University of Dhaka

Department of Computer Science and Engineering

CSE-3111 : Computer Networking Lab

Lab Report 1 : Lab exercises on LAN configuration and troubleshooting tools (PING, Traceroute, ARP, Static routing, netstat, ifconfig, nslook, whois, etc.)

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1 Introduction

In the realm of computer networking, understanding and mastering fundamental network diagnostic tools is crucial for both troubleshooting and optimizing network performance. This laboratory experiment delves into the exploration and utilization of essential network commands, namely PING, TRACEROUTE, IFCONFIG, ARP, RARP, NSLOOKUP, and NETSTAT. These commands serve as powerful utilities that allow network administrators and professionals to gather valuable information, diagnose connectivity issues, and analyze network configurations.

1.1 Objectives

- Enhance Our Network Troubleshooting Skills-

  Our aim in this lab is to improve our proficiency in network troubleshooting by actively using tools like PING, TRACEROUTE, IFCONFIG, ARP, RARP, NSLOOKUP, and NETSTAT. Through hands-on practice, we seek to gain practical experience in employing these tools to diagnose and resolve network issues effectively.

- Test Connectivity and Retrieve Network Information-

  In this experiment, we will utilize specific tools—PING for checking host reachability, TRACEROUTE for route tracing, IFCONFIG for network interface inspection, ARP and RARP for address resolution, NSLOOKUP for DNS queries, and NETSTAT for viewing network statistics. Our objective is to familiarize ourselves with these tools, interpret their outputs, and proficiently use them to test connectivity and retrieve crucial network information.

2 Theory

Network troubleshooting commands are essential tools for diagnosing and resolving issues within a computer network. In this lab experiment, we explore several fundamental commands that aid in troubleshooting connectivity problems, retrieving network information, and managing network resources. The following commands are key components of this exploration:

- PING (Packet Internet Groper):

  PING is used to test the reachability of a host on an Internet Protocol (IP) network. It sends ICMP Echo Request messages to the target

host and waits for an Echo Reply, providing insights into network connectivity.

Using the ping tool helps diagnose the network connectivity between a device and a network destination.

It achieves this by sending a packet to the destination and awaiting a response. The time it takes for this request to be sent and a response received is calculated giving the latency.It measures the time it takes for a packet to travel from the source (your computer) to the destination (the target IP address or domain) and back.

When the ping command doesn't get a request back, it can indicate the device either has no connection to the destination. Some services actively block the ICMP packet the ping tool utilizes.

- TRACEROUTE:

  TRACEROUTE is employed to trace the route that packets take to reach a destination. It helps identify the path and any potential delays or failures along the way, aiding in diagnosing network routing issues.

- IFCONFIG (Interface Configuration):

  IFCONFIG is a command-line tool that displays and configures network interfaces on a system. It provides information about the current state of network interfaces, such as IP addresses, subnet masks, and MAC addresses.

- ARP (Address Resolution Protocol):

  ARP is used to map an IP address to a physical (MAC) address on a local network. It resolves IP addresses to MAC addresses, facilitating communication between devices on the same network.

- RARP (Reverse Address Resolution Protocol):

  RARP performs the reverse of ARP by mapping a MAC address to an IP address. It is less commonly used in modern networks but may be relevant in certain scenarios.

- NSLOOKUP (Name Server Lookup):

  NSLOOKUP is a command-line tool used to query Domain Name System (DNS) servers. It provides information about domain names, IP addresses, and other DNS-related details, aiding in troubleshooting DNS-related issues.

- NETSTAT (Network Statistics):

  NETSTAT displays network-related information, such as active network connections, routing tables, interface statistics, masquerade connections, and more. It is a valuable tool for monitoring and diagnosing various aspects of network activity.

3 Methodology

The methodology for this network troubleshooting experiment followed a systematic progression, starting with the exploration of fundamental commands like PING, TRACEROUTE, IFCONFIG, ARP, RARP, NSLOOKUP, and NETSTAT. Building upon this foundation, the analysis extended to different switches and options available for each command, with an emphasis on practical, hands-on application to simulate and address network issues. The process involved consulting relevant online resources and documentation to extract additional insights into network configuration and usage statistics. Collaboration with peers facilitated collective learning and problem-solving. Detailed documentation of commands, outcomes, and challenges provided a comprehensive reference for analysis. An iterative testing approach ensured a continual refinement of troubleshooting skills and a deeper understanding of the commands' practical applications. This methodology aimed to equip with a proficient understanding of network troubleshooting tools, combining theoretical knowledge with practical expertise.

4 Experimental result

```
mushiurmukul@Mushiurs-MacBook-Air ~ % ping google.com
PING google.com (142.250.195.174): 56 data bytes
64 bytes from 142.250.195.174: icmp_seq=0 ttl=56 time=33.936 ms
64 bytes from 142.250.195.174: icmp_seq=1 ttl=56 time=34.579 ms
64 bytes from 142.250.195.174: icmp_seq=2 ttl=56 time=34.475 ms
^C
--- google.com ping statistics ---
3 packets transmitted, 3 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 33.936/34.330/34.579/0.282 ms
mushiurmukul@Mushiurs-MacBook-Air ~ % ping -c 5 google.com
PING google.com (142.250.195.174): 56 data bytes
64 bytes from 142.250.195.174: icmp_seq=0 ttl=56 time=35.242 ms
64 bytes from 142.250.195.174: icmp_seq=1 ttl=56 time=37.289 ms
64 bytes from 142.250.195.174: icmp_seq=2 ttl=56 time=37.763 ms
64 bytes from 142.250.195.174: icmp_seq=3 ttl=56 time=35.399 ms
64 bytes from 142.250.195.174: icmp_seq=4 ttl=56 time=35.096 ms

--- google.com ping statistics ---
5 packets transmitted, 5 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 35.096/36.158/37.763/1.131 ms
```

Figure 1: Ping Command Test

```
student@lab707-7:~$ ping 10.33.3.7
PING 10.33.3.7 (10.33.3.7) 56(84) bytes of data.
64 bytes from 10.33.3.7: icmp_seq=1 ttl=64 time=0.035 ms
64 bytes from 10.33.3.7: icmp_seq=2 ttl=64 time=0.052 ms
64 bytes from 10.33.3.7: icmp_seq=3 ttl=64 time=0.036 ms
64 bytes from 10.33.3.7: icmp_seq=4 ttl=64 time=0.047 ms
64 bytes from 10.33.3.7: icmp_seq=5 ttl=64 time=0.047 ms
64 bytes from 10.33.3.7: icmp_seq=6 ttl=64 time=0.051 ms
^C
--- 10.33.3.7 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5109ms
rtt min/avg/max/mdev = 0.035/0.044/0.052/0.006 ms
```

Figure 2: Ping Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % traceroute google.com
traceroute to google.com (142.250.195.174), 64 hops max, 52 byte packets
 1  192.168.0.1 (192.168.0.1)  4.415 ms  3.343 ms  2.692 ms
 2  10.205.0.1 (10.205.0.1)  4.043 ms  3.854 ms  5.712 ms
 3  172.16.180.1 (172.16.180.1)  4.114 ms  5.941 ms  3.608 ms
 4  172.16.104.8 (172.16.104.8)  3.740 ms  4.939 ms  6.099 ms
 5  16.102.15.5 (16.102.15.5)  35.221 ms  10.313 ms  4.386 ms
 6  16.100.17.2 (16.100.17.2)  6.813 ms  6.290 ms  7.818 ms
 7  * 10.131.163.216 (10.131.163.216)  6.144 ms  5.231 ms
 8  103.179.62.95 (103.179.62.95)  6.112 ms  6.836 ms  6.128 ms
 9  72.14.221.138 (72.14.221.138)  35.902 ms  38.988 ms  36.131 ms
10  * * *
11  74.125.242.129 (74.125.242.129)  35.857 ms
    74.125.253.16 (74.125.253.16)  37.520 ms
    142.251.55.28 (142.251.55.28)  40.501 ms
12  74.125.242.131 (74.125.242.131)  36.199 ms
    74.125.242.147 (74.125.242.147)  37.368 ms
    142.251.55.89 (142.251.55.89)  35.269 ms
13  maa03s41-in-f14.1e100.net (142.250.195.174)  34.925 ms  34.509 ms  35.351 ms
mushiurmukul@Mushiurs-MacBook-Air ~ % traceroute -d google.com
traceroute to google.com (142.250.71.14), 64 hops max, 52 byte packets
 1  192.168.0.1 (192.168.0.1)  3.987 ms  4.671 ms  3.086 ms
 2  10.205.0.1 (10.205.0.1)  2.458 ms  4.166 ms  3.644 ms
 3  172.16.180.1 (172.16.180.1)  3.965 ms  5.731 ms  3.594 ms
 4  172.16.104.8 (172.16.104.8)  4.923 ms  5.341 ms  6.941 ms
 5  16.102.15.5 (16.102.15.5)  6.083 ms  17.524 ms  5.035 ms
 6  16.100.17.2 (16.100.17.2)  5.340 ms  5.474 ms  4.768 ms
 7  10.131.163.216 (10.131.163.216)  5.154 ms  4.947 ms *
 8  te-google-chn-sw4-cig2-0212.pico.net.bd (103.7.250.50)  30.797 ms  33.143 ms  30.032 ms
 9  * * *
10  74.125.242.129 (74.125.242.129)  32.888 ms
    maa03s34-in-f14.1e100.net (142.250.71.14)  30.575 ms
    74.125.242.129 (74.125.242.129)  31.378 ms
```

Figure 3: Traceroute Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % traceroute -m 5 google.com
traceroute to google.com (142.250.71.14), 5 hops max, 52 byte packets
 1  192.168.0.1 (192.168.0.1)  4.005 ms  3.379 ms  5.585 ms
 2  10.205.0.1 (10.205.0.1)  3.714 ms  3.815 ms  3.728 ms
 3  172.16.180.1 (172.16.180.1)  4.094 ms  4.459 ms  3.001 ms
 4  172.16.104.8 (172.16.104.8)  7.462 ms  4.131 ms  4.730 ms
 5  16.102.15.5 (16.102.15.5)  9.475 ms  16.013 ms  7.898 ms
mushiurmukul@Mushiurs-MacBook-Air ~ % traceroute -q 2 google.com
traceroute to google.com (142.250.71.14), 64 hops max, 52 byte packets
 1  192.168.0.1 (192.168.0.1)  4.479 ms  2.106 ms
 2  10.205.0.1 (10.205.0.1)  3.797 ms  3.017 ms
 3  172.16.180.1 (172.16.180.1)  5.051 ms  3.633 ms
 4  172.16.104.8 (172.16.104.8)  7.443 ms  6.386 ms
 5  16.102.15.5 (16.102.15.5)  5.455 ms  7.512 ms
 6  16.100.17.2 (16.100.17.2)  5.595 ms  4.921 ms
 7  10.131.163.216 (10.131.163.216)  6.254 ms  4.517 ms
 8  te-google-chn-sw4-cig2-0212.pico.net.bd (103.7.250.50)  32.593 ms  29.684 ms
 9  * *
10  209.85.142.246 (209.85.142.246)  30.688 ms
    142.250.224.6 (142.250.224.6)  33.332 ms
11  74.125.242.155 (74.125.242.155)  32.836 ms
    74.125.242.154 (74.125.242.154)  30.499 ms
12  108.170.253.97 (108.170.253.97)  30.998 ms
    maa03s34-in-f14.1e100.net (142.250.71.14)  31.112 ms
```

Figure 4: Traceroute Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % traceroute -n google.com
traceroute to google.com (142.250.71.14), 64 hops max, 52 byte packets
 1  192.168.0.1  3.564 ms  2.764 ms  3.671 ms
 2  10.205.0.1  4.918 ms  4.587 ms  3.831 ms
 3  172.16.180.1  5.817 ms  4.025 ms  4.589 ms
 4  172.16.104.8  3.379 ms  5.693 ms  5.465 ms
 5  16.102.15.5  6.308 ms  5.358 ms  5.686 ms
 6  16.100.17.2  4.689 ms  10.640 ms  4.589 ms
 7  10.131.163.216  6.782 ms * *
 8  103.7.250.50  31.990 ms  30.717 ms  30.274 ms
 9  * * *
10  142.250.228.80  31.931 ms
    74.125.242.129  34.689 ms
    142.251.55.68  30.599 ms
11  74.125.242.154  39.056 ms
    172.253.73.35  32.540 ms  32.318 ms
12  108.170.253.97  34.937 ms  31.162 ms  34.513 ms
13  142.250.71.14  30.402 ms  30.980 ms
    172.253.73.35  31.433 ms
mushiurmukul@Mushiurs-MacBook-Air ~ % traceroute -f 15 google.com
traceroute to google.com (142.250.195.174), 64 hops max, 52 byte packets
15  maa03s41-in-f14.1e100.net (142.250.195.174)  36.825 ms  34.911 ms  36.300 ms
```

Figure 5: Traceroute Command Test

```
mushirmukul@Mushirs-MacBook-Air ~ % 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
anpi1: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether 8a:62:52:c2:87:ca
        media: none
        status: inactive
anpi0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether 8a:62:52:c2:87:c9
        media: none
        status: inactive
en3: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether 8a:62:52:c2:87:a9
        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 8a:62:52:c2:87:aa
        nd6 options=201<PERFORMNUD,DAD>
        media: none
        status: inactive
en1: flags=8963<UP,BROADCAST,SMART,RUNNING,PROMISC,SIMPLEX,MULTICAST> mtu 1500
        options=460<TSO4,TSO6,CHANNEL_IO>
        ether 36:ce:c5:cc:c8:00
        media: autoselect <full-duplex>
        status: inactive
en2: flags=8963<UP,BROADCAST,SMART,RUNNING,PROMISC,SIMPLEX,MULTICAST> mtu 1500
        options=460<TSO4,TSO6,CHANNEL_IO>
        ether 36:ce:c5:cc:c8:04
        media: autoselect <full-duplex>
```

Figure 6: Ifconfig Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % ifconfig -a
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
anpi1: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether 8a:62:52:c2:87:ca
        media: none
        status: inactive
anpi0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether 8a:62:52:c2:87:c9
        media: none
        status: inactive
en3: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether 8a:62:52:c2:87:a9
        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 8a:62:52:c2:87:aa
        nd6 options=201<PERFORMNUD,DAD>
        media: none
        status: inactive
en1: flags=8963<UP,BROADCAST,SMART,RUNNING,PROMISC,SIMPLEX,MULTICAST> mtu 1500
        options=460<TSO4,TSO6,CHANNEL_IO>
        ether 36:ce:c5:cc:c8:00
        media: autoselect <full-duplex>
        status: inactive
en2: flags=8963<UP,BROADCAST,SMART,RUNNING,PROMISC,SIMPLEX,MULTICAST> mtu 1500
        options=460<TSO4,TSO6,CHANNEL_IO>
        ether 36:ce:c5:cc:c8:04
        media: autoselect <full-duplex>
```

Figure 7: Ifconfig Command Test

```
        status: inactive
bridge0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=63<RXCSUM,TXCSUM,TSO4,TSO6>
        ether 36:ce:c5:cc:c8:00
        Configuration:
                id 0:0:0:0:0:0 priority 0 hellotime 0 fwddelay 0
                maxage 0 holdcnt 0 proto stp maxaddr 100 timeout 1200
                root id 0:0:0:0:0:0 priority 0 ifcost 0 port 0
                ipfilter disabled flags 0x0
        member: en1 flags=3<LEARNING,DISCOVER>
                ifmaxaddr 0 port 8 priority 0 path cost 0
        member: en2 flags=3<LEARNING,DISCOVER>
                ifmaxaddr 0 port 9 priority 0 path cost 0
        nd6 options=201<PERFORMNUD,DAD>
        media: <unknown type>
        status: inactive
ap1: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=6460<TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether f2:88:0c:74:09:c2
        inet6 fe80::f088:cff:fe74:9c2%ap1 prefixlen 64 scopeid 0xb
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (<unknown type>)
        status: inactive
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=6460<TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether d0:88:0c:74:09:c2
        inet 192.168.0.106 netmask 0xffffff00 broadcast 192.168.0.255
        inet6 fe80::101d:6ed8:76ff:1bb7%en0 prefixlen 64 secured scopeid 0xc
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect
        status: active
awdl0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=6460<TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether 26:da:d7:a6:50:87
        inet6 fe80::24da:d7ff:fea6:5087%awdl0 prefixlen 64 scopeid 0xd
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect
        status: active
llw0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
```

Figure 8: Ifconfig Command Test

```
llw0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether 26:da:d7:a6:50:87
        inet6 fe80::24da:d7ff:fea6:5087%llw0 prefixlen 64 scopeid 0xe
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect
        status: inactive
utun0: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1500
        inet6 fe80::dfd5:ed1b:99b7:c7cf%utun0 prefixlen 64 scopeid 0xf
        nd6 options=201<PERFORMNUD,DAD>
utun1: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 2000
        inet6 fe80::aaf3:8ee2:2bb7:4a53%utun1 prefixlen 64 scopeid 0x10
        nd6 options=201<PERFORMNUD,DAD>
utun2: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1000
        inet6 fe80::ce81:b1c:bd2c:69e%utun2 prefixlen 64 scopeid 0x11
        nd6 options=201<PERFORMNUD,DAD>
utun3: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
        inet6 fe80::c711:2b45:a6c1:e989%utun3 prefixlen 64 scopeid 0x12
        nd6 options=201<PERFORMNUD,DAD>
utun4: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
        inet6 fe80::d10d:128:ec91:d9ef%utun4 prefixlen 64 scopeid 0x13
        nd6 options=201<PERFORMNUD,DAD>
utun5: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
        inet6 fe80::b45b:852f:b6ca:fe30%utun5 prefixlen 64 scopeid 0x14
        nd6 options=201<PERFORMNUD,DAD>
```

Figure 9: Ifconfig Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % ifconfig lo0
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>
mushiurmukul@Mushiurs-MacBook-Air ~ % ifconfig lo0 up
ifconfig: up: permission denied
mushiurmukul@Mushiurs-MacBook-Air ~ % ifconfig lo0 down
ifconfig: down: permission denied
mushiurmukul@Mushiurs-MacBook-Air ~ % ifconfig lo0 127.0.0.2
ifconfig: ioctl (SIOCDIFADDR): permission denied
mushiurmukul@Mushiurs-MacBook-Air ~ % ifconfig eth0 netmask 255.255.255.224
ifconfig: interface eth0 does not exist
mushiurmukul@Mushiurs-MacBook-Air ~ % ifconfig lo0 netmask 255.255.255.224
ifconfig: ioctl (SIOCAIFADDR): permission denied
mushiurmukul@Mushiurs-MacBook-Air ~ % ifconfig lo0 mtu 100
ifconfig: ioctl (set mtu): Operation not permitted
mushiurmukul@Mushiurs-MacBook-Air ~ % ifconfig lo0 promisc
ifconfig: promisc: bad value
mushiurmukul@Mushiurs-MacBook-Air ~ % ifconfig lo0 -promisc
ifconfig: -promisc: bad value
```

Figure 10: Ifconfig Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % arp -a
? (192.168.0.1) at 0:5f:67:20:54:a2 on en0 ifscope [ethernet]
? (192.168.0.102) at ca:3d:d9:f:25:9e on en0 ifscope [ethernet]
mdns.mcast.net (224.0.0.251) at 1:0:5e:0:0:fb on en0 ifscope permanent [ethernet]
```

Figure 11: Arp Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % nslookup google.com
Server:         192.168.0.1
Address:        192.168.0.1#53

Non-authoritative answer:
Name:   google.com
Address: 142.250.71.46

mushiurmukul@Mushiurs-MacBook-Air ~ % nslookup 142.250.71.46
Server:         192.168.0.1
Address:        192.168.0.1#53

Non-authoritative answer:
46.71.250.142.in-addr.arpa      name = maa03s35-in-f14.1e100.net.

Authoritative answers can be found from:
```

Figure 12: NSLOOKUP Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % nslookup -type=any google.com
;; Truncated, retrying in TCP mode.
Server:         192.168.0.1
Address:        192.168.0.1#53

Non-authoritative answer:
Name:   google.com
Address: 142.251.42.14
google.com      has AAAA address 2404:6800:4009:82f::200e
google.com      text = "docusign=1b0a6754-49b1-4db5-8540-d2c12664b289"
google.com      rdata_257 = 0 issue "pki.goog"
google.com      text = "MS=E4A68B9AB2BB9670BCE15412F62916164C0B20BB"
google.com      text = "google-site-verification=wD8N7i1JTNTkezJ49swvWW48f8_9xveREV4oB-0Hf5o"
google.com
        origin = ns1.google.com
        mail addr = dns-admin.google.com
        serial = 601064008
        refresh = 900
        retry = 900
        expire = 1800
        minimum = 60
google.com      text = "apple-domain-verification=30afIBcvSuDV2PLX"
google.com      text = "onetrust-domain-verification=de01ed21f2fa4d8781cbc3ffb89cf4ef"
google.com      text = "google-site-verification=TV9-DBe4R80X4v0M4U_bd_J9cpOJM0nikft0jAgjmsQ"
google.com      text = "facebook-domain-verification=22rm551cu4k0ab0bxsw536tlds4h95"
google.com      nameserver = ns4.google.com.
google.com      mail exchanger = 10 smtp.google.com.
google.com      text = "docusign=05958488-4752-4ef2-95eb-aa7ba8a3bd0e"
google.com      nameserver = ns3.google.com.
google.com      text = "webexdomainverification.8YX6G=6e6922db-e3e6-4a36-904e-a805c28087fa"
google.com      nameserver = ns2.google.com.
google.com      text = "globalsign-smime-dv=CDYX+XFHUw2wml6/Gb8+59BsH31KzUr6c112BPvqKX8="
google.com      nameserver = ns1.google.com.
google.com      text = "atlassian-domain-verification=5YjTmWmjI92ewqkx2oXmBaD60Td9zWon9r6eakvHX6B77zzkFQto8PQ9QsKnbf4I"
google.com      rdata_65 = \# 13 000100000100006026832026833
google.com      text = "v=spf1 include:_spf.google.com ~all"

Authoritative answers can be found from:
```

Figure 13: NSLOOKUP Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % nslookup -type=soa google.com
Server:         192.168.0.1
Address:        192.168.0.1#53

Non-authoritative answer:
google.com
        origin = ns1.google.com
        mail addr = dns-admin.google.com
        serial = 601064008
        refresh = 900
        retry = 900
        expire = 1800
        minimum = 60

Authoritative answers can be found from:

mushiurmukul@Mushiurs-MacBook-Air ~ % nslookup -type=ns google.com
Server:         192.168.0.1
Address:        192.168.0.1#53

Non-authoritative answer:
google.com      nameserver = ns4.google.com.
google.com      nameserver = ns3.google.com.
google.com      nameserver = ns2.google.com.
google.com      nameserver = ns1.google.com.

Authoritative answers can be found from:

mushiurmukul@Mushiurs-MacBook-Air ~ % nslookup -type=a google.com
Server:         192.168.0.1
Address:        192.168.0.1#53

Non-authoritative answer:
Name:   google.com
Address: 142.250.71.46
```

Figure 14: NSLOOKUP Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % nslookup -type=mx google.com
Server:         192.168.0.1
Address:        192.168.0.1#53

Non-authoritative answer:
google.com      mail exchanger = 10 smtp.google.com.

Authoritative answers can be found from:

mushiurmukul@Mushiurs-MacBook-Air ~ % nslookup -type=txt google.com
;; Truncated, retrying in TCP mode.
Server:         192.168.0.1
Address:        192.168.0.1#53

Non-authoritative answer:
google.com      text = "globalsign-smime-dv=CDYX+XFHUw2wml6/Gb8+59BsH31KzUr6c1l2BPvqKX8="
google.com      text = "google-site-verification=WD8N7i1JTNTkezJ49swvWW48f8_9xveREV4oB-0Hf5o"
google.com      text = "docusign=1b0a6754-49b1-4db5-8540-d2c12664b289"
google.com      text = "v=spf1 include:_spf.google.com ~all"
google.com      text = "google-site-verification=TV9-DBe4R80X4v0M4U_bd_J9cpOJM0nikft0jAgjmsQ"
google.com      text = "MS=E4A68B9AB2BB9670BCE15412F62916164C0B20BB"
google.com      text = "docusign=05958488-4752-4ef2-95eb-aa7ba8a3bd0e"
google.com      text = "onetrust-domain-verification=de01ed21f2fa4d8781cbc3ffb89cf4ef"
google.com      text = "facebook-domain-verification=22rm551cu4k0ab0bxsw536tlds4h95"
google.com      text = "apple-domain-verification=30afIBcvSuDV2PLX"
google.com      text = "atlassian-domain-verification=5YjTmWmjI92ewqkx2oXmBaD60Td9zWon9r6eakvHX6B77zzkFQto8PQ9QsKnbf4I"
google.com      text = "webexdomainverification.8YX6G=6e6922db-e3e6-4a36-904e-a805c28087fa"

Authoritative answers can be found from:
```

Figure 15: NSLOOKUP Command Test

```
mushiurmukul@Mushiurs-MacBook-Air ~ % netstat -a
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address          Foreign Address        (state)
tcp4       0      0  192.168.0.106.49909    91.108.56.102.https    ESTABLISHED
tcp4      24      0  192.168.0.106.49844    a23-212-164-66.d.https CLOSE_WAIT
tcp4       0      0  192.168.0.106.49621    192.168.0.102.50604    ESTABLISHED
tcp6       0      0  mushiurs-macbook.cap   fe80::8515:d714:.1025  ESTABLISHED
tcp6       0      0  mushiurs-macbook.1024  fe80::8515:d714:.1024  ESTABLISHED
tcp6       0      0  *.49621                *.*                    LISTEN
tcp4       0      0  *.49621                *.*                    LISTEN
tcp4       0      0  192.168.0.106.49614    91.108.56.102.https    ESTABLISHED
tcp4       0      0  192.168.0.106.49591    maa05s18-in-f14..https ESTABLISHED
tcp4       0      0  192.168.0.106.49579    maa03s44-in-f14..https ESTABLISHED
tcp46      0      0  *.pearldoc-xact        *.*                    LISTEN
tcp4       0      0  *.pearldoc-xact        *.*                    LISTEN
tcp46      0      0  *.licensedaemon        *.*                    LISTEN
tcp4       0      0  *.licensedaemon        *.*                    LISTEN
tcp46      0      0  *.unisql-java          *.*                    LISTEN
tcp4       0      0  *.unisql-java          *.*                    LISTEN
tcp46      0      0  *.unisql               *.*                    LISTEN
tcp4       0      0  *.unisql               *.*                    LISTEN
```

Figure 16: NETSTAT

```
mushiurmukul@Mushiurs-MacBook-Air ~ % netstat -at
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address          Foreign Address        (state)
tcp4       0      0  192.168.0.106.49910    a23-59-188-32.de.https ESTABLISHED
tcp4       0      0  192.168.0.106.49909    91.108.56.102.https    ESTABLISHED
tcp4      24      0  192.168.0.106.49844    a23-212-164-66.d.https CLOSE_WAIT
tcp4       0      0  192.168.0.106.49621    192.168.0.102.50604    ESTABLISHED
tcp6       0      0  mushiurs-macbook.cap   fe80::8515:d714:.1025  ESTABLISHED
tcp6       0      0  mushiurs-macbook.1024  fe80::8515:d714:.1024  ESTABLISHED
tcp6       0      0  *.49621                *.*                    LISTEN
tcp4       0      0  *.49621                *.*                    LISTEN
tcp4       0      0  192.168.0.106.49614    91.108.56.102.https    ESTABLISHED
tcp4       0      0  192.168.0.106.49591    maa05s18-in-f14..https ESTABLISHED
tcp4       0      0  192.168.0.106.49579    maa03s44-in-f14..https ESTABLISHED
tcp46      0      0  *.pearldoc-xact        *.*                    LISTEN
tcp4       0      0  *.pearldoc-xact        *.*                    LISTEN
tcp46      0      0  *.licensedaemon        *.*                    LISTEN
tcp4       0      0  *.licensedaemon        *.*                    LISTEN
```

Figure 17: NETSTAT

```
mushiurmukul@Mushiurs-MacBook-Air ~ % netstat -au
Active LOCAL (UNIX) domain sockets
Address          Type   Recv-Q Send-Q            Inode             Conn             Refs          Nextref Addr
 4d63e6476779afd stream      0      0                0  4d63e6476779a35                0               0 /var/run/mDNSResponder
 4d63e6476779a35 stream      0      0                0  4d63e6476779afd                0               0
 4d63e647677900d stream      0      0                0  4d63e6476778f45                0               0 /var/run/mDNSResponder
 4d63e6476778f45 stream      0      0                0  4d63e647677900d                0               0
 4d63e6476778a95 stream      0      0                0  4d63e647677883d                0               0 /var/run/mDNSResponder
 4d63e647677883d stream      0      0                0  4d63e6476778a95                0               0
 4d63e6476778775 stream      0      0                0  4d63e6476777a2d                0               0 /var/run/mDNSResponder
 4d63e6476777a2d stream      0      0                0  4d63e6476778775                0               0
 4d63e647677be25 stream      0      0                0  4d63e64767786ad                0               0 /var/run/mDNSResponder
 4d63e64767786ad stream      0      0                0  4d63e647677be25                0               0
 4d63e64767789cd stream      0      0                0  4d63e6476778905                0               0 /var/run/mDNSResponder
 4d63e6476778905 stream      0      0                0  4d63e64767789cd                0               0
 4d63e64767746bd stream      0      0                0  4d63e647677452d                0               0 /var/run/mDNSResponder
 4d63e647677452d stream      0      0                0  4d63e64767746bd                0               0
 4d63e647677c465 stream      0      0                0  4d63e647677c2d5                0               0 /var/run/usbmuxd
 4d63e647677c2d5 stream      0      0                0  4d63e647677c465                0               0
 4d63e647677a45d stream      0      0                0  4d63e647677a395                0               0 /var/run/mDNSResponder
 4d63e647677a395 stream      0      0                0  4d63e647677a45d                0               0
 4d63e64767770cd stream      0      0                0  4d63e6476777005                0               0 /var/run/mDNSResponder
 4d63e6476777005 stream      0      0                0  4d63e64767770cd                0               0
 4d63e647677371d stream      0      0                0  4d63e6476773655                0               0 /var/run/mDNSResponder
 4d63e6476773655 stream      0      0                0  4d63e647677371d                0               0
 4d63e647677a205 stream      0      0                0  4d63e647677c5f5                0               0 /var/run/mDNSResponder
```

Figure 18: NETSTAT

```
mushiurmukul@Mushiurs-MacBook-Air ~ % netstat -l
Active Internet connections
Proto Recv-Q Send-Q  Local Address                Foreign Address                      (state)
tcp4       0      0  192.168.0.106.49909         91.108.56.102.https                  ESTABLISHED
tcp4      24      0  192.168.0.106.49844         a23-212-164-66.d.https               CLOSE_WAIT
tcp4       0      0  192.168.0.106.49621         192.168.0.102.50604                  ESTABLISHED
tcp6       0      0  mushiurs-macbook-air.cap    fe80::8515:d714:a24c:ee78%utun4.1025 ESTABLISHED
tcp6       0      0  mushiurs-macbook-air.1024   fe80::8515:d714:a24c:ee78%utun4.1024 ESTABLISHED
tcp4       0      0  192.168.0.106.49614         91.108.56.102.https                  ESTABLISHED
tcp4       0      0  192.168.0.106.49591         maa05s18-in-f14..https               ESTABLISHED
tcp4       0      0  192.168.0.106.49579         maa03s44-in-f14..https               ESTABLISHED
tcp4       0      0  192.168.0.106.49212         17.57.145.150.5223                   ESTABLISHED
udp4       0      0  192.168.0.106.60565         17.248.164.196.https
udp4       0      0  *.xserveraid                *.*
udp4       0      0  192.168.0.106.51649         142.250.82.211.19305
udp4       0      0  192.168.0.106.51649         142.250.82.211.3478
udp4       0      0  192.168.0.106.51649         *.*
udp4       0      0  *.*                         *.*
udp4       0      0  *.*                         *.*
```

Figure 19: NETSTAT

```
mushiurmukul@Mushiurs-MacBook-Air ~ % netstat -lt
Active Internet connections
Proto Recv-Q Send-Q  Local Address                                 Foreign Address                                 (state)
tcp4       0      0  192.168.0.106.49909                          91.108.56.102.https                             ESTABLISHED
tcp4      24      0  192.168.0.106.49844                          a23-212-164-66.d.https                          CLOSE_WAIT
tcp4       0      0  192.168.0.106.49621                          192.168.0.102.50604                             ESTABLISHED
tcp6       0      0  mushiurs-macbook-air.cap                     fe80::8515:d714:a24c:ee78%utun4.1025            ESTABLISHED
tcp6       0      0  mushiurs-macbook-air.1024                    fe80::8515:d714:a24c:ee78%utun4.1024            ESTABLISHED
tcp4       0      0  192.168.0.106.49614                          91.108.56.102.https                             ESTABLISHED
tcp4       0      0  192.168.0.106.49591                          maa05s18-in-f14..https                          ESTABLISHED
tcp4       0      0  192.168.0.106.49579                          maa03s44-in-f14..https                          ESTABLISHED
tcp4       0      0  192.168.0.106.49212                          17.57.145.150.5223                              ESTABLISHED
udp4       0      0  192.168.0.106.60565                          17.248.164.196.https
udp4       0      0  *.xserveraid                                 *.*
udp4       0      0  192.168.0.106.51649                          142.250.82.211.19305
udp4       0      0  192.168.0.106.51649                          142.250.82.211.3478
udp4       0      0  192.168.0.106.51649                          *.*
udp4       0      0  *.*                                          *.*
udp4       0      0  *.*                                          *.*
udp4       0      0  *.*                                          *.*
```

Figure 20: NETSTAT

```
mushiurmukul@Mushiurs-MacBook-Air ~ % netstat -lu
Active LOCAL (UNIX) domain sockets
Address          Type   Recv-Q Send-Q            Inode             Conn             Refs          Nextref Addr
 4d63e6476779afd stream      0      0                0  4d63e6476779a35                0               0 /var/run/mDNSResponder
 4d63e6476779a35 stream      0      0                0  4d63e6476779afd                0               0
 4d63e647677900d stream      0      0                0  4d63e6476778f45                0               0 /var/run/mDNSResponder
 4d63e6476778f45 stream      0      0                0  4d63e647677900d                0               0
 4d63e6476778a95 stream      0      0                0  4d63e647677883d                0               0 /var/run/mDNSResponder
 4d63e647677883d stream      0      0                0  4d63e6476778a95                0               0
 4d63e6476778775 stream      0      0                0  4d63e6476777a2d                0               0 /var/run/mDNSResponder
 4d63e6476777a2d stream      0      0                0  4d63e6476778775                0               0
 4d63e647677be25 stream      0      0                0  4d63e64767786ad                0               0 /var/run/mDNSResponder
 4d63e64767786ad stream      0      0                0  4d63e647677be25                0               0
 4d63e64767789cd stream      0      0                0  4d63e6476778905                0               0 /var/run/mDNSResponder
 4d63e6476778905 stream      0      0                0  4d63e64767789cd                0               0
 4d63e64767746bd stream      0      0                0  4d63e6476777452d               0               0 /var/run/mDNSResponder
 4d63e6476777452d stream      0      0                0  4d63e64767746bd                0               0
 4d63e647677c465 stream      0      0                0  4d63e647677c2d5                0               0 /var/run/usbmuxd
 4d63e647677c2d5 stream      0      0                0  4d63e647677c465                0               0
 4d63e647677a45d stream      0      0                0  4d63e647677a395                0               0 /var/run/mDNSResponder
 4d63e647677a395 stream      0      0                0  4d63e647677a45d                0               0
```

Figure 21: NETSTAT

5 Experience

During the execution of this lab experiment, the application of various network troubleshooting commands provided a hands-on experience that significantly enriched our understanding of network diagnostics. The practical implementation of fundamental commands, including PING, TRACEROUTE, IFCONFIG, ARP, RARP, NSLOOKUP, and NETSTAT, allowed for a direct exploration of their functionalities.

References

[1] ping : https://pimylifeup.com/ubuntu-ping/

[2] traceroute : https://cloudinfrastructureservices.co.uk/how-to-install-traceroute-and-run-on-ubuntu-20-04/

[3] ifconfig : https://www.tecmint.com/ifconfig-command-examples/

[4] arp : https://www.geeksforgeeks.org/arp-command-in-linux-with-examples/

[5] rarp : https://www.geeksforgeeks.org/what-is-rarp/

[6] nslookup : https://www.geeksforgeeks.org/nslookup-command-in-linux-with-examples/

[7] netstat : https://www.geeksforgeeks.org/netstat-command-linux/