



Networking Fundamentals

OSI Model

Layer 7: Application	Provides network services to applications. (e.g., HTTP, SMTP, DNS)
Layer 6: Presentation	Deals with data representation, encryption, and decryption. (e.g., SSL/TLS)
Layer 5: Session	Manages connections between applications. (e.g., session establishment, termination)
Layer 4: Transport	Provides reliable or unreliable data delivery. (e.g., TCP, UDP)
Layer 3: Network	Handles routing of data packets. (e.g., IP)
Layer 2: Data Link	Provides error-free transmission of data frames. (e.g., Ethernet, MAC addresses)
Layer 1: Physical	Deals with physical transmission of data. (e.g., cables, connectors)

Common Protocols

TCP	Transmission Control Protocol - Reliable, connection-oriented protocol.
UDP	User Datagram Protocol - Unreliable, connectionless protocol.
IP	Internet Protocol - Responsible for addressing and routing packets.
HTTP	Hypertext Transfer Protocol - Used for web communication.
HTTPS	HTTP Secure - Secure web communication using SSL/TLS.
DNS	Domain Name System - Translates domain names to IP addresses.
DHCP	Dynamic Host Configuration Protocol - Automatically assigns IP addresses to devices.

IP Addressing

IP addresses are logical addresses assigned to network interfaces.
IPv4: 32-bit address (e.g., 192.168.1.1)
IPv6: 128-bit address (e.g., 2001:db8::1)
Subnet Mask: Used to determine the network and host portions of an IP address. (e.g., 255.255.255.0)
CIDR Notation: Represents the subnet mask as a suffix to the IP address. (e.g., 192.168.1.0/24)
Private IP Addresses: Used within private networks (e.g., 10.0.0.0/8, 172.16.0.0/12, 192.168.0.0/16)
Public IP Addresses: Used on the internet and are globally routable.

System Administration Basics

User Management (Linux)

<code>useradd <username></code>	Create a new user account.
<code>passwd <username></code>	Set or change the password for a user.
<code>userdel <username></code>	Delete a user account.
<code>usermod</code>	Modify a user account
<code>groupadd <groupname></code>	Create a new group.
<code>groupdel <groupname></code>	Delete a group.
<code>gpasswd -a <username> <groupname></code>	Add a user to a group.
<code>id <username></code>	Display user identity (UID, GID, groups).

File Permissions (Linux)

File permissions control access to files and directories.
Permissions: <code>r</code> (read), <code>w</code> (write), <code>x</code> (execute)
Users: <code>u</code> (user), <code>g</code> (group), <code>o</code> (others)
<code>chmod <permissions> <file></code> - Change file permissions.
Example: <code>chmod 755 myfile.sh</code> (rwxr-xr-x)
<code>chown <user>:<group> <file></code> - Change file ownership.
<code>ls -l</code> - List files with detailed permissions.

Process Management (Linux)

<code>ps</code>	Display running processes.
<code>top</code>	Display real-time system resource usage.
<code>kill <PID></code>	Terminate a process by its PID.
<code>pkill <processname></code>	Terminate a process by name.
<code>bg</code>	Move a process to the background.
<code>fg</code>	Move a process to the foreground.
<code>nohup <command> &</code>	Run a command that persists after logout.

Network Configuration

ifconfig/ip (Linux)

<code>ifconfig</code> (deprecated)	Display network interface configuration.
<code>ip addr show</code>	Display network interface addresses.
<code>ip link show</code>	Display network interface link status.
<code>ip route show</code>	Display routing table.
<code>ip addr add <ip>/<cidr> dev <interface></code>	Add an IP address to an interface.
<code>ip link set dev <interface> up</code>	Enable a network interface.
<code>ip link set dev <interface> down</code>	Disable a network interface.

netstat/ss

<code>netstat -tulnp</code> (deprecated)	Display listening TCP and UDP ports.
<code>ss -tulnp</code>	Display listening TCP and UDP ports (using <code>ss</code>).
<code>netstat -rn</code> (deprecated)	Display routing table.
<code>ss -s</code>	Display network statistics.

Firewall (iptables/firewalld)

iptables (legacy):
<code>iptables -L</code> - List firewall rules.
<code>iptables -A INPUT -p tcp --dport 22 -j ACCEPT</code> - Allow SSH traffic.
<code>iptables -P INPUT DROP</code> - Set default policy to drop incoming traffic.
firewalld (modern):
<code>firewall-cmd --state</code> - Check firewall status.
<code>firewall-cmd --zone=public --add-port=80/tcp --permanent</code> - Allow HTTP traffic.
<code>firewall-cmd --reload</code> - Apply changes.

Troubleshooting

Network Troubleshooting

<code>ping <host></code>	Check network connectivity to a host.
<code>traceroute <host></code>	Trace the route packets take to reach a host.
<code>nslookup <domain></code>	Query DNS servers to resolve domain names.
<code>tcpdump -i <interface> <filter></code>	Capture and analyze network traffic.
<code>wireshark</code>	Graphical network protocol analyzer.
<code>mtr <host></code>	Combines ping and traceroute functionality.

System Troubleshooting

<code>dmesg</code>	Display kernel messages (useful for hardware issues).
<code>journalctl</code>	Query systemd journal logs.
<code>free -m</code>	Display memory usage.
<code>df -h</code>	Display disk space usage.
<code>uptime</code>	Show system uptime and load averages.
<code>vmstat</code>	Report virtual memory statistics.

Log Analysis

Log files provide valuable information for troubleshooting and security analysis.

Common Log Locations (Linux):

`/var/log/syslog` or `/var/log/messages` - System logs

`/var/log/auth.log` - Authentication logs

`/var/log/apache2/` or `/var/log/nginx/` - Web server logs

`grep <pattern> <logfile>` - Search for specific patterns in log files.

`tail -f <logfile>` - Monitor a log file in real-time.

`awk` and `sed` - Powerful text processing tools for log analysis.