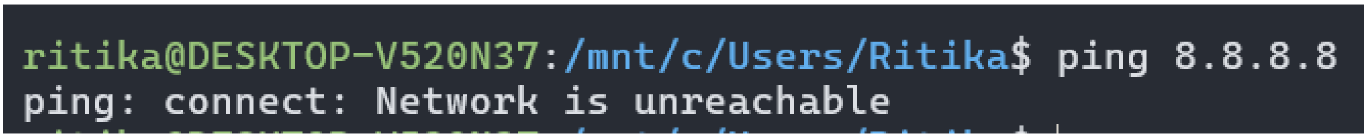


```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ sudo ifconfig eth0 up
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ifconfig -a
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.30.159.3  netmask 255.255.240.0  broadcast 172.30.159.255
        inet6 fe80::215:5dff:fe66:8087  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:66:80:87  txqueuelen 1000  (Ethernet)
        RX packets 32  bytes 4275 (4.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 22  bytes 1668 (1.6 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Notice how `UP, RUNNING` is displayed for `eth0` again.

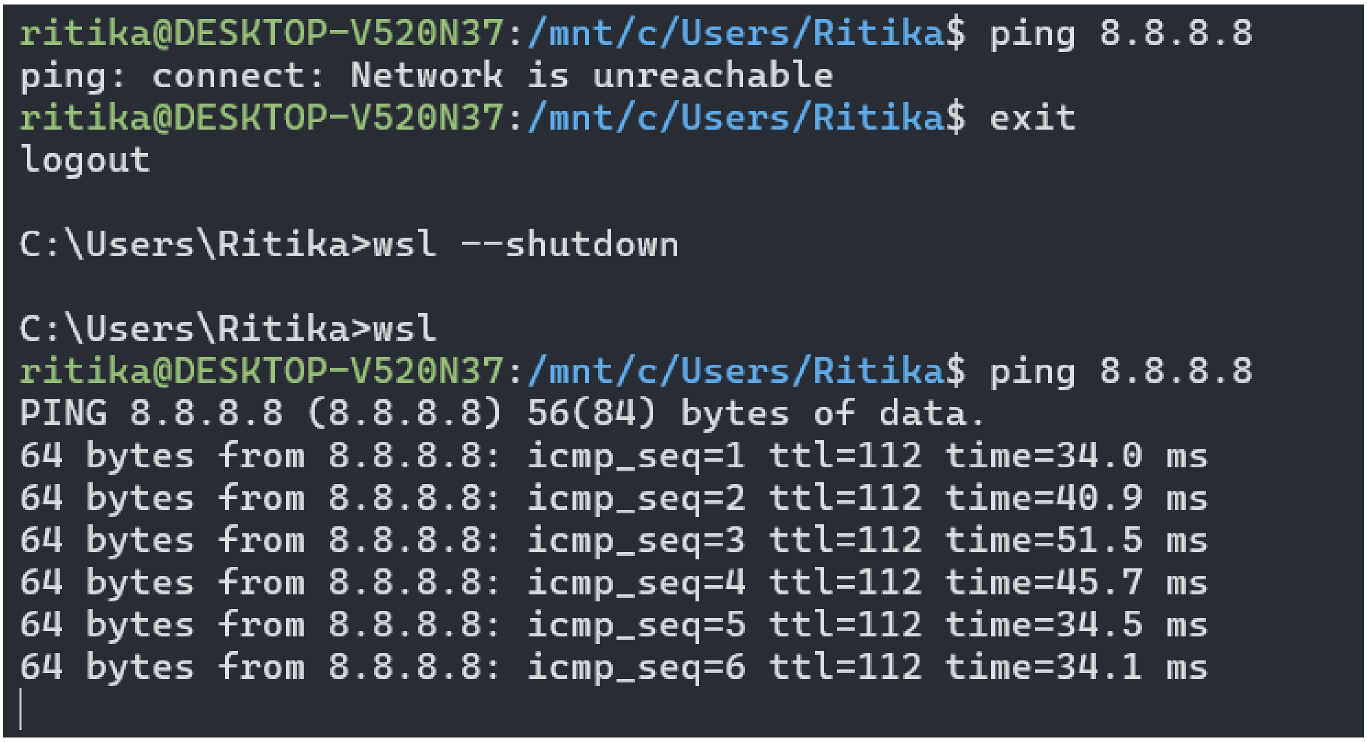
An interesting observation:

Although we brought the `eth0` interface up, the internet connection was not restored.



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ping 8.8.8.8
ping: connect: Network is unreachable
```

This is because it takes some time for the connection to be restored and since we brought the interface down we need to restart our WSL to access internet again.

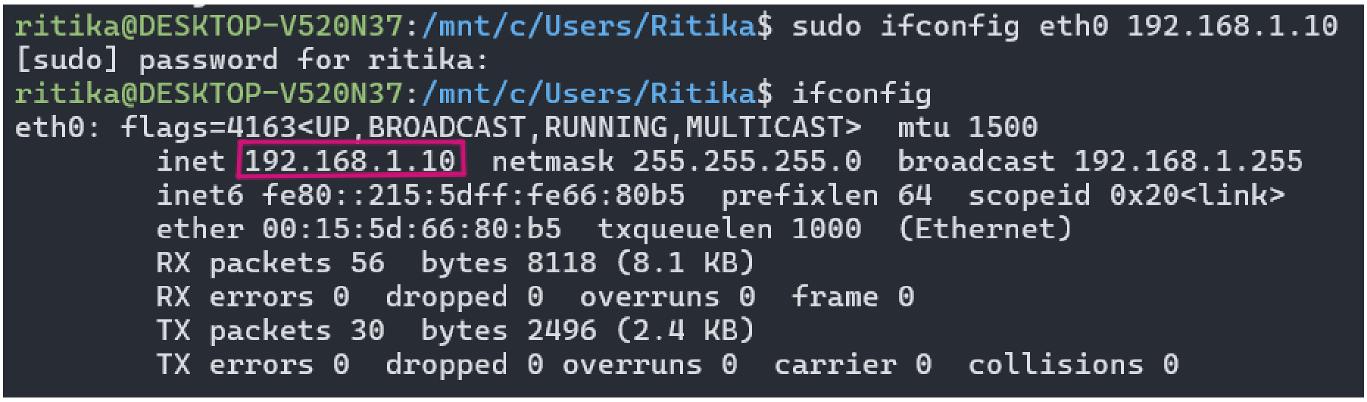


```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ping 8.8.8.8
ping: connect: Network is unreachable
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ exit
logout

C:\Users\Ritika>wsl --shutdown

C:\Users\Ritika>wsl
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=112 time=34.0 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=112 time=40.9 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=112 time=51.5 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=112 time=45.7 ms
64 bytes from 8.8.8.8: icmp_seq=5 ttl=112 time=34.5 ms
64 bytes from 8.8.8.8: icmp_seq=6 ttl=112 time=34.1 ms
```

5. We can change the IP address of our interface using the command

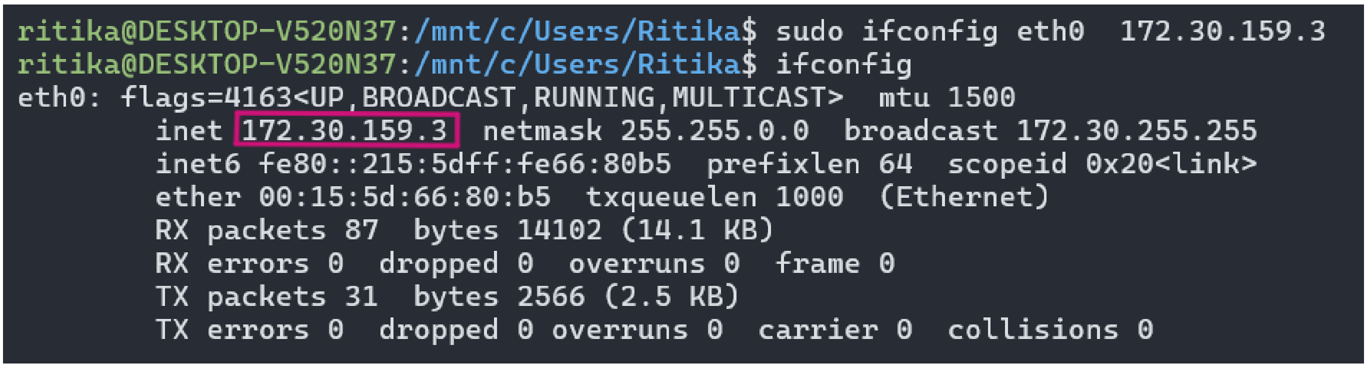
```
sudo ifconfig <interface_name> <new_ip_addr>
```

My current IP address is `172.30.159.31` and I changed it to `192.168.1.10` as shown below:



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ sudo ifconfig eth0 192.168.1.10
[sudo] password for ritika:
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.1.10  netmask 255.255.255.0  broadcast 192.168.1.255
        inet6 fe80::215:5dff:fe66:80b5  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:66:80:b5  txqueuelen 1000  (Ethernet)
        RX packets 56  bytes 8118 (8.1 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 30  bytes 2496 (2.4 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

We can revert back to the original IP address using the same command.



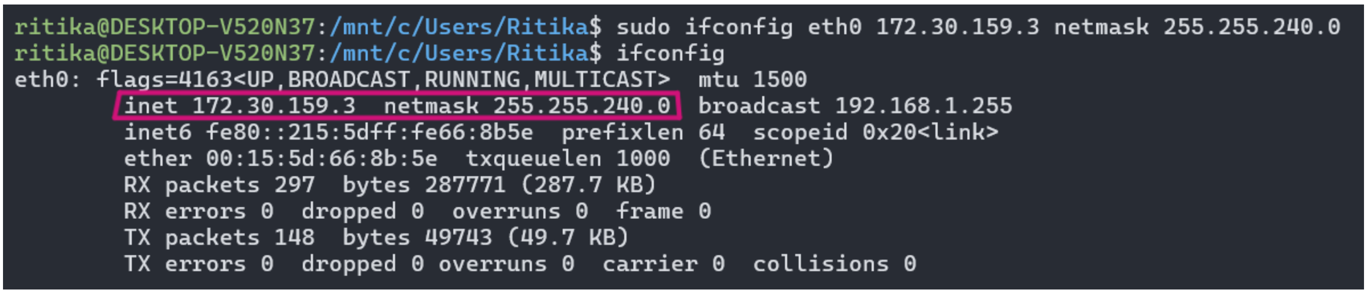
```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ sudo ifconfig eth0  172.30.159.3
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.30.159.3  netmask 255.255.0.0  broadcast 172.30.255.255
        inet6 fe80::215:5dff:fe66:80b5  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:66:80:b5  txqueuelen 1000  (Ethernet)
        RX packets 87  bytes 14102 (14.1 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 31  bytes 2566 (2.5 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Interesting note:

The IP address change affects the internet connection and we need to restart our WSL to access the internet again.

6. We can also change the subnet mask of our interface using the command

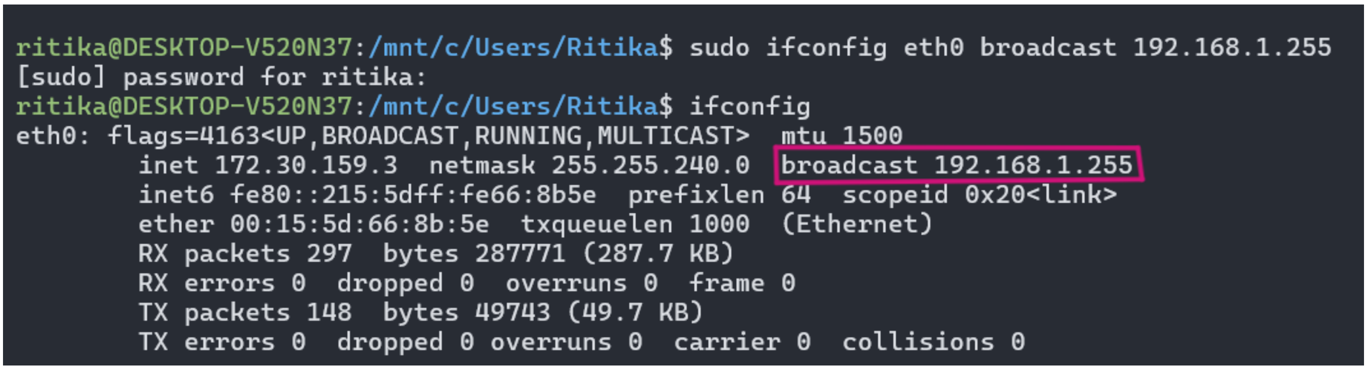
```
sudo ifconfig <interface_name> netmask <new_subnet_mask>
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ sudo ifconfig eth0 172.30.159.3 netmask 255.255.240.0
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.30.159.3  netmask 255.255.240.0  broadcast 192.168.1.255
        inet6 fe80::215:5dff:fe66:8b5e  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:66:8b:5e  txqueuelen 1000  (Ethernet)
        RX packets 297  bytes 287771 (287.7 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 148  bytes 49743 (49.7 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

7. We can also change the broadcast address of our interface using the command

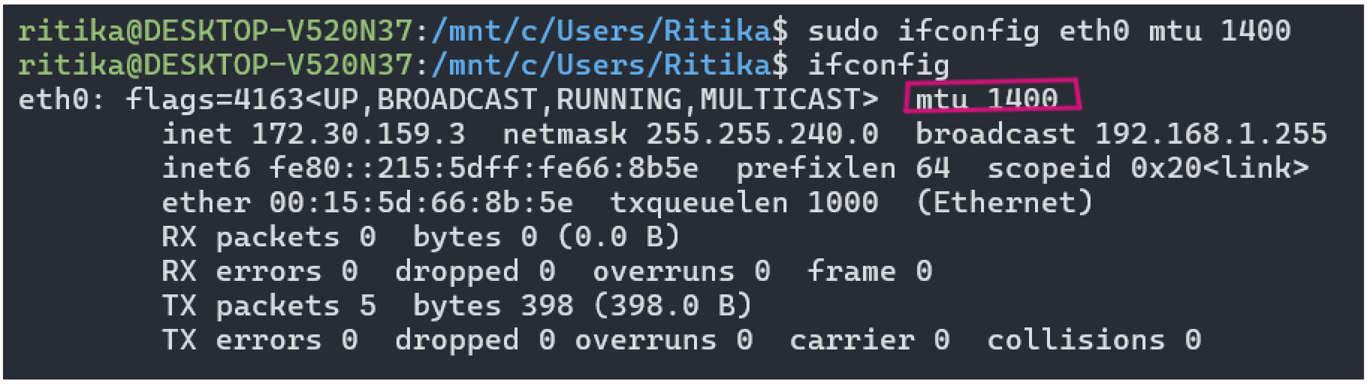
```
sudo ifconfig <interface_name> broadcast <new_broadcast_addr>
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ sudo ifconfig eth0 broadcast 192.168.1.255
[sudo] password for ritika:
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.30.159.3  netmask 255.255.240.0  broadcast 192.168.1.255
        inet6 fe80::215:5dff:fe66:8b5e  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:66:8b:5e  txqueuelen 1000  (Ethernet)
        RX packets 297  bytes 287771 (287.7 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 148  bytes 49743 (49.7 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

8. We can also change the Maximum Transmission Unit (MTU) of our interface using the command

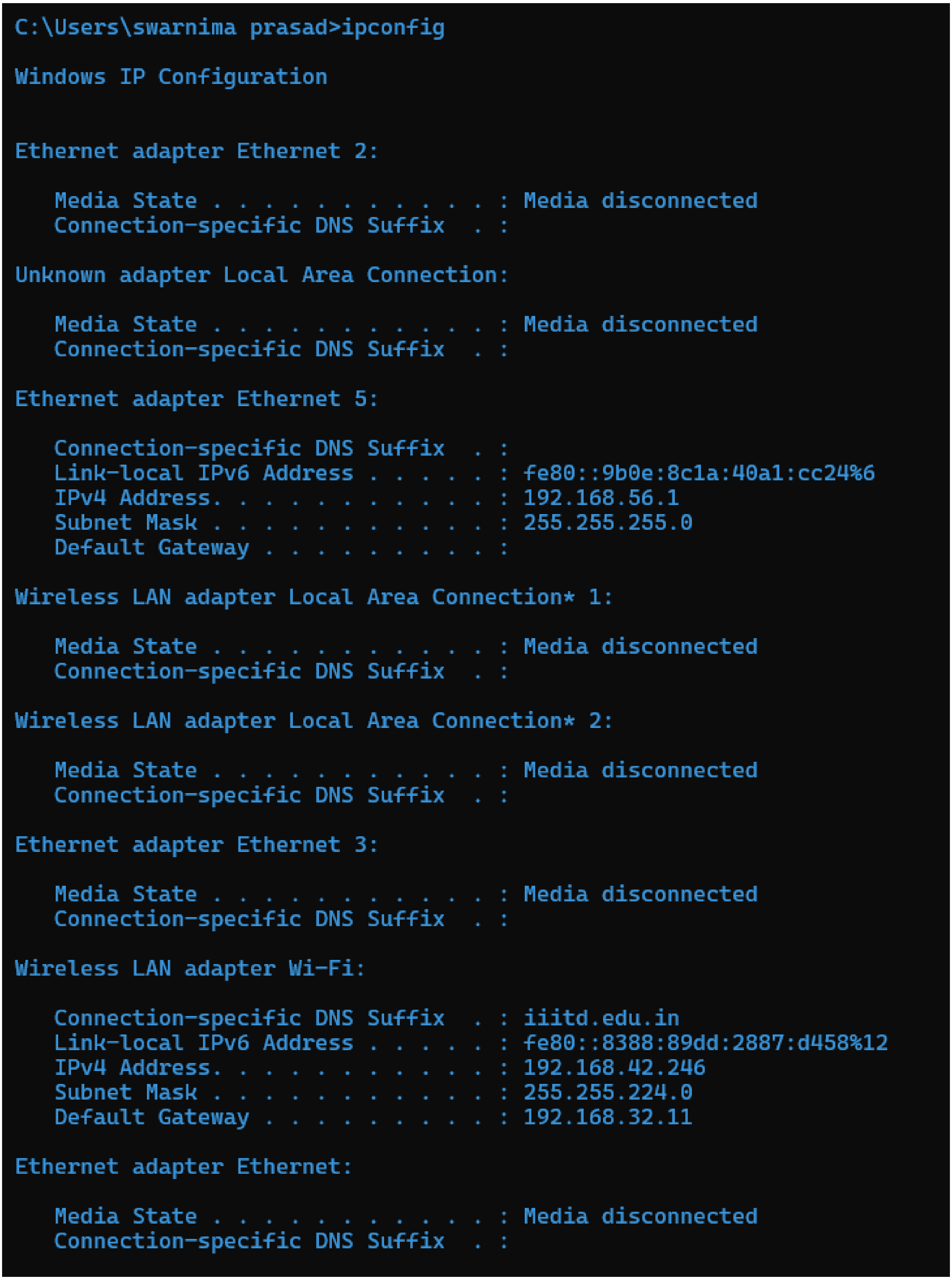
```
sudo ifconfig <interface_name> mtu <new_mtu>
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ sudo ifconfig eth0 mtu 1400
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1400
        inet 172.30.159.3  netmask 255.255.240.0  broadcast 192.168.1.255
        inet6 fe80::215:5dff:fe66:8b5e  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:66:8b:5e  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 5  bytes 398 (398.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

9. We can use `man ifconfig` to get more information about the `ifconfig`.

10. The `ipconfig` command is a command-line utility in Windows operating systems used to display and manage the IP configuration of the network interfaces on your computer.



```
C:\Users\swarnima prasad>ipconfig

Windows IP Configuration


Ethernet adapter Ethernet 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Unknown adapter Local Area Connection:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Ethernet adapter Ethernet 5:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::9b0e:8c1a:40a1:cc24%6
   IPv4 Address. . . . . . . . . . . : 192.168.56.1
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :

Wireless LAN adapter Local Area Connection* 1:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Ethernet adapter Ethernet 3:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . : iiitd.edu.in
   Link-local IPv6 Address . . . . . : fe80::8388:89dd:2887:d458%12
   IPv4 Address. . . . . . . . . . . : 192.168.42.246
   Subnet Mask . . . . . . . . . . . : 255.255.224.0
   Default Gateway . . . . . . . . . : 192.168.32.11

Ethernet adapter Ethernet:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
```

Wireless LAN Adapter Wi-Fi

- **Connection-specific DNS Suffix**: `iiitd.edu.in`
  This indicates the Wi-Fi connection is associated with the domain `iiitd.edu.in`.

- **IPv4 Address**: `192.168.42.246`
  This is the IP address assigned to the Wi-Fi adapter.

- **Subnet Mask**: `255.255.224.0`
  This determines the range of IP addresses within the same network.

- **Default Gateway**: `192.168.32.11`
  The gateway through which devices access other networks, including the internet.

Ethernet Adapter Ethernet 5

- **Connection-specific DNS Suffix**: (None)
  This is blank, indicating no specific DNS suffix is assigned.

- **Link-local IPv6 Address**: `fe80::`
  IPv6 addresses starting with `fe80::` are link-local addresses, meaning they are only valid within the local network segment.

- **IPv4 Address**: `192.168.56.1`
  This is a private IPv4 address, often used for internal network communication (e.g., a virtual machine's network or a local network).

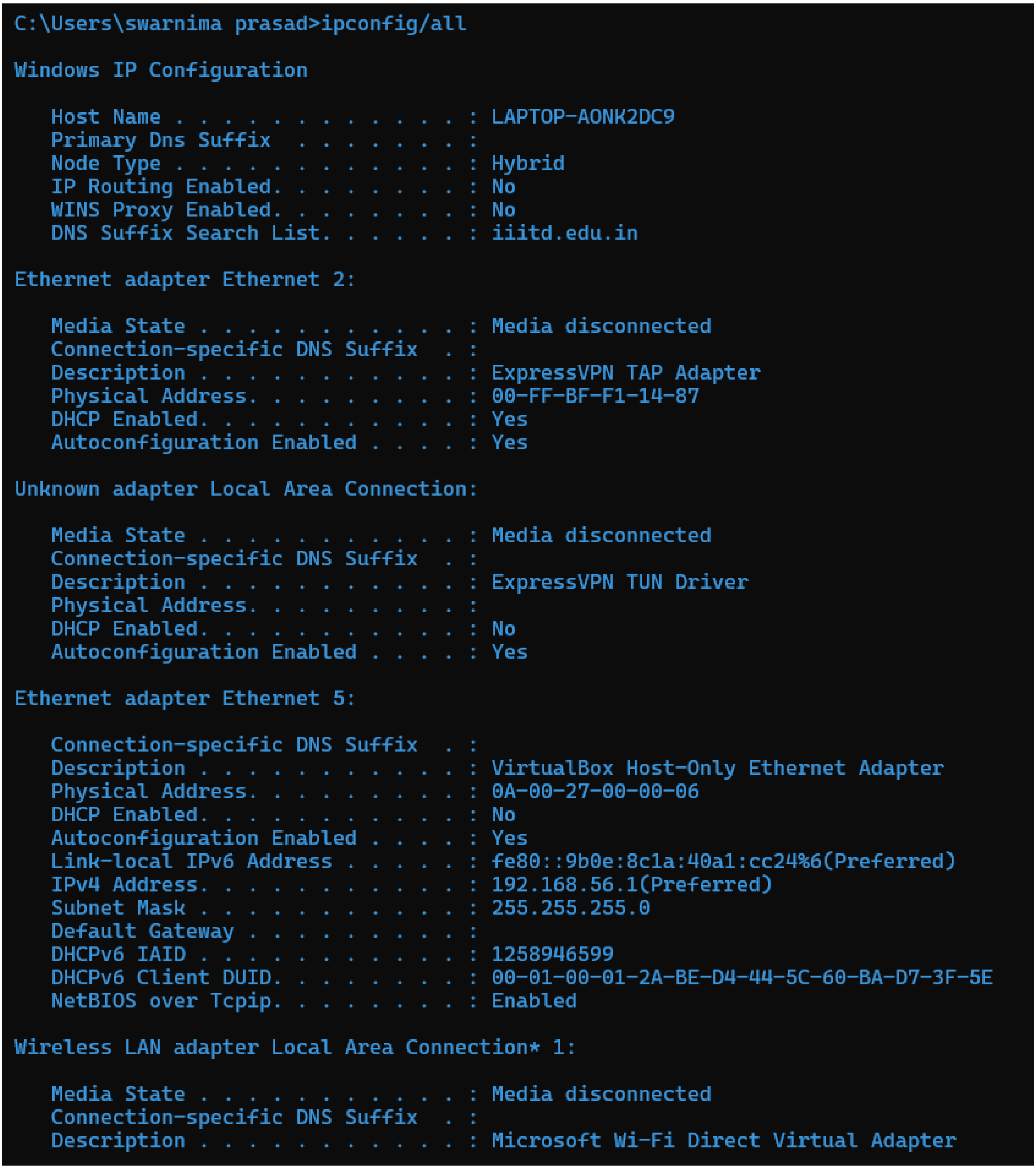
- **Subnet Mask**: `255.255.255.0`
  This is the subnet mask, which determines the range of IP addresses within the same network.

- **Default Gateway**: (None)
  This is missing, indicating that this adapter is not configured to route traffic outside the local network.

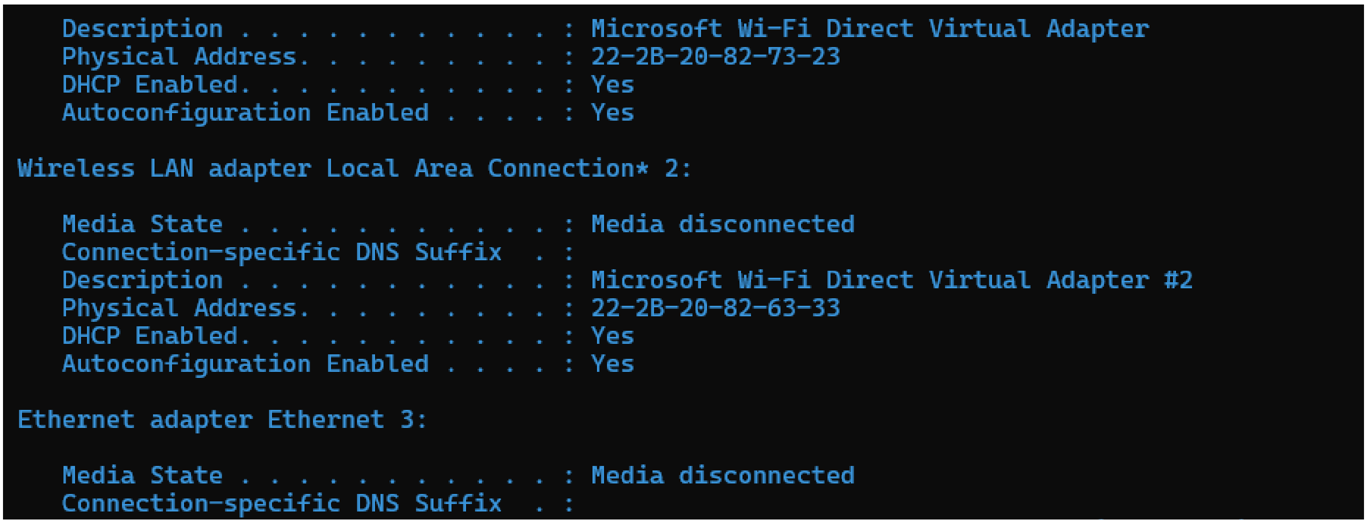
Disconnected Interfaces

Several Ethernet adapters and wireless LAN connections are present but not currently in use.

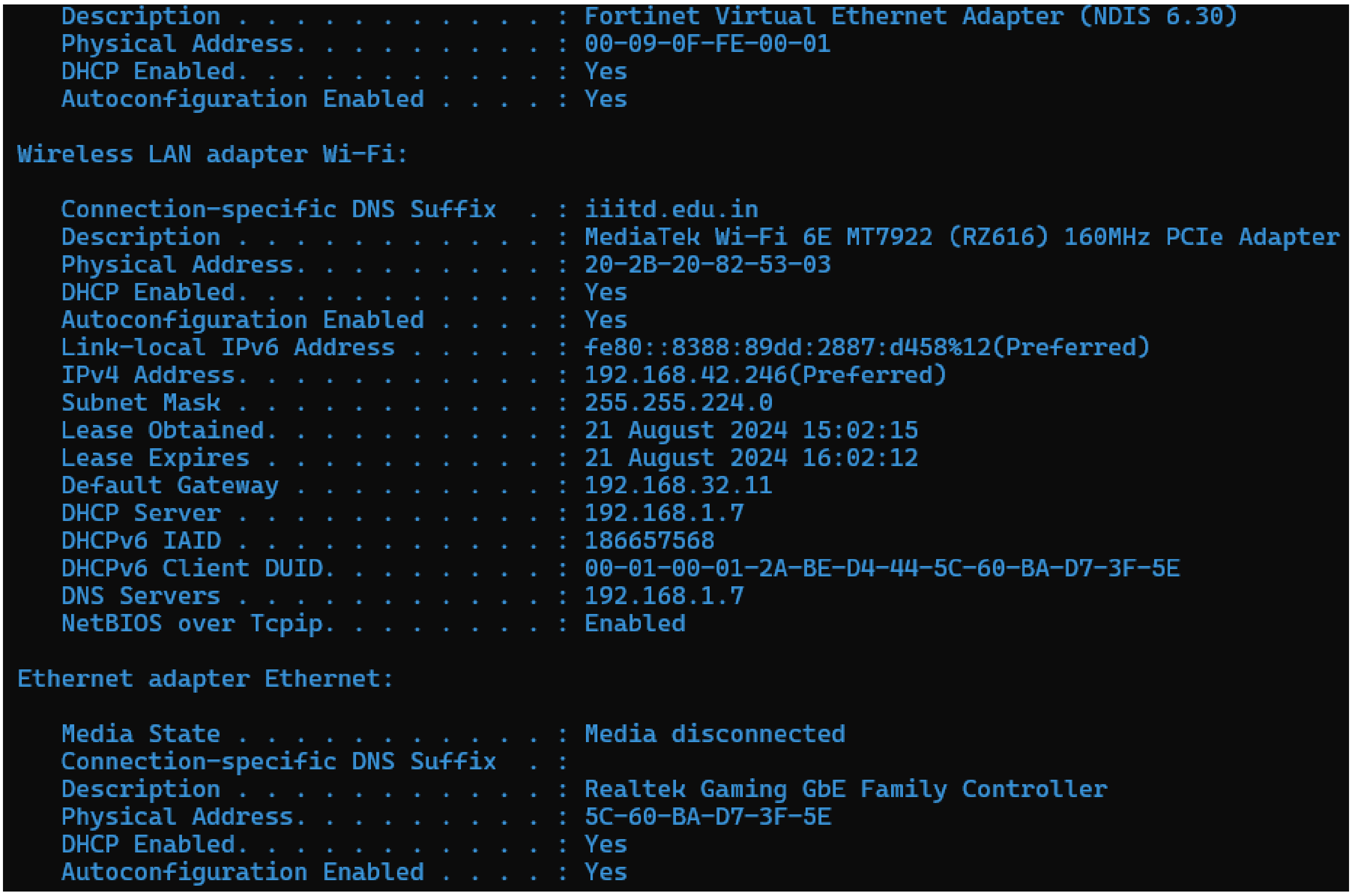
11. `ipconfig/all`



```
C:\Users\swarnima prasad>ipconfig/all

Windows IP Configuration

   Host Name . . . . . . . . . . . . : LAPTOP-AONK2DC9
   Primary Dns Suffix  . . . . . . . :
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
   WINS Proxy Enabled. . . . . . . . : No
   DNS Suffix Search List. . . . . . : iiitd.edu.in

Ethernet adapter Ethernet 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : ExpressVPN TAP Adapter
   Physical Address. . . . . . . . . : 00-FF-BF-F1-14-87
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Unknown adapter Local Area Connection:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : ExpressVPN TUN Driver
   Physical Address. . . . . . . . . :
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes

Ethernet adapter Ethernet 5:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : VirtualBox Host-Only Ethernet Adapter
   Physical Address. . . . . . . . . : 0A-00-27-00-00-06
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::9b0e:8c1a:40a1:cc24%6(Preferred)
   IPv4 Address. . . . . . . . . . . : 192.168.56.1(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :
   DHCPv6 IAID . . . . . . . . . . . : 1258946599
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-2A-BE-D4-44-5C-60-BA-D7-3F-5E
   NetBIOS over Tcpip. . . . . . . . : Enabled

Wireless LAN adapter Local Area Connection* 1:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter
```



```
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter
   Physical Address. . . . . . . . . : 22-2B-20-82-73-23
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter #2
   Physical Address. . . . . . . . . : 22-2B-20-82-63-33
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Ethernet adapter Ethernet 3:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
```



```
   Description . . . . . . . . . . . : Fortinet Virtual Ethernet Adapter (NDIS 6.30)
   Physical Address. . . . . . . . . : 00-09-0F-FE-00-01
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . : iiitd.edu.in
   Description . . . . . . . . . . . : MediaTek Wi-Fi 6E MT7922 (RZ616) 160MHz PCIe Adapter
   Physical Address. . . . . . . . . : 20-2B-20-82-53-03
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::8388:89dd:2887:d458%12(Preferred)
   IPv4 Address. . . . . . . . . . . : 192.168.42.246(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.224.0
   Lease Obtained. . . . . . . . . . : 21 August 2024 15:02:15
   Lease Expires . . . . . . . . . . : 21 August 2024 16:02:12
   Default Gateway . . . . . . . . . : 192.168.32.11
   DHCP Server . . . . . . . . . . . : 192.168.1.7
   DHCPv6 IAID . . . . . . . . . . . : 186657568
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-2A-BE-D4-44-5C-60-BA-D7-3F-5E
   DNS Servers . . . . . . . . . . . : 192.168.1.7
   NetBIOS over Tcpip. . . . . . . . : Enabled

Ethernet adapter Ethernet:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Realtek Gaming GbE Family Controller
   Physical Address. . . . . . . . . : 5C-60-BA-D7-3F-5E
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
```

Wireless LAN Adapter Wi-Fi

- **Data Link Layer uses**:
  - **Physical address**: 20-2B-20-82-53-03
- **Network Layer uses**:
  - **IPv4 Address**: 192.168.42.246

Differences in between `ipconfig` & `ipconfig /all`:

`ipconfig` (Layer 3 Information)

- **Provides basic Layer 3 (Network Layer) information**:
  - IPv4 Address
  - Subnet Mask
  - Default Gateway
- **Focuses on logical addressing and routing information.**

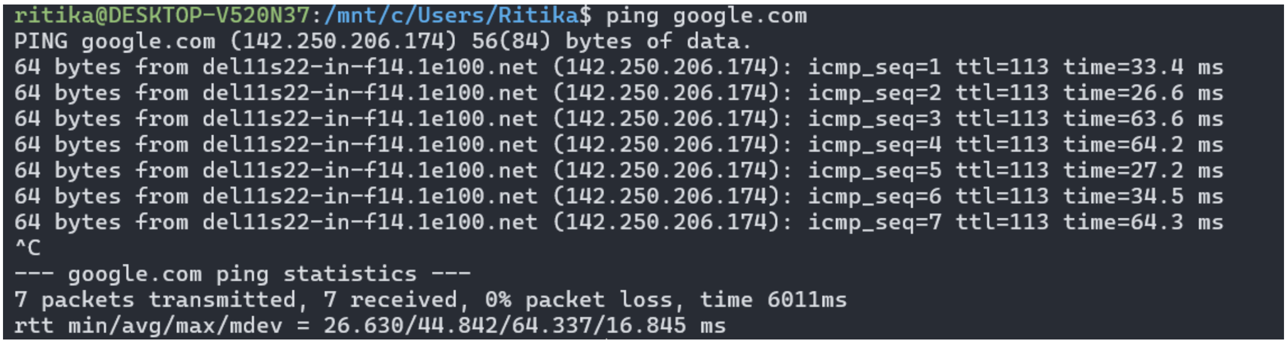
`ipconfig /all` (Layer 2 and Layer 3 Information)

- **Provides comprehensive Layer 2 (Data Link Layer) and Layer 3 (Network Layer) information.**
- **Includes MAC addresses (Layer 2)** in addition to the IP configuration (Layer 3).
- Useful for in-depth network troubleshooting, as it shows both physical (MAC) and logical (IP) addressing.

2. `ping` command:

`ping` or Packet Internet Groper is a network administration utility used to check the connectivity between two devices. It sends an ICMP echo request to a host and waits for an ICMP echo reply.

1. Using `ping` to check the connectivity between my device and `www.google.com`:

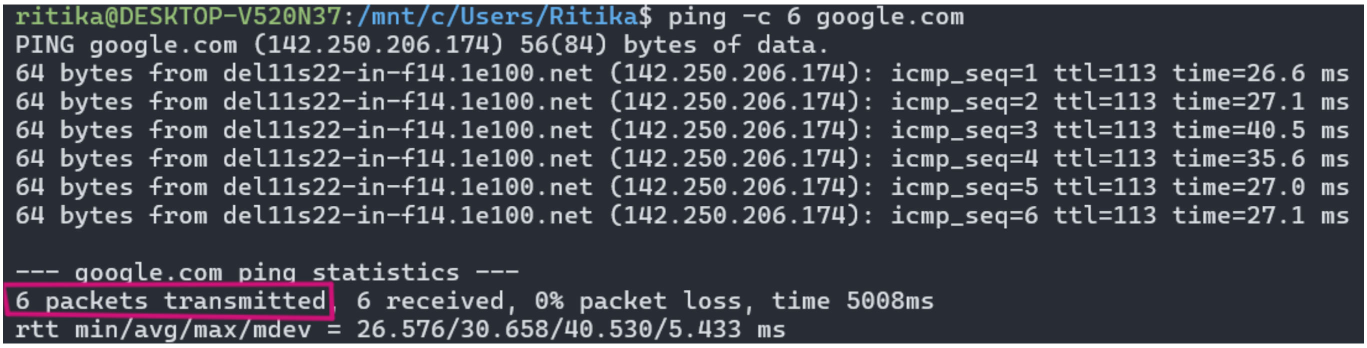


```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ping google.com
PING google.com (142.250.206.174) 56(84) bytes of data.
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=1 ttl=113 time=33.4 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=2 ttl=113 time=26.6 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=3 ttl=113 time=63.6 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=4 ttl=113 time=64.2 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=5 ttl=113 time=27.2 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=6 ttl=113 time=34.5 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=7 ttl=113 time=64.3 ms
^C
--- google.com ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6011ms
rtt min/avg/max/mdev = 26.630/44.842/64.337/16.845 ms
```

The output shows that the packets are being sent and received successfully with 0% packet loss.

2. Transmitting a specific number of packets using

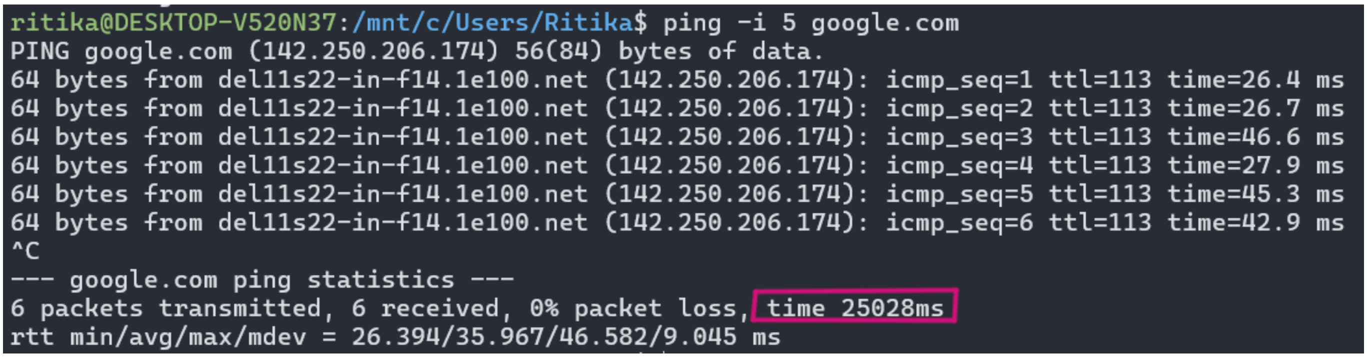
```
ping -c <number_of_packets> <host>
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ping -c 6 google.com
PING google.com (142.250.206.174) 56(84) bytes of data.
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=1 ttl=113 time=26.6 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=2 ttl=113 time=27.1 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=3 ttl=113 time=40.5 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=4 ttl=113 time=35.6 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=5 ttl=113 time=27.0 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=6 ttl=113 time=27.1 ms

--- google.com ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5008ms
rtt min/avg/max/mdev = 26.576/30.658/40.530/5.433 ms
```

3. Setting the time interval between the packets using

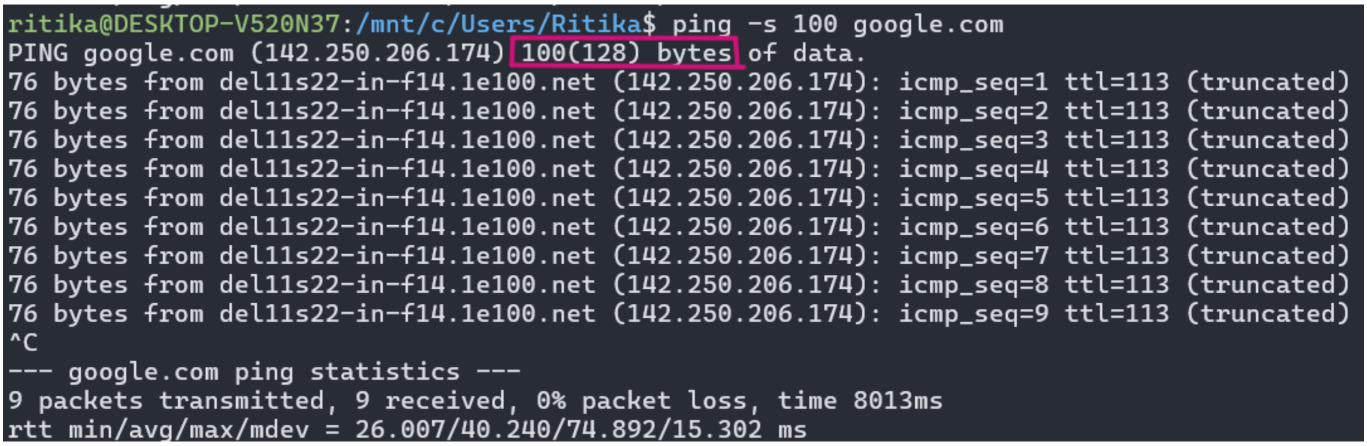
```
ping -i <time_interval> <host>
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ping -i 5 google.com
PING google.com (142.250.206.174) 56(84) bytes of data.
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=1 ttl=113 time=26.4 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=2 ttl=113 time=26.7 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=3 ttl=113 time=46.6 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=4 ttl=113 time=27.9 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=5 ttl=113 time=45.3 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=6 ttl=113 time=42.9 ms
^C
--- google.com ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 25028ms
rtt min/avg/max/mdev = 26.394/35.967/46.582/9.045 ms
```

4. Setting the packet size using

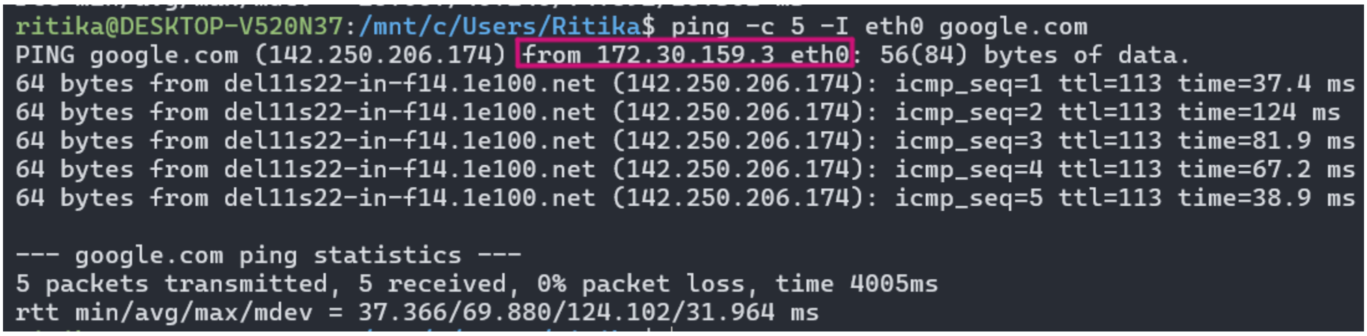
```
ping -s <packet_size> <host>
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ping -s 100 google.com
PING google.com (142.250.206.174) 100(128) bytes of data.
76 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=1 ttl=113 (truncated)
76 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=2 ttl=113 (truncated)
76 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=3 ttl=113 (truncated)
76 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=4 ttl=113 (truncated)
76 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=5 ttl=113 (truncated)
76 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=6 ttl=113 (truncated)
76 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=7 ttl=113 (truncated)
76 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=8 ttl=113 (truncated)
76 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=9 ttl=113 (truncated)
^C
--- google.com ping statistics ---
9 packets transmitted, 9 received, 0% packet loss, time 8013ms
rtt min/avg/max/mdev = 26.007/40.240/74.892/15.302 ms
```

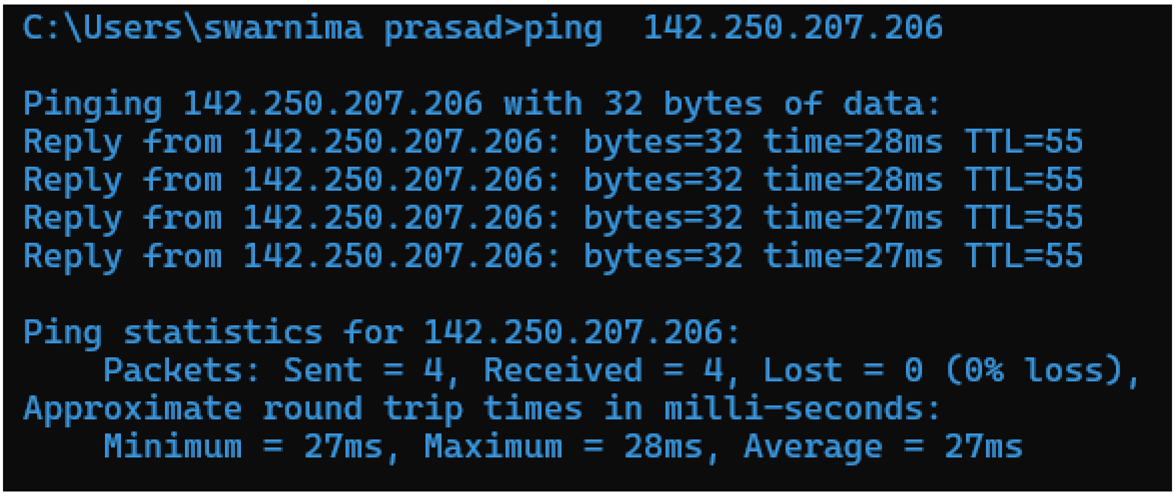
5. We can specify the interface to be used for sending the packets using

```
ping -I <interface_name> <host>
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ping -c 5 -I eth0 google.com
PING google.com (142.250.206.174) from 172.30.159.3 eth0: 56(84) bytes of data.
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=1 ttl=113 time=37.4 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=2 ttl=113 time=124 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=3 ttl=113 time=81.9 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=4 ttl=113 time=67.2 ms
64 bytes from del11s22-in-f14.1e100.net (142.250.206.174): icmp_seq=5 ttl=113 time=38.9 ms

--- google.com ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 37.366/69.880/124.102/31.964 ms
```

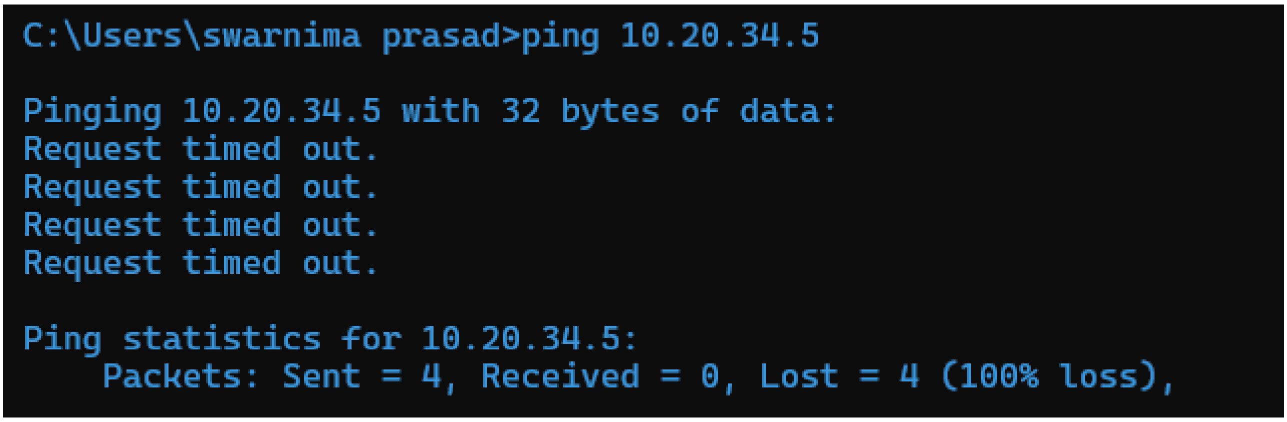
6. Ping using an IP address



```
C:\Users\swarnima prasad>ping  142.250.207.206

Pinging 142.250.207.206 with 32 bytes of data:
Reply from 142.250.207.206: bytes=32 time=28ms TTL=55
Reply from 142.250.207.206: bytes=32 time=28ms TTL=55
Reply from 142.250.207.206: bytes=32 time=27ms TTL=55
Reply from 142.250.207.206: bytes=32 time=27ms TTL=55

Ping statistics for 142.250.207.206:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 27ms, Maximum = 28ms, Average = 27ms
```

- Pinging one of the ip address of youtube
- 4 packets sent and received which implies no data loss.

7. Pinging one of the non existent random ip address



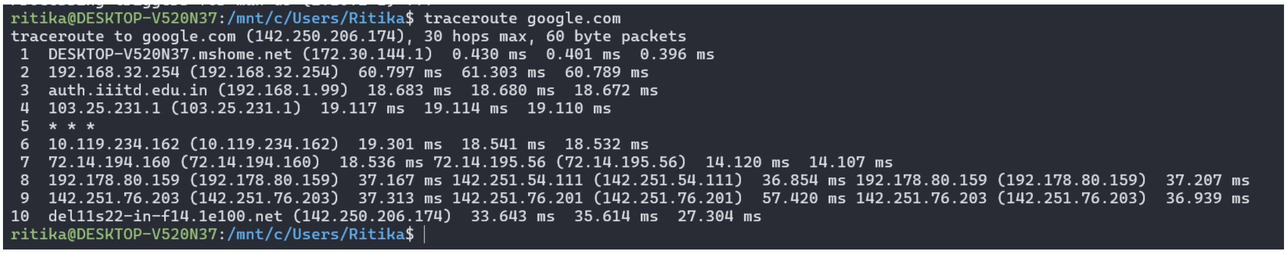
```
C:\Users\swarnima prasad>ping 10.20.34.5

Pinging 10.20.34.5 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.20.34.5:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

- 4 packets sent and 0 received which implies 100% data loss.

3. `traceroute` command:

`traceroute` is used for tracing the full path from your local system to another network system. It shows the number of hops taken to reach the destination and the time taken for each hop. It sends an order of UDP packets, routes three packets of data to test each hop by default.

1. Using `traceroute` to trace the path to `www.google.com`:

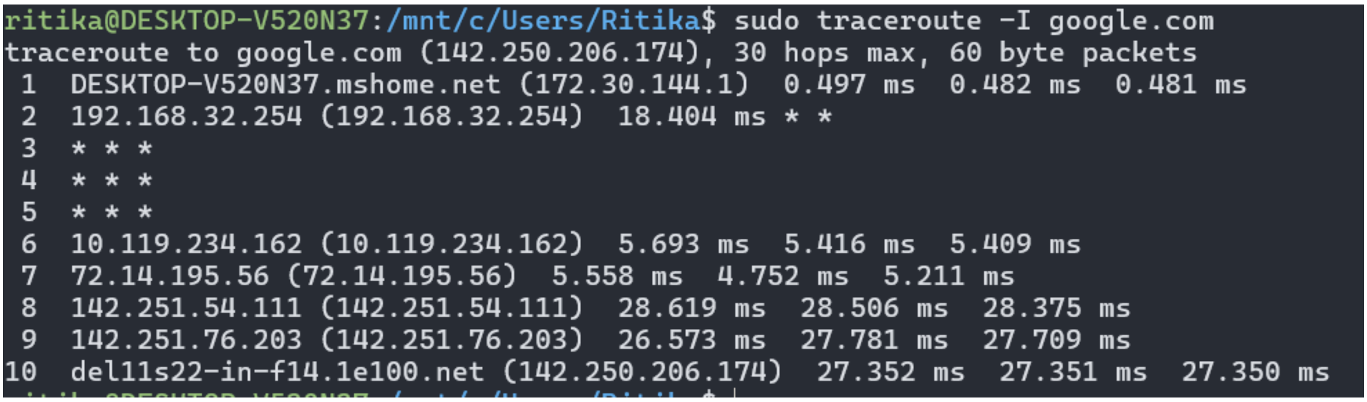


```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ traceroute google.com
traceroute to google.com (142.250.206.174), 30 hops max, 60 byte packets
 1  DESKTOP-V520N37.mshome.net (172.30.144.1)  0.430 ms  0.401 ms  0.396 ms
 2  192.168.32.254 (192.168.32.254)  60.797 ms  61.303 ms  60.789 ms
 3  auth.iiitd.edu.in (192.168.1.99)  18.683 ms  18.680 ms  18.672 ms
 4  103.25.231.1 (103.25.231.1)  19.117 ms  19.114 ms  19.110 ms
 5  * * *
 6  10.119.234.162 (10.119.234.162)  19.301 ms  18.541 ms  18.532 ms
 7  72.14.194.160 (72.14.194.160)  18.536 ms 72.14.195.56 (72.14.195.56)  14.120 ms  14.107 ms
 8  192.178.80.159 (192.178.80.159)  37.167 ms 142.251.54.111 (142.251.54.111)  36.854 ms 192.178.80.159 (192.178.80.159)  37.207 ms
 9  142.251.76.203 (142.251.76.203)  37.313 ms 142.251.76.201 (142.251.76.201)  57.420 ms 142.251.76.203 (142.251.76.203)  36.939 ms
10  del11s22-in-f14.1e100.net (142.250.206.174)  33.643 ms  35.614 ms  27.304 ms
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$
```

The `* * *` most probably suggest that the specific organization does not want to reveal details of their internal network or there might be an overload.

2. To use ICMP echo requests instead of UDP packets, we can use

```
sudo traceroute -I <host>
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ sudo traceroute -I google.com
traceroute to google.com (142.250.206.174), 30 hops max, 60 byte packets
 1  DESKTOP-V520N37.mshome.net (172.30.144.1)  0.497 ms  0.482 ms  0.481 ms
 2  192.168.32.254 (192.168.32.254)  18.404 ms * *
 3  * * *
 4  * * *
 5  * * *
 6  10.119.234.162 (10.119.234.162)  5.693 ms  5.416 ms  5.409 ms
 7  72.14.195.56 (72.14.195.56)  5.558 ms  4.752 ms  5.211 ms
 8  142.251.54.111 (142.251.54.111)  28.619 ms  28.506 ms  28.375 ms
 9  142.251.76.203 (142.251.76.203)  26.573 ms  27.781 ms  27.709 ms
10  del11s22-in-f14.1e100.net (142.250.206.174)  27.352 ms  27.351 ms  27.350 ms
```

An increase in the number of hops giving `* * *` is observed when using ICMP echo requests.

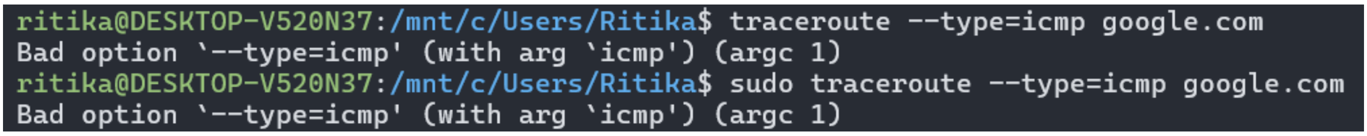
Interestingly, using the command given in the tutorial slides

```
traceroute --type=icmp <host>
```

or

```
sudo traceroute --type=icmp <host>
```

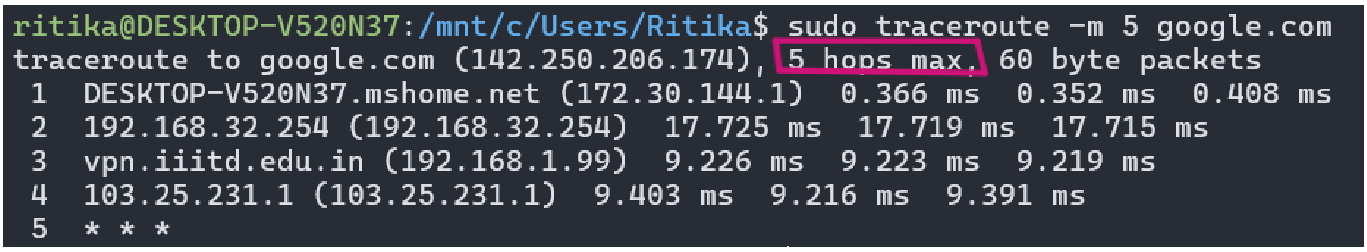
did not work for my WSL and gave Bad Option.



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ traceroute --type=icmp google.com
Bad option `--type=icmp' (with arg `icmp') (argc 1)
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ sudo traceroute --type=icmp google.com
Bad option `--type=icmp' (with arg `icmp') (argc 1)
```

3. We can specify the maximum number of hops using

```
traceroute -m <max_hops> <host>
```

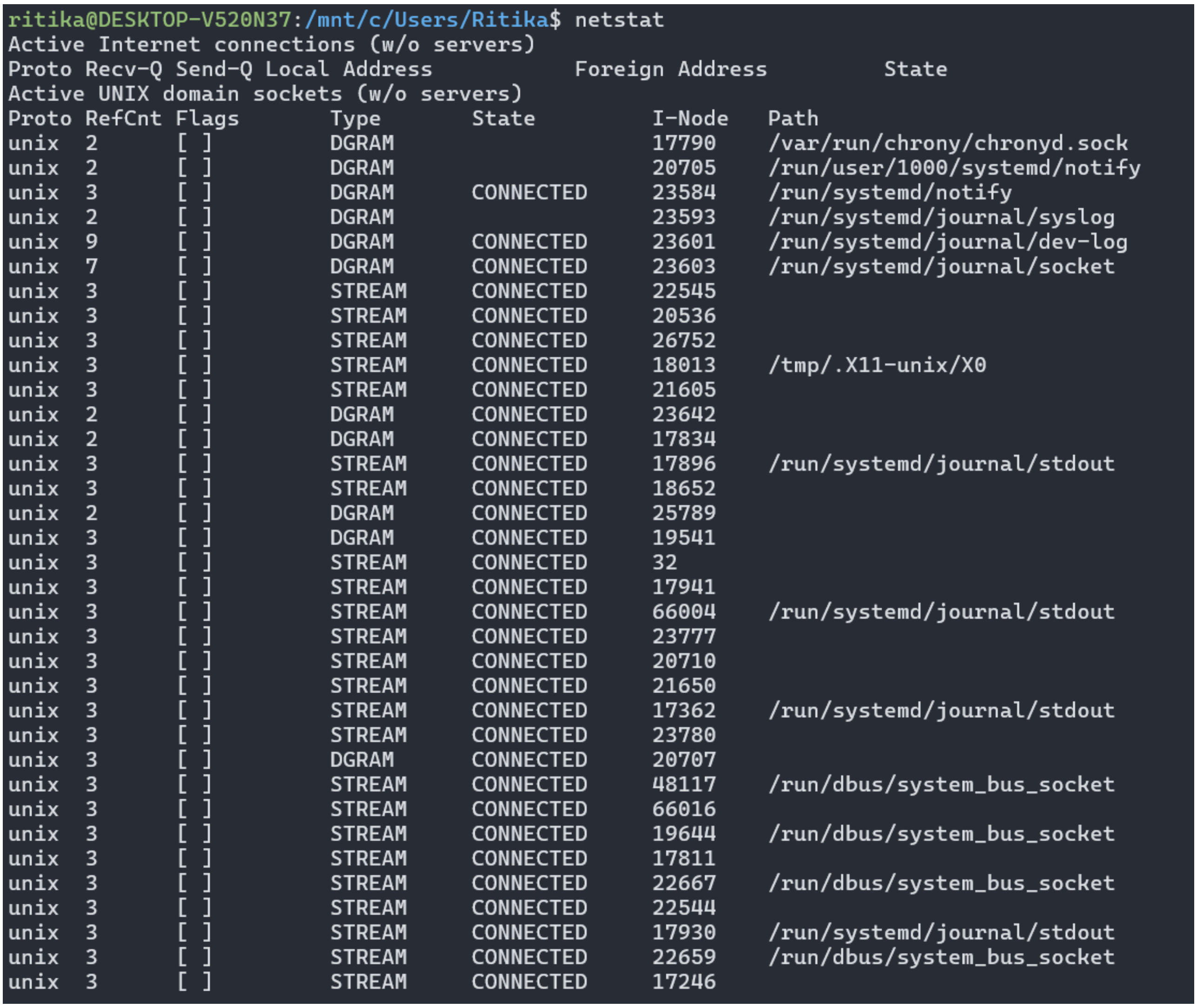


```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ sudo traceroute -m 5 google.com
traceroute to google.com (142.250.206.174), 5 hops max, 60 byte packets
 1  DESKTOP-V520N37.mshome.net (172.30.144.1)  0.366 ms  0.352 ms  0.408 ms
 2  192.168.32.254 (192.168.32.254)  17.725 ms  17.719 ms  17.715 ms
 3  vpn.iiitd.edu.in (192.168.1.99)  9.226 ms  9.223 ms  9.219 ms
 4  103.25.231.1 (103.25.231.1)  9.403 ms  9.216 ms  9.391 ms
 5  * * *
```

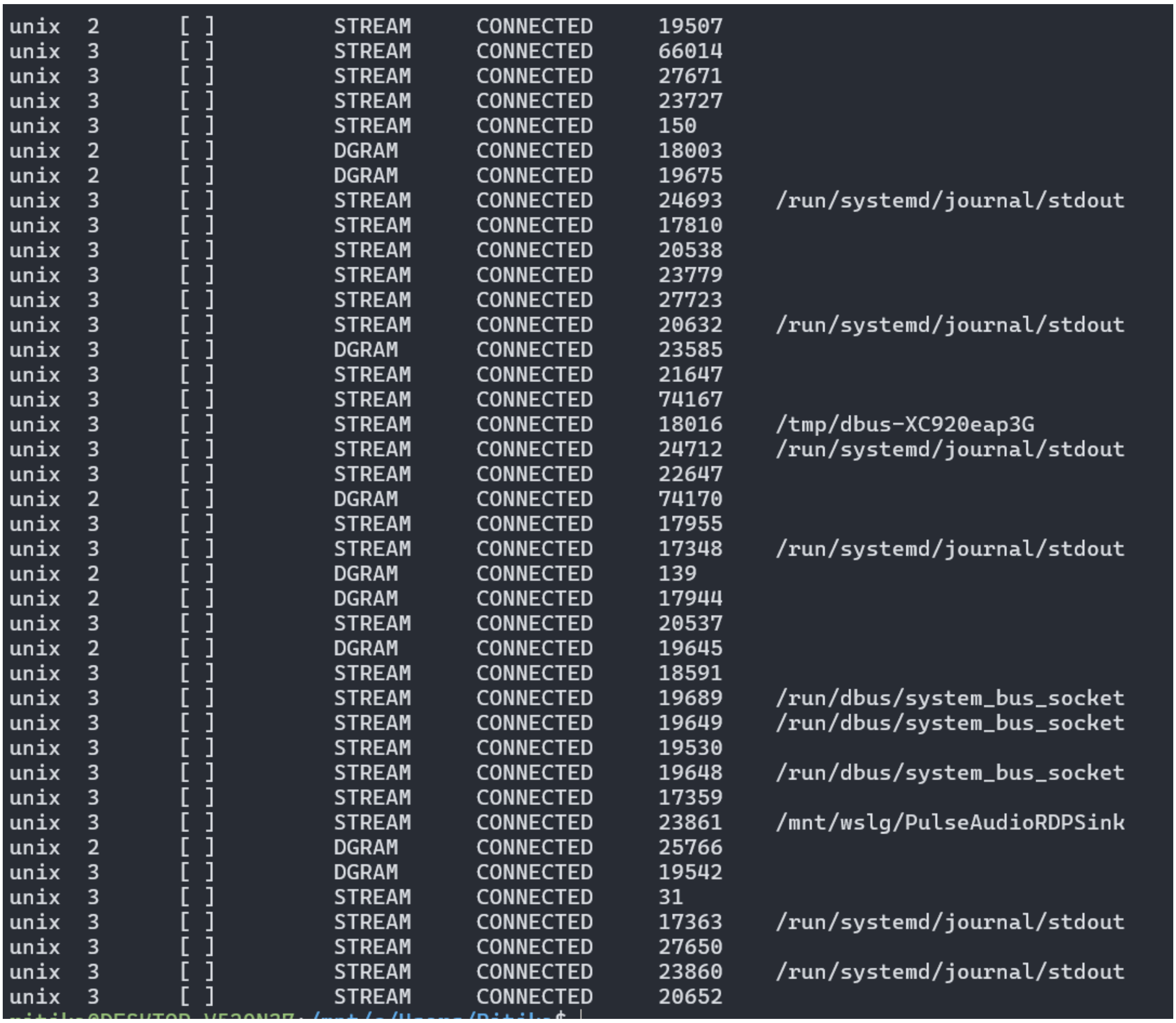
4. `netstat` command:

`netstat` or Network Statistics is used to display network connections, routing tables, interface statistics and masquerade connections.

1. Using `netstat` to display the routing table:



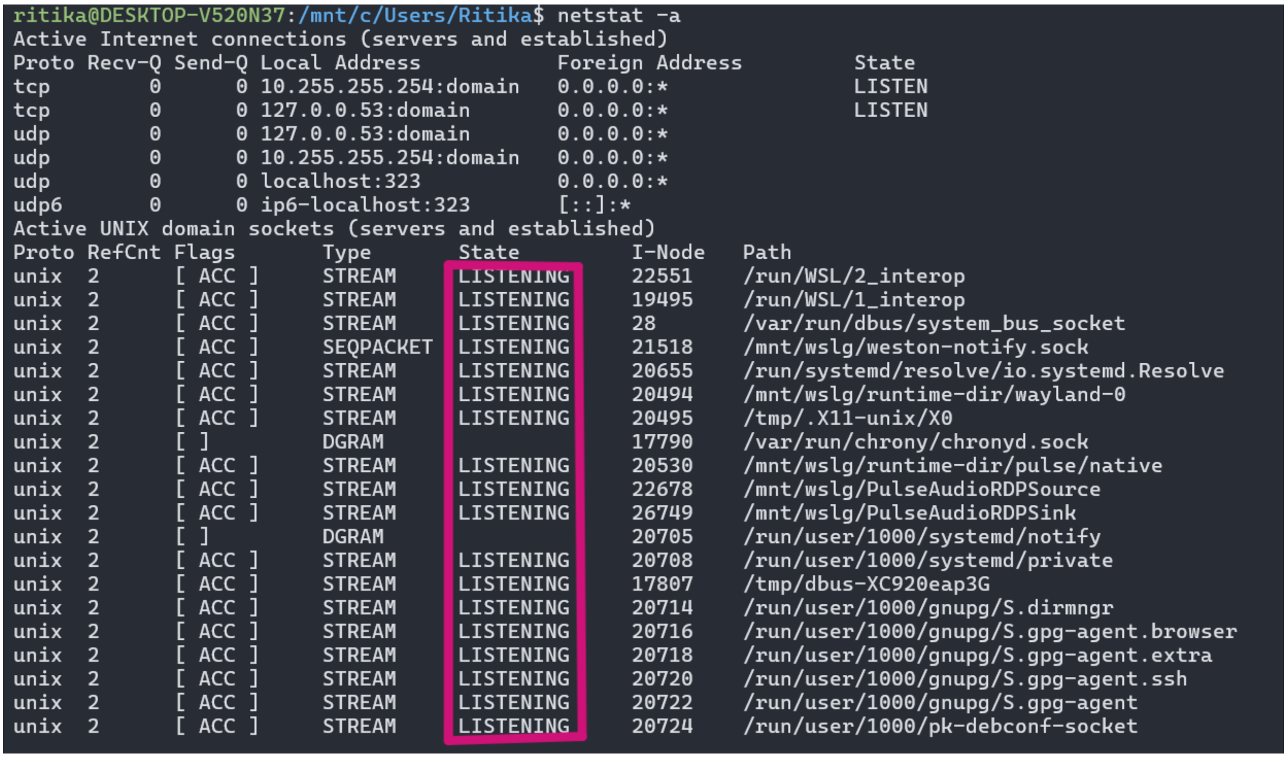
```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
Active UNIX domain sockets (w/o servers)
Proto RefCnt Flags       Type       State         I-Node   Path
unix  2      [ ]         DGRAM                    17790    /var/run/chrony/chronyd.sock
unix  2      [ ]         DGRAM                    20705    /run/user/1000/systemd/notify
unix  3      [ ]         DGRAM      CONNECTED     23584    /run/systemd/notify
unix  2      [ ]         DGRAM                    23593    /run/systemd/journal/syslog
unix  9      [ ]         DGRAM      CONNECTED     23601    /run/systemd/journal/dev-log
unix  7      [ ]         DGRAM      CONNECTED     23603    /run/systemd/journal/socket
unix  3      [ ]         STREAM     CONNECTED     22545
unix  3      [ ]         STREAM     CONNECTED     20536
unix  3      [ ]         STREAM     CONNECTED     26752
unix  3      [ ]         STREAM     CONNECTED     18013    /tmp/.X11-unix/X0
unix  3      [ ]         STREAM     CONNECTED     21605
unix  2      [ ]         DGRAM      CONNECTED     23642
unix  2      [ ]         DGRAM      CONNECTED     17834
unix  3      [ ]         STREAM     CONNECTED     17896    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     18652
unix  2      [ ]         DGRAM      CONNECTED     25789
unix  3      [ ]         DGRAM      CONNECTED     19541
unix  3      [ ]         STREAM     CONNECTED     32
unix  3      [ ]         STREAM     CONNECTED     17941
unix  3      [ ]         STREAM     CONNECTED     66004    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     23777
unix  3      [ ]         STREAM     CONNECTED     20710
unix  3      [ ]         STREAM     CONNECTED     21650
unix  3      [ ]         STREAM     CONNECTED     17362    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     23780
unix  3      [ ]         DGRAM      CONNECTED     20707
unix  3      [ ]         STREAM     CONNECTED     48117    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     66016
unix  3      [ ]         STREAM     CONNECTED     19644    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     17811
unix  3      [ ]         STREAM     CONNECTED     22667    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     22544
unix  3      [ ]         STREAM     CONNECTED     17930    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     22659    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     17246
```



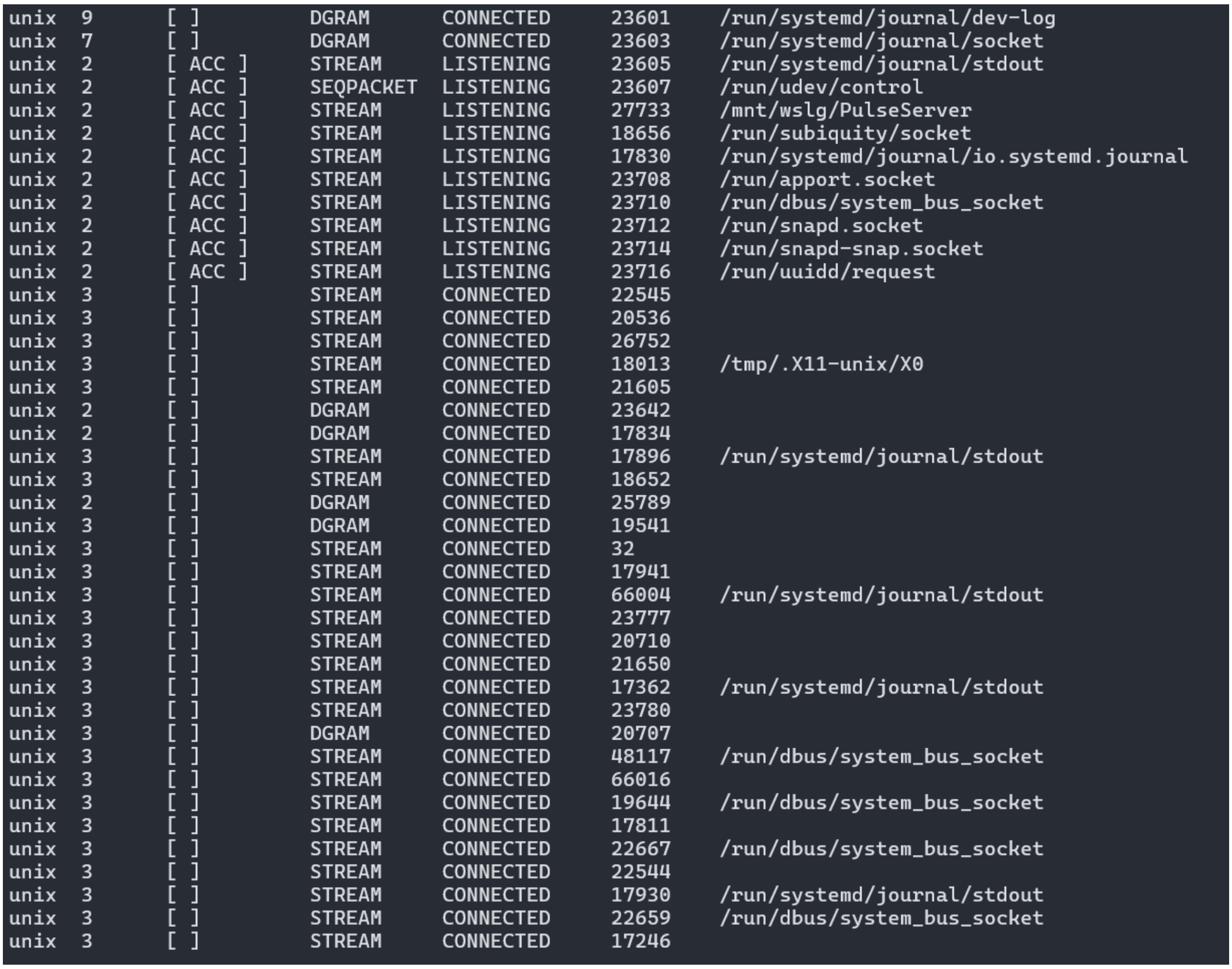
```
unix  2      [ ]         STREAM     CONNECTED     19507
unix  3      [ ]         STREAM     CONNECTED     66014
unix  3      [ ]         STREAM     CONNECTED     27671
unix  3      [ ]         STREAM     CONNECTED     23727
unix  3      [ ]         STREAM     CONNECTED     150
unix  2      [ ]         DGRAM      CONNECTED     18003
unix  2      [ ]         DGRAM      CONNECTED     19675
unix  3      [ ]         STREAM     CONNECTED     24693    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     17810
unix  3      [ ]         STREAM     CONNECTED     20538
unix  3      [ ]         STREAM     CONNECTED     23779
unix  3      [ ]         STREAM     CONNECTED     27723
unix  3      [ ]         STREAM     CONNECTED     20632    /run/systemd/journal/stdout
unix  3      [ ]         DGRAM      CONNECTED     23585
unix  3      [ ]         STREAM     CONNECTED     21647
unix  3      [ ]         STREAM     CONNECTED     74167
unix  3      [ ]         STREAM     CONNECTED     18016    /tmp/dbus-XC920eap3G
unix  3      [ ]         STREAM     CONNECTED     24712    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     22647
unix  2      [ ]         DGRAM      CONNECTED     74170
unix  3      [ ]         STREAM     CONNECTED     17955
unix  3      [ ]         STREAM     CONNECTED     17348    /run/systemd/journal/stdout
unix  2      [ ]         DGRAM      CONNECTED     139
unix  2      [ ]         DGRAM      CONNECTED     17944
unix  3      [ ]         STREAM     CONNECTED     20537
unix  2      [ ]         DGRAM      CONNECTED     19645
unix  3      [ ]         STREAM     CONNECTED     18591
unix  3      [ ]         STREAM     CONNECTED     19689    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     19649    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     19530
unix  3      [ ]         STREAM     CONNECTED     19648    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     17359
unix  3      [ ]         STREAM     CONNECTED     23861    /mnt/wslg/PulseAudioRDPSink
unix  2      [ ]         DGRAM      CONNECTED     25766
unix  3      [ ]         DGRAM      CONNECTED     19542
unix  3      [ ]         STREAM     CONNECTED     31
unix  3      [ ]         STREAM     CONNECTED     17363    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     27650
unix  3      [ ]         STREAM     CONNECTED     23860    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     20652
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$
```

The routing table shows Protocol, Reference Count, Flags, Type of Service, State (in this case, all `CONNECTED`), I-Node and Path.

2. Using `netstat -a` to display all connections:



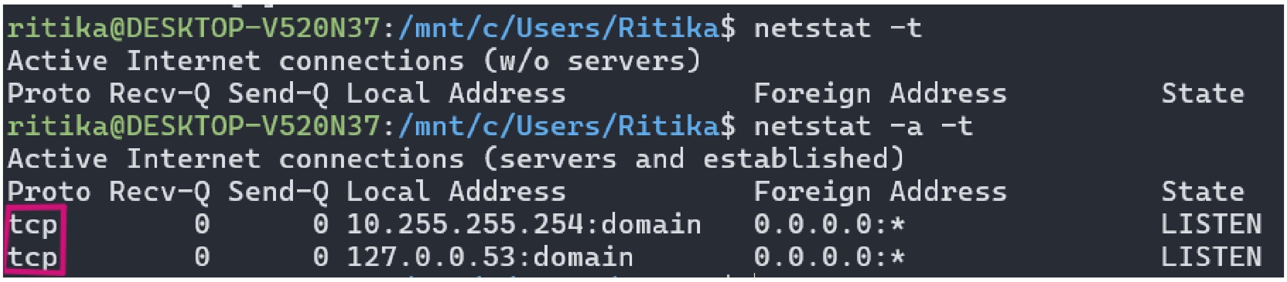
```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -a
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 10.255.255.254:domain   0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.53:domain       0.0.0.0:*               LISTEN
udp        0      0 127.0.0.53:domain       0.0.0.0:*
udp        0      0 10.255.255.254:domain   0.0.0.0:*
udp        0      0 localhost:323           0.0.0.0:*
udp6       0      0 ip6-localhost:323       [::]:*
Active UNIX domain sockets (servers and established)
Proto RefCnt Flags       Type       State         I-Node   Path
unix  2      [ ACC ]     STREAM     LISTENING     22551    /run/WSL/2_interop
unix  2      [ ACC ]     STREAM     LISTENING     19495    /run/WSL/1_interop
unix  2      [ ACC ]     STREAM     LISTENING     28       /var/run/dbus/system_bus_socket
unix  2      [ ACC ]     SEQPACKET  LISTENING     21518    /mnt/wslg/weston-notify.sock
unix  2      [ ACC ]     STREAM     LISTENING     20655    /run/systemd/resolve/io.systemd.Resolve
unix  2      [ ACC ]     STREAM     LISTENING     20494    /mnt/wslg/runtime-dir/wayland-0
unix  2      [ ACC ]     STREAM     LISTENING     20495    /tmp/.X11-unix/X0
unix  2      [ ]         DGRAM                    17790    /var/run/chrony/chronyd.sock
unix  2      [ ACC ]     STREAM     LISTENING     20530    /mnt/wslg/runtime-dir/pulse/native
unix  2      [ ACC ]     STREAM     LISTENING     22678    /mnt/wslg/PulseAudioRDPSource
unix  2      [ ACC ]     STREAM     LISTENING     26749    /mnt/wslg/PulseAudioRDPSink
unix  2      [ ]         DGRAM                    20705    /run/user/1000/systemd/notify
unix  2      [ ACC ]     STREAM     LISTENING     20708    /run/user/1000/systemd/private
unix  2      [ ACC ]     STREAM     LISTENING     17807    /tmp/dbus-XC920eap3G
unix  2      [ ACC ]     STREAM     LISTENING     20714    /run/user/1000/gnupg/S.dirmngr
unix  2      [ ACC ]     STREAM     LISTENING     20716    /run/user/1000/gnupg/S.gpg-agent.browser
unix  2      [ ACC ]     STREAM     LISTENING     20718    /run/user/1000/gnupg/S.gpg-agent.extra
unix  2      [ ACC ]     STREAM     LISTENING     20720    /run/user/1000/gnupg/S.gpg-agent.ssh
unix  2      [ ACC ]     STREAM     LISTENING     20722    /run/user/1000/gnupg/S.gpg-agent
unix  2      [ ACC ]     STREAM     LISTENING     20724    /run/user/1000/pk-debconf-socket
```



```
unix  9      [ ]         DGRAM      CONNECTED     23601    /run/systemd/journal/dev-log
unix  7      [ ]         DGRAM      CONNECTED     23603    /run/systemd/journal/socket
unix  2      [ ACC ]     STREAM     LISTENING     23605    /run/systemd/journal/stdout
unix  2      [ ACC ]     SEQPACKET  LISTENING     23607    /run/udev/control
unix  2      [ ACC ]     STREAM     LISTENING     27733    /mnt/wslg/PulseServer
unix  2      [ ACC ]     STREAM     LISTENING     18656    /run/subiquity/socket
unix  2      [ ACC ]     STREAM     LISTENING     17830    /run/systemd/journal/io.systemd.journal
unix  2      [ ACC ]     STREAM     LISTENING     23708    /run/apport.socket
unix  2      [ ACC ]     STREAM     LISTENING     23710    /run/dbus/system_bus_socket
unix  2      [ ACC ]     STREAM     LISTENING     23712    /run/snapd.socket
unix  2      [ ACC ]     STREAM     LISTENING     23714    /run/snapd-snap.socket
unix  2      [ ACC ]     STREAM     LISTENING     23716    /run/uuidd/request
unix  3      [ ]         STREAM     CONNECTED     22545
unix  3      [ ]         STREAM     CONNECTED     20536
unix  3      [ ]         STREAM     CONNECTED     26752
unix  3      [ ]         STREAM     CONNECTED     18013    /tmp/.X11-unix/X0
unix  3      [ ]         STREAM     CONNECTED     21605
unix  2      [ ]         DGRAM      CONNECTED     23642
unix  2      [ ]         DGRAM      CONNECTED     17834
unix  3      [ ]         STREAM     CONNECTED     17896    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     18652
unix  2      [ ]         DGRAM      CONNECTED     25789
unix  3      [ ]         DGRAM      CONNECTED     19541
unix  3      [ ]         STREAM     CONNECTED     32
unix  3      [ ]         STREAM     CONNECTED     17941
unix  3      [ ]         STREAM     CONNECTED     66004    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     23777
unix  3      [ ]         STREAM     CONNECTED     20710
unix  3      [ ]         STREAM     CONNECTED     21650
unix  3      [ ]         STREAM     CONNECTED     17362    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     23780
unix  3      [ ]         DGRAM      CONNECTED     20707
unix  3      [ ]         STREAM     CONNECTED     48117    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     66016
unix  3      [ ]         STREAM     CONNECTED     19644    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     17811
unix  3      [ ]         STREAM     CONNECTED     22667    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     22544
unix  3      [ ]         STREAM     CONNECTED     17930    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     22659    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     17246
```

`netstat -a` displays all connections and `LISTENING` ports.

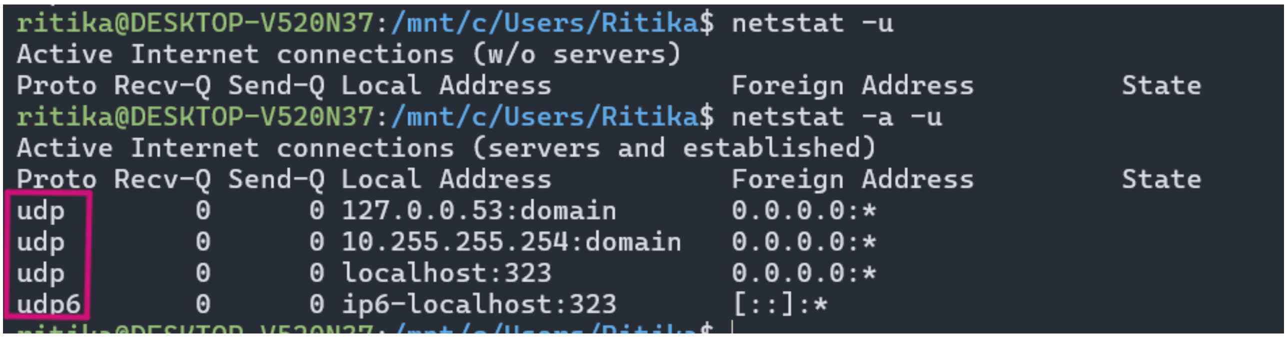
3. Using `netstat -t` to display TCP connections:



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -t
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -a -t
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 10.255.255.254:domain   0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.53:domain       0.0.0.0:*               LISTEN
```

Notice how there are no active connections in the TCP table but listening ports are available.

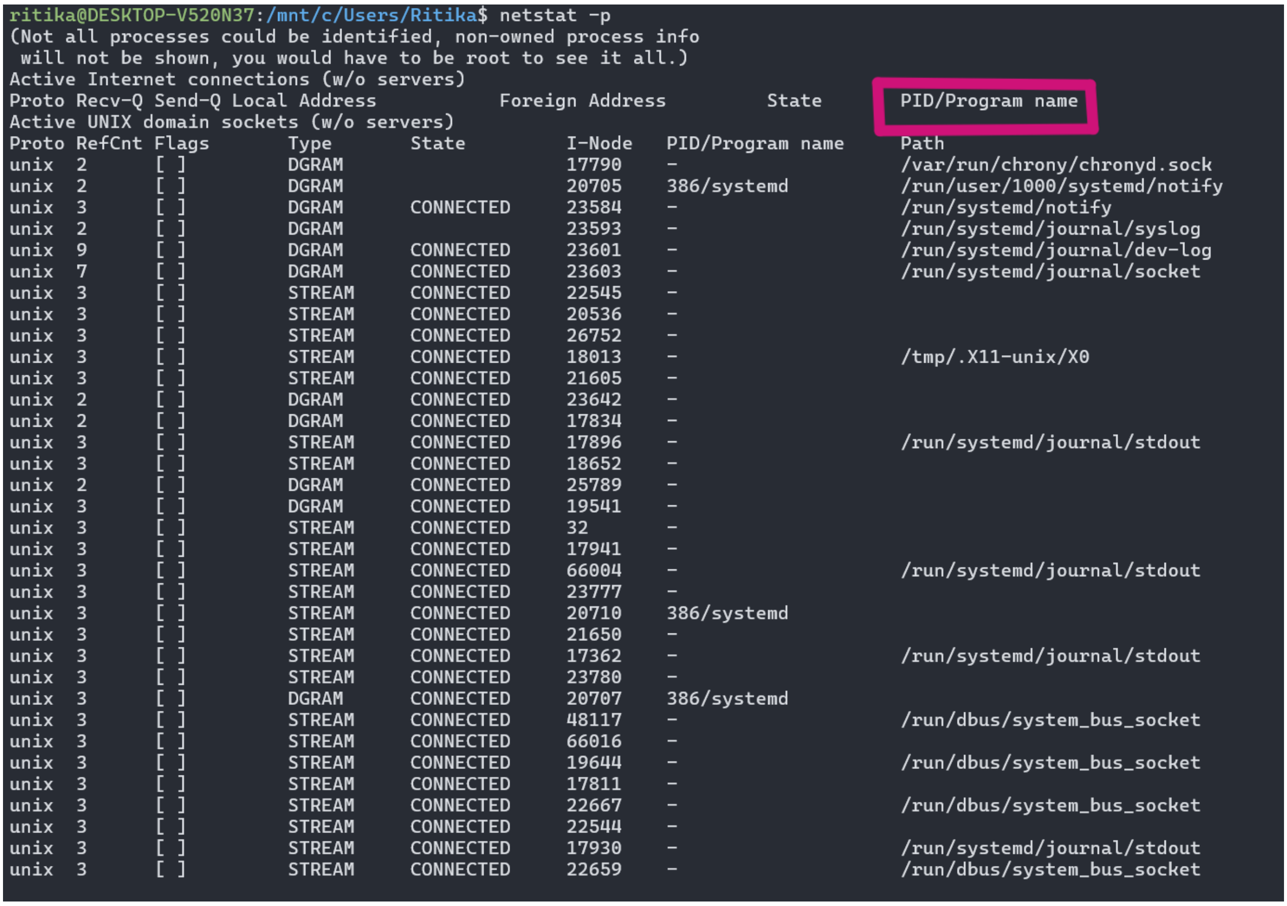
4. Using `netstat -u` to display UDP connections:



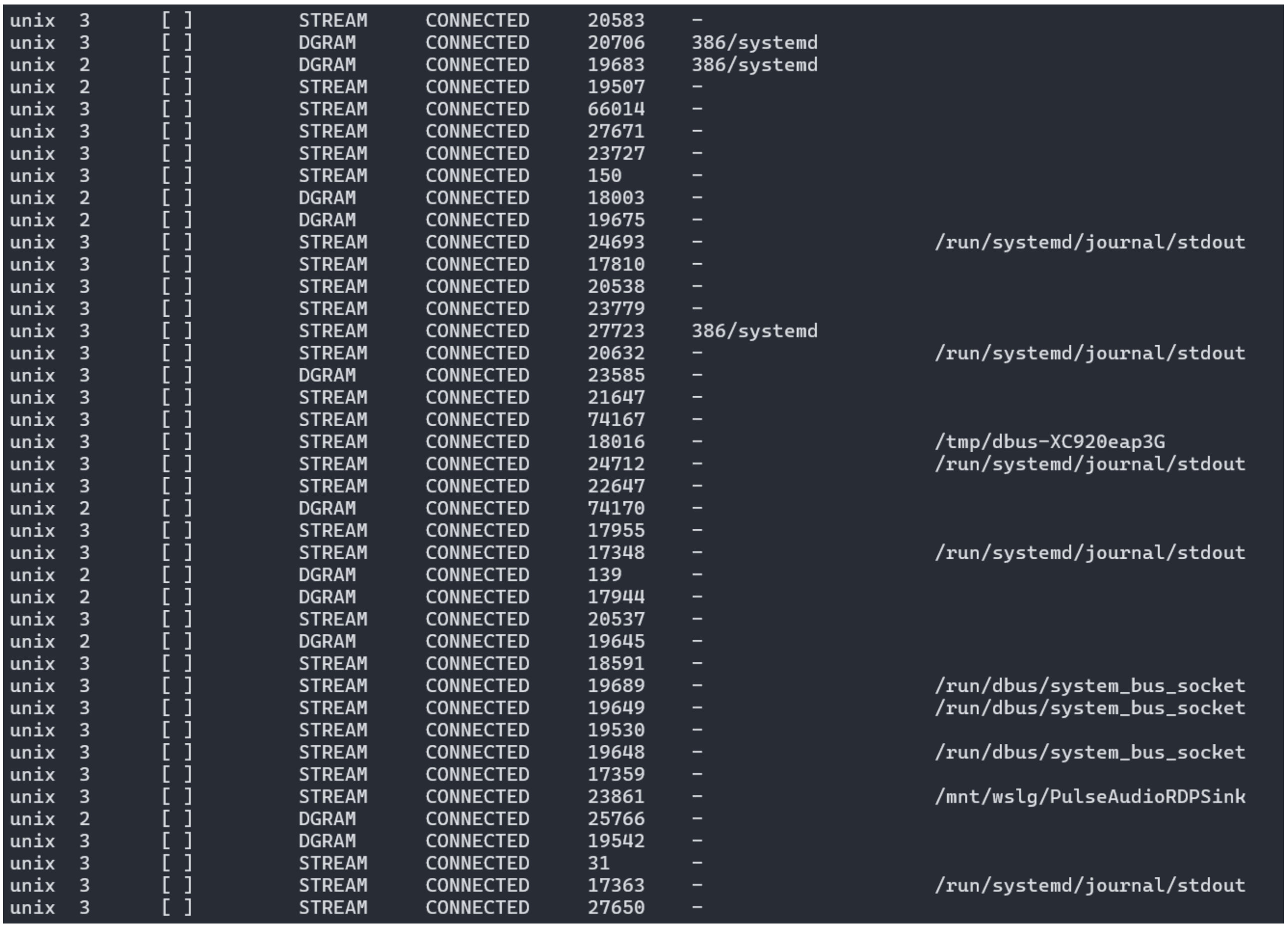
```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -u
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -a -u
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
udp        0      0 127.0.0.53:domain       0.0.0.0:*
udp        0      0 10.255.255.254:domain   0.0.0.0:*
udp        0      0 localhost:323           0.0.0.0:*
udp6       0      0 ip6-localhost:323       [::]:*
```

Similar to the TCP table, there are no active connections in the UDP table but listening ports are available.

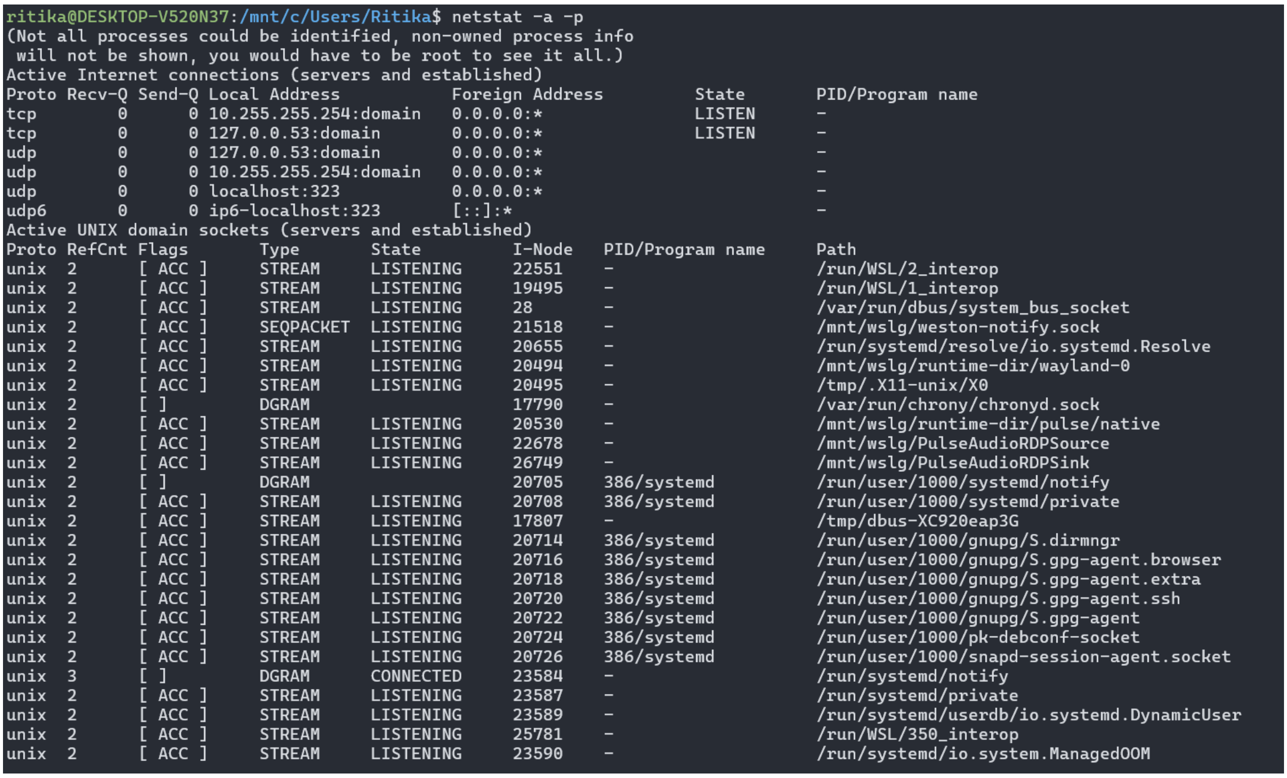
5. Using `netstat -p` to display the process ID of the connections:



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -p
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
Active UNIX domain sockets (w/o servers)
Proto RefCnt Flags       Type       State         I-Node   PID/Program name     Path
unix  2      [ ]         DGRAM                    17790    -                    /var/run/chrony/chronyd.sock
unix  2      [ ]         DGRAM                    20705    386/systemd          /run/user/1000/systemd/notify
unix  3      [ ]         DGRAM      CONNECTED     23584    -                    /run/systemd/notify
unix  2      [ ]         DGRAM                    23593    -                    /run/systemd/journal/syslog
unix  9      [ ]         DGRAM      CONNECTED     23601    -                    /run/systemd/journal/dev-log
unix  7      [ ]         DGRAM      CONNECTED     23603    -                    /run/systemd/journal/socket
unix  3      [ ]         STREAM     CONNECTED     22545    -
unix  3      [ ]         STREAM     CONNECTED     20536    -
unix  3      [ ]         STREAM     CONNECTED     26752    -
unix  3      [ ]         STREAM     CONNECTED     18013    -                    /tmp/.X11-unix/X0
unix  3      [ ]         STREAM     CONNECTED     21605    -
unix  2      [ ]         DGRAM      CONNECTED     23642    -
unix  2      [ ]         DGRAM      CONNECTED     17834    -
unix  3      [ ]         STREAM     CONNECTED     17896    -                    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     18652    -
unix  2      [ ]         DGRAM      CONNECTED     25789    -
unix  3      [ ]         DGRAM      CONNECTED     19541    -
unix  3      [ ]         STREAM     CONNECTED     32       -
unix  3      [ ]         STREAM     CONNECTED     17941    -
unix  3      [ ]         STREAM     CONNECTED     66004    -                    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     23777    -
unix  3      [ ]         STREAM     CONNECTED     20710    386/systemd
unix  3      [ ]         STREAM     CONNECTED     21650    -
unix  3      [ ]         STREAM     CONNECTED     17362    -                    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     23780    -
unix  3      [ ]         DGRAM      CONNECTED     20707    386/systemd
unix  3      [ ]         STREAM     CONNECTED     48117    -                    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     66016    -
unix  3      [ ]         STREAM     CONNECTED     19644    -                    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     17811    -
unix  3      [ ]         STREAM     CONNECTED     22667    -                    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     22544    -
unix  3      [ ]         STREAM     CONNECTED     17930    -                    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     22659    -                    /run/dbus/system_bus_socket
```

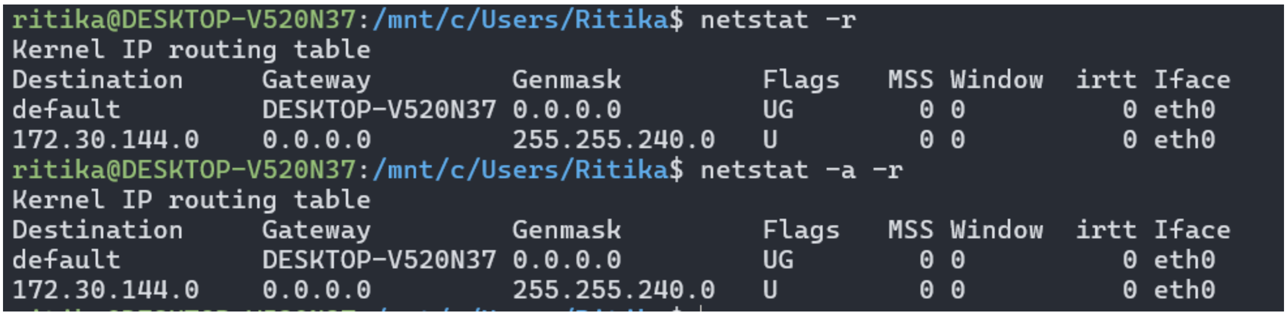


```
unix  3      [ ]         STREAM     CONNECTED     20583    -
unix  3      [ ]         DGRAM      CONNECTED     20706    386/systemd
unix  2      [ ]         DGRAM      CONNECTED     19683    386/systemd
unix  2      [ ]         STREAM     CONNECTED     19507    -
unix  3      [ ]         STREAM     CONNECTED     66014    -
unix  3      [ ]         STREAM     CONNECTED     27671    -
unix  3      [ ]         STREAM     CONNECTED     23727    -
unix  3      [ ]         STREAM     CONNECTED     150      -
unix  2      [ ]         DGRAM      CONNECTED     18003    -
unix  2      [ ]         DGRAM      CONNECTED     19675    -
unix  3      [ ]         STREAM     CONNECTED     24693    -                    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     17810    -
unix  3      [ ]         STREAM     CONNECTED     20538    -
unix  3      [ ]         STREAM     CONNECTED     23779    -
unix  3      [ ]         STREAM     CONNECTED     27723    386/systemd
unix  3      [ ]         STREAM     CONNECTED     20632    -                    /run/systemd/journal/stdout
unix  3      [ ]         DGRAM      CONNECTED     23585    -
unix  3      [ ]         STREAM     CONNECTED     21647    -
unix  3      [ ]         STREAM     CONNECTED     74167    -
unix  3      [ ]         STREAM     CONNECTED     18016    -                    /tmp/dbus-XC920eap3G
unix  3      [ ]         STREAM     CONNECTED     24712    -                    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     22647    -
unix  2      [ ]         DGRAM      CONNECTED     74170    -
unix  3      [ ]         STREAM     CONNECTED     17955    -
unix  3      [ ]         STREAM     CONNECTED     17348    -                    /run/systemd/journal/stdout
unix  2      [ ]         DGRAM      CONNECTED     139      -
unix  2      [ ]         DGRAM      CONNECTED     17944    -
unix  3      [ ]         STREAM     CONNECTED     20537    -
unix  2      [ ]         DGRAM      CONNECTED     19645    -
unix  3      [ ]         STREAM     CONNECTED     18591    -
unix  3      [ ]         STREAM     CONNECTED     19689    -                    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     19649    -                    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     19530    -
unix  3      [ ]         STREAM     CONNECTED     19648    -                    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     17359    -
unix  3      [ ]         STREAM     CONNECTED     23861    -                    /mnt/wslg/PulseAudioRDPSink
unix  2      [ ]         DGRAM      CONNECTED     25766    -
unix  3      [ ]         DGRAM      CONNECTED     19542    -
unix  3      [ ]         STREAM     CONNECTED     31       -
unix  3      [ ]         STREAM     CONNECTED     17363    -                    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     27650    -
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -a -p
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      0 10.255.255.254:domain   0.0.0.0:*               LISTEN      -
tcp        0      0 127.0.0.53:domain       0.0.0.0:*               LISTEN      -
udp        0      0 127.0.0.53:domain       0.0.0.0:*                           -
udp        0      0 10.255.255.254:domain   0.0.0.0:*                           -
udp        0      0 localhost:323           0.0.0.0:*                           -
udp6       0      0 ip6-localhost:323       [::]:*                              -
Active UNIX domain sockets (servers and established)
Proto RefCnt Flags       Type       State         I-Node   PID/Program name     Path
unix  2      [ ACC ]     STREAM     LISTENING     22551    -                    /run/WSL/2_interop
unix  2      [ ACC ]     STREAM     LISTENING     19495    -                    /run/WSL/1_interop
unix  2      [ ACC ]     STREAM     LISTENING     28       -                    /var/run/dbus/system_bus_socket
unix  2      [ ACC ]     SEQPACKET  LISTENING     21518    -                    /mnt/wslg/weston-notify.sock
unix  2      [ ACC ]     STREAM     LISTENING     20655    -                    /run/systemd/resolve/io.systemd.Resolve
unix  2      [ ACC ]     STREAM     LISTENING     20494    -                    /mnt/wslg/runtime-dir/wayland-0
unix  2      [ ACC ]     STREAM     LISTENING     20495    -                    /tmp/.X11-unix/X0
unix  2      [ ]         DGRAM                    17790    -                    /var/run/chrony/chronyd.sock
unix  2      [ ACC ]     STREAM     LISTENING     20530    -                    /mnt/wslg/runtime-dir/pulse/native
unix  2      [ ACC ]     STREAM     LISTENING     22678    -                    /mnt/wslg/PulseAudioRDPSource
unix  2      [ ACC ]     STREAM     LISTENING     26749    -                    /mnt/wslg/PulseAudioRDPSink
unix  2      [ ]         DGRAM                    20705    386/systemd          /run/user/1000/systemd/notify
unix  2      [ ACC ]     STREAM     LISTENING     20708    386/systemd          /run/user/1000/systemd/private
unix  2      [ ACC ]     STREAM     LISTENING     17807    -                    /tmp/dbus-XC920eap3G
unix  2      [ ACC ]     STREAM     LISTENING     20714    386/systemd          /run/user/1000/gnupg/S.dirmngr
unix  2      [ ACC ]     STREAM     LISTENING     20716    386/systemd          /run/user/1000/gnupg/S.gpg-agent.browser
unix  2      [ ACC ]     STREAM     LISTENING     20718    386/systemd          /run/user/1000/gnupg/S.gpg-agent.extra
unix  2      [ ACC ]     STREAM     LISTENING     20720    386/systemd          /run/user/1000/gnupg/S.gpg-agent.ssh
unix  2      [ ACC ]     STREAM     LISTENING     20722    386/systemd          /run/user/1000/gnupg/S.gpg-agent
unix  2      [ ACC ]     STREAM     LISTENING     20724    386/systemd          /run/user/1000/pk-debconf-socket
unix  2      [ ACC ]     STREAM     LISTENING     20726    386/systemd          /run/user/1000/snapd-session-agent.socket
unix  3      [ ]         DGRAM      CONNECTED     23584    -                    /run/systemd/notify
unix  2      [ ACC ]     STREAM     LISTENING     23587    -                    /run/systemd/private
unix  2      [ ACC ]     STREAM     LISTENING     23589    -                    /run/systemd/userdb/io.systemd.DynamicUser
unix  2      [ ACC ]     STREAM     LISTENING     25781    -                    /run/WSL/350_interop
unix  2      [ ACC ]     STREAM     LISTENING     23590    -                    /run/systemd/io.system.ManagedOOM
```

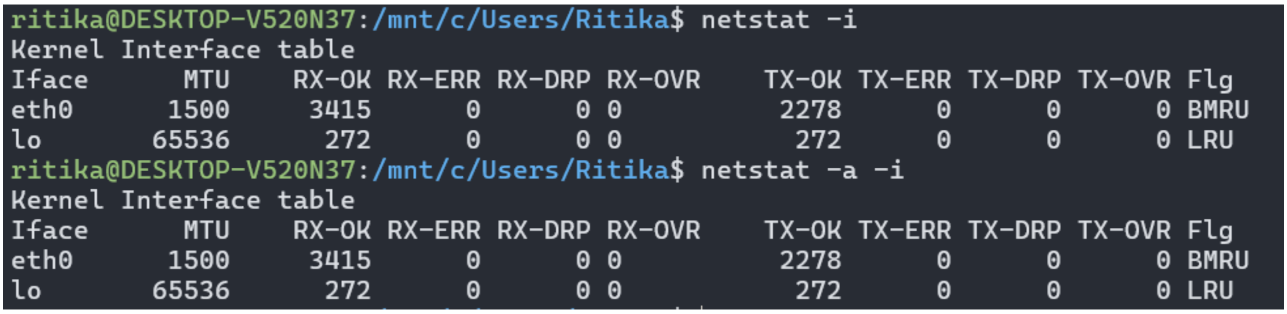
6. Using `netstat -r` to display the kernel routing table:



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -r
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
default         DESKTOP-V520N37 0.0.0.0         UG        0 0          0 eth0
172.30.144.0    0.0.0.0         255.255.240.0   U         0 0          0 eth0
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -a -r
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
default         DESKTOP-V520N37 0.0.0.0         UG        0 0          0 eth0
172.30.144.0    0.0.0.0         255.255.240.0   U         0 0          0 eth0
```

The routing table shows Destination, Gateway, Genmask, Flags, MSS, Window, IRTT and Interface.

7. Using `netstat -i` to display the network interfaces:

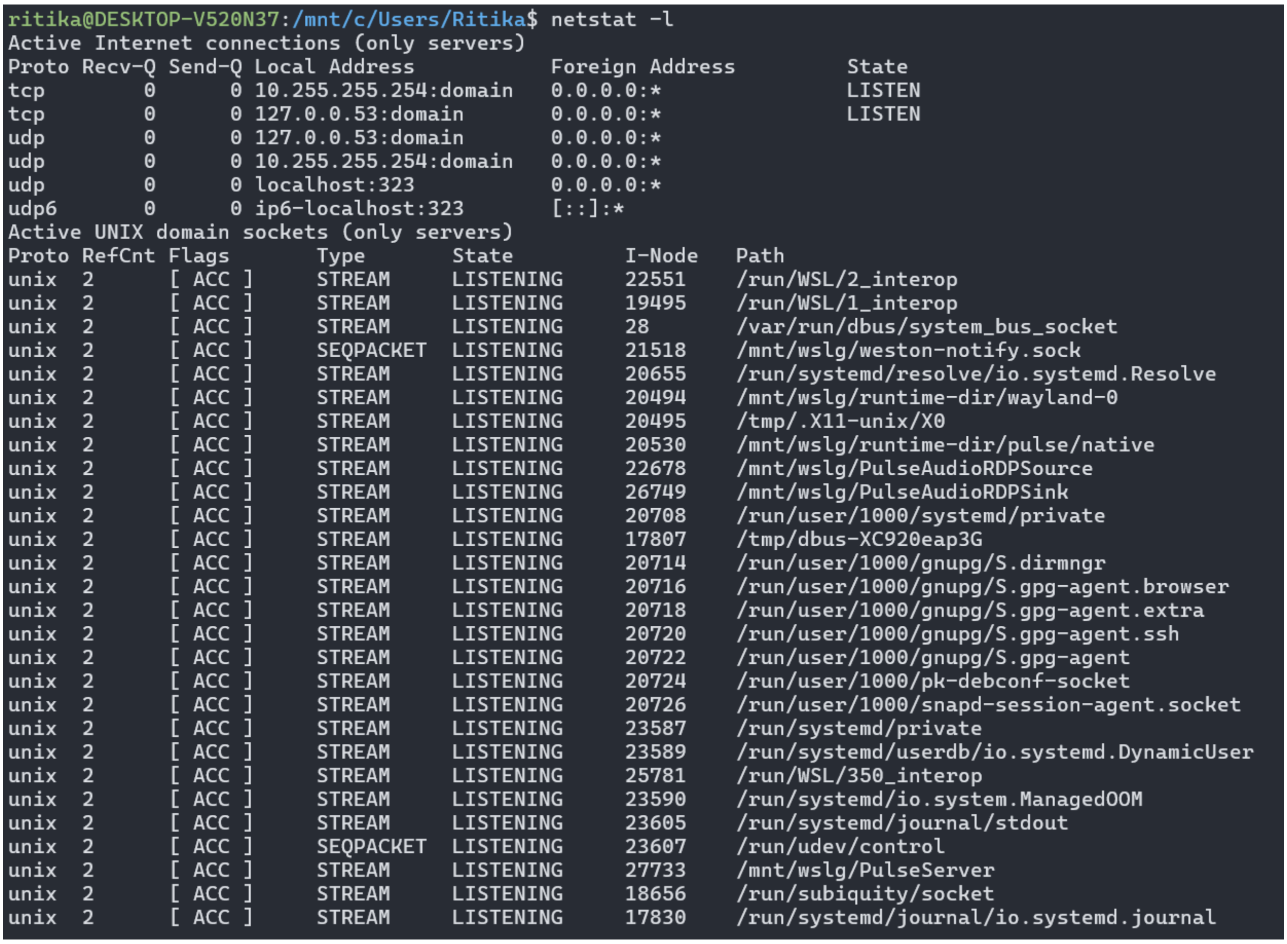


```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -i
Kernel Interface table
Iface      MTU    RX-OK RX-ERR RX-DRP RX-OVR    TX-OK TX-ERR TX-DRP TX-OVR Flg
eth0      1500     3415      0      0 0          2278      0      0      0 BMRU
lo       65536      272      0      0 0           272      0      0      0 LRU
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -a -i
Kernel Interface table
Iface      MTU    RX-OK RX-ERR RX-DRP RX-OVR    TX-OK TX-ERR TX-DRP TX-OVR Flg
eth0      1500     3415      0      0 0          2278      0      0      0 BMRU
lo       65536      272      0      0 0           272      0      0      0 LRU
```

The network interfaces table shows Kernel Interface, MTU, Met, RX-OK, RX-ERR, RX-DRP, RX-OVR, TX-OK, TX-ERR, TX-DRP, TX-OVR and Flags. What this means:

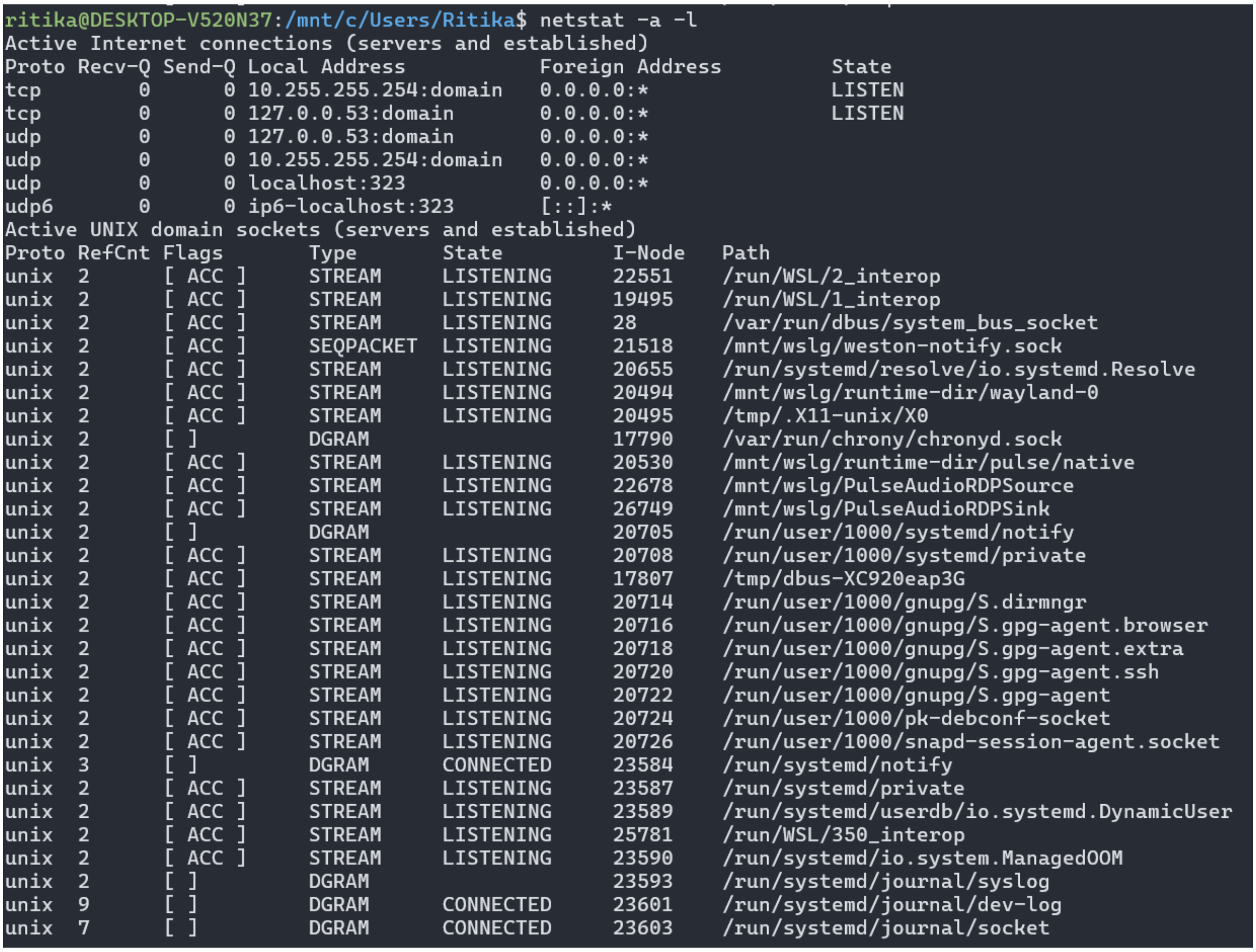
- `RX-OK` is the number of packets received without errors.
- `RX-ERR` is the number of packets received with errors.
- `RX-DRP` is the number of packets dropped.
- `RX-OVR` is the number of packets received but the buffer was full.
- `TX-OK` is the number of packets transmitted without errors.
- `TX-ERR` is the number of packets transmitted with errors.
- `TX-DRP` is the number of packets dropped.
- `TX-OVR` is the number of packets transmitted but the buffer was full.

8. Using `netstat -l` to display only listening ports:

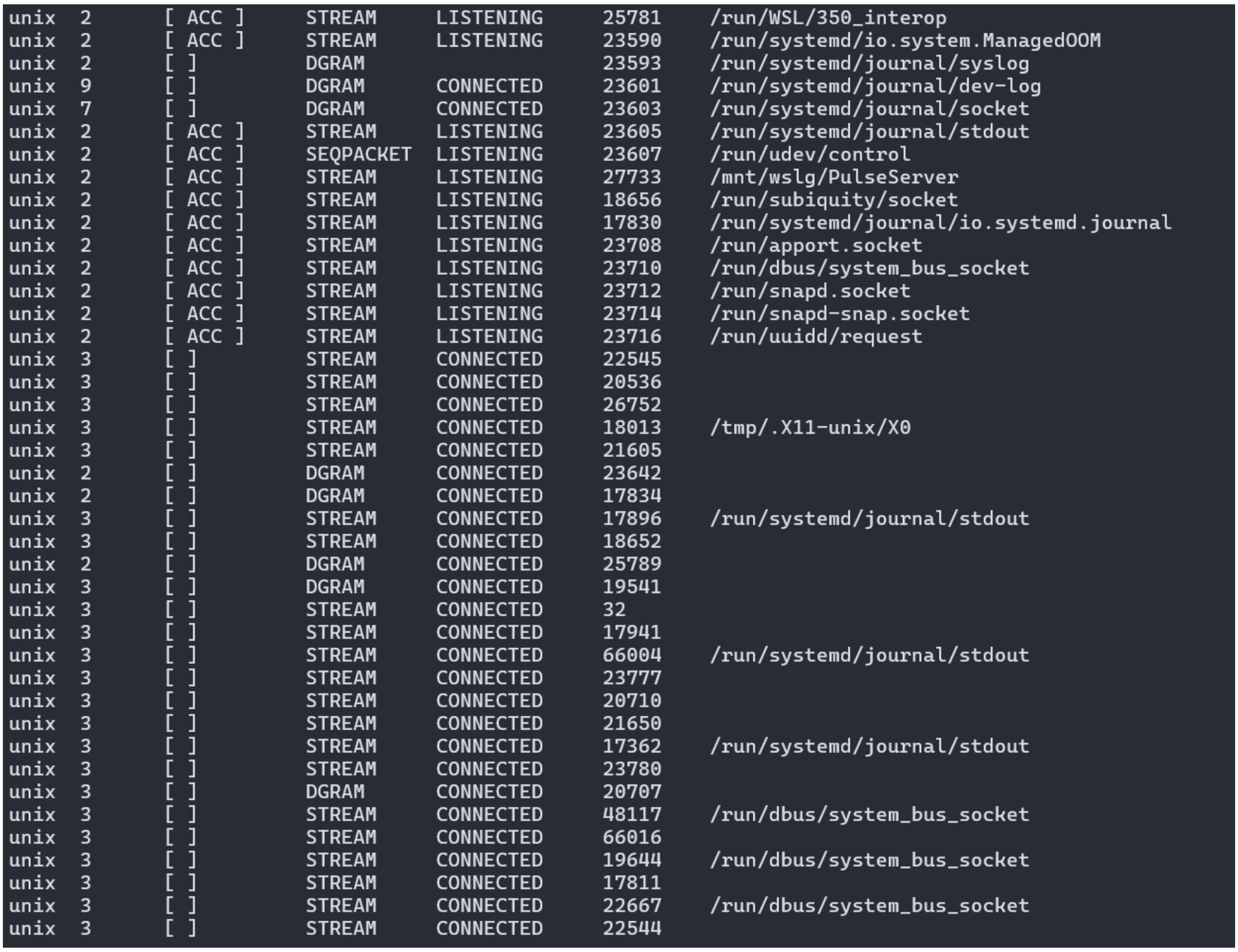


```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -l
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 10.255.255.254:domain   0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.53:domain       0.0.0.0:*               LISTEN
udp        0      0 127.0.0.53:domain       0.0.0.0:*
udp        0      0 10.255.255.254:domain   0.0.0.0:*
udp        0      0 localhost:323           0.0.0.0:*
udp6       0      0 ip6-localhost:323       [::]:*
Active UNIX domain sockets (only servers)
Proto RefCnt Flags       Type       State         I-Node   Path
unix  2      [ ACC ]     STREAM     LISTENING     22551    /run/WSL/2_interop
unix  2      [ ACC ]     STREAM     LISTENING     19495    /run/WSL/1_interop
unix  2      [ ACC ]     STREAM     LISTENING     28       /var/run/dbus/system_bus_socket
unix  2      [ ACC ]     SEQPACKET  LISTENING     21518    /mnt/wslg/weston-notify.sock
unix  2      [ ACC ]     STREAM     LISTENING     20655    /run/systemd/resolve/io.systemd.Resolve
unix  2      [ ACC ]     STREAM     LISTENING     20494    /mnt/wslg/runtime-dir/wayland-0
unix  2      [ ACC ]     STREAM     LISTENING     20495    /tmp/.X11-unix/X0
unix  2      [ ACC ]     STREAM     LISTENING     20530    /mnt/wslg/runtime-dir/pulse/native
unix  2      [ ACC ]     STREAM     LISTENING     22678    /mnt/wslg/PulseAudioRDPSource
unix  2      [ ACC ]     STREAM     LISTENING     26749    /mnt/wslg/PulseAudioRDPSink
unix  2      [ ACC ]     STREAM     LISTENING     20708    /run/user/1000/systemd/private
unix  2      [ ACC ]     STREAM     LISTENING     17807    /tmp/dbus-XC920eap3G
unix  2      [ ACC ]     STREAM     LISTENING     20714    /run/user/1000/gnupg/S.dirmngr
unix  2      [ ACC ]     STREAM     LISTENING     20716    /run/user/1000/gnupg/S.gpg-agent.browser
unix  2      [ ACC ]     STREAM     LISTENING     20718    /run/user/1000/gnupg/S.gpg-agent.extra
unix  2      [ ACC ]     STREAM     LISTENING     20720    /run/user/1000/gnupg/S.gpg-agent.ssh
unix  2      [ ACC ]     STREAM     LISTENING     20722    /run/user/1000/gnupg/S.gpg-agent
unix  2      [ ACC ]     STREAM     LISTENING     20724    /run/user/1000/pk-debconf-socket
unix  2      [ ACC ]     STREAM     LISTENING     20726    /run/user/1000/snapd-session-agent.socket
unix  2      [ ACC ]     STREAM     LISTENING     23587    /run/systemd/private
unix  2      [ ACC ]     STREAM     LISTENING     23589    /run/systemd/userdb/io.systemd.DynamicUser
unix  2      [ ACC ]     STREAM     LISTENING     25781    /run/WSL/350_interop
unix  2      [ ACC ]     STREAM     LISTENING     23590    /run/systemd/io.system.ManagedOOM
unix  2      [ ACC ]     STREAM     LISTENING     23605    /run/systemd/journal/stdout
unix  2      [ ACC ]     SEQPACKET  LISTENING     23607    /run/udev/control
unix  2      [ ACC ]     STREAM     LISTENING     27733    /mnt/wslg/PulseServer
unix  2      [ ACC ]     STREAM     LISTENING     18656    /run/subiquity/socket
unix  2      [ ACC ]     STREAM     LISTENING     17830    /run/systemd/journal/io.systemd.journal
```

However, using `netstat -a -l` displays all connections and listening ports.



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ netstat -a -l
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 10.255.255.254:domain   0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.53:domain       0.0.0.0:*               LISTEN
udp        0      0 127.0.0.53:domain       0.0.0.0:*
udp        0      0 10.255.255.254:domain   0.0.0.0:*
udp        0      0 localhost:323           0.0.0.0:*
udp6       0      0 ip6-localhost:323       [::]:*
Active UNIX domain sockets (servers and established)
Proto RefCnt Flags       Type       State         I-Node   Path
unix  2      [ ACC ]     STREAM     LISTENING     22551    /run/WSL/2_interop
unix  2      [ ACC ]     STREAM     LISTENING     19495    /run/WSL/1_interop
unix  2      [ ACC ]     STREAM     LISTENING     28       /var/run/dbus/system_bus_socket
unix  2      [ ACC ]     SEQPACKET  LISTENING     21518    /mnt/wslg/weston-notify.sock
unix  2      [ ACC ]     STREAM     LISTENING     20655    /run/systemd/resolve/io.systemd.Resolve
unix  2      [ ACC ]     STREAM     LISTENING     20494    /mnt/wslg/runtime-dir/wayland-0
unix  2      [ ACC ]     STREAM     LISTENING     20495    /tmp/.X11-unix/X0
unix  2      [ ]         DGRAM                    17790    /var/run/chrony/chronyd.sock
unix  2      [ ACC ]     STREAM     LISTENING     20530    /mnt/wslg/runtime-dir/pulse/native
unix  2      [ ACC ]     STREAM     LISTENING     22678    /mnt/wslg/PulseAudioRDPSource
unix  2      [ ACC ]     STREAM     LISTENING     26749    /mnt/wslg/PulseAudioRDPSink
unix  2      [ ]         DGRAM                    20705    /run/user/1000/systemd/notify
unix  2      [ ACC ]     STREAM     LISTENING     20708    /run/user/1000/systemd/private
unix  2      [ ACC ]     STREAM     LISTENING     17807    /tmp/dbus-XC920eap3G
unix  2      [ ACC ]     STREAM     LISTENING     20714    /run/user/1000/gnupg/S.dirmngr
unix  2      [ ACC ]     STREAM     LISTENING     20716    /run/user/1000/gnupg/S.gpg-agent.browser
unix  2      [ ACC ]     STREAM     LISTENING     20718    /run/user/1000/gnupg/S.gpg-agent.extra
unix  2      [ ACC ]     STREAM     LISTENING     20720    /run/user/1000/gnupg/S.gpg-agent.ssh
unix  2      [ ACC ]     STREAM     LISTENING     20722    /run/user/1000/gnupg/S.gpg-agent
unix  2      [ ACC ]     STREAM     LISTENING     20724    /run/user/1000/pk-debconf-socket
unix  2      [ ACC ]     STREAM     LISTENING     20726    /run/user/1000/snapd-session-agent.socket
unix  3      [ ]         DGRAM      CONNECTED     23584    /run/systemd/notify
unix  2      [ ACC ]     STREAM     LISTENING     23587    /run/systemd/private
unix  2      [ ACC ]     STREAM     LISTENING     23589    /run/systemd/userdb/io.systemd.DynamicUser
unix  2      [ ACC ]     STREAM     LISTENING     25781    /run/WSL/350_interop
unix  2      [ ACC ]     STREAM     LISTENING     23590    /run/systemd/io.system.ManagedOOM
unix  2      [ ]         DGRAM                    23593    /run/systemd/journal/syslog
unix  9      [ ]         DGRAM      CONNECTED     23601    /run/systemd/journal/dev-log
unix  7      [ ]         DGRAM      CONNECTED     23603    /run/systemd/journal/socket
```

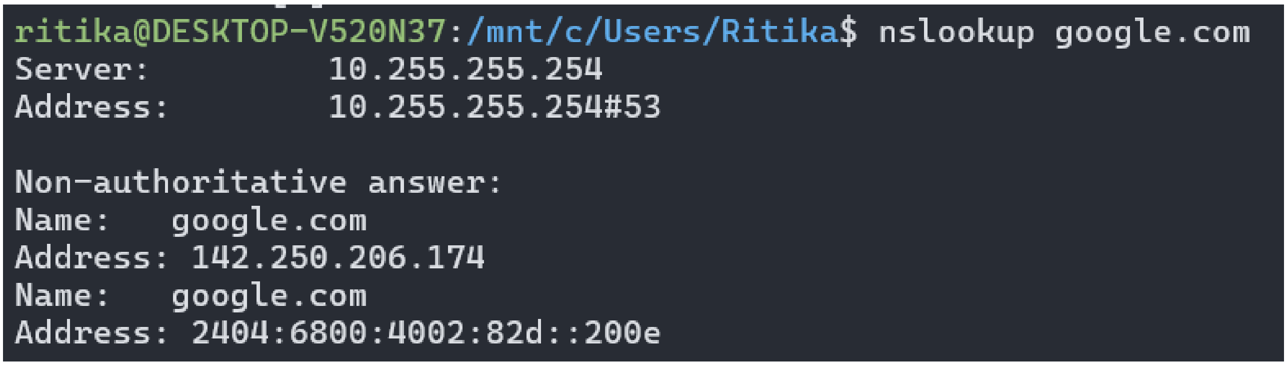


```
unix  2      [ ACC ]     STREAM     LISTENING     25781    /run/WSL/350_interop
unix  2      [ ACC ]     STREAM     LISTENING     23590    /run/systemd/io.system.ManagedOOM
unix  2      [ ]         DGRAM                    23593    /run/systemd/journal/syslog
unix  9      [ ]         DGRAM      CONNECTED     23601    /run/systemd/journal/dev-log
unix  7      [ ]         DGRAM      CONNECTED     23603    /run/systemd/journal/socket
unix  2      [ ACC ]     STREAM     LISTENING     23605    /run/systemd/journal/stdout
unix  2      [ ACC ]     SEQPACKET  LISTENING     23607    /run/udev/control
unix  2      [ ACC ]     STREAM     LISTENING     27733    /mnt/wslg/PulseServer
unix  2      [ ACC ]     STREAM     LISTENING     18656    /run/subiquity/socket
unix  2      [ ACC ]     STREAM     LISTENING     17830    /run/systemd/journal/io.systemd.journal
unix  2      [ ACC ]     STREAM     LISTENING     23708    /run/apport.socket
unix  2      [ ACC ]     STREAM     LISTENING     23710    /run/dbus/system_bus_socket
unix  2      [ ACC ]     STREAM     LISTENING     23712    /run/snapd.socket
unix  2      [ ACC ]     STREAM     LISTENING     23714    /run/snapd-snap.socket
unix  2      [ ACC ]     STREAM     LISTENING     23716    /run/uuidd/request
unix  3      [ ]         STREAM     CONNECTED     22545
unix  3      [ ]         STREAM     CONNECTED     20536
unix  3      [ ]         STREAM     CONNECTED     26752
unix  3      [ ]         STREAM     CONNECTED     18013    /tmp/.X11-unix/X0
unix  3      [ ]         STREAM     CONNECTED     21605
unix  2      [ ]         DGRAM      CONNECTED     23642
unix  2      [ ]         DGRAM      CONNECTED     17834
unix  3      [ ]         STREAM     CONNECTED     17896    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     18652
unix  2      [ ]         DGRAM      CONNECTED     25789
unix  3      [ ]         DGRAM      CONNECTED     19541
unix  3      [ ]         STREAM     CONNECTED     32
unix  3      [ ]         STREAM     CONNECTED     17941
unix  3      [ ]         STREAM     CONNECTED     66004    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     23777
unix  3      [ ]         STREAM     CONNECTED     20710
unix  3      [ ]         STREAM     CONNECTED     21650
unix  3      [ ]         STREAM     CONNECTED     17362    /run/systemd/journal/stdout
unix  3      [ ]         STREAM     CONNECTED     23780
unix  3      [ ]         DGRAM      CONNECTED     20707
unix  3      [ ]         STREAM     CONNECTED     48117    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     66016
unix  3      [ ]         STREAM     CONNECTED     19644    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     17811
unix  3      [ ]         STREAM     CONNECTED     22667    /run/dbus/system_bus_socket
unix  3      [ ]         STREAM     CONNECTED     22544
```

5. `nslookup` command:

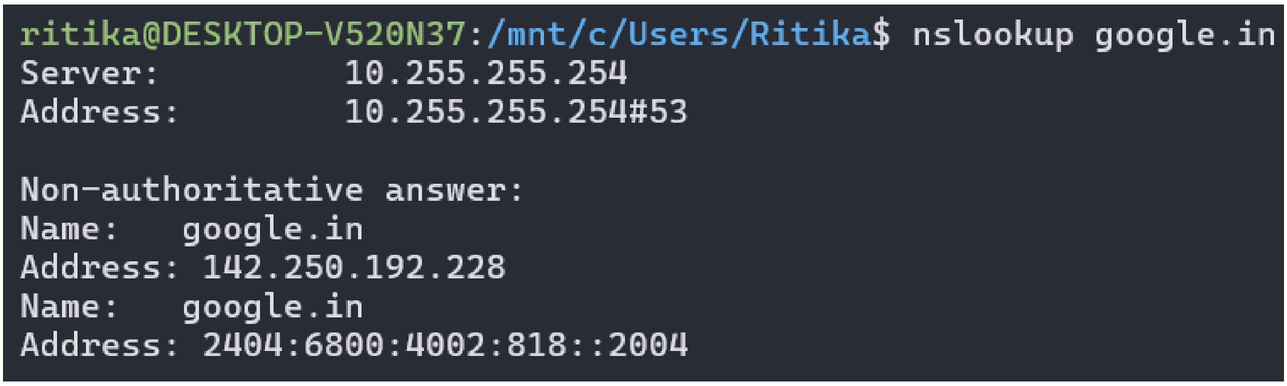
nslookup or Name Server Lookup is used to query the Domain Name System (DNS) to obtain domain name or IP address mapping or other DNS records.

1. Using nslookup to query the IP address of www.google.com:



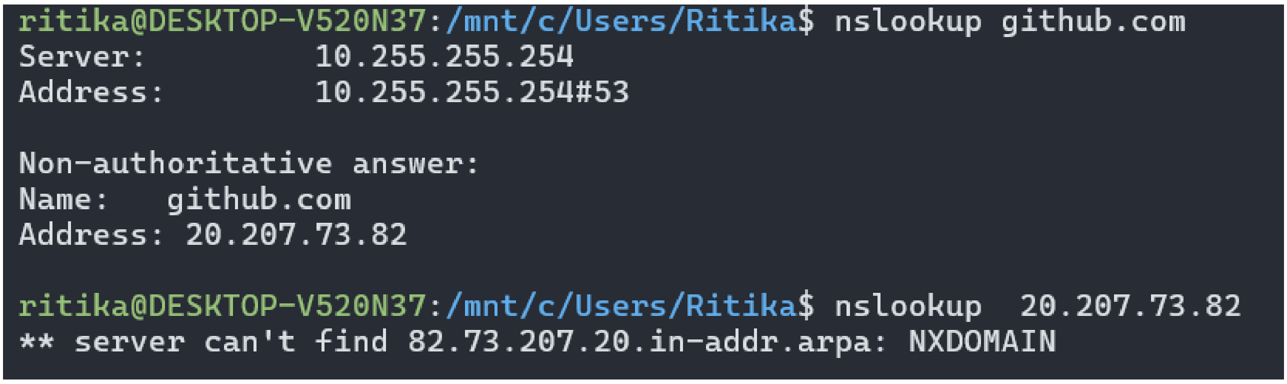
```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nslookup google.com
Server:         10.255.255.254
Address:        10.255.255.254#53

Non-authoritative answer:
Name:   google.com
Address: 142.250.206.174
Name:   google.com
Address: 2404:6800:4002:82d::200e
```

The address changes when we query nslookup for www.google.in.



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nslookup google.in
Server:         10.255.255.254
Address:        10.255.255.254#53

Non-authoritative answer:
Name:   google.in
Address: 142.250.192.228
Name:   google.in
Address: 2404:6800:4002:818::2004
```

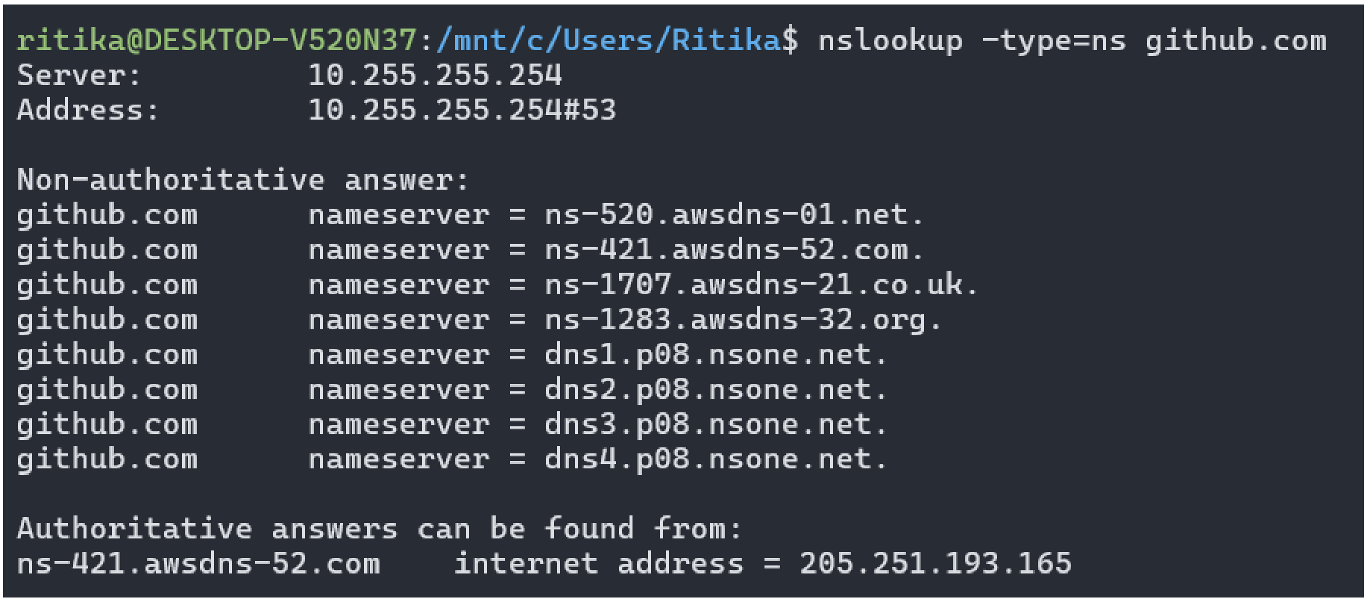
2. Using nslookup to query the domain name of www.github.com:



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nslookup github.com
Server:         10.255.255.254
Address:        10.255.255.254#53

Non-authoritative answer:
Name:   github.com
Address: 20.207.73.82

ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nslookup  20.207.73.82
** server can't find 82.73.207.20.in-addr.arpa: NXDOMAIN
```

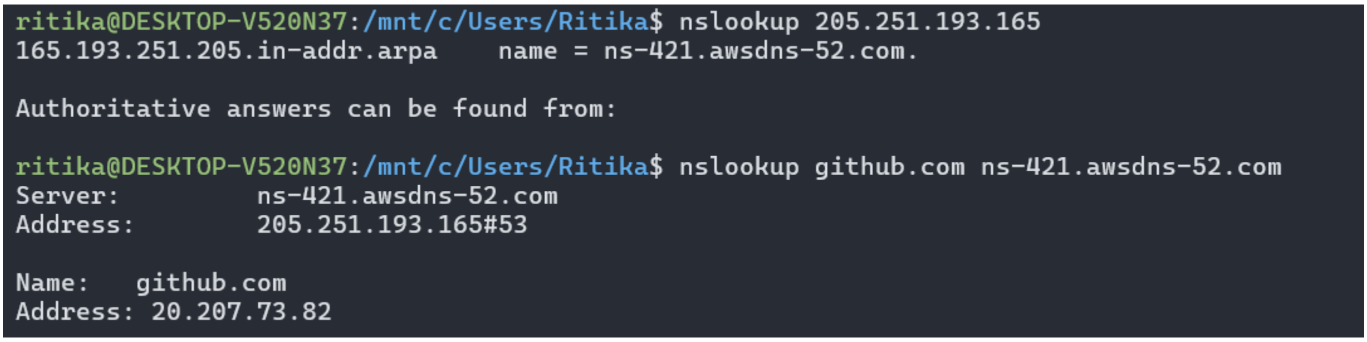
However, doing reverse lookup using the IP address of www.github.com does not give the domain name. So, we try to get an authoritative answer using the command

```
nslookup -type=ns <host>
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nslookup -type=ns github.com
Server:         10.255.255.254
Address:        10.255.255.254#53

Non-authoritative answer:
github.com      nameserver = ns-520.awsdns-01.net.
github.com      nameserver = ns-421.awsdns-52.com.
github.com      nameserver = ns-1707.awsdns-21.co.uk.
github.com      nameserver = ns-1283.awsdns-32.org.
github.com      nameserver = dns1.p08.nsone.net.
github.com      nameserver = dns2.p08.nsone.net.
github.com      nameserver = dns3.p08.nsone.net.
github.com      nameserver = dns4.p08.nsone.net.

Authoritative answers can be found from:
ns-421.awsdns-52.com    internet address = 205.251.193.165
```

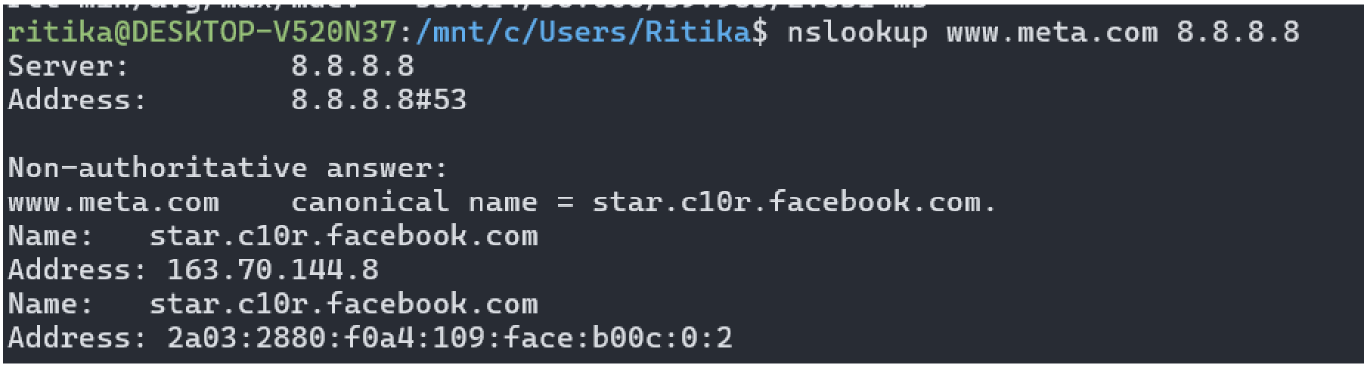
Now, doing reverse lookup directly on the address still gives no answer. But doing the same using the address name successfully gives the domain name.



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nslookup 205.251.193.165
165.193.251.205.in-addr.arpa    name = ns-421.awsdns-52.com.

Authoritative answers can be found from:

ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nslookup github.com ns-421.awsdns-52.com
Server:         ns-421.awsdns-52.com
Address:        205.251.193.165#53

Name:   github.com
Address: 20.207.73.82
```

3. We can also query a specific DNS server using the command

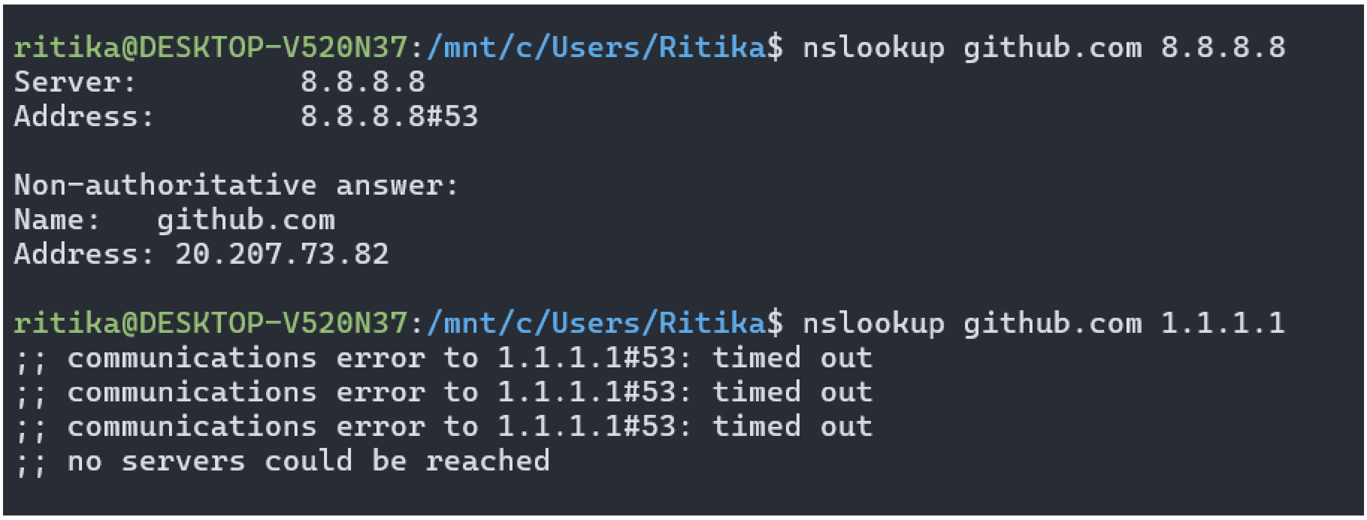
```
nslookup <host> <dns_server>
```



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nslookup www.meta.com 8.8.8.8
Server:         8.8.8.8
Address:        8.8.8.8#53

Non-authoritative answer:
www.meta.com    canonical name = star.c10r.facebook.com.
Name:   star.c10r.facebook.com
Address: 163.70.144.8
Name:   star.c10r.facebook.com
Address: 2a03:2880:f0a4:109:face:b00c:0:2
```

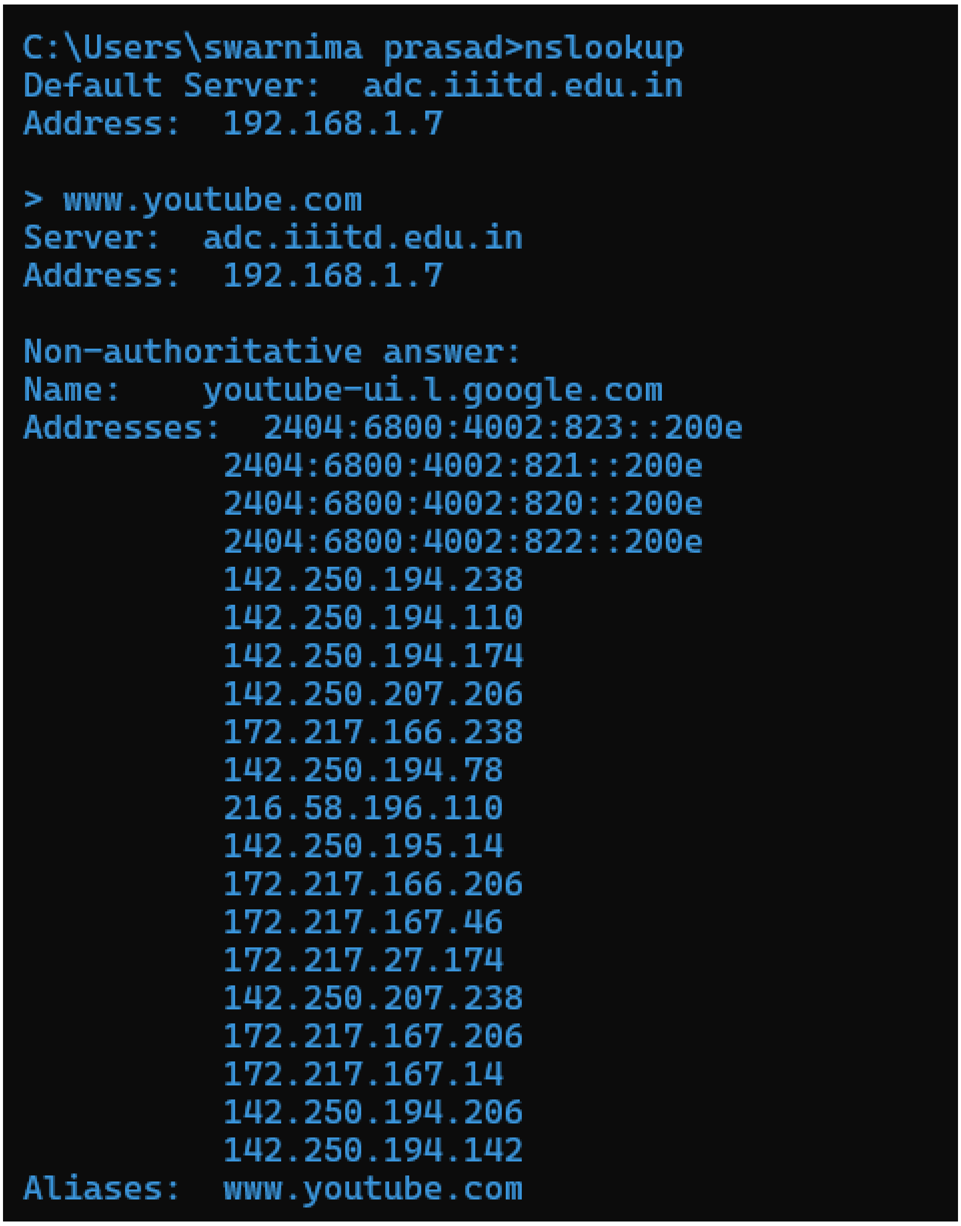
Here we try to query `www.meta.com` using `8.8.8.8` as the DNS server.

Trying to perform a similar query using `1.1.1.1` as the DNS server gives an error because the DNS server is not reachable.



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nslookup github.com 8.8.8.8
Server:         8.8.8.8
Address:        8.8.8.8#53

Non-authoritative answer:
Name:   github.com
Address: 20.207.73.82

ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nslookup github.com 1.1.1.1
;; communications error to 1.1.1.1#53: timed out
;; communications error to 1.1.1.1#53: timed out
;; communications error to 1.1.1.1#53: timed out
;; no servers could be reached
```

Trying nslookup for youtube.com which is a part of google services

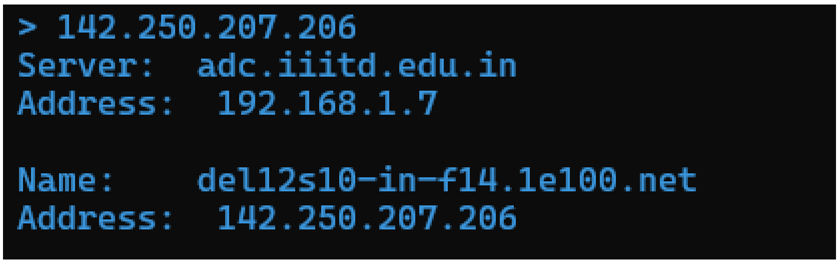


```
C:\Users\swarnima prasad>nslookup
Default Server:  adc.iiitd.edu.in
Address:  192.168.1.7

> www.youtube.com
Server:  adc.iiitd.edu.in
Address:  192.168.1.7

Non-authoritative answer:
Name:    youtube-ui.l.google.com
Addresses:  2404:6800:4002:823::200e
          2404:6800:4002:821::200e
          2404:6800:4002:820::200e
          2404:6800:4002:822::200e
          142.250.194.238
          142.250.194.110
          142.250.194.174
          142.250.207.206
          172.217.166.238
          142.250.194.78
          216.58.196.110
          142.250.195.14
          172.217.166.206
          172.217.167.46
          172.217.27.174
          142.250.207.238
          172.217.167.206
          172.217.167.14
          142.250.194.206
          142.250.194.142
Aliases:  www.youtube.com
```

- DNS server responded with both IPv4 and IPv6 addresses for youtube-ui.l.google.com, which is an alias for www.youtube.com.
- The list of IP addresses provided can be used by your device to connect to YouTube.

- IPv6 Addresses: The addresses starting with 2404
- IPv4 Addresses: The addresses like 142.250.194.238 and 172.217.166.238

Using one of the above IP address given above to get the domain name .



```
> 142.250.207.206
Server:  adc.iiitd.edu.in
Address:  192.168.1.7

Name:    del12s10-in-f14.1e100.net
Address:  142.250.207.206
```

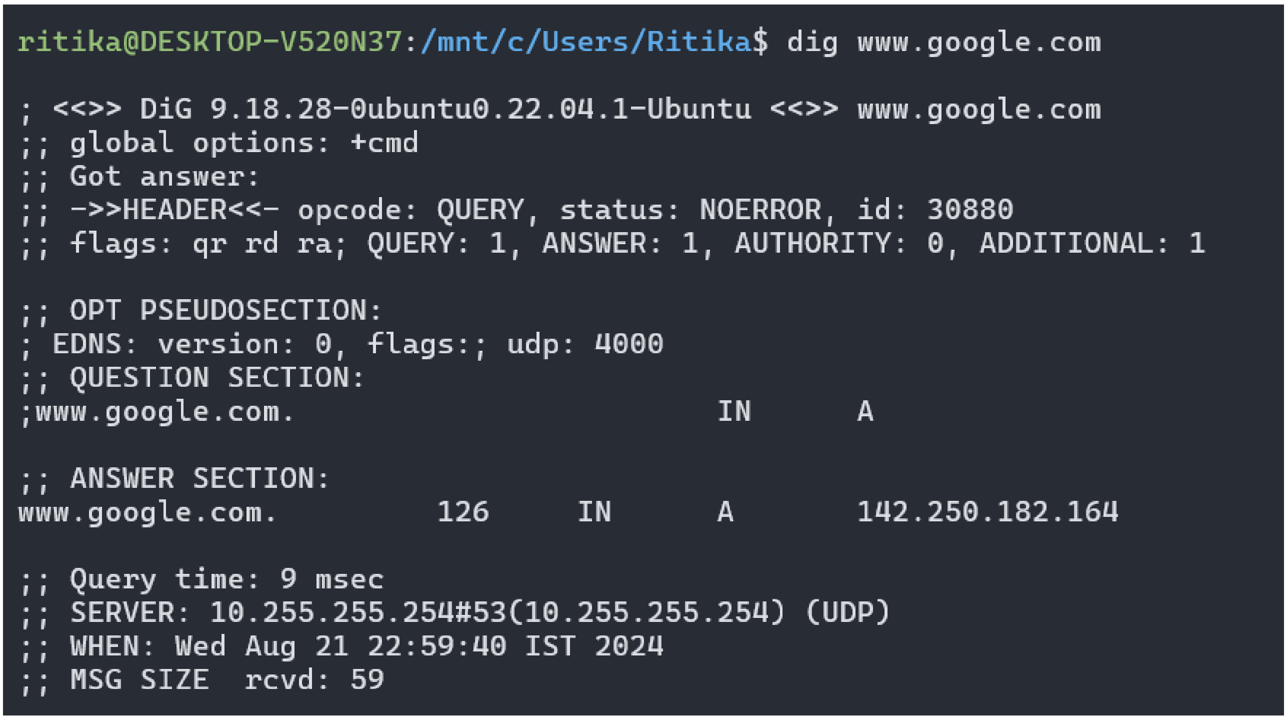
Interesting Observation

It was found that the hostnames `del12s10-in-f14.1e100.net` and `del12s06-in-x0e.1e100.net` do not directly reference `youtube.com`. Instead, they are part of Google's internal infrastructure, often used for various Google services, including YouTube.

6. `dig` command:

`dig` or Domain Information Groper is a network administration command-line tool for querying Domain Name System (DNS) name servers, mostly for troubleshooting DNS problems.

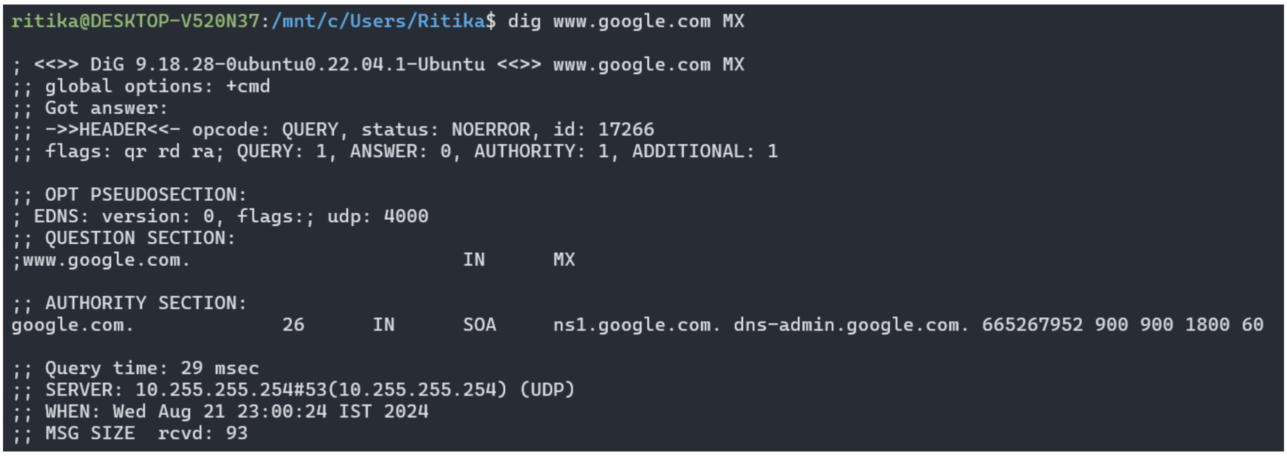
1. Using `dig` to query the IP address of `www.google.com`:



```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ dig www.google.com

; <<>> DiG 9.18.28-0ubuntu0.22.04.1-Ubuntu <<>> www.google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 30880
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4000
;; QUESTION SECTION:
;www.google.com.                        IN      A

;; ANSWER SECTION:
www.google.com.         126     IN      A       142.250.182.164

;; Query time: 9 msec
;; SERVER: 10.255.255.254#53(10.255.255.254) (UDP)
;; WHEN: Wed Aug 21 22:59:40 IST 2024
;; MSG SIZE  rcvd: 59
```

. In the output, we can see the IP address of `www.google.com` and the time taken to query the DNS server, as well as date, message size, flags, query time, server, when the query was received, the answer section, authority section and additional section. Answer section gives the IP address of `www.google.com`. Authority section gives the name servers for `google.com`. Additional section gives the IP address of the name servers.

2. Using `MX` record to query the mail servers of `google.com`:

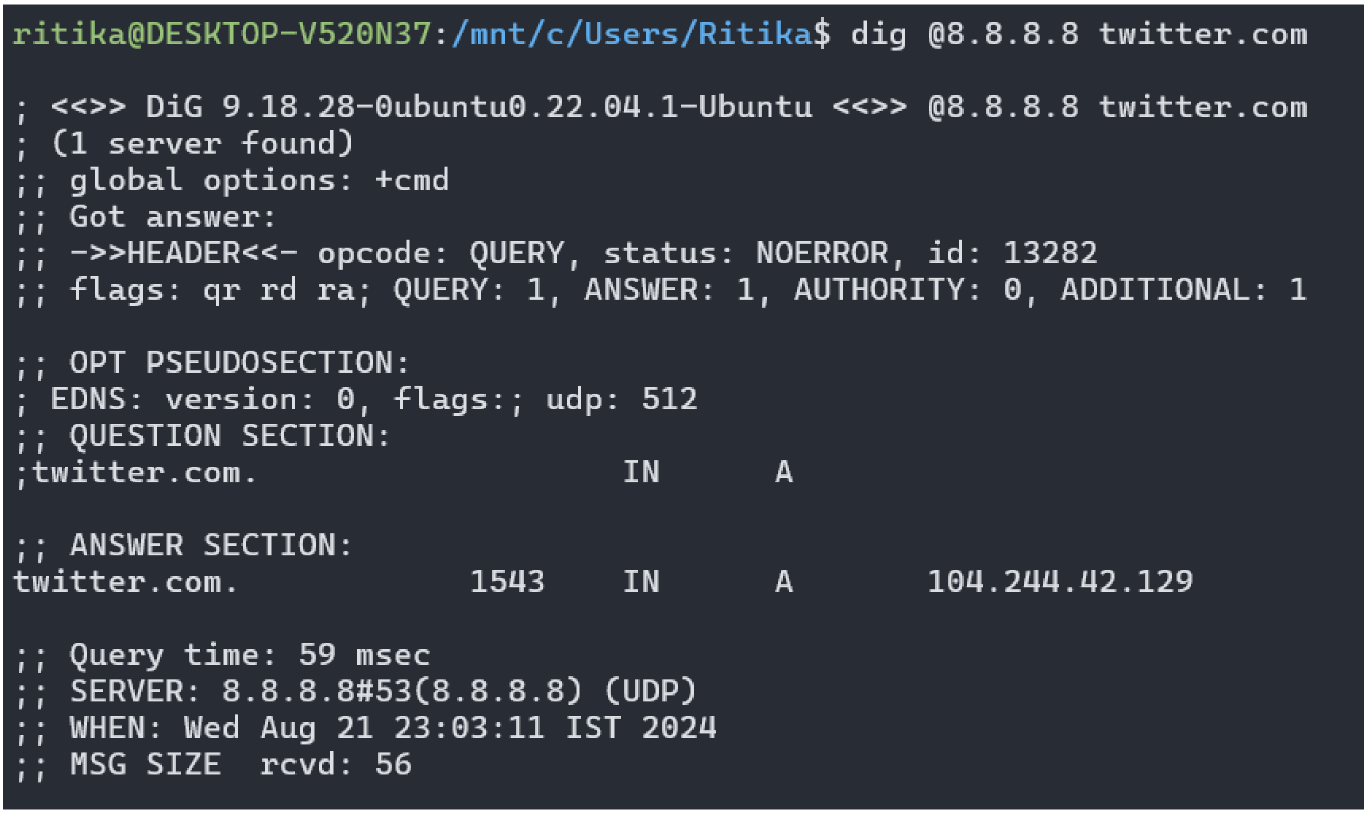


```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ dig www.google.com MX

; <<>> DiG 9.18.28-0ubuntu0.22.04.1-Ubuntu <<>> www.google.com MX
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 17266
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 1, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4000
;; QUESTION SECTION:
;www.google.com.                IN      MX

;; AUTHORITY SECTION:
google.com.             26      IN      SOA     ns1.google.com. dns-admin.google.com. 665267952 900 900 1800 60

;; Query time: 29 msec
;; SERVER: 10.255.255.254#53(10.255.255.254) (UDP)
;; WHEN: Wed Aug 21 23:00:24 IST 2024
;; MSG SIZE  rcvd: 93
```

Mail servers are basically the servers that receive and send emails.

3. We can also query a specific DNS server using the command

```
dig @<dns_server> <host>
```

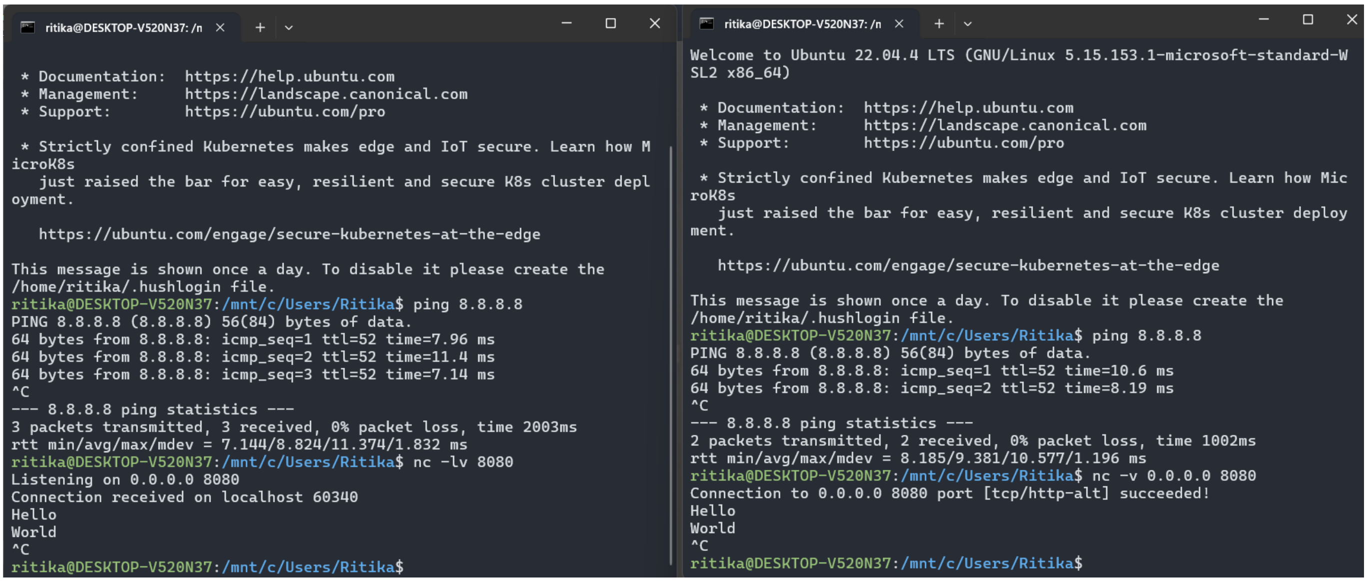


```
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ dig @8.8.8.8 twitter.com

; <<>> DiG 9.18.28-0ubuntu0.22.04.1-Ubuntu <<>> @8.8.8.8 twitter.com
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 13282
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 512
;; QUESTION SECTION:
;twitter.com.                   IN      A

;; ANSWER SECTION:
twitter.com.            1543    IN      A       104.244.42.129

;; Query time: 59 msec
;; SERVER: 8.8.8.8#53(8.8.8.8) (UDP)
;; WHEN: Wed Aug 21 23:03:11 IST 2024
;; MSG SIZE  rcvd: 56
```

This command was used to query `www.twitter.com` using `8.8.8.8` as the DNS server.

7. `netcat` command:

`netcat` is a simple Unix utility that reads and writes data across network connections using the TCP or UDP protocol. It is also known as the TCP/IP swiss army knife. It is like WhatsApp for the command line. Here is a simple example of me establishing a connection between two terminals on my device using `netcat` in a way that whatever is typed in the first terminal is displayed in the second terminal.

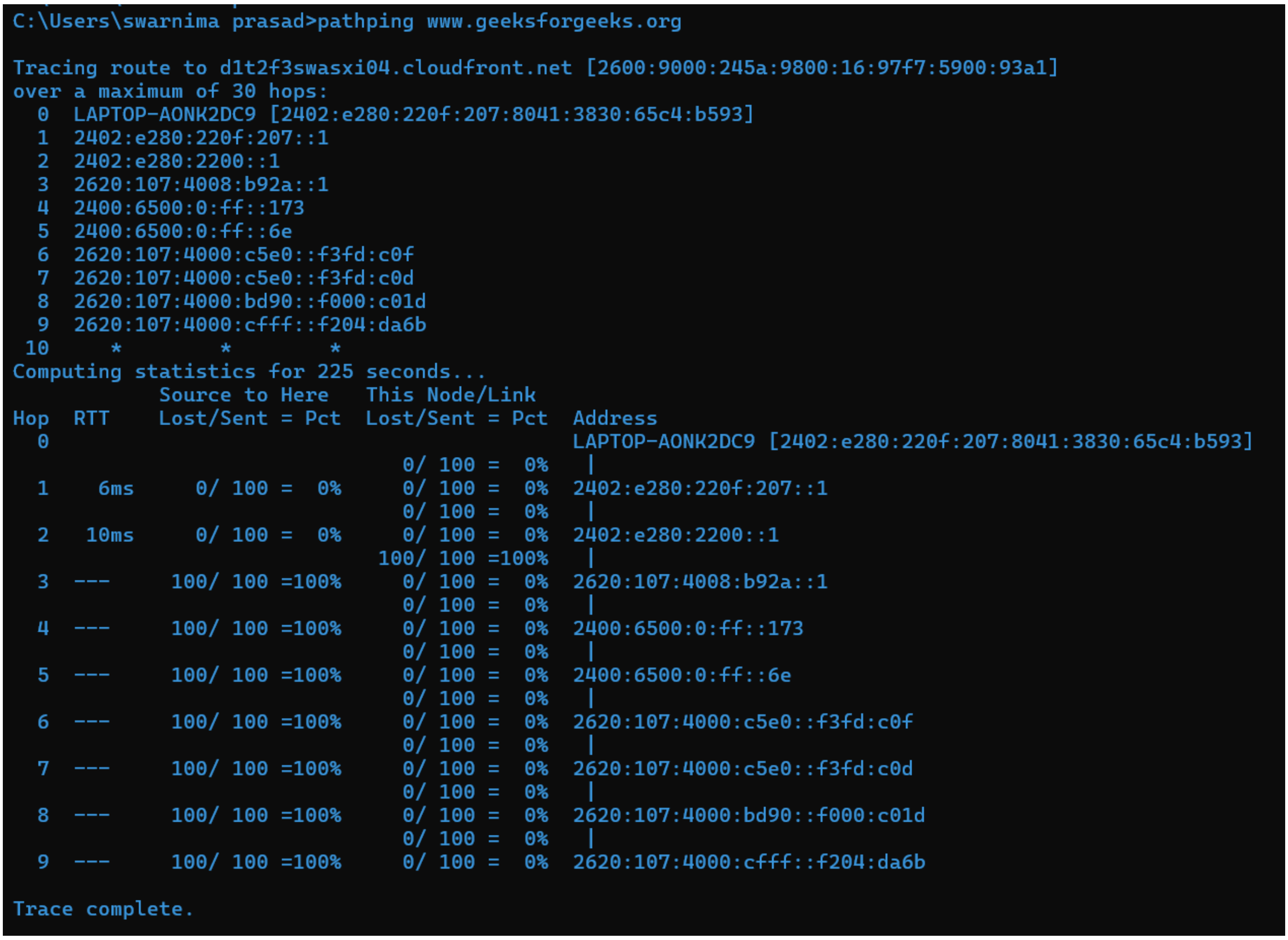


```
 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how M
icroK8s
   just raised the bar for easy, resilient and secure K8s cluster depl
oyment.

   https://ubuntu.com/engage/secure-kubernetes-at-the-edge

This message is shown once a day. To disable it please create the
/home/ritika/.hushlogin file.
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=52 time=7.96 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=52 time=11.4 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=52 time=7.14 ms
^C
--- 8.8.8.8 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 7.144/8.824/11.374/1.832 ms
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nc -lv 8080
Listening on 0.0.0.0 8080
Connection received on localhost 60340
Hello
World
^C
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$
```

```
Welcome to Ubuntu 22.04.4 LTS (GNU/Linux 5.15.153.1-microsoft-standard-W
SL2 x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how Mic
roK8s
   just raised the bar for easy, resilient and secure K8s cluster deploy
ment.

   https://ubuntu.com/engage/secure-kubernetes-at-the-edge

This message is shown once a day. To disable it please create the
/home/ritika/.hushlogin file.
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=52 time=10.6 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=52 time=8.19 ms
^C
--- 8.8.8.8 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1002ms
rtt min/avg/max/mdev = 8.185/9.381/10.577/1.196 ms
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$ nc -v 0.0.0.0 8080
Connection to 0.0.0.0 8080 port [tcp/http-alt] succeeded!
Hello
World
^C
ritika@DESKTOP-V520N37:/mnt/c/Users/Ritika$
```

7. `pathping` command:

Combines the functionality of ping and tracert (traceroute) to test connectivity and analyze the path to a target. Provides detailed information about network latency and packet loss at each hop along the route to the target host.



```
C:\Users\swarnima prasad>pathping www.geeksforgeeks.org

Tracing route to d1t2f3swasxi04.cloudfront.net [2600:9000:245a:9800:16:97f7:5900:93a1]
over a maximum of 30 hops:
  0  LAPTOP-AONK2DC9 [2402:e280:220f:207:8041:3830:65c4:b593]
  1  2402:e280:220f:207::1
  2  2402:e280:2200::1
  3  2620:107:4008:b92a::1
  4  2400:6500:0:ff::173
  5  2400:6500:0:ff::6e
  6  2620:107:4000:c5e0::f3fd:c0f
  7  2620:107:4000:c5e0::f3fd:c0d
  8  2620:107:4000:bd90::f000:c01d
  9  2620:107:4000:cfff::f204:da6b
 10     *        *        *
Computing statistics for 225 seconds...
            Source to Here   This Node/Link
Hop  RTT    Lost/Sent = Pct  Lost/Sent = Pct  Address
  0                                           LAPTOP-AONK2DC9 [2402:e280:220f:207:8041:3830:65c4:b593]
                                0/ 100 =  0%   |
  1    6ms     0/ 100 =  0%     0/ 100 =  0%  2402:e280:220f:207::1
                                0/ 100 =  0%   |
  2   10ms     0/ 100 =  0%     0/ 100 =  0%  2402:e280:2200::1
                              100/ 100 =100%   |
  3  ---      100/ 100 =100%     0/ 100 =  0%  2620:107:4008:b92a::1
                                0/ 100 =  0%   |
  4  ---      100/ 100 =100%     0/ 100 =  0%  2400:6500:0:ff::173
                                0/ 100 =  0%   |
  5  ---      100/ 100 =100%     0/ 100 =  0%  2400:6500:0:ff::6e
                                0/ 100 =  0%   |
  6  ---      100/ 100 =100%     0/ 100 =  0%  2620:107:4000:c5e0::f3fd:c0f
                                0/ 100 =  0%   |
  7  ---      100/ 100 =100%     0/ 100 =  0%  2620:107:4000:c5e0::f3fd:c0d
                                0/ 100 =  0%   |
  8  ---      100/ 100 =100%     0/ 100 =  0%  2620:107:4000:bd90::f000:c01d
                                0/ 100 =  0%   |
  9  ---      100/ 100 =100%     0/ 100 =  0%  2620:107:4000:cfff::f204:da6b

Trace complete.
```

- The command is tracing the route to www.geeksforgeeks.org, which resolves to an IPv6 address 2600:9000:245a:9800:16:97f7:5900:93a1.

- The path traced by pathping shows that your connection starts well but encounters 100% packet loss starting from hop 3 onward.
- The lack of response from hops 3 to 9 likely indicates that the routers are not configured to respond to ping requests (ICMP Echo Requests), which is common in secure networks.

Overall,

we were able to learn about the basic Linux command line utilities and their usage. We also learned how to change the IP address, subnet mask, broadcast address and MTU of a network interface using `ifconfig`. We learned how to check the connectivity between two devices using `ping`, trace the path to a network system using `traceroute`, display network connections, routing tables, interface statistics and masquerade connections using `netstat`, query the Domain Name System (DNS) to obtain domain name or IP address mapping or other DNS records using `nslookup` and `dig` and establish a connection between two terminals using `netcat`.