Windows Networking Commands Lab

AIM

To study and run basic networking commands in the Windows environment to gather network configuration details, diagnose network connectivity issues, and understand network behavior and performance.

THEORY

The following commands are executed primarily using the **Command Prompt** (cmd.exe) or **PowerShell**.

1. arp -a

- **Purpose:** Displays the **A**ddress **R**esolution **P**rotocol cache, showing the current IPv4 to physical **MAC address** mappings stored by the system.
- **Explanation:** ARP is used to resolve IPv4 addresses to physical MAC addresses within a local subnet. The cache stores these mappings to speed up communication.
- **Use Case:** Useful for verifying if a device's MAC address is known and for detecting ARP spoofing attacks.
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```
C:\Users\Daksh>arp -a

Interface: 192.168.1.8 --- 0x11
  Internet Address      Physical Address      Type
  192.168.1.1           6c-22-f7-4b-5f-40     dynamic
  192.168.1.255         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
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

2. hostname

- **Purpose:** Displays the **identifier** (name) assigned to the local device on the network.
- **Explanation:** The hostname is the device's identifier, used in DNS and local network identification.
- **Use Case:** Useful for confirming the device’s network identity, especially in multi-device environments.

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```
C:\Users\Daksh>hostname
DESKTOP-T00E87B
```

3. ipconfig

- **Purpose:** Shows essential IP configuration details for each active network adapter: **IPv4 Address**, **Subnet Mask**, and **Default Gateway**.
- **Explanation:** This is the Windows equivalent of the basic ifconfig command.
- **Use Case:** Initial step in troubleshooting network connectivity.
-
```
C:\Users\Daksh>ipconfig

Windows IP Configuration


Ethernet adapter Ethernet:

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

Wireless LAN adapter Local Area Connection* 1:

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

Wireless LAN adapter Local Area Connection* 10:

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

Wireless LAN adapter WiFi:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::7e66:c67f:7ca0:89eb%17
   IPv4 Address. . . . . . . . . . . : 192.168.1.8
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : fe80::1%17
                                       192.168.1.1
```

4. ipconfig /all

- **Purpose:** Shows detailed configuration information, including the **MAC address** (Physical Address), DHCP status, DNS servers, and IP lease times.
- **Explanation:** This is the Windows equivalent of ifconfig -a.
- **Use Case:** Useful for in-depth troubleshooting and verifying DHCP and DNS configurations.

```
C:\Users\Daksh>ipconfig /all

Windows IP Configuration

   Host Name . . . . . . . . . . . . : DESKTOP-TOOE87B
   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  . : bbrouter
   Description . . . . . . . . . . . : Realtek PCIe GbE Family Controller
   Physical Address. . . . . . . . . : 30-9C-23-5F-48-05
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 1:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter
   Physical Address. . . . . . . . . : 12-25-E9-13-A5-DD
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 10:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter #2
   Physical Address. . . . . . . . . : 22-25-E9-13-A5-DD
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes
```

5. ipconfig /renew

- **Purpose:** Forces the client to **renew its IP address** lease from the DHCP server.
- **Explanation:** This command initiates a new DHCP request.
- **Use Case:** Resolves IP conflicts or connectivity issues related to an expired or invalid DHCP lease.

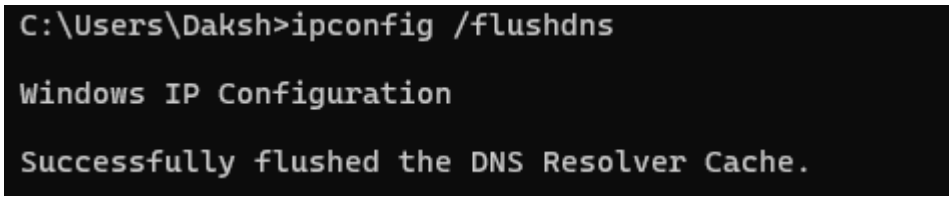
```
C:\Users\Daksh>ipconfig /renew

Windows IP Configuration

No operation can be performed on Ethernet while it has its media disconnected.
No operation can be performed on Local Area Connection* 1 while it has its media disconnected.
No operation can be performed on Local Area Connection* 10 while it has its media disconnected.

Ethernet adapter Ethernet:

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

Wireless LAN adapter Local Area Connection* 1:

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

Wireless LAN adapter Local Area Connection* 10:

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

Wireless LAN adapter WiFi:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::7e66:c67f:7ca0:89eb%17
   IPv4 Address. . . . . . . . . . . : 192.168.1.8
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : fe80::1%17
                                       192.168.1.1
```

6. ipconfig /release

- **Purpose: Drops the current IP address** by notifying the DHCP server and setting the interface to an unconfigured state.
- **Explanation:** This command releases the IP address back to the DHCP pool.
- **Use Case:** Used before renewing an IP or reconfiguring network settings.

```
C:\Users\Daksh>ipconfig /release

Windows IP Configuration

No operation can be performed on Ethernet while it has its media disconnected.
No operation can be performed on Local Area Connection* 1 while it has its media disconnected.

Ethernet adapter Ethernet:

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

Wireless LAN adapter Local Area Connection* 1:

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

Wireless LAN adapter Local Area Connection* 10:

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

Wireless LAN adapter WiFi:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::7e66:c67f:7ca0:89eb%17
   Default Gateway . . . . . . . . . : fe80::1%17
```

7. ipconfig /flushdns

- **Purpose:** Removes all cached DNS entries from the local system.
- **Explanation:** This forces the system to query DNS servers anew for subsequent requests.
- **Use Case:** Fixes DNS-related issues such as stale or incorrect DNS records.
- 

8. nbtstat -a <IP address>

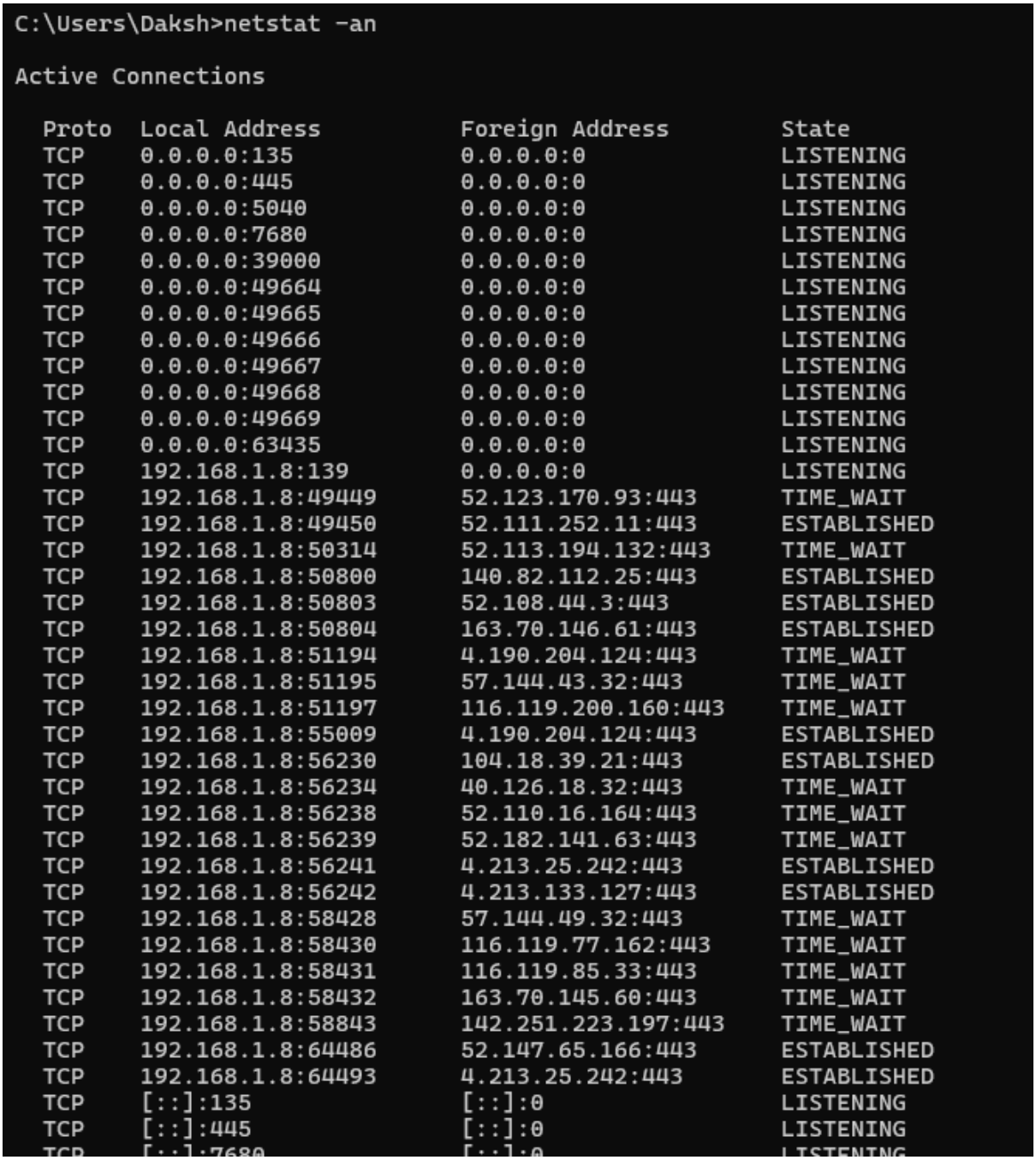
- **Purpose:** Displays the **NetBIOS over TCP/IP** name table of a remote machine using its IP address.
- **Explanation:** NetBIOS is used for name resolution and session services in Windows networks, particularly in legacy environments.
- **Use Case:** Troubleshooting Windows network name resolution and browsing issues.

9. netsh diag show test

- **Purpose:** Runs a series of diagnostic tests on network components and reports problems.
- **Explanation:** This is the closest functional replacement for the deprecated netdiag in modern Windows.
- **Use Case:** Comprehensive network troubleshooting and reporting.

10. netstat -an

- **Purpose:** Displays **Net**work **Stat**istics, showing active TCP and UDP connections and listening ports.
- **Explanation:** The -an flags show **a**ll connections and ports in **n**umerical form.
- **Use Case:** Identifying open ports, active connections, and potential unauthorized access or malware.



```
C:\Users\Daksh>netstat -an

Active Connections

  Proto  Local Address          Foreign Address        State
  TCP    0.0.0.0:135            0.0.0.0:0              LISTENING
  TCP    0.0.0.0:445            0.0.0.0:0              LISTENING
  TCP    0.0.0.0:5040           0.0.0.0:0              LISTENING
  TCP    0.0.0.0:7680           0.0.0.0:0              LISTENING
  TCP    0.0.0.0:39000          0.0.0.0:0              LISTENING
  TCP    0.0.0.0:49664          0.0.0.0:0              LISTENING
  TCP    0.0.0.0:49665          0.0.0.0:0              LISTENING
  TCP    0.0.0.0:49666          0.0.0.0:0              LISTENING
  TCP    0.0.0.0:49667          0.0.0.0:0              LISTENING
  TCP    0.0.0.0:49668          0.0.0.0:0              LISTENING
  TCP    0.0.0.0:49669          0.0.0.0:0              LISTENING
  TCP    0.0.0.0:63435          0.0.0.0:0              LISTENING
  TCP    192.168.1.8:139        0.0.0.0:0              LISTENING
  TCP    192.168.1.8:49449      52.123.170.93:443      TIME_WAIT
  TCP    192.168.1.8:49450      52.111.252.11:443      ESTABLISHED
  TCP    192.168.1.8:50314      52.113.194.132:443     TIME_WAIT
  TCP    192.168.1.8:50800      140.82.112.25:443      ESTABLISHED
  TCP    192.168.1.8:50803      52.108.44.3:443        ESTABLISHED
  TCP    192.168.1.8:50804      163.70.146.61:443      ESTABLISHED
  TCP    192.168.1.8:51194      4.190.204.124:443      TIME_WAIT
  TCP    192.168.1.8:51195      57.144.43.32:443       TIME_WAIT
  TCP    192.168.1.8:51197      116.119.200.160:443    TIME_WAIT
  TCP    192.168.1.8:55009      4.190.204.124:443      ESTABLISHED
  TCP    192.168.1.8:56230      104.18.39.21:443       ESTABLISHED
  TCP    192.168.1.8:56234      40.126.18.32:443       TIME_WAIT
  TCP    192.168.1.8:56238      52.110.16.164:443      TIME_WAIT
  TCP    192.168.1.8:56239      52.182.141.63:443      TIME_WAIT
  TCP    192.168.1.8:56241      4.213.25.242:443       ESTABLISHED
  TCP    192.168.1.8:56242      4.213.133.127:443      ESTABLISHED
  TCP    192.168.1.8:58428      57.144.49.32:443       TIME_WAIT
  TCP    192.168.1.8:58430      116.119.77.162:443     TIME_WAIT
  TCP    192.168.1.8:58431      116.119.85.33:443      TIME_WAIT
  TCP    192.168.1.8:58432      163.70.145.60:443      TIME_WAIT
  TCP    192.168.1.8:58843      142.251.223.197:443    TIME_WAIT
  TCP    192.168.1.8:64486      52.147.65.166:443      ESTABLISHED
  TCP    192.168.1.8:64493      4.213.25.242:443       ESTABLISHED
  TCP    [::]:135               [::]:0                 LISTENING
  TCP    [::]:445               [::]:0                 LISTENING
  TCP    [::]:7680              [::]:0                 LISTENING
```

ifconfig

Explanation:

Shows IPv4 address, subnet mask, and default gateway for each network adapter.

Output:

```
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 a6:e2:59:eb:5c:66
        media: none
        status: inactive
anpi1: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether a6:e2:59:eb:5c:67
        media: none
        status: inactive
en3: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether a6:e2:59:eb:5c:46
        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 a6:e2:59:eb:5c:47
        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 36:17:3f:1d:bd:c0
        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 36:17:3f:1d:bd:c4
        media: autoselect <full-duplex>
        status: inactive
bridge0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=63<RXCSUM,TXCSUM,TSO4,TSO6>
        ether 36:17:3f:1d:bd:c0
        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
```

```
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=6460<TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether 46:9e:2f:d4:68:80
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (<unknown type>)
        status: inactive
ap1: flags=8822<BROADCAST,SMART,SIMPLEX,MULTICAST> mtu 1500
        options=6460<TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether ba:e5:ae:42:bf:8e
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (none)
        status: inactive
awdl0: flags=8822<BROADCAST,SMART,SIMPLEX,MULTICAST> mtu 1500
        options=6460<TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether 4a:e7:bb:9f:b7:cb
        inet6 fe80::48e7:bbff:fe9f:b7cb%awdl0 prefixlen 64 scopeid 0xe
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (<unknown type>)
        status: inactive
llw0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether 4a:e7:bb:9f:b7:cb
        inet6 fe80::48e7:bbff:fe9f:b7cb%llw0 prefixlen 64 scopeid 0xf
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (none)
utun0: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1500
        inet6 fe80::4704:bc84:c8d8:1b49%utun0 prefixlen 64 scopeid 0x10
        nd6 options=201<PERFORMNUD,DAD>
utun1: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
        inet6 fe80::e60d:3088:1bf0:febe%utun1 prefixlen 64 scopeid 0x11
        nd6 options=201<PERFORMNUD,DAD>
utun2: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 2000
        inet6 fe80::f55d:6be5:ea47:e13d%utun2 prefixlen 64 scopeid 0x12
        nd6 options=201<PERFORMNUD,DAD>
utun3: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1000
        inet6 fe80::ce81:b1c:bd2c:69e%utun3 prefixlen 64 scopeid 0x13
        nd6 options=201<PERFORMNUD,DAD>
utun4: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
        inet6 fe80::137a:f93:d053:1c47%utun4 prefixlen 64 scopeid 0x14
        nd6 options=201<PERFORMNUD,DAD>
utun5: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
        inet6 fe80::45fd:9b8d:44cd:c1db%utun5 prefixlen 64 scopeid 0x15
        nd6 options=201<PERFORMNUD,DAD>
en6: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=6464<VLAN_MTU,TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether 20:7b:d5:1a:10:b5
        inet6 fe80::1085:27d:2270:a3f5%en6 prefixlen 64 secured scopeid 0xd
        inet 10.10.32.120 netmask 0xffffff00 broadcast 10.10.32.255
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (100baseTX <full-duplex>)
        status: active
```

Use Case:

Initial step in troubleshooting network connectivity.

4. ifconfig -a

Explanation:

Includes MAC addresses, DHCP status, DNS servers, lease times, and more.

Output:

```
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 a6:e2:59:eb:5c:66
        media: none
        status: inactive
anpi1: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether a6:e2:59:eb:5c:67
        media: none
        status: inactive
en3: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether a6:e2:59:eb:5c:46
        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 a6:e2:59:eb:5c:47
        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 36:17:3f:1d:bd:c0
        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 36:17:3f:1d:bd:c4
        media: autoselect <full-duplex>
        status: inactive
bridge0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=63<RXCSUM,TXCSUM,TSO4,TSO6>
        ether 36:17:3f:1d:bd:c0
        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
```

```
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=6460<TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether 46:9e:2f:d4:68:80
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (<unknown type>)
        status: inactive
ap1: flags=8822<BROADCAST,SMART,SIMPLEX,MULTICAST> mtu 1500
        options=6460<TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether ba:e5:ae:42:bf:8e
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (none)
        status: inactive
awdl0: flags=8822<BROADCAST,SMART,SIMPLEX,MULTICAST> mtu 1500
        options=6460<TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether 4a:e7:bb:9f:b7:cb
        inet6 fe80::48e7:bbff:fe9f:b7cb%awdl0 prefixlen 64 scopeid 0xe
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (<unknown type>)
        status: inactive
llw0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether 4a:e7:bb:9f:b7:cb
        inet6 fe80::48e7:bbff:fe9f:b7cb%llw0 prefixlen 64 scopeid 0xf
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (none)
utun0: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1500
        inet6 fe80::4704:bc84:c8d8:1b49%utun0 prefixlen 64 scopeid 0x10
        nd6 options=201<PERFORMNUD,DAD>
utun1: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
        inet6 fe80::e60d:3088:1bf0:febe%utun1 prefixlen 64 scopeid 0x11
        nd6 options=201<PERFORMNUD,DAD>
utun2: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 2000
        inet6 fe80::f55d:6be5:ea47:e13d%utun2 prefixlen 64 scopeid 0x12
        nd6 options=201<PERFORMNUD,DAD>
utun3: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1000
        inet6 fe80::ce81:b1c:bd2c:69e%utun3 prefixlen 64 scopeid 0x13
        nd6 options=201<PERFORMNUD,DAD>
utun4: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
        inet6 fe80::137a:f93:d053:1c47%utun4 prefixlen 64 scopeid 0x14
        nd6 options=201<PERFORMNUD,DAD>
utun5: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
        inet6 fe80::45fd:9b8d:44cd:c1db%utun5 prefixlen 64 scopeid 0x15
        nd6 options=201<PERFORMNUD,DAD>
en6: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=6464<VLAN_MTU,TSO4,TSO6,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
        ether 20:7b:d5:1a:10:b5
        inet6 fe80::1085:27d:2270:a3f5%en6 prefixlen 64 secured scopeid 0xd
        inet 10.10.32.120 netmask 0xffffff00 broadcast 10.10.32.255
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect (100baseTX <full-duplex>)
        status: active
```

Use Case: Useful for in-depth troubleshooting and verifying DHCP and DNS configurations.

5. ipconfig /renew

Explanation: Forces the client to renew its IP address, useful if the current lease is expired or invalid.

Output:

```
C:\Users\Tanishq>ipconfig /renew

Windows IP Configuration

No operation can be performed on Local Area Connection* 1 while it has its media disconnected.
No operation can be performed on Local Area Connection* 2 while it has its media disconnected.

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  . :

Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2405:204:109d:5326:9368:d0f0:ef4e:652d
   Temporary IPv6 Address. . . . . . : 2405:204:109d:5326:8d3a:5414:392a:cae8
   Link-local IPv6 Address . . . . . : fe80::34d9:f865:437c:6fc1%19
   IPv4 Address. . . . . . . . . . . : 10.89.175.178
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : fe80::a864:88ff:fe05:291b%19
                                       10.89.175.200
```

Use Case: Resolves IP conflicts or connectivity issues related to DHCP.

6. ipconfig /release

Explanation:

Drops the current IP address, making the interface temporarily unconfigured.

Output:

```
C:\Users\Tanishq>ipconfig /release

Windows IP Configuration

No operation can be performed on Local Area Connection* 1 while it has its media disconnected.
No operation can be performed on Local Area Connection* 2 while it has its media disconnected.

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  . :

Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2405:204:109d:5326:9368:d0f0:ef4e:652d
   Temporary IPv6 Address. . . . . . : 2405:204:109d:5326:8d3a:5414:392a:cae8
   Link-local IPv6 Address . . . . . : fe80::34d9:f865:437c:6fc1%19
   Default Gateway . . . . . . . . . : fe80::a864:88ff:fe05:291b%19
```

Use Case: Used before renewing IP or reconfiguring network settings.

7. ipconfig /flushdns

Explanation:

Removes all cached DNS entries, forcing the system to query DNS servers anew.

Output:

```
C:\Users\Tanishq>ipconfig /flushdns

Windows IP Configuration

Successfully flushed the DNS Resolver Cache.
```

Use Case:

Fixes DNS-related issues such as stale or incorrect DNS records.

8. nbtstat -a <IP address>

Explanation:

NetBIOS is used for name resolution and session services in Windows networks.

Output:

```
C:\Users\Tanishq>nbtstat -a 192.168.1.10

Local Area Connection* 1:
Node IpAddress: [0.0.0.0] Scope Id: []

    Host not found.

Wi-Fi:
Node IpAddress: [10.89.175.178] Scope Id: []

    Host not found.

Local Area Connection* 2:
Node IpAddress: [0.0.0.0] Scope Id: []

    Host not found.
```

Use Case:

Troubleshooting Windows network name resolution and browsing issues.

9. netdiag – Has been Deprecated in newer versions of windows

Explanation:

Runs a series of tests on network components and reports problems.

Use Case:

Comprehensive network troubleshooting tool.

10. netstat

Explanation:

Shows current network connections and ports in use.

Output:

```
tashikmiddha@Tashiks-MacBook-Air ~ % netstat
Active Internet connections
Proto Recv-Q Send-Q  Local Address          Foreign Address        (state)
tcp4       0      0  10.10.32.120.53387     212.123.125.34.b.https ESTABLISHED
tcp4       0      0  10.10.32.120.53386     212.123.125.34.b.https ESTABLISHED
tcp4       0      0  10.10.32.120.53385     212.123.125.34.b.https ESTABLISHED
tcp4       0      0  10.10.32.120.53384     212.123.125.34.b.https ESTABLISHED
tcp4       0      0  10.10.32.120.53383     212.123.125.34.b.https ESTABLISHED
tcp4       0      0  10.10.32.120.53382     212.123.125.34.b.https ESTABLISHED
tcp4      31      0  10.10.32.120.53374     156.227.14.43.https    CLOSE_WAIT
tcp4      31      0  10.10.32.120.53373     156.227.14.43.https    CLOSE_WAIT
tcp4       0      0  10.10.32.120.53171     104.18.39.21.https     ESTABLISHED
tcp4       0      0  10.10.32.120.52736     104.18.36.252.https    ESTABLISHED
tcp4       0      0  10.10.32.120.50916     si-in-f188.1e100.https ESTABLISHED
tcp6       0      0  tashiks-macbook-.black fe80::c151:41e:7.1027  ESTABLISHED
tcp6       0      0  tashiks-macbook-.1024  fe80::c151:41e:7.1024  ESTABLISHED
tcp4       0      0  10.10.32.120.53395     18.7.8.34.bc.goo.https TIME_WAIT
tcp4       0      0  10.10.32.120.52877     20.204.245.84.443      ESTABLISHED
tcp4       0      0  10.10.32.120.52532     17.242.13.5.5223       ESTABLISHED
tcp4       0      0  10.10.32.120.52524     whatsapp-chatd-e.5222  ESTABLISHED
udp4       0      0  10.10.32.120.56508     bkk02s03-in-f10..https
udp4       0      0  10.10.32.120.55488     dns.google.https
```

Use Case:

Identifying open ports, active connections, and potential unauthorized access.

11. nslookup <domain>

Explanation:

Interacts with DNS servers to retrieve DNS records.

Output:

```
tashikmiddha@Tashiks-MacBook-Air ~ % nslookup google.com
Server:         8.8.8.8
Address:        8.8.8.8#53

Non-authoritative answer:
Name:   google.com
Address: 172.217.24.238
```

Use Case:

Verifying DNS resolution and diagnosing DNS issues.

12. pathping <IP/hostname>

- **Purpose**: Combines **ping** and **tracert** to show packet loss and latency at each hop.

- **Usage**: **pathping google.com**
- **Explanation**: Sends packets to each router on the path and calculates statistics.
- **Output Interpretation**: Displays latency and packet loss per hop.
- **Use Case**: Identifying problematic routers or links causing packet loss.

13. ping <IP/hostname>

Explanation:

Measures round-trip time and packet loss.

Output:

```
tashikmiddha@Tashiks-MacBook-Air ~ % ping google.com
PING google.com (142.251.43.110): 56 data bytes
64 bytes from 142.251.43.110: icmp_seq=0 ttl=116 time=3.618 ms
64 bytes from 142.251.43.110: icmp_seq=1 ttl=116 time=3.325 ms
64 bytes from 142.251.43.110: icmp_seq=2 ttl=116 time=3.538 ms
64 bytes from 142.251.43.110: icmp_seq=3 ttl=116 time=3.726 ms
64 bytes from 142.251.43.110: icmp_seq=4 ttl=116 time=3.581 ms
64 bytes from 142.251.43.110: icmp_seq=5 ttl=116 time=3.535 ms
64 bytes from 142.251.43.110: icmp_seq=6 ttl=116 time=3.610 ms
```

Use Case:

Basic connectivity test and latency measurement.

14. route print

Explanation:

Shows network routes, including destination, gateway, interface, and metric.

Output:

```
tashikmiddha@Tashiks-MacBook-Air ~ % netstat -rn
Routing tables

Internet:
Destination        Gateway            Flags               Netif Expire
default            10.10.32.1         UGScg                 en6
10.10.32/24        link#13            UCS                   en6      !
10.10.32.1/32      link#13            UCS                   en6      !
10.10.32.1         64:12:25:33:e0:5f  UHLWIir               en6   1084
10.10.32.120/32    link#13            UCS                   en6      !
127                127.0.0.1          UCS                   lo0
127.0.0.1          127.0.0.1          UH                    lo0
169.254            link#13            UCS                   en6      !
224.0.0/4          link#13            UmCS                  en6      !
224.0.0.251        1:0:5e:0:0:fb      UHmLWI                en6
255.255.255.255/32 link#13            UCS                   en6      !

Internet6:
Destination                             Gateway                                 Flags               Netif Expire
default                                 fe80::%utun0                            UGcIg               utun0
default                                 fe80::%utun1                            UGcIg               utun1
default                                 fe80::%utun2                            UGcIg               utun2
default                                 fe80::%utun3                            UGcIg               utun3
default                                 fe80::%utun4                            UGcIg               utun4
default                                 fe80::%utun5                            UGcIg               utun5
::1                                     ::1                                     UHL                   lo0
fe80::%lo0/64                           fe80::1%lo0                             UcI                   lo0
fe80::1%lo0                             link#1                                  UHLI                  lo0
fe80::%en6/64                           link#13                                 UCI                   en6
fe80::4bf:3ac0:56d8:a853%en6            0:e0:4c:28:4a:a0                        UHLWI                 en6
fe80::1085:27d:2270:a3f5%en6            20:7b:d5:1a:10:b5                       UHLI                  lo0
fe80::48e7:bbff:fe9f:b7cb%awdl0         4a:e7:bb:9f:b7:cb                       UHLI                  lo0
fe80::48e7:bbff:fe9f:b7cb%llw0          4a:e7:bb:9f:b7:cb                       UHLI                  lo0
fe80::%utun0/64                         fe80::4704:bc84:c8d8:1b49%utun0         UcI                 utun0
fe80::4704:bc84:c8d8:1b49%utun0         link#16                                 UHLI                  lo0
fe80::%utun1/64                         fe80::e60d:3088:1bf0:febe%utun1         UcI                 utun1
fe80::e60d:3088:1bf0:febe%utun1         link#17                                 UHLI                  lo0
fe80::%utun2/64                         fe80::f55d:6be5:ea47:e13d%utun2         UcI                 utun2
fe80::f55d:6be5:ea47:e13d%utun2         link#18                                 UHLI                  lo0
fe80::%utun3/64                         fe80::ce81:b1c:bd2c:69e%utun3           UcI                 utun3
fe80::ce81:b1c:bd2c:69e%utun3           link#19                                 UHLI                  lo0
fe80::%utun4/64                         fe80::137a:f93:d053:1c47%utun4          UcI                 utun4
fe80::137a:f93:d053:1c47%utun4          link#20                                 UHLI                  lo0
fe80::%utun5/64                         fe80::45fd:9b8d:44cd:c1db%utun5         UcI                 utun5
fe80::45fd:9b8d:44cd:c1db%utun5         link#21                                 UHLI                  lo0
ff00::/8                                ::1                                     UmCI                  lo0
ff00::/8                                link#11                                 UmCI                  en0
ff00::/8                                link#13                                 UmCI                  en6
ff00::/8                                link#14                                 UmCI                awdl0
ff00::/8                                link#15                                 UmCI                 llw0
ff00::/8                                fe80::4704:bc84:c8d8:1b49%utun0         UmCI                utun0
ff00::/8                                fe80::e60d:3088:1bf0:febe%utun1         UmCI                utun1
ff00::/8                                fe80::f55d:6be5:ea47:e13d%utun2         UmCI                utun2
ff00::/8                                fe80::ce81:b1c:bd2c:69e%utun3           UmCI                utun3
ff00::/8                                fe80::137a:f93:d053:1c47%utun4          UmCI                utun4
ff00::/8                                fe80::45fd:9b8d:44cd:c1db%utun5         UmCI                utun5
ff01::%lo0/32                           ::1                                     UmCI                  lo0
ff01::%en0/32                           link#11                                 UmCI                  en0
```

Use Case:

Troubleshooting routing issues and verifying static routes.

15. traceroute <IP/hostname>

Explanation:

Sends ICMP packets with increasing TTL values to identify each hop.

Output:

```
tashikmiddha@Tashiks-MacBook-Air ~ % traceroute google.com
traceroute to google.com (142.251.43.110), 64 hops max, 40 byte packets
 1  10.10.32.1 (10.10.32.1)  1.911 ms  7.521 ms  1.926 ms
 2  172.16.1.1 (172.16.1.1)  0.311 ms  0.508 ms  0.358 ms
 3  115.248.191.1 (115.248.191.1)  0.766 ms  0.863 ms  0.688 ms
 4  220.224.180.30 (220.224.180.30)  2.370 ms  2.552 ms  2.339 ms
 5  220.224.180.29 (220.224.180.29)  2.162 ms  2.388 ms  2.134 ms
 6  72.14.211.230 (72.14.211.230)  3.277 ms  3.557 ms  3.340 ms
 7  * * *
 8  142.251.76.194 (142.251.76.194)  4.761 ms
    142.251.76.192 (142.251.76.192)  3.572 ms
    142.251.52.212 (142.251.52.212)  4.250 ms
 9  142.251.54.89 (142.251.54.89)  3.523 ms
    216.239.54.92 (216.239.54.92)  3.362 ms
    216.239.50.22 (216.239.50.22)  4.498 ms
10  bkk02s03-in-f14.1e100.net (142.251.43.110)  3.500 ms  3.367 ms  3.278 ms
```

Use Case:

Diagnosing routing problems and network delays.

12. pathping <IP/hostname>

- **Purpose:** Combines ping and tracert to show packet loss and latency at each hop.
- **Explanation:** Sends packets to each router on the path and calculates statistics, making it superior to tracert for identifying *where* packet loss occurs.
- **Use Case:** Identifying problematic routers or links causing high latency or packet loss.

13. ping <IP/hostname>

- **Purpose:** Sends ICMP packets to a destination to measure round-trip time and packet loss, confirming basic connectivity.
- **Explanation:** This command measures round-trip time and packet loss.
- **Use Case:** Basic connectivity test and latency measurement.

14. route print

- **Purpose:** Shows the local **IP routing table**.
- **Explanation:** Displays network routes, including destination, gateway, interface, and metric (cost).
- **Use Case:** Troubleshooting routing issues and verifying static routes.

15. tracert <IP/hostname>

- **Purpose:** Identifies the path (hops) taken from source to destination.

- **Explanation: Trac**e **R**out**e** sends ICMP packets with increasing **Time-to-Live (TTL)** values to map the network path.
- **Use Case:** Diagnosing routing problems and identifying where network delays begin.

PROCEDURE

1. Open the **Command Prompt** or **PowerShell** window. (Running as Administrator is recommended for commands that modify network state like ipconfig /release).
2. Execute each command listed above, replacing <IP/hostname> with a relevant target (e.g., your router's IP address or an external site like google.com).
3. Observe the output for each command and note the relevant network details.
4. For state-changing commands (ipconfig /release, ipconfig /renew), observe the change in configuration by running ipconfig before and after.

SUMMARY OF COMMAND CATEGORIES

- **IP Configuration:** ipconfig, ipconfig /all, ipconfig /renew, ipconfig /release — Used to view and manage IP settings.
- **Address Resolution:** arp -a, nbtstat -a — Used to map IP to MAC address and perform NetBIOS name resolution.
- **Connectivity Testing:** ping, tracert, pathping — Used to test reachability and trace the route/path to a destination.
- **DNS Resolution:** nslookup, ipconfig /flushdns — Used to resolve domain names and manage the local DNS cache.
- **Network Statistics:** netstat -an, route print — Used to view active connections, listening ports, and the routing table.
- **Diagnostics:** netsh diag show test — Used for comprehensive network diagnostics.
- **System Info:** hostname — Used to identify the local machine name.

CONCLUSION

Basic networking commands are **indispensable tools** for network management and troubleshooting in the Windows environment. They provide **visibility** into network configurations, connectivity status, routing paths, and DNS resolution. Proficiency in these commands enables IT professionals to quickly diagnose and resolve network issues, ensuring reliable and secure network operations.