

# Comprehensive Network Administration Guide

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November 18, 2024

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# 1 IP Address Assignment

## 1.1 Types of Address Assignment

- **Manual** → Static assignment
- **Dynamic** → DHCP server

## 1.2 Network Configuration Commands

```
# Display all network interfaces
ifconfig -a
# Show routing table
route -n
ip route show

# Network configuration files
# Ubuntu/Debian:
/etc/network/interfaces
# CentOS/RHEL:
/etc/sysconfig/network-scripts/

# Restart networking service
systemctl restart networking
```

## 1.3 Secure Shell (SSH)

- Remote management protocol (TCP/22)
- Encrypted communication

```
# Install SSH server
apt-get install openssh-server # Debian/Ubuntu
yum install openssh-server     # CentOS/RHEL

# Check listening ports
netstat -ntulp
n -> numeric      t -> TCP
u -> UDP          l -> listening
p -> PID

# DNS configuration
cat /etc/resolv.conf

# Generate UUID for network interfaces
uuidgen
```

# 2 DHCP Server Configuration

## 2.1 ISC DHCP Server Setup

```
# Configure DHCP server interface
vi /etc/default/isc-dhcp-server
INTERFACES="interface_name"

# DHCP configuration file
vi /etc/dhcp/dhcpd.conf
# Set IP range, DNS, reservations

# Manage DHCP service
```

```
systemctl restart isc-dhcp-server
systemctl status isc-dhcp-server

# Check DHCP port
netstat -ntulp | grep :67

# Remove packages
apt-get remove package_name
apt-get purge package_name

# DHCP logs
cat /var/log/syslog | grep -i dhcp
cat /var/lib/dhcp/dhcpd.leases
```

## 3 Name Resolution

### 3.1 Types of Name Servers

- **DNS Server (BIND):** FQDN/DNS name → IP
- **WINS Server:** NetBIOS → IP

### 3.2 Local Name Resolution

```
# Local hosts file
vi /etc/hosts

# Name service switch configuration
vi /etc/nsswitch.conf
```

## 4 BIND DNS Server

### 4.1 DNS Concepts

- **FQDN Structure:** www.example.com.
- **Local DNS Server:** Forwarding/Recursive
- **DDNS:** Dynamic DNS
- **Master/Slave DNS:** Zone transfer

### 4.2 DNS Query Tools

```
nslookup example.com
host example.com
dig example.com
dig @DNS_SERVER_IP example.com
```

### 4.3 Resource Records

- **SOA:** Start of Authority (Zone transfer)
- **NS:** Name Server (Authoritative)
- **A:** IPv4 address record
- **AAAA:** IPv6 address record
- **PTR:** Reverse lookup

- **MX:** Mail exchange
- **CNAME:** Alias/Canonical name
- **TXT/SPF:** Text records

## 4.4 BIND Installation and Configuration

```
# Install BIND
apt-get install bind9 bind9utils      # Debian/Ubuntu
yum install bind bind-utils           # CentOS/RHEL

# Check installed packages
rpm -qa | grep bind                  # CentOS/RHEL

# Main configuration files
vi /etc/bind/named.conf.options
vi /etc/bind/named.conf.local

# Enable recursion
recursion yes;

# Reload configuration
rndc reload
systemctl restart bind9
systemctl status bind9
```

## 4.5 Master DNS Server Setup

```
# Zone configuration
zone "example.com" {
    type master;
    file "/etc/bind/db.example.com";
};

# Create zone database file
vi /etc/bind/db.example.com

$TTL 3600
@ IN SOA example.com. root.example.com. (
    10      ; Serial
    1200    ; Refresh
    300     ; Retry
    86400   ; Expire
    3600 )  ; Minimum TTL

@      IN NS      ns1.example.com.
ns1    IN A       192.168.56.10
www    IN A       192.168.56.60
ftp    IN A       192.168.56.70
```

## 4.6 Reverse DNS Zone

```
# Reverse zone configuration
zone "56.168.192.in-addr.arpa" {
    type master;
    file "/etc/bind/db.56.168.192";
};

# PTR records
10 IN PTR ns1.example.com.
```

```
60 IN PTR www.example.com.
70 IN PTR ftp.example.com.

# Test reverse lookup
dig @localhost -x 192.168.56.60
```

## 4.7 Time Zone Configuration

```
# Debian/Ubuntu
vi /etc/timezone
Asia/Tehran

cp /usr/share/zoneinfo/Iran /etc/localtime

# CentOS/RHEL
timedatectl list-timezones
timedatectl set-timezone Asia/Tehran
timedatectl
```

## 4.8 Slave DNS Server Configuration (CentOS)

```
vi /etc/named.conf

# Listen on all interfaces
listen-on port 53 { any; };

# Allow queries from any
allow-query { any; };

# Slave zone configuration
zone "example.com" {
    type slave;
    masters { 192.168.56.10; };
    file "slaves/db.example.com";
};

# Enable named service on boot
systemctl enable named
systemctl disable named
```

## 4.9 DNSSEC with TSIG

```
# Generate TSIG key
cd /etc/bind
dnssec-keygen -a HMAC-MD5 -b 128 -n HOST transferkey

# Create key file
vi /etc/bind/named.conf.tsig
key "transferkey" {
    algorithm HMAC-MD5;
    secret "KEY_STRING";
};

# Include in main config
include "/etc/bind/named.conf.tsig";

# Configure zone transfer
allow-transfer { key "transferkey"; };
```

## 5 Apache Web Server

### 5.1 Virtual Hosting Methods

1. Different IP addresses
2. Same IP, different ports
3. Same IP and port, different hostnames (Name-based)

### 5.2 Apache Installation

```
# Debian/Ubuntu
apt-get install apache2

# CentOS/RHEL
yum install httpd

# Configuration directories
/etc/apache2/          # Debian/Ubuntu
/etc/httpd/            # CentOS/RHEL
```

### 5.3 Virtual Host Configuration

```
# Debian/Ubuntu structure
/etc/apache2/sites-available/
/etc/apache2/sites-enabled/

# Enable site
a2ensite example.conf
systemctl reload apache2

# Virtual host example
<VirtualHost 192.168.56.20:80>
    ServerName www.example.com
    DocumentRoot /var/www/example
</VirtualHost>
```

### 5.4 Authentication and Redirection

```
# Create password file
htpasswd -c /etc/apache2/.htpasswd username

# Directory protection
<Directory "/var/www/secure">
    AuthType Basic
    AuthName "Restricted Area"
    AuthUserFile /etc/apache2/.htpasswd
    Require valid-user
</Directory>

# URL redirection
Redirect /old /new
```

### 5.5 SSL/TLS Configuration

```
# Generate self-signed certificate
openssl req -x509 -nodes -days 365 -newkey rsa:2048 \
    -keyout /etc/httpd/private.key \
    -out /etc/httpd/public.crt
```

```
# Apache SSL configuration
SSLCertificateFile /etc/httpd/public.crt
SSLCertificateKeyFile /etc/httpd/private.key
```

## 6 SSH Configuration

### 6.1 Passwordless SSH Authentication

```
# Generate SSH key pair
ssh-keygen -t rsa

# Copy public key to remote server
ssh-copy-id user@remote_host

# Test connection
ssh user@remote_host
```

## 7 Routing

### 7.1 Route Types

- Network Route: 192.168.56.0/24
- Host Route: 192.168.56.20/32
- Default Route: 0.0.0.0/0

### 7.2 Enable IP Forwarding

```
# Temporary enable
echo 1 > /proc/sys/net/ipv4/ip_forward

# Permanent enable
vi /etc/sysctl.conf
net.ipv4.ip_forward = 1

# Apply changes
sysctl -p
```

## 8 Firewall Configuration

### 8.1 UFW (Ubuntu)

```
ufw status
ufw allow 22/tcp
ufw deny 23/tcp
ufw delete RULE_NUMBER
ufw reset
```

### 8.2 FirewallD (CentOS)

```
systemctl start firewalld
firewall-cmd --list-all
firewall-cmd --add-service=ssh --permanent
firewall-cmd --add-port=80/tcp --permanent
firewall-cmd --reload
```



## 9 iptables

### 9.1 iptables Tables and Chains

- **Tables:** filter, nat, mangle, raw, security
- **Built-in Chains:** INPUT, OUTPUT, FORWARD, PREROUTING, POSTROUTING

### 9.2 Common iptables Commands

```
# List rules
iptables -L -n -v
iptables -t nat -L

# Flush rules
iptables -F
iptables -t nat -F

# Save rules
iptables-save > /etc/iptables/rules.v4

# Restore rules
iptables-restore < /etc/iptables/rules.v4
```

### 9.3 Example Rules

```
# Block ICMP from specific IP
iptables -A INPUT -p icmp -s 192.168.56.20 -j REJECT

# Allow SSH from specific network
iptables -A INPUT -p tcp --dport 22 -s 192.168.56.0/24 -j ACCEPT

# Default policies
iptables -P INPUT DROP
iptables -P FORWARD DROP
iptables -P OUTPUT ACCEPT
```

### 9.4 NAT Configuration

```
# Masquerading (Internet sharing)
iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
iptables -A FORWARD -i eth1 -j ACCEPT

# Port forwarding
iptables -t nat -A PREROUTING -p tcp --dport 2222 \
-j DNAT --to-destination 192.168.56.30:22
```

## 10 DHCP Relay Agent

```
# DHCP server configuration
subnet 172.20.1.0 netmask 255.255.255.0 {
    range 172.20.1.111 172.20.1.120;
    option routers 172.20.1.2;
}

# DHCP relay configuration
apt-get install isc-dhcp-relay # Ubuntu
yum install dhcp               # CentOS
```

```
# Configure relay
vi /etc/default/isc-dhcp-relay
SERVERS="192.168.56.10"
INTERFACES="eth0_eth1"
```

## 11 LVM (Logical Volume Manager)

### 11.1 LVM Basic Operations

```
# Create physical volumes
pvcreate /dev/sdb1 /dev/sdc1

# Create volume group
vgcreate vg_data /dev/sdb1 /dev/sdc1

# Create logical volume
lvcreate -n lv_www -L 10G vg_data

# Create filesystem
mkfs.ext4 /dev/vg_data/lv_www

# Mount filesystem
mount /dev/vg_data/lv_www /var/www

# Extend logical volume
lvextend -L +5G /dev/vg_data/lv_www
resize2fs /dev/vg_data/lv_www
```

## 12 RAID Configuration

### 12.1 RAID Levels

- **RAID 0:** Striping (performance)
- **RAID 1:** Mirroring (redundancy)
- **RAID 5:** Distributed parity
- **RAID 10:** Mirroring + striping

### 12.2 Software RAID with mdadm

```
# Create RAID 1 array
mdadm --create --verbose /dev/md0 \
    --level=1 --raid-devices=2 /dev/sdb1 /dev/sdc1

# Create filesystem
mkfs.ext4 /dev/md0

# Monitor RAID status
cat /proc/mdstat
mdadm --detail /dev/md0

# Save configuration
mdadm --detail --scan > /etc/mdadm.conf
```

## 13 Samba File Sharing

### 13.1 Samba Server Configuration

```
# Install Samba
apt-get install samba smbclient # Ubuntu
yum install samba samba-client  # CentOS

# Configure Samba
vi /etc/samba/smb.conf

[shared]
    path = /srv/samba/shared
    valid users = @smbgroup
    read only = no
    create mask = 0775

# Add Samba user
smbpasswd -a username

# Restart service
systemctl restart smbd nmbd
```

## 14 Kernel Modules

### 14.1 Module Management

```
# List loaded modules
lsmod

# Module information
modinfo module_name

# Load module
modprobe module_name
insmod /path/to/module.ko

# Remove module
rmmod module_name
modprobe -r module_name

# Update module dependencies
depmod -a
```

## 15 Nginx Web Server

### 15.1 Nginx Installation and Configuration

```
# Install Nginx
apt-get install nginx # Ubuntu
yum install nginx     # CentOS

# Configuration structure
/etc/nginx/

# Test configuration
nginx -t

# Reload configuration
```

```
nginx -s reload
systemctl reload nginx
```

## 15.2 Nginx as Reverse Proxy

```
upstream backend {
    server backend1.example.com:8080;
    server backend2.example.com:8080;
    server backend3.example.com:8080;
}

server {
    listen 80;
    location / {
        proxy_pass http://backend;
    }
}
```

## 16 IPv6 Configuration

### 16.1 IPv6 Address Types

- **Global Unicast:** 2001:db8::/32
- **Link-local:** fe80::/64
- **Unique Local:** fd00::/8
- **Multicast:** ff00::/8

### 16.2 IPv6 Network Configuration

```
# Static IPv6 configuration
iface eth0 inet6 static
    address 2001:db8::10
    netmask 64

# IPv6 ping
ping6 2001:db8::1

# IPv6 DNS configuration
host example.com AAAA
dig example.com AAAA
```

## 17 FTP Server (vsftpd)

### 17.1 vsftpd Configuration

```
# Install vsftpd
apt-get install vsftpd # Ubuntu
yum install vsftpd     # CentOS

# Main configuration
vi /etc/vsftpd.conf

# Enable write access
write_enable=YES

# User access control
```

```
userlist_enable=YES
userlist_file=/etc/vsftpd.user_list
userlist_deny=NO

# Restart service
systemctl restart vsftpd
```

## 18 Fail2ban Intrusion Prevention

### 18.1 Fail2ban Configuration

```
# Install Fail2ban
apt-get install fail2ban

# Configuration files
/etc/fail2ban/jail.conf
/etc/fail2ban/jail.local

# Example SSH protection
[sshd]
enabled = true
port = ssh
filter = sshd
logpath = /var/log/auth.log
maxretry = 3
bantime = 600

# Manage service
systemctl restart fail2ban
fail2ban-client status
```

## 19 OpenVPN

### 19.1 OpenVPN Configuration

```
# Install OpenVPN
apt-get install openvpn # Ubuntu
yum install openvpn     # CentOS

# Generate static key
openvpn --genkey --secret static.key

# Server configuration
dev tun
ifconfig 10.8.0.1 10.8.0.2
secret static.key

# Client configuration
remote server.example.com
dev tun
ifconfig 10.8.0.2 10.8.0.1
secret static.key
```

## 20 NFS (Network File System)

### 20.1 NFS Server Configuration

```
# Install NFS server
apt-get install nfs-kernel-server # Ubuntu
yum install nfs-utils            # CentOS

# Export directory
vi /etc/exports
/shared *(rw, sync, no_subtree_check)

# Apply exports
exportfs -ra

# Start services
systemctl restart nfs-server
```

## 21 Squid Proxy Server

### 21.1 Squid Configuration

```
# Install Squid
apt-get install squid

# Basic configuration
vi /etc/squid/squid.conf

# Allow all clients
http_access allow all

# Cache configuration
cache_dir ufs /var/spool/squid 100 16 256

# Access control list
acl localnet src 192.168.0.0/16
http_access allow localnet

# Restart service
systemctl restart squid
```

## 22 Mail Server (Postfix, Dovecot)

### 22.1 Postfix Configuration

```
# Install Postfix
apt-get install postfix mailutils

# Main configuration
vi /etc/postfix/main.cf

# Test mail
echo "Test_message" | mail -s "Test" user@example.com

# Mail aliases
vi /etc/aliases
admin: user1, user2
newaliases
```

### 22.2 Dovecot IMAP/POP3

```
# Install Dovecot
apt-get install dovecot-imapd dovecot-pop3d

# Configuration
vi /etc/dovecot/conf.d/10-mail.conf
mail_location = maildir:~/Maildir

# SSL configuration
vi /etc/dovecot/conf.d/10-ssl.conf
ssl = required
ssl_cert = </etc/ssl/certs/dovecot.pem
ssl_key = </etc/ssl/private/dovecot.pem

# Restart service
systemctl restart dovecot
```

## 23 Monitoring Tools

### 23.1 Network Monitoring

```
# Port scanning
nmap localhost
nc -vz hostname port

# Bandwidth monitoring
iftop
nload

# Network testing
iperf -s # Server
iperf -c server_ip # Client
```