

ROUTING & FULL NETWORKING

Basics of Networking

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

Subnetting and CIDR

- ◆ What is subnetting?
 - ◆ Subnet mask and CIDR
 - ◆ IP range, broadcast address
 - ◆ Linux tool: `ipcalc`
-

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)
-

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
```

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

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
```

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.

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
-

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.

Linux Networking Tasks (Hands-On)

Task	Command
Check IP address	<code>ip a or 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 or route -n</code>
Restart network	<code>sudo systemctl restart networking</code>
Show open ports	<code>sudo netstat -tuln or ss -tuln</code>

Common Tools for Practice

Tool	Use
ping	Check connectivity
traceroute	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

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

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
-