

## Lab Report – 2

### Network Commands for Testing and Troubleshooting

#### Objective

The objective of this laboratory experiment is to become familiar with commonly used network commands that assist in testing network connectivity and troubleshooting basic network-related issues.

#### Tools and Requirements

- Computer system with command-line interface access
- Active network connection (wired or wireless)

#### Theory

Network diagnostic commands are essential tools for understanding how data travels across a network, verifying connectivity, and identifying configuration or routing problems. Different operating systems provide various command-line utilities to analyze network behavior. Proper knowledge of these commands helps network administrators quickly detect and resolve network issues.

#### Network Commands Used

- ping
- ipconfig / ifconfig
- tracert / traceroute
- netstat (-a, -n)
- nslookup
- arp
- telnet
- pathping
- route print
- getmac
- nbtstat
- whois

## Description of Commands along with output

**ping:** Tests reachability of a host and measures round-trip time.

```
[~] ~ ping youtube.com
PING youtube.com (172.217.174.78): 56 data bytes
64 bytes from 172.217.174.78: icmp_seq=0 ttl=112 time=48.337 ms
64 bytes from 172.217.174.78: icmp_seq=1 ttl=112 time=57.205 ms
64 bytes from 172.217.174.78: icmp_seq=2 ttl=112 time=59.596 ms
64 bytes from 172.217.174.78: icmp_seq=3 ttl=112 time=53.838 ms
64 bytes from 172.217.174.78: icmp_seq=4 ttl=112 time=48.616 ms
64 bytes from 172.217.174.78: icmp_seq=5 ttl=112 time=53.982 ms
64 bytes from 172.217.174.78: icmp_seq=6 ttl=112 time=47.722 ms
64 bytes from 172.217.174.78: icmp_seq=7 ttl=112 time=55.963 ms
64 bytes from 172.217.174.78: icmp_seq=8 ttl=112 time=54.093 ms
64 bytes from 172.217.174.78: icmp_seq=9 ttl=112 time=56.225 ms
64 bytes from 172.217.174.78: icmp_seq=10 ttl=112 time=57.755 ms
64 bytes from 172.217.174.78: icmp_seq=11 ttl=112 time=47.247 ms
64 bytes from 172.217.174.78: icmp_seq=12 ttl=112 time=55.364 ms
64 bytes from 172.217.174.78: icmp_seq=13 ttl=112 time=53.453 ms
64 bytes from 172.217.174.78: icmp_seq=14 ttl=112 time=55.073 ms
64 bytes from 172.217.174.78: icmp_seq=15 ttl=112 time=54.266 ms
^C
--- youtube.com ping statistics ---
16 packets transmitted, 16 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 47.247/53.671/59.596/3.642 ms
```

**ipconfig / ifconfig:** Displays current network configuration details.

```
[□ ~ ifconfig
lo0: flags=8049<UP,LOOPBACK,RUNNING,MULTICAST> mtu 16384
    options=1203<RXCSUM,TXCSUM,TXSTATUS,SW_TIMESTAMP>
    inet 127.0.0.1 netmask 0xff000000
        inet6 ::1 prefixlen 128
        inet6 fe80::1%lo0 prefixlen 64 scopeid 0x1
            nd6 options=201<PERFORMNUD,DAD>
gif0: flags=8010<POINTOPOINT,MULTICAST> mtu 1280
stf0: flags=0<> mtu 1280
anpi0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    options=400<CHANNEL_IO>
    ether 26:89:91:eb:35:85
    media: none
    status: inactive
anpi1: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    options=400<CHANNEL_IO>
    ether 26:89:91:eb:35:86
    media: none
    status: inactive
en3: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    options=400<CHANNEL_IO>
    ether 26:89:91:eb:35:65
    nd6 options=201<PERFORMNUD,DAD>
    media: none
    status: inactive
en4: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    options=400<CHANNEL_IO>
    ether 26:89:91:eb:35:66
    nd6 options=201<PERFORMNUD,DAD>
    media: none
    status: inactive
en1: flags=8963<UP,BROADCAST,SMART,RUNNING,PROMISC,SIMPLEX,MULTICAST> mtu 1500
    options=460<TS04,TS06,CHANNEL_IO>
    ether 36:2a:ea:43:75:40
    media: autoselect <full-duplex>
    status: inactive
en2: flags=8963<UP,BROADCAST,SMART,RUNNING,PROMISC,SIMPLEX,MULTICAST> mtu 1500
    options=460<TS04,TS06,CHANNEL_IO>
    ether 36:2a:ea:43:75:44
    media: autoselect <full-duplex>
    status: inactive
bridge0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    options=63<RXCSUM,TXCSUM,TS04,TS06>
    ether 36:2a:ea:43:75:40
```

**tracert / traceroute:** Shows the route taken by packets to reach a destination.

```
[□ ~ traceroute youtube.com
traceroute to youtube.com (172.217.174.78), 64 hops max, 40 byte packets
 1  192.168.1.254 (192.168.1.254)  6.023 ms  3.637 ms  3.372 ms
 2  lo-0-4.192.bras-dhub-01.wlink.com.np (202.166.192.4)  5.430 ms  5.988 ms  12.948 ms
 3  be-71-9.40.gwc-dhub-core-01.wlink.com.np (202.79.40.9)  7.737 ms  13.273 ms  5.510 ms
 4  ae-21-170.41.gwmj-lknt-01.wlink.com.np (202.79.41.170)  14.616 ms  9.348 ms  10.711 ms
 5  ae-20-128.41.gwj-btwl-core-01.wlink.com.np (202.79.41.128)  12.110 ms  11.829 ms  10.241 ms
 6  ae52-ipt-bhwa-01.wlink.com.np (72.9.128.67)  8.592 ms  11.171 ms  33.509 ms
 7  * * *
 8  142.250.174.2 (142.250.174.2)  32.757 ms  26.380 ms  21.478 ms
 9  192.178.83.245 (192.178.83.245)  22.090 ms
    142.250.208.225 (142.250.208.225)  25.004 ms
    192.178.81.9 (192.178.81.9)  24.816 ms
10  192.178.83.224 (192.178.83.224)  25.817 ms
    216.239.54.92 (216.239.54.92)  25.922 ms
    192.178.82.238 (192.178.82.238)  28.114 ms
11  74.125.253.107 (74.125.253.107)  27.104 ms * *
12  142.251.197.114 (142.251.197.114)  58.323 ms *  47.339 ms
13  192.178.254.238 (192.178.254.238)  47.893 ms
    192.178.254.30 (192.178.254.30)  47.106 ms
    192.178.254.212 (192.178.254.212)  50.414 ms
14  142.251.77.69 (142.251.77.69)  47.473 ms
    192.178.111.61 (192.178.111.61)  51.112 ms  51.965 ms
15  142.250.228.49 (142.250.228.49)  44.539 ms  47.073 ms  48.770 ms
16  bom07s25-in-f14.1e100.net (172.217.174.78)  48.589 ms  46.446 ms  47.738 ms
```

**netstat:** Displays active connections, listening ports, and network statistics.

```
[□ ~ netstat -a
Active Internet connections (including servers)
Proto Recv-Q Send-Q Local Address          Foreign Address        (state)
tcp4   0      0      192.168.1.154.50017  9.65.199.104.bc..4070 ESTABLISHED
tcp6   0      0      2400:1a00:3b20:6.49992  si-in-f109.1e100.imaps ESTABLISHED
tcp4   0      0      *.49786               *.*                  LISTEN
tcp4   0      0      192.168.1.154.49649  ec2-44-192-201-1.https ESTABLISHED
tcp6   0      0      2400:1a00:3b20:6.49643  2600:1901:1:a98:.https ESTABLISHED
tcp6   0      0      2400:1a00:3b20:6.49640  sa-in-f188.1e100.5228 ESTABLISHED
tcp6   0      0      *.49636               *.*                  LISTEN
tcp4   0      0      *.49636               *.*                  LISTEN
tcp6   0      0      localhost.mysql       localhost.49272   ESTABLISHED
tcp6   0      0      localhost.49272       localhost.mysql   ESTABLISHED
tcp6   0      0      localhost.mysql       localhost.49271   ESTABLISHED
tcp6   0      0      localhost.49271       localhost.mysql   ESTABLISHED
tcp4   0      0      *.57621               *.*                  LISTEN
tcp6   0      0      localhost.42050       *.*                  LISTEN
tcp4   0      0      localhost.7768       *.*                  LISTEN
tcp4   0      0      localhost.45112       *.*                  LISTEN
tcp6   0      0      *.compplex-main     *.*                  LISTEN
tcp4   0      0      *.compplex-main     *.*                  LISTEN
tcp6   0      0      *.afs3-fileserver   *.*                  LISTEN
tcp4   0      0      *.afs3-fileserver   *.*                  LISTEN
tcp46  0      0      *.49542               *.*                  LISTEN
tcp46  0      0      *.mysql              *.*                  LISTEN
tcp46  0      0      *.33060               *.*                  LISTEN
tcp6   0      0      2400:1a00:3b20:6.50021  2620:1ec:46::68.https TIME_WAIT
tcp6   0      0      2400:1a00:3b20:6.50201  2403:300:1366::2.443 TIME_WAIT
tcp6   0      0      2400:1a00:3b20:6.50200  2403:300:a41:c80.443 ESTABLISHED
tcp6   0      0      2400:1a00:3b20:6.50199  2403:300:1366::2.443 ESTABLISHED
tcp6   0      0      2400:1a00:3b20:6.50198  2403:300:1366::2.443 TIME_WAIT
tcp6   0      0      2400:1a00:3b20:6.50183  2606:50c0:8002::443 ESTABLISHED
tcp4   0      0      192.168.1.154.49511  lb-140-82-112-25.443 ESTABLISHED
tcp6   0      0      2400:1a00:3b20:6.50133  2a06:98c1:3107::443 ESTABLISHED
tcp4   0      0      192.168.1.154.49195  17.57.145.133.5223 ESTABLISHED
tcp6   0      0      2400:1a00:3b20:6.63660  2600:1901:1:7c5:.https
```

**nslookup:** Retrieves DNS information for a given domain.

```
[□ ~ nslookup www.youtube.com
Server:      2400:1a00:0:32::165
Address:     2400:1a00:0:32::165#53

Non-authoritative answer:
www.youtube.com canonical name = youtube-ui.l.google.com.
Name: youtube-ui.l.google.com
Address: 142.250.195.78
Name: youtube-ui.l.google.com
Address: 142.250.207.238
Name: youtube-ui.l.google.com
Address: 142.250.67.238
Name: youtube-ui.l.google.com
Address: 172.217.174.78
Name: youtube-ui.l.google.com
Address: 142.250.77.46
Name: youtube-ui.l.google.com
Address: 142.250.77.78
Name: youtube-ui.l.google.com
Address: 142.250.70.46
Name: youtube-ui.l.google.com
Address: 142.250.70.78
Name: youtube-ui.l.google.com
Address: 142.250.70.110
Name: youtube-ui.l.google.com
Address: 172.217.174.238
Name: youtube-ui.l.google.com
Address: 142.250.71.110
Name: youtube-ui.l.google.com
Address: 216.58.203.46
Name: youtube-ui.l.google.com
Address: 142.251.42.238
Name: youtube-ui.l.google.com
Address: 142.250.195.14
Name: youtube-ui.l.google.com
Address: 142.250.195.46
Name: youtube-ui.l.google.com
Address: 142.250.205.206
```

**arp:** Displays IP to MAC address mappings.

```
[□ ~ arp -a
? (169.254.169.254) at (incomplete) on en0 [ethernet]
? (192.168.1.151) at d2:e7:e2:1d:5c:1b on en0 ifscope [ethernet]
? (192.168.1.154) at 26:42:88:fa:e0:f4 on en0 ifscope permanent [ethernet]
? (192.168.1.254) at c4:48:fa:5:1a:80 on en0 ifscope [ethernet]
? (192.168.1.255) at ff:ff:ff:ff:ff:ff on en0 ifscope [ethernet]
mdns.mcast.net (224.0.0.251) at 1:0:5e:0:0:fb on en0 ifscope permanent [ethernet]
? (239.255.255.250) at 1:0:5e:7f:ff:fa on en0 ifscope permanent [ethernet]
```

**telnet:** Tests connectivity to a specific host and port.

```
[□ ~ telnet www.youtube.com
zsh: command not found: telnet
[□ ~ telnet 142.250.70.78
zsh: command not found: telnet
```

**pathping:** Combines ping and tracert to analyze packet loss and latency (Windows only).

**route print:** Displays the system routing table (Windows only).

Routing tables						
Internet:		Gateway	Flags	Netif	Expire	
Destination	default	192.168.1.254	UGScg	en0		
127	127.0.0.1		UCS	lo0		
127.0.0.1	127.0.0.1		UH	lo0		
169.254	link#11		UCS	en0	!	
169.254.169.254	link#11		UHRLSW	en0	!	
192.168.1	link#11		UCS	en0	!	
192.168.1.151	d2:e7:e2:1d:5c:1b		UHLWI	en0	!	
192.168.1.154/32	link#11		UCS	en0	!	
192.168.1.154	26:42:88:fa:e0:f4		UHLWI	lo0		
192.168.1.254/32	link#11		UCS	en0	!	
192.168.1.254	c4:48:fa:5:1a:80		UHLWIir	en0	1195	
192.168.1.255	ff:ff:ff:ff:ff:ff		UHLWbI	en0	!	
224.0.0/4	link#11		UmCS	en0	!	
224.0.0.251	1:0:5e:0:0:fb		UHmLWI	en0		
239.255.255.250	1:0:5e:7f:ff:fa		UHmLWI	en0		
255.255.255.255/32	link#11		UCS	en0	!	

**getmac:** Displays MAC addresses of network interfaces (Windows only).

```
C:\Users\Admin>getmac
Physical Address      Transport Name
===== =====
00-FF-21-F8-90-63    Media disconnected
E0-D0-45-FC-D8-C5    \Device\Tcpip_{6D85EB9B-9CF6-4220-9D52-A5CE24852D00}
```

**nbtstat:** Displays NetBIOS over TCP/IP statistics.

```
[□ ~ nbtstat www.youtube.com
zsh: command not found: nbtstat
```

**whois:** Retrieves domain registration information.

```
[root ~] whois  
usage: whois [-aAbfgiIklmPQrRS] [-c country-code | -h hostname] [-p port] name ...
```

## Procedure

1. The command-line interface was opened on the system.
2. Network configuration was checked using ipconfig or ifconfig.
3. The listed network commands were executed as required.
4. Outputs of each command were observed and saved.

## Observations

The commands produced outputs corresponding to network configuration, connectivity, and routing information. Some commands such as pathping, route print, and getmac were found to be specific to Windows systems. Equivalent macOS commands were used where applicable.

## Result

The network diagnostic commands were successfully executed, and their outputs were collected for analysis.

## Conclusion

This lab provided hands-on experience with essential network troubleshooting commands. Understanding these commands is important for diagnosing connectivity issues and maintaining reliable network operations.

## Precautions

- Ensure an active network connection before executing commands.
- Use correct command syntax based on the operating system.
- Save outputs carefully for future reference.