Practical - 02

Title: - Basic networking commands in Linux

Aim: - To understand and execute basic networking commands in Linux for monitoring, configuring, and troubleshooting network connectivity and interfaces

Description: -

Networking commands in Linux are essential tools that allow users and administrators to:

- View and configure network interfaces
- Test and troubleshoot network connectivity
- Analyze and manage routing tables
- Monitor active connections and open ports
- Resolve DNS names
- Diagnose network issues like latency, packet loss, and unreachable hosts

These commands are widely used for network configuration, diagnostics, and performance monitoring, making them vital for system and network administrators.

Basic Networking Commands

1. **ifconfig**: Configure network interfaces.
2. **ip**: Show/manipulate routing, devices, policy routing, and tunnels.
3. **ping**: Send ICMP ECHO_REQUEST to network hosts.
4. **netstat**: Print network connections, routing tables, interface statistics, masquerade connections, and multicast memberships.
5. **traceroute**: Print the route packets take to a network host.
6. **nslookup**: Query Internet name servers interactively.
7. **dig**: DNS lookup.
8. **route**: Show/manipulate the IP routing table.
9. **arp**: Manipulate the system ARP cache.
10. **hostname**: Show or set the system's host name.
11. **whois**: Whois query program.
12. **curl**: Transfer a URL.
13. **wget**: Retrieve files from the web.

Advanced Networking Commands

1. **ip addr**: Display and modify IP addresses.
2. **ip link**: Display and modify network interfaces.
3. **ip route**: Display and modify the routing table.
4. **ip neigh**: Show/manipulate the neighbor cache.
5. **nmcli**: Command-line client for NetworkManager.
6. **ethtool**: Display or change Ethernet device settings.

7. **ss**: Utility to investigate sockets.
8. **tcpdump**: Command-line packet analyzer.
9. **wireshark**: Network protocol analyzer with a graphical interface.
10. **nmap**: Network exploration tool and security/port scanner.
11. **mtr**: Network diagnostic tool combining the functionality of ping and traceroute.
12. **iwconfig**: Configure wireless network interfaces.
13. **iwlist**: Get more detailed wireless information.
14. **tc**: Traffic control utility.
15. **iftop**: Display bandwidth usage on an interface.
16. **bmon**: Bandwidth monitor and rate estimator.
17. **hping**: TCP/IP packet assembler/analyzer.

Exercises

1	Execute the above given basic and advanced linux networking commands one by one.
Output	(Paste the command and your output here)

ifconfig:

```
student@student-VirtualBox:~$ ifconfig enp0s3
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
        inet6 fe80::b770:2f2a:dc33:5ae3  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:e8:2d:3e  txqueuelen 1000  (Ethernet)
        RX packets 177697  bytes 241152808 (241.1 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 62000  bytes 7714603 (7.7 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

student@student-VirtualBox:~$
```

Ip

```
student@student-VirtualBox:~$ ip route show
default via 10.0.2.2 dev enp0s3 proto dhcp metric 100
10.0.2.0/24 dev enp0s3 proto kernel scope link src 10.0.2.15 metric 100
169.254.0.0/16 dev enp0s3 scope link metric 1000
student@student-VirtualBox:~$
```

Ping:

```
student@student-VirtualBox:~$ ping google.com
PING google.com (142.250.192.110) 56(84) bytes of data.
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=1 ttl=117 ti
me=8.38 ms
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=2 ttl=117 ti
me=8.70 ms
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=3 ttl=117 ti
me=8.20 ms
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=4 ttl=117 ti
me=9.25 ms
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=5 ttl=117 ti
me=7.65 ms
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=6 ttl=117 ti
me=8.24 ms
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=7 ttl=117 ti
me=25.5 ms
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=8 ttl=117 ti
me=36.1 ms
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=9 ttl=117 ti
me=25.6 ms
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=10 ttl=117 t
ime=41.7 ms
64 bytes from bom12s17-in-f14.1e100.net (142.250.192.110): icmp_seq=11 ttl=117 t
ime=50.8 ms
```

Netstat:

```
student@student-VirtualBox:~$ netstat -tuln
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 127.0.0.53:53           0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.1:631           0.0.0.0:*               LISTEN
tcp6       0      0 ::1:631                 :::*                    LISTEN
udp        0      0 0.0.0.0:53885           0.0.0.0:*
udp        0      0 0.0.0.0:50156           0.0.0.0:*
udp        0      0 0.0.0.0:40017           0.0.0.0:*
udp        0      0 0.0.0.0:5353            0.0.0.0:*
udp        0      0 0.0.0.0:59426           0.0.0.0:*
udp        0      0 127.0.0.53:53           0.0.0.0:*
udp        0      0 0.0.0.0:47428           0.0.0.0:*
udp6       0      0 :::33910                :::*
udp6       0      0 :::5353                 :::*
student@student-VirtualBox:~$
```

Traceroute:

```
student@student-VirtualBox:~$ traceroute google.com
traceroute to google.com (142.250.192.110), 64 hops max
  1   10.0.2.2  0.537ms  0.055ms  0.055ms
  2   *  *  *
  3   *  *  *
  4   *  *  *
  5   *  *  *
  6   *  *  *
  7   *  *  *
  8   *  *  *
  9   *  *  *
 10   *  *  *
 11   *  *  *
 12   *  *  *
 13   *  *  *
 14   *  *  *
 15   *  *  *
```

nslookup:

```
student@student-VirtualBox:~$ nslookup google.com
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
Name:   google.com
Address: 142.250.192.110
Name:   google.com
Address: 2404:6800:4009:82a::200e
```

dig:

```
student@student-VirtualBox:~$ dig google.com

; <<>> DiG 9.18.30-0ubuntu0.20.04.2-Ubuntu <<>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 18590
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;google.com.                    IN      A

;; ANSWER SECTION:
google.com.             300     IN      A       142.250.192.110

;; Query time: 67 msec
;; SERVER: 127.0.0.53#53(127.0.0.53) (UDP)
;; WHEN: Tue Apr 15 12:20:58 IST 2025
;; MSG SIZE  rcvd: 55
```

route:

```
student@student-VirtualBox:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         10.0.2.2        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
student@student-VirtualBox:~$
```

```
student@student-VirtualBox:~$ sudo route add default gw 10.0.2.2
```

```
student@student-VirtualBox:~$ ip route
default via 10.0.2.2 dev enp0s3
default via 10.0.2.2 dev enp0s3 proto dhcp metric 100
10.0.2.0/24 dev enp0s3 proto kernel scope link src 10.0.2.15 metric 100
169.254.0.0/16 dev enp0s3 scope link metric 1000
student@student-VirtualBox:~$
```

arp:

```
student@student-VirtualBox:~$ arp -a
_gateway (10.0.2.2) at 52:54:00:12:35:02 [ether] on enp0s3
student@student-VirtualBox:~$
```

hostname:

```
student@student-VirtualBox:~$ hostname
student-VirtualBox
```

whois:

```
student@student-VirtualBox:~$ whois google.com
   Domain Name: GOOGLE.COM
   Registry Domain ID: 2138514_DOMAIN_COM-VRSN
   Registrar WHOIS Server: whois.markmonitor.com
   Registrar URL: http://www.markmonitor.com
   Updated Date: 2019-09-09T15:39:04Z
   Creation Date: 1997-09-15T04:00:00Z
   Registry Expiry Date: 2028-09-14T04:00:00Z
   Registrar: MarkMonitor Inc.
   Registrar IANA ID: 292
   Registrar Abuse Contact Email: abusecomplaints@markmonitor.com
   Registrar Abuse Contact Phone: +1.2086851750
   Domain Status: clientDeleteProhibited https://icann.org/epp#clientDeletePro
hibited
   Domain Status: clientTransferProhibited https://icann.org/epp#clientTransfe
rProhibited
   Domain Status: clientUpdateProhibited https://icann.org/epp#clientUpdatePro
hibited
   Domain Status: serverDeleteProhibited https://icann.org/epp#serverDeletePro
hibited
   Domain Status: serverTransferProhibited https://icann.org/epp#serverTransfe
rProhibited
```

curl:

```
student@student-VirtualBox:~$ curl -I https://example.com
HTTP/2 200
content-type: text/html
etag: "84238dfc8092e5d9c0dac8ef93371a07:1736799080.121134"
last-modified: Mon, 13 Jan 2025 20:11:20 GMT
cache-control: max-age=865
date: Tue, 15 Apr 2025 07:40:45 GMT
alt-svc: h3=":443"; ma=93600,h3-29=":443"; ma=93600,quic=":443"; ma=93600; v="43"

student@student-VirtualBox:~$
```

```
student@student-VirtualBox:~$ curl https://example.com
<!doctype html>
<html>
<head>
    <title>Example Domain</title>

    <meta charset="utf-8" />
    <meta http-equiv="Content-type" content="text/html; charset=utf-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1" />
    <style type="text/css">
    body {
        background-color: #f0f0f2;
        margin: 0;
        padding: 0;
        font-family: -apple-system, system-ui, BlinkMacSystemFont, "Segoe UI", "Open Sans", "Helvetica Neue", Helvetica, Arial, sans
-serif;

    }
    div {
        width: 600px;
        margin: 5em auto;
        padding: 2em;
        background-color: #fdfdff;
        border-radius: 0.5em;
        box-shadow: 2px 3px 7px 2px rgba(0,0,0,0.02);
    }
    a:link, a:visited {
        color: #38488f;
        text-decoration: none;
    }
    @media (max-width: 700px) {
        div {
            margin: 0 auto;
            width: auto;
        }
    }
    </style>
```

wget:

```
student@student-VirtualBox:~$ wget https://example.com/file.zip
--2025-04-15 13:15:47--  https://example.com/file.zip
Resolving example.com (example.com)... 23.215.0.136, 23.215.0.138, 96.7.128.
175, ...
Connecting to example.com (example.com)|23.215.0.136|:443... connected.
HTTP request sent, awaiting response... 404 Not Found
2025-04-15 13:15:48 ERROR 404: Not Found.
```

Advanced Networking Commands

ip addr:

```
student@student-VirtualBox: ~
student@student-VirtualBox:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group defaul
t qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP gr
oup default qlen 1000
    link/ether 08:00:27:e8:2d:3e brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic noprefixroute enp0s3
       valid_lft 85771sec preferred_lft 85771sec
    inet6 fe80::b770:2f2a:dc33:5ae3/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
student@student-VirtualBox:~$
```

ip link:

```
student@student-VirtualBox:~$ ip link show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT
 group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mo
de DEFAULT group default qlen 1000
    link/ether 08:00:27:e8:2d:3e brd ff:ff:ff:ff:ff:ff
student@student-VirtualBox:~$
```

ip neigh:

```
student@student-VirtualBox:~$ ip neigh show
10.0.2.2 dev enp0s3 lladdr 52:54:00:12:35:02 REACHABLE
student@student-VirtualBox:~$
```

nmcli:

```
student@student-VirtualBox:~$ ip neigh show
10.0.2.2 dev enp0s3 lladdr 52:54:00:12:35:02 REACHABLE
student@student-VirtualBox:~$ nmcli device status
DEVICE  TYPE      STATE      CONNECTION
enp0s3  ethernet  connected  Wired connection 1
lo      loopback  unmanaged  --
student@student-VirtualBox:~$
```

ethtool:

```
student@student-VirtualBox:~$ sudo ethtool enp0s3
Settings for enp0s3:
        Supported ports: [ TP ]
        Supported link modes:   10baseT/Half 10baseT/Full
                                100baseT/Half 100baseT/Full
                                1000baseT/Full
        Supported pause frame use: No
        Supports auto-negotiation: Yes
        Supported FEC modes: Not reported
        Advertised link modes:  10baseT/Half 10baseT/Full
                                100baseT/Half 100baseT/Full
                                1000baseT/Full
        Advertised pause frame use: No
        Advertised auto-negotiation: Yes
        Advertised FEC modes: Not reported
        Speed: 1000Mb/s
        Duplex: Full
        Port: Twisted Pair
        PHYAD: 0
        Transceiver: internal
        Auto-negotiation: on
        MDI-X: off (auto)
        Supports Wake-on: umbg
        Wake-on: d
        Current message level: 0x00000007 (7)
                               drv probe link
        Link detected: yes
```

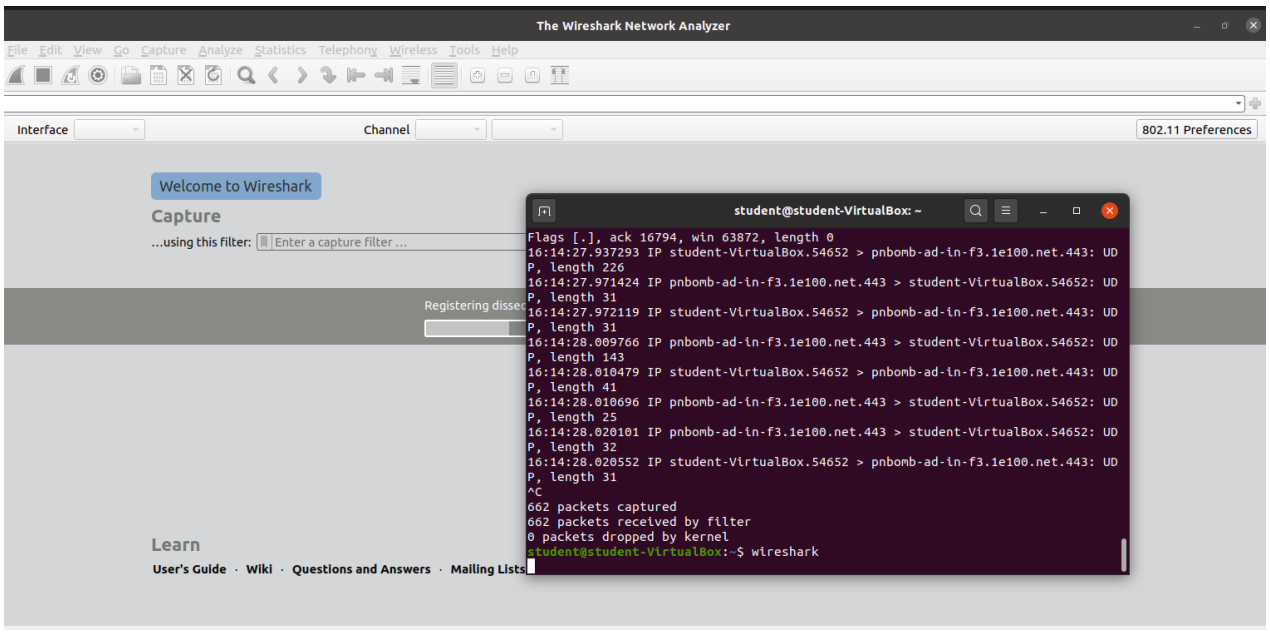
ss:

```
student@student-VirtualBox:~$ ss -tuln
Netid  State    Recv-Q   Send-Q     Local Address:Port     Peer Address:Port Process
udp    UNCONN   0        0                0.0.0.0:38831         0.0.0.0:*
udp    UNCONN   0        0          127.0.0.53%lo:53            0.0.0.0:*
udp    UNCONN   0        0                0.0.0.0:49386         0.0.0.0:*
udp    UNCONN   0        0                0.0.0.0:43372         0.0.0.0:*
udp    UNCONN   0        0                0.0.0.0:55693         0.0.0.0:*
udp    UNCONN   0        0                0.0.0.0:35351         0.0.0.0:*
udp    UNCONN   0        0                0.0.0.0:5353          0.0.0.0:*
udp    UNCONN   0        0                0.0.0.0:48623         0.0.0.0:*
udp    UNCONN   0        0                0.0.0.0:59096         0.0.0.0:*
udp    UNCONN   0        0                   [::]:53409            [::]:*
udp    UNCONN   0        0                   [::]:5353             [::]:*
tcp    LISTEN   0        5              127.0.0.1:631           0.0.0.0:*
tcp    LISTEN   0        4096       127.0.0.53%lo:53            0.0.0.0:*
tcp    LISTEN   0        5                  [::1]:631             [::]:*
student@student-VirtualBox:~$
```

tcpdump:

```
student@student-VirtualBox:~$ sudo tcpdump -i enp0s3
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on enp0s3, link-type EN10MB (Ethernet), capture size 262144 bytes
16:12:41.293402 IP bom07s37-in-f10.1e100.net.https > student-VirtualBox.43784:
Flags [P.], seq 388626177:388626262, ack 677686169, win 65535, length 85
16:12:41.293467 IP student-VirtualBox.43784 > bom07s37-in-f10.1e100.net.https:
Flags [.], ack 85, win 62780, length 0
16:12:41.295936 IP student-VirtualBox.36711 > dns.sse.cisco.com.domain: 4629+ [
1au] PTR? 15.2.0.10.in-addr.arpa. (51)
16:12:41.302657 IP dns.sse.cisco.com.domain > student-VirtualBox.36711: 4629 NX
Domain* 0/1/1 (110)
16:12:41.302829 IP student-VirtualBox.36711 > dns.sse.cisco.com.domain: 4629+ P
TR? 15.2.0.10.in-addr.arpa. (40)
16:12:41.308000 IP student-VirtualBox.51844 > bom12s16-in-f10.1e100.net.https:
Flags [P.], seq 4020787763:4020787802, ack 377798270, win 62780, length 39
16:12:41.308497 IP bom12s16-in-f10.1e100.net.https > student-VirtualBox.51844:
Flags [.], ack 39, win 65535, length 0
16:12:41.310412 IP dns.sse.cisco.com.domain > student-VirtualBox.36711: 4629 NX
```

wireshark:



ip route:

```
student@student-VirtualBox:~$ ip route show
default via 10.0.2.2 dev enp0s3 proto dhcp metric 100
10.0.2.0/24 dev enp0s3 proto kernel scope link src 10.0.2.15 metric 100
169.254.0.0/16 dev enp0s3 scope link metric 1000
student@student-VirtualBox:~$
```

nmap:

```
student@student-VirtualBox:~$ nmap 127.0.0.1
Starting Nmap 7.95 ( https://nmap.org ) at 2025-04-09 16:23 IST
Nmap scan report for localhost (127.0.0.1)
Host is up (0.00084s latency).
Not shown: 999 closed tcp ports (conn-refused)
PORT    STATE SERVICE
631/tcp open  ipp

Nmap done: 1 IP address (1 host up) scanned in 0.34 seconds
student@student-VirtualBox:~$
```

nmcli:

```
student@student-VirtualBox:~$ nmcli connection show
NAME                UUID                                  TYPE      DEVICE
Wired connection 1  218e2495-01a0-3ba7-b2f6-149540c902a4  ethernet  enp0s3
student@student-VirtualBox:~$
```

mtr:

```
                                 My traceroute  [v0.93]
student-VirtualBox (10.0.2.15)                                  2025-04-09T16:26:08+0530
Keys:  Help   Display mode   Restart statistics   Order of fields   quit
                                                 Packets               Pings
 Host                                         Loss%   Snt   Last   Avg  Best  Wrst StDev
 1. _gateway                                  0.0%    20    0.7   1.3   0.5  12.6   2.7
 2. 172.16.2.32                               0.0%    20   11.4   3.8   1.6  11.4   3.0
 3. 183.87.205.161.broad-band.jprdigital.in   0.0%    19   27.6  12.1   2.1 101.0  22.7
 4. 183.87.210.25.broad-band.jprdigital.in    0.0%    19   26.8  15.1   7.0  59.5  13.3
 5. (waiting for reply)
 6. 10.20.20.5                                5.3%    19   27.4  15.2   5.9  66.0  13.9
 7. 72.14.209.97                              5.3%    19   29.7  13.1   5.0  56.8  12.4
 8. 192.178.110.123                           0.0%    19   20.6  16.6   7.4  69.7  18.7
 9. 72.14.237.139                             5.3%    19   31.8  15.0   6.4  58.4  13.6
10. bom12s17-in-f14.1e100.net                 5.3%    19   25.6  11.9   6.8  29.2   6.8
```

iwconfig:

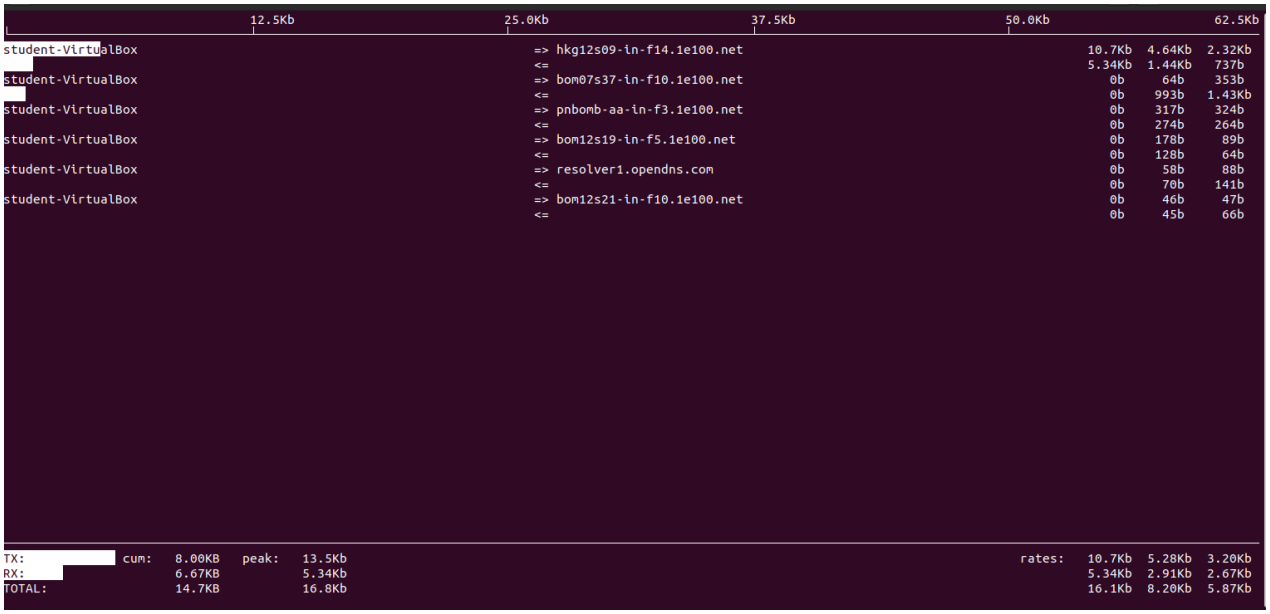
```
student@student-VirtualBox:~$ iwconfig
lo        no wireless extensions.

enp0s3    no wireless extensions.

student@student-VirtualBox:~$
```

iwlist:

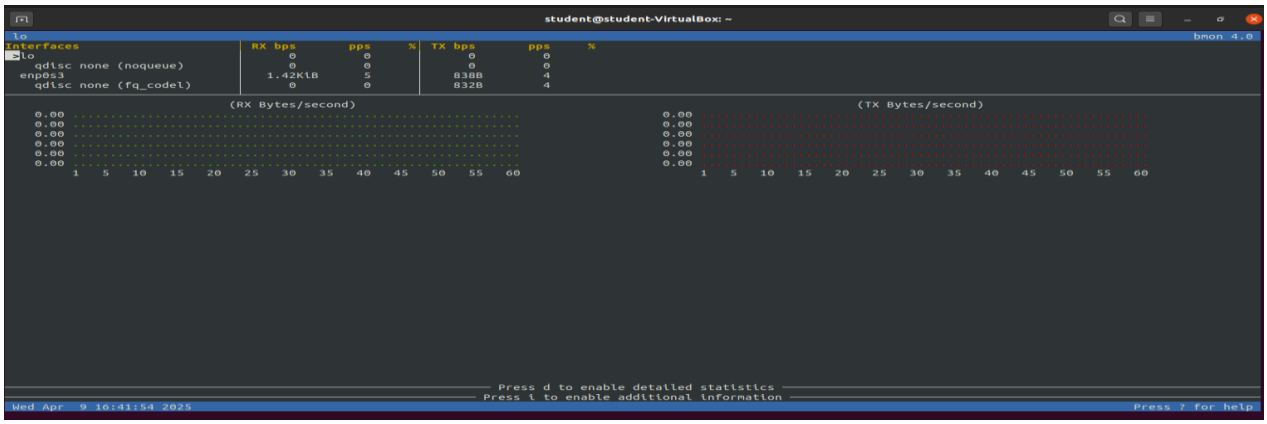
```
student@student-VirtualBox:~$ sudo iftop -i enp0s3
interface: enp0s3
IP address is: 10.0.2.15
MAC address is: 08:00:27:e8:2d:3e
student@student-VirtualBox:~$
```

iftop:

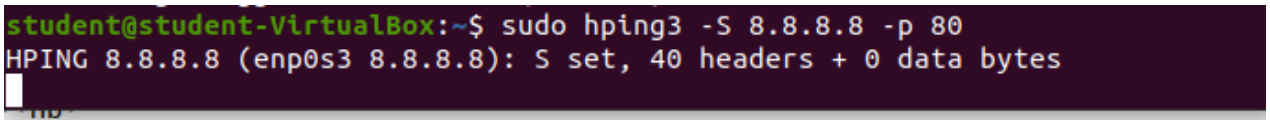
```
student@student-VirtualBox:~$ sudo iftop -i enp0s3
interface: enp0s3
IP address is: 10.0.2.15
MAC address is: 08:00:27:e8:2d:3e
student@student-VirtualBox:~$
```



bmon:



hping:



Conclusion: The practical helped in understanding and using basic Linux networking commands for configuring, monitoring, and troubleshooting network connections.