Lecture Two

Introduction to Network Operating Systems

Dr. Tarfa Yaseen Hamed
Department of Networks
College of Computer Science and Mathematics
University of Mosul
2025

What is an Operating System?

- **Definition**: An OS is system software that manages hardware and software resources.
- **Types**: Standalone OS (e.g., Windows, Linux) vs. Network OS (e.g., Windows Server, Linux-based NOS).

What is a Network Operating System?

- A NOS is an OS designed to manage network resources.
- Enables multiple computers to communicate and share resources.
- **Examples**: Windows Server, Linux (Ubuntu Server, Red Hat), Cisco IOS.

NOS vs. Standalone OS

- A **NOS** is optimized for managing multiple users and network resources, making it essential for businesses, data centers, and enterprise environments, whereas **standalone** OS are better suited for personal computing.

NOS vs. Standalone OS (cont.)

Feature	Standalone OS	Network OS
User Focus	Single user	Multi-user, multi-device
Resource Management	Local resources	Network resources
Security	Local security policies	Centralized security policies
Examples	Windows 11, macOS	Windows Server, Linux Server

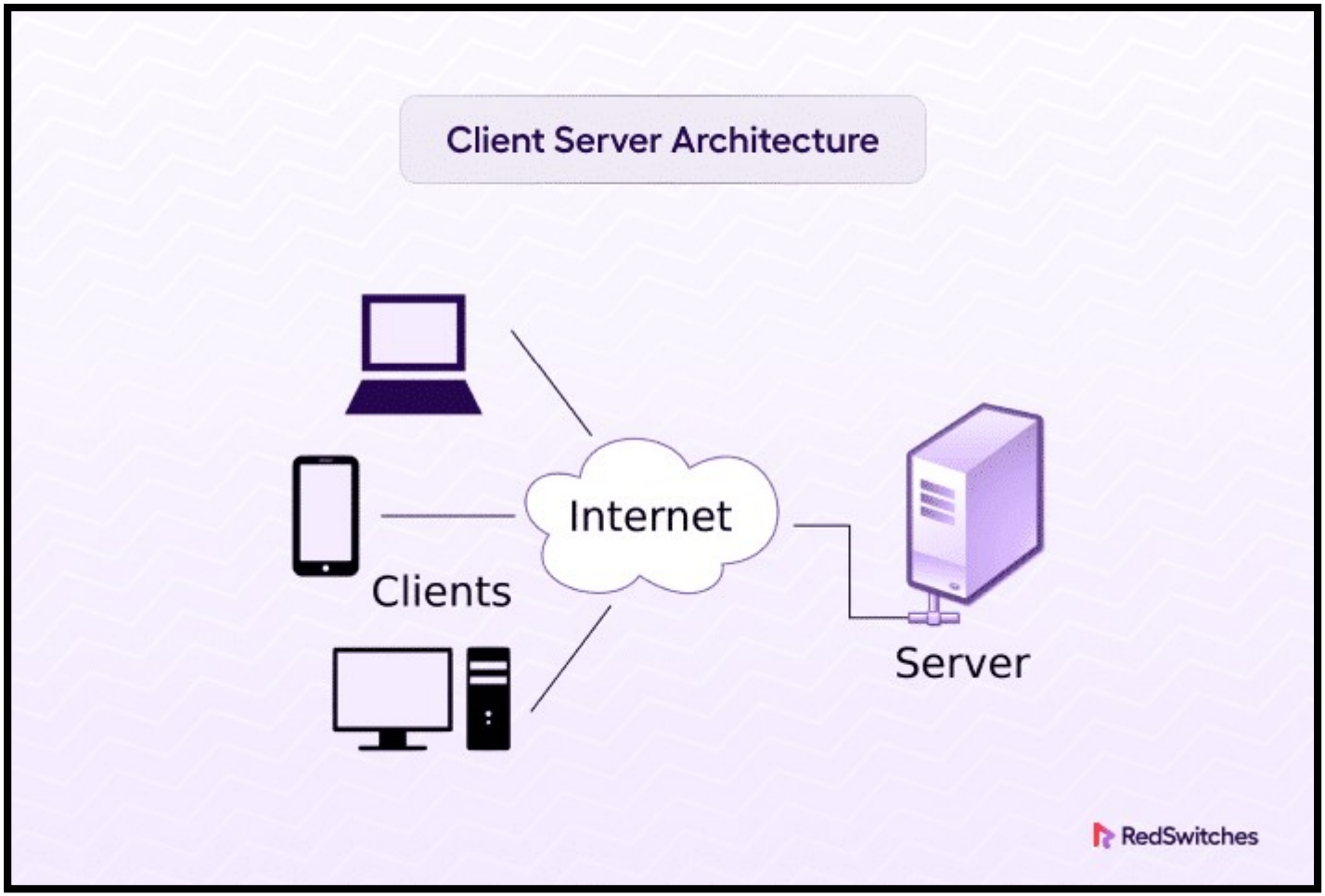
Key Functions of NOS

- Network Resource Management
- Multi-user Access & Authentication
- Security & Data Protection
- Remote Access
- Network Communication & Routing
- Performance Monitoring & Optimization

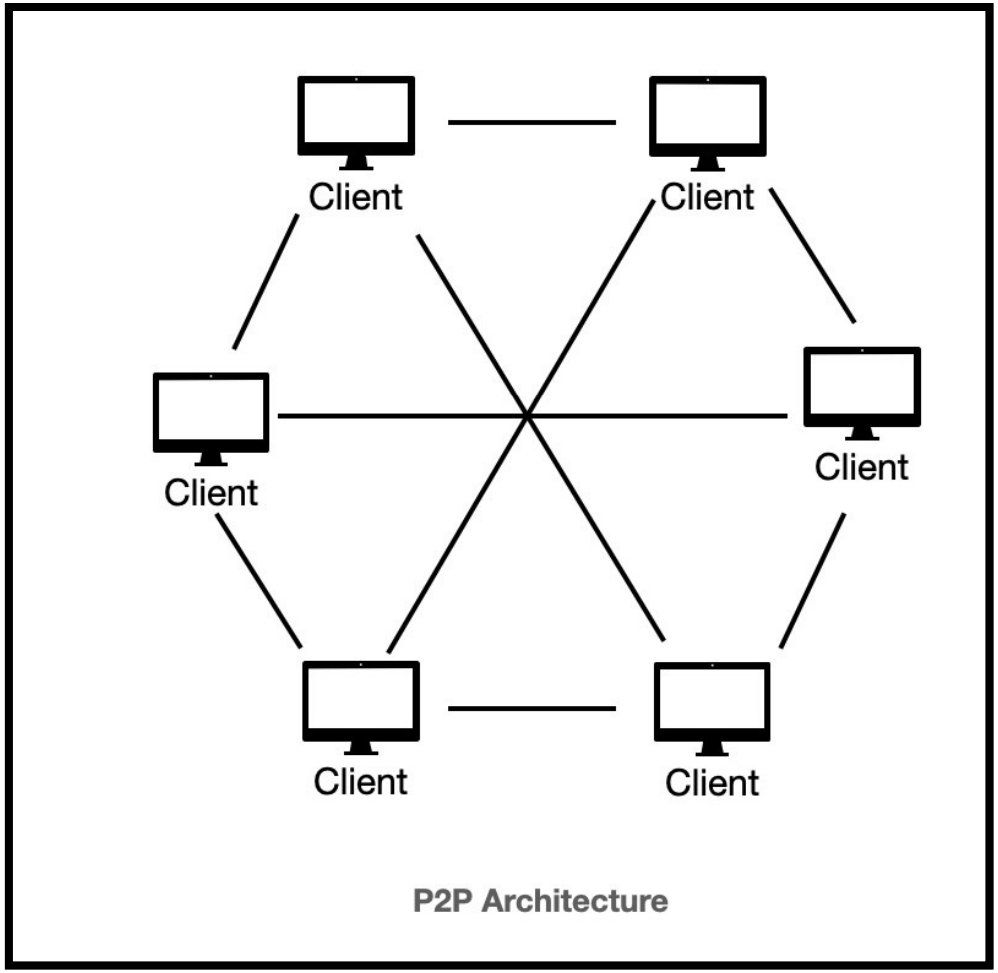
Architecture of a NOS

- Client-Server Model: Centralized control with client machines.
- Peer-to-Peer Model: Decentralized with equal devices.

Client-Server Model



Peer-to-Peer Model



Examples of NOS

- Microsoft Windows Server: Enterprise-grade server OS
- Linux-based NOS: Ubuntu Server, Red Hat Enterprise Linux
- Unix-based NOS: Solaris, FreeBSD
- Cisco IOS: Used in networking devices

Network Resource Management

- **File and Print Sharing:** Manages shared access to files and printers across the network, ensuring users have appropriate permissions.
- **User and Group Management**: Allows administrators to create, modify, and manage user accounts and group policies to control access and security.
- **Disk Quotas and Storage Management**: Monitors and allocates storage resources to prevent excessive usage and ensure optimal performance.

Network Resource Management (cont.)

- **Resource Allocation & Load Balancing**: Distributes network resources efficiently to prevent bottlenecks and maintain system performance.
- **Peripheral Device Management**: Controls and monitors network-attached devices such as scanners, printers, and external storage.

User Management in NOS

- **Authentication** (Usernames, Passwords, Multi-factor Authentication)
- **Authorization** (Permissions, Access Control Lists)
- User Roles and Policies

Security Features in NOS

- Firewalls & Intrusion Detection
- Encryption (TLS, SSL)
- VPN & Remote Access Security
- Role-based access control

Remote Access in NOS

- Remote Desktop Protocol (RDP)
- Secure Shell (SSH)
- Virtual Private Networks (VPNs)
- Web-based access portals

Remote Desktop Protocol (RDP)

- RDP is a protocol developed by Microsoft that allows users to remotely access and control a computer running Windows.
- It provides a graphical user interface (GUI) so you can see the desktop of the remote machine and interact with it as if you were sitting in front of it.

Secure Shell (SSH)

- A cryptographic network protocol that allows secure remote login and other secure network services over an unsecured network.
- It provides confidentiality, integrity, and authentication.

Virtual Private Networks (VPNs)

- A Virtual Private Network (VPN) extends a private network across a public network, such as the Internet.
- It enables users to send and receive data across shared or public networks as if their computing devices were directly connected to the private network.
- In a NOS context, a VPN allows secure access to network resources from remote locations.

Web-based access portals

- Web-based access portals provide a single point of entry for users to access various applications, resources, and information through a web browser.
- They offer a centralized and user-friendly interface, simplifying access and improving productivity.
- In a (NOS) context, these portals often provide access to network resources and administrative tools.

Network Communication & Protocols

- TCP/IP model
- Network Protocols (DHCP, DNS, FTP, SMTP, HTTP/HTTPS)
- Packet Switching & Routing
- Internet Printing Protocol (IPP)
  - Enables remote printing over networks or the internet.
  - Uses HTTP/HTTPS for communication.
  - Supports encryption, authentication, and print job management.
  - Commonly used in enterprise printing and CUPS (Common Unix Printing System).

Performance Monitoring in NOS

- Network Traffic Analysis
- Resource Utilization Monitoring
- Load Balancing & Fault Tolerance

Windows Server Overview

- **Features**: Active Directory, IIS, Hyper-V
- **Common Uses**: Enterprise Networks, Cloud Services

Linux-Based NOS Overview

- **Features**: Open-source, Secure, Flexible
- **Common Uses**: Web Servers, Data Centers

Case Study – Enterprise Network Setup

- A large organization with multiple departments using Windows Server and Linux-based NOS.
- Centralized authentication using Active Directory.
- Challenges faced:
  - **Scalability**: Managing increasing users and network traffic.
  - **Security Risks**: Ensuring data protection against cyber threats.
  - **Interoperability**: Integrating different operating systems and applications.
  - **Maintenance & Downtime**: Ensuring continuous network availability and quick recovery from failures.

Case Study – Enterprise Network Setup (cont.)

- Solutions and best practices for overcoming these challenges.
- A large organization with multiple departments using Windows Server and Linux-based NOS.
- Centralized authentication using Active Directory.

Future Trends in NOS

- **Cloud-based NOS solutions**: Enhancing scalability and reducing infrastructure costs for businesses.
- **AI & Machine Learning in network management**: Improving automation, security, and predictive maintenance.
- **Edge Computing & IoT Integration**: Allowing faster processing and real-time decision-making for IT professionals managing large-scale networks.