SUB: Computer Networks
EXPERIMENT NO. 1

To study different networking commands.

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Theory

Windows has some very useful networking utilities that are accessed from a command line (cmd console). The networking commands are mainly used for getting system information and troubleshooting networking problems.

The following commands are used most often.

1. **ipconfig Command**
   It is used for finding network information about your local machine-like IP addresses, DNS addresses etc.

   OUPUT :

```
Wireless LAN adapter Local Area Connection* 4:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::7c74:6c19:ec8d:3cf%24
   IPv4 Address. . . . . . . . . . . : 192.168.137.1
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :

Ethernet adapter Ethernet 2:

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

Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::49eb:36ea:4eba:d3d%25
   IPv4 Address. . . . . . . . . . . : 192.168.0.103
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 192.168.0.1

Ethernet adapter Ethernet 5:

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

2. **ipconfig/all**

   It displays more information about the network setup on your systems including the MAC address.

   OUTPUT :

```
Windows IP Configuration

   Host Name . . . . . . . . . . . . : LAPTOP-66KSD5LS
   Primary Dns Suffix  . . . . . . . :
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
   WINS Proxy Enabled. . . . . . . . : No

Ethernet adapter Ethernet:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Realtek PCIe GbE Family Controller
   Physical Address. . . . . . . . . : 04-D4-C4-E0-29-F7
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes

Ethernet adapter Ethernet 3:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : TAP-NordVPN Windows Adapter V9
   Physical Address. . . . . . . . . : 00-FF-7D-CF-E3-16
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 3:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter #5
   Physical Address. . . . . . . . . : 40-74-E0-84-BF-A8
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 4:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter #6
   Physical Address. . . . . . . . . : 42-74-E0-84-BF-A7
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::7c74:6c19:ec8d:3cf%24(Preferred)
   IPv4 Address. . . . . . . . . . . : 192.168.137.1(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :
   DHCPv6 IAID . . . . . . . . . . . : 356676832
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-EE-04-68-04-D4-C4-E0-29-F7
   DNS Servers . . . . . . . . . . . : fec0:0:0:ffff::1%1
                                       fec0:0:0:ffff::2%1
                                       fec0:0:0:ffff::3%1
   NetBIOS over Tcpip. . . . . . . . : Enabled

Ethernet adapter Ethernet 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : TAP-Windows Adapter V9
   Physical Address. . . . . . . . . : 00-FF-50-20-9C-A3
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Intel(R) Wireless-AC 9560 160MHz
   Physical Address. . . . . . . . . : 40-74-E0-84-BF-A7
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::49eb:36ea:4eba:d3d%25(Preferred)
   IPv4 Address. . . . . . . . . . . : 192.168.0.103(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : 26 February 2021 13:56:10
   Lease Expires . . . . . . . . . . : 26 February 2021 15:56:09
   Default Gateway . . . . . . . . . : 192.168.0.1
   DHCP Server . . . . . . . . . . . : 192.168.0.1
   DHCPv6 IAID . . . . . . . . . . . : 390100192
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-EE-04-68-04-D4-C4-E0-29-F7
   DNS Servers . . . . . . . . . . . : 192.168.0.1
   NetBIOS over Tcpip. . . . . . . . : Enabled
```

3. Ping

The ping command is one of the most often used networking utilities for detecting devices on a network and for troubleshooting network problems. Ping is used to test the ability of one network host to communicate with another. Simply enter the Ping command, followed by the name or the IP address of the destination host. Assuming that there are no network problems or firewalls preventing the ping from completing, the remote host will respond to the ping with four packets. Receiving these packets confirms that a valid and functional network path exists between the two hosts. When you ping a device, you send that device a short message, which it then sends back (the echo). The general format is **ping hostname** or **ping IPaddress**.

OUTPUT :

```
Pinging 192.168.0.1 with 32 bytes of data:
Reply from 192.168.0.1: bytes=32 time=1ms TTL=64
Reply from 192.168.0.1: bytes=32 time=1ms TTL=64
Reply from 192.168.0.1: bytes=32 time=2ms TTL=64
Reply from 192.168.0.1: bytes=32 time=2ms TTL=64

Ping statistics for 192.168.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 2ms, Average = 1ms
```

4. **Nslookup**

Used for checking DNS record entries.

OUTPUT :

```
Server:  UnKnown
Address:  192.168.0.1

Non-authoritative answer:
Name:    www.google.com
Addresses:  2404:6800:4009:80e::2004
          172.217.166.164
```

5. **Arp –a**

This is used for showing the address resolution cache.

The ARP command corresponds to the Address Resolution Protocol. Although it is easy to think of network communications in terms of IP addressing, packet delivery is ultimately dependent on the Media Access Control (MAC) address of the device’s network adapter. This is where the Address Resolution Protocol comes into play. Its job is to map IP addresses to MAC addresses. Windows devices maintain an ARP cache, which contains the results of recent ARP queries. You can see the contents of this cache by using the ARP -A command. If you are having problems communicating with one specific host, you can append the remote host’s IP address to the **ARP -A** command. This command must be used with a command line switch **arp -a** is the most common.

OUTPUT :

```
Interface: 192.168.137.1 --- 0x18
  Internet Address      Physical Address      Type
  192.168.137.255       ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  224.77.77.77          01-00-5e-4d-4d-4d     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 192.168.0.103 --- 0x19
  Internet Address      Physical Address      Type
  192.168.0.1           98-da-c4-91-4d-52     dynamic
  192.168.0.102         08-25-25-57-28-25     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  224.77.77.77          01-00-5e-4d-4d-4d     static
  239.255.102.18        01-00-5e-7f-66-12     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

6. **Netstat**

Displays the active TCP connections, ports on which the computer is listening. If you are experiencing problems with network communications, then network statistics can sometimes help point you toward the root cause of the problem. That is where the aptly named NetStat command comes into play. This command has several different functions, but the most useful of these is to display network summary information for the device. The command used is **NetStat -e.**

```
OUTPUT :
Active Connections

  Proto  Local Address          Foreign Address        State
  TCP    127.0.0.1:1043         LAPTOP-66KSD5LS:49699  ESTABLISHED
  TCP    127.0.0.1:9012         LAPTOP-66KSD5LS:49700  ESTABLISHED
  TCP    127.0.0.1:9487         LAPTOP-66KSD5LS:49698  ESTABLISHED
  TCP    127.0.0.1:49671        LAPTOP-66KSD5LS:49672  ESTABLISHED
  TCP    127.0.0.1:49672        LAPTOP-66KSD5LS:49671  ESTABLISHED
  TCP    127.0.0.1:49698        LAPTOP-66KSD5LS:9487   ESTABLISHED
  TCP    127.0.0.1:49699        LAPTOP-66KSD5LS:1043   ESTABLISHED
  TCP    127.0.0.1:49700        LAPTOP-66KSD5LS:9012   ESTABLISHED
  TCP    127.0.0.1:49703        LAPTOP-66KSD5LS:57310  ESTABLISHED
  TCP    127.0.0.1:51870        LAPTOP-66KSD5LS:51871  ESTABLISHED
  TCP    127.0.0.1:51871        LAPTOP-66KSD5LS:51870  ESTABLISHED
  TCP    127.0.0.1:57301        LAPTOP-66KSD5LS:65001  ESTABLISHED
  TCP    127.0.0.1:57310        LAPTOP-66KSD5LS:49703  ESTABLISHED
  TCP    127.0.0.1:65001        LAPTOP-66KSD5LS:57301  ESTABLISHED
  TCP    192.168.0.103:59548    40.90.189.152:https    ESTABLISHED
  TCP    192.168.0.103:62215    40.90.189.152:https    ESTABLISHED
  TCP    192.168.0.103:62226    relay-2944465e:http    ESTABLISHED
  TCP    192.168.0.103:62236    sa-in-f188:https       ESTABLISHED
  TCP    192.168.0.103:62268    52.114.6.173:https     ESTABLISHED
  TCP    192.168.0.103:62330    52.111.244.0:https     ESTABLISHED
  TCP    192.168.0.103:62335    52.114.6.216:https     ESTABLISHED
  TCP    192.168.0.103:62340    52.109.124.53:https    ESTABLISHED
  TCP    192.168.0.103:62583    75:4070                ESTABLISHED
```

7. **Nbtstat**

Computers that are running a Windows operating system are assigned a computer name. Often, there is a domain name or a workgroup name that is also assigned to the computer. The computer name is sometimes referred to as the NetBIOS name. Windows uses several different methods to map NetBIOS names to IP addresses, such as broadcast, LMHost lookup, or even using the nearly extinct method of querying a WINS server. Of course, NetBIOS over TCP/IP can occasionally break down. The NbtStat command can help you to diagnose and correct such problems. The NbtStat -n command for example, shows the NetBIOS names that are in use by a device. The **NbtStat -r** command shows how many NetBIOS names the device has been able to resolve recently. It is a MS-DOS utility that displays protocol statistics and current TCP/IP connections. The command used is **nbtstat –c**.

OUTPUT : Nbtstat -c

```
Node IpAddress: [0.0.0.0] Scope Id: []

    No names in cache



Ethernet:
Node IpAddress: [0.0.0.0] Scope Id: []

    No names in cache

Wi-Fi:
Node IpAddress: [192.168.0.103] Scope Id: []

    No names in cache

Local Area Connection* 3:
Node IpAddress: [0.0.0.0] Scope Id: []

    No names in cache
```

OUTPUT : nbtstat -n

```
Ethernet 3:
Node IpAddress: [0.0.0.0] Scope Id: []

    No names in cache

Ethernet 2:
Node IpAddress: [0.0.0.0] Scope Id: []

    No names in cache


Ethernet:
Node IpAddress: [0.0.0.0] Scope Id: []

    No names in cache

Wi-Fi:
Node IpAddress: [192.168.0.103] Scope Id: []

                NetBIOS Local Name Table

       Name               Type         Status
    ---------------------------------------------
    LAPTOP-66KSD5LS<00>  UNIQUE      Registered
    WORKGROUP      <00>  GROUP       Registered
    LAPTOP-66KSD5LS<20>  UNIQUE      Registered

Local Area Connection* 3:
Node IpAddress: [0.0.0.0] Scope Id: []

    No names in cache

Local Area Connection* 4:
Node IpAddress: [192.168.137.1] Scope Id: []

                NetBIOS Local Name Table

       Name               Type         Status
    ---------------------------------------------
    LAPTOP-66KSD5LS<00>  UNIQUE      Registered
    WORKGROUP      <00>  GROUP       Registered
    LAPTOP-66KSD5LS<20>  UNIQUE      Registered
```

8. Hostname

The previously discussed NbtStat command can provide you with the host name that has been assigned to a Windows device, if you know which switch to use with the command. However, if you are just looking for a fast and easy way of verifying a computer’s name, then try using the Hostname command. Typing **Hostname** at the command prompt returns the local computer name.

OUTPUT :

```
LAPTOP-66KSD5LS
```

9. Tracert

Traceroute is a computer network diagnostic tool for displaying the route (path) and measuring the transit delays of packets across an Internet Protocol network. It gives you the number of hops required to reach the destination.

OUTPUT :

```
Tracing route to www.google.com [172.217.166.164]
over a maximum of 30 hops:

  1    <1 ms     1 ms     3 ms  192.168.0.1
  2     4 ms     4 ms     4 ms  45.248.138.38
  3    12 ms    12 ms    13 ms  103.102.145.65
  4    11 ms    12 ms    11 ms  103.80.117.165
  5    12 ms    14 ms    14 ms  108.170.248.193
  6    13 ms    13 ms     *     74.125.253.107
  7    14 ms    13 ms    12 ms  bom07s20-in-f4.1e100.net [172.217.166.164]

Trace complete.
```

10. Route

IP networks use routing tables to direct packets from one subnet to another. The Windows Route utility allows you to view the device’s routing tables. To do so, simply type **Route Print**.

OUTPUT :

```
Interface List
  4...04 d4 c4 e0 29 f7 ......Realtek PCIe GbE Family Controller
 62...........................NordLynx Tunnel
 19...........................WireGuard Tunnel
 21...00 ff 7d cf e3 16 ......TAP-NordVPN Windows Adapter V9
 15...40 74 e0 84 bf a8 ......Microsoft Wi-Fi Direct Virtual Adapter #5
 24...42 74 e0 84 bf a7 ......Microsoft Wi-Fi Direct Virtual Adapter #6
 13...00 ff 50 20 9c a3 ......TAP-Windows Adapter V9
 25...40 74 e0 84 bf a7 ......Intel(R) Wireless-AC 9560 160MHz
 20...00 ff 7c b5 d3 49 ......TunnelBear Adapter V9
  1...........................Software Loopback Interface 1
```

```
=================================================================
==============

IPv4 Route Table
=================================================================
==============
Active Routes:
Network Destination        Netmask          Gateway       Interface  Metric
          0.0.0.0          0.0.0.0      192.168.0.1    192.168.0.103     40
        127.0.0.0        255.0.0.0         On-link         127.0.0.1    331
        127.0.0.1  255.255.255.255         On-link         127.0.0.1    331
  127.255.255.255  255.255.255.255         On-link         127.0.0.1    331
      192.168.0.0    255.255.255.0         On-link     192.168.0.103    296
    192.168.0.103  255.255.255.255         On-link     192.168.0.103    296
    192.168.0.255  255.255.255.255         On-link     192.168.0.103    296
    192.168.137.0    255.255.255.0         On-link     192.168.137.1    281
    192.168.137.1  255.255.255.255         On-link     192.168.137.1    281
  192.168.137.255  255.255.255.255         On-link     192.168.137.1    281
        224.0.0.0        240.0.0.0         On-link         127.0.0.1    331
        224.0.0.0        240.0.0.0         On-link     192.168.0.103    296
        224.0.0.0        240.0.0.0         On-link     192.168.137.1    281
  255.255.255.255  255.255.255.255         On-link         127.0.0.1    331
  255.255.255.255  255.255.255.255         On-link     192.168.0.103    296
  255.255.255.255  255.255.255.255         On-link     192.168.137.1    281
=================================================================
==============
Persistent Routes:
  Network Address          Netmask  Gateway Address  Metric
          0.0.0.0          0.0.0.0      192.168.1.2  Default
=================================================================
==============

IPv6 Route Table
=================================================================
==============
Active Routes:
 If Metric Network Destination      Gateway
  1    331 ::1/128                  On-link
 25    296 fe80::/64                On-link
 24    281 fe80::/64                On-link
 25    296 fe80::49eb:36ea:4eba:d3d/128
                                    On-link
 24    281 fe80::7c74:6c19:ec8d:3cf/128
                                    On-link
  1    331 ff00::/8                 On-link
 25    296 ff00::/8                 On-link
 24    281 ff00::/8                On-link
===========================================================================
===============
Persistent Routes:
  None
```

11. PathPing

Entering the PathPing command followed by a host name initiates what looks like a somewhat standard Tracert process. Once this process completes however, the tool takes 300 seconds (five minutes) to gather statistics, and then reports latency and packet loss statistics that are more detailed than those provided by Ping or Tracert.

OUTPUT :

```
Tracing route to www.google.com [142.250.67.228]
over a maximum of 30 hops:
  0  LAPTOP-66KSD5LS [192.168.0.103]
  1  192.168.0.1
  2  45.248.138.38
  3  103.102.145.65
  4  103.80.117.165
  5  108.170.248.209
  6  216.239.58.19
  7  bom07s24-in-f4.1e100.net [142.250.67.228]

Computing statistics for 175 seconds...
            Source to Here   This Node/Link
Hop  RTT    Lost/Sent = Pct  Lost/Sent = Pct  Address
  0                                           LAPTOP-66KSD5LS [192.168.0.103]
                                0/ 100 =  0%   |
  1    2ms     0/ 100 =  0%     0/ 100 =  0%  192.168.0.1
                                0/ 100 =  0%   |
  2    5ms     0/ 100 =  0%     0/ 100 =  0%  45.248.138.38
                                2/ 100 =  2%   |
  3   14ms     3/ 100 =  3%     1/ 100 =  1%  103.102.145.65
                                0/ 100 =  0%   |
  4   14ms     7/ 100 =  7%     5/ 100 =  5%  103.80.117.165
                                0/ 100 =  0%   |
  5   15ms     3/ 100 =  3%     1/ 100 =  1%  108.170.248.209
                                0/ 100 =  0%   |
  6  ---     100/ 100 =100%    98/ 100 = 98%  216.239.58.19
                                0/ 100 =  0%   |
  7   14ms     2/ 100 =  2%     0/ 100 =  0%  bom07s24-in-f4.1e100.net [142.250.67.228]

Trace complete.
```