

# ROUTING & FULL NETWORKING

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## Basics of Networking

- ◆ What is a network?
  - ◆ Types: LAN, WAN, MAN, WLAN
  - ◆ IP Address, MAC, DNS, ports
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## Subnetting and CIDR

- ◆ What is subnetting?
  - ◆ Subnet mask and CIDR
  - ◆ IP range, broadcast address
  - ◆ Linux tool: `ipcalc`
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## How Routing Works (Static vs Dynamic)

### ◆ What is Routing?

Routing is how data finds its way from one network to another — like GPS for internet traffic.

There are two types:

### 1. Static Routing

- Manually added by the network admin
- Used in small/simple networks

Example in Linux:

```
sudo ip route add 192.168.2.0/24 via 192.168.1.1
```

### 2. Dynamic Routing

- Routes learned automatically
- Uses protocols like:
  - **RIP** – simple, slow

- **OSPF** – fast and smart (open)
  - **BGP** – used on the internet (between ISPs)
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## How DNS & DHCP Work

### ◆ DNS (Domain Name System)

Converts **domain names** (e.g., google.com) into **IP addresses**.

- Uses **port 53**
- Type of queries: A (IPv4), AAAA (IPv6), MX (mail), CNAME (alias)

🔧 Test it:

```
nslookup google.com
dig google.com
```

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### DHCP (Dynamic Host Configuration Protocol)

Assigns **IP addresses automatically** to devices in a network.

- Uses **port 67 (server)** and **68 (client)**
  - Gives:
    - IP
    - Gateway
    - DNS
    - Subnet mask
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## Network Security Basics

### 1. Firewall

- Blocks or allows traffic
- Linux firewall tool: `ufw` or `iptables`

Examples:

```
sudo ufw allow 22      # allow SSH
sudo ufw deny 80       # block HTTP
```

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### 2. NAT (Network Address Translation)

Translates **private IP** to **public IP** so internal devices can access the internet.

Example:  
Your home router uses NAT to let all your devices use one public IP.

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### 3. VPN (Virtual Private Network)

Creates a **secure encrypted tunnel** between your computer and a remote server.

- Protects data
  - Hides real IP
  - Often used for privacy and remote work
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## OSI Model (7 Layers of Networking)

Layer	Name	Example
7	Application	Browser, FTP, SSH
6	Presentation	Encryption (SSL, TLS)
5	Session	Sessions (TCP sessions)
4	Transport	TCP/UDP
3	Network	IP, routing
2	Data Link	MAC, Ethernet
1	Physical	Cables, Wi-Fi signals

✓ You only interact with **Layer 7** (App), but issues can happen at any level.

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## Linux Networking Tasks (Hands-On)

Task	Command
Check IP address	<code>ip a</code> or <code>ifconfig</code>
Check DNS server	<code>cat /etc/resolv.conf</code>
Test internet	<code>ping 8.8.8.8</code>
Show routing table	<code>ip r</code> or <code>route -n</code>
Restart network	<code>sudo systemctl restart networking</code>
Show open ports	<code>sudo netstat -tuln</code> or <code>ss -tuln</code>

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## Common Tools for Practice

Tool	Use
ping	Check connectivity
tracert	Show path to destination
dig / nslookup	DNS lookup
nmap	Port scanning / discover open ports
tcpdump	Capture packets (advanced)
netstat / ss	Show sockets and open ports
Wireshark	GUI tool for packet analysis

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## Common Port Numbers

Service	Port	Protocol
HTTP	80	TCP
HTTPS	443	TCP
SSH	22	TCP
FTP	21	TCP
DNS	53	UDP/TCP
DHCP	67/68	UDP

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## Summary Checklist

- ✓ Networking basics
  - ✓ Subnetting & CIDR
  - ✓ Routing (static/dynamic)
  - ✓ DNS & DHCP
  - ✓ Network Security (firewall, NAT, VPN)
  - ✓ OSI Model
  - ✓ Linux hands-on networking
  - ✓ Tools and real-world tasks
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