Detailed Report on Network Cable Preparation, IP Configuration, and Network Tools

Bachelor of Technology
Computer Science and Engineering

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Detailed Report on Networking Concepts and Tools

1. CAT-5/CAT-6 Cable Preparation with RJ-45 Connector

A. Introduction

CAT-5 and CAT-6 cables are twisted pair cables used in networking for connecting devices like computers, routers, and switches. These cables use RJ-45 connectors for termination.

B. Tools Required

i) CAT-5/CAT-6 cable

ii) RJ-45 connectors

iii) Crimping tool

iv) Cable stripper

v) Network tester

C. Wiring Standards

There are two standards for Ethernet cabling:
   (a) TIA/EIA-568A (T568A)
   (b) TIA/EIA-568B (T568B)

D. Used for connecting different devices (PC to switch, switch to router). The wire order remains the same on both ends.

i) Straight-through cable: Used to connect different types of devices (e.g., PC to switch, switch to router).

ii) Crossover cable: Used to connect similar devices (e.g., PC to PC, switch to switch).

Straight-Through Wiring (T568B Standard)

Pin	Colour
1	Orange-White

2	Orange
3	Green-White
4	Blue
5	Blue-White
6	Green
7	Brown-White
8	Brown

Crossover Wiring (T568A on One End, T568B on Other)

Pin (End 1 - T568A)	Pin (End 2 - T568B)
1 (Green-White)	1 (Orange-White)
2 (Green)	2 (Orange)
3 (Orange-White)	3 (Green-White)
4 (Blue)	4 (Blue)
5 (Blue-White)	5 (Blue-White)
6 (Orange)	6 (Green)
7 (Brown-White)	7 (Brown-White)
8 (Brown)	8 (Brown)

E. Steps to Crimp an RJ-45 Connector

i) Strip about 1 inch of the cable's outer sheath.

ii) Untwist and arrange the wires according to the desired standard.

iii) Insert the wires into the RJ-45 connector.

iv) Use the crimping tool to secure the connector.

v) Test the cable using a network tester.

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2. IP Address Configuration (Static and DHCP) on Linux and Windows

A. Windows Configuration

i) Static IP Configuration

(a) Open Control Panel → Network and Sharing Centre → Change adapter settings.

(b) Right-click on the network adapter → Properties.

(c) Select "Internet Protocol Version 4 (TCP/IPv4)" → Properties.

(d) Select "Use the following IP address" and enter details.

(e) Click "OK" to apply changes.

ii) DHCP Configuration

(a) Follow steps 1-3 above.

(b) Select "Obtain an IP address automatically".

(c) Click "OK" to apply changes.

iii) Linux IP Configuration
(a) Static IP Configuration (Ubuntu/Debian)

- Open Terminal.

- Edit network configuration:

```
sudo nano /etc/netplan/00-installer-config.yaml
```

- Add the following:

```
network:
  ethernets:
    eth0:
      dhcp4: no
      addresses: [192.168.1.100/24]
      gateway4: 192.168.1.1
      nameservers:
        addresses: [8.8.8.8, 8.8.4.4]
    version: 2
```

- Save and exit. Restart the network service:

```
sudo netplan apply
```

(b) DHCP Configuration

- Modify /etc/netplan/00-installer-config.yaml

```
network:
  ethernets:
    eth0:
      dhcp4: true
    version: 2
```

- Apply changes:

```
sudo netplan apply
```

3. Important Network Tools and Commands

A. ipconfig (Windows)

Displays network configuration details.

```
ipconfig /all
```

Example output:

```
IPv4 Address: 192.168.1.100

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.1.1
```

B. ifconfig (Linux)

Displays network interface information.

```
iconfig
```

Example output:

```
abhirup ~ via C v13.3.0-gcc took 1s
X ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1400
        inet 172.31.240.53  netmask 255.255.240.0  broadcast 172.31.255.255
        inet6 fe80::215:5dff:feaa:b4c4  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:aa:b4:c4  txqueuelen 1000  (Ethernet)
        RX packets 822  bytes 540053 (540.0 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 443  bytes 49210 (49.2 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 40069  bytes 53568550 (53.5 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 40069  bytes 53568550 (53.5 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

C. ip (Linux)

Displays and configures IP addresses.

```
 abhirup ~ via C v13.3.0-gcc took 0s
● > ip a
 1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
     link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
     inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
     inet 10.255.255.254/32 brd 10.255.255.254 scope global lo
        valid_lft forever preferred_lft forever
     inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
 2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1400 qdisc mq state UP group default qlen 1000
     link/ether 00:15:5d:aa:b4:c4 brd ff:ff:ff:ff:ff:ff
     inet 172.31.240.53/20 brd 172.31.255.255 scope global eth0
        valid_lft forever preferred_lft forever
     inet6 fe80::215:5dff:feaa:b4c4/64 scope link
        valid_lft forever preferred_lft forever
```

D. hostname

Displays or sets the system's hostname.

```
 abhirup ~ via C v13.3.0-gcc took 0s
● > hostnamectl
  Static hostname: LAPTOP-KIQ8R4C3
        Icon name: computer-container
          Chassis: container ▢
       Machine ID: 43fa5164d3e345a094d99daf4d495ff8
          Boot ID: 40eb6247b3d44960a18bb92917b5fd26
   Virtualization: wsl
 Operating System: Ubuntu 24.04.1 LTS
           Kernel: Linux 5.15.167.4-microsoft-standard-WSL2
     Architecture: x86-64
```

E. ping

Tests network connectivity.

Example:

ping 10.10.101.135

```
 abhirup ~ via C v13.3.0-gcc took 0s
 > ping 10.10.101.135
PING 10.10.101.135 (10.10.101.135) 56(84) bytes of data.

--- 10.10.101.135 ping statistics ---
10 packets transmitted, 0 received, 100% packet loss, time 9791ms
```

F. netstat

Displays network connections and statistics.

```
abhirup ~ via C v13.3.0-gcc took 0s
> netstat -tulnp
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address          Foreign Address        State       PID/Program name
tcp        0      0 127.0.0.1:43433        0.0.0.0:*              LISTEN      22172/node
tcp        0      0 127.0.0.54:53          0.0.0.0:*              LISTEN      -
tcp        0      0 127.0.0.53:53          0.0.0.0:*              LISTEN      -
tcp        0      0 10.255.255.254:53      0.0.0.0:*              LISTEN      -
udp        0      0 127.0.0.54:53          0.0.0.0:*                          -
udp        0      0 127.0.0.53:53          0.0.0.0:*                          -
udp        0      0 10.255.255.254:53      0.0.0.0:*                          -
udp        0      0 127.0.0.1:323          0.0.0.0:*                          -
udp6       0      0 ::1:323                :::*                                -
```

G. route

Displays/manages routing table.

```
abhirup ~ via C v13.3.0-gcc took 0s
> route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         172.31.240.1    0.0.0.0         UG    0      0        0 eth0
172.31.240.0    0.0.0.0         255.255.240.0   U     0      0        0 eth0
```

H. traceroute (Linux) / tracert (Windows)

Traces the route packets take to a destination.

```
 abhirup ~ via C v13.3.0-gcc took 0s
⊗ > traceroute google.com
 traceroute to google.com (142.250.194.110), 64 hops max
    1    172.31.240.1  0.538ms  0.545ms  0.365ms
    2    192.168.129.135  7.558ms  4.332ms  3.566ms
    3    *  *  *
    4    *  *  *
    5    *  *  *
    6    *  *  *
    7    *  *  *
    8    *  *  *
    9    *  *  *
   10    *  * ^C
```

I. tcpdump

Captures and analyzes network traffic (Linux).

```
 abhirup ~ via C v13.3.0-gcc took 0s
⊗ > tcpdump -i eth0
 tcpdump: eth0: You don't have permission to perform this capture on that device
 (socket: Operation not permitted)
```

J. Wireshark

Graphical tool for analyzing network packets.

4. Open Wireshark.

A GUI-based network packet analyzer.

- Open Wireshark.

- Select the network interface.

- Start packet capture.

- Apply filters (e.g., tcp.port == 80).

5. Conclusion

This report covered the preparation of network cables, IP address configuration, and essential networking tools. Understanding these basics is crucial for network administration and troubleshooting.

6. References

- ANSI/TIA-568.2-D (TIA)
- IEEE 802.3 (IEEE)
- RFC 791 (IETF)
- RFC 2131 (IETF)
- RFC 792 (IETF)
- Microsoft Official Documentation (Microsoft Docs)
- Linux Man Pages
- Wireshark User Guide (Wireshark Docs)