



Network Operating Systems

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WHAT'S COVERED

In this lesson, you will learn how server operating systems (OSs) differ from those used on client systems, including server applications and server roles. You will also learn how some servers use virtualization to combine server functions on a single hardware device.

Specifically, this lesson will cover the following:

- 1. The Role of a Server Operating System**
 - 1a. Client Versus Server Operating Systems**
 - 1b. Server Applications**
 - 1c. Server Roles**
- 2. Server Virtualization**
 - 2a. Hypervisors**
 - 2b. Types of Server Virtualization**
- 3. Popular Server Operating Systems**
 - 3a. Windows Server**
 - 3b. Linux Server Distros**
 - 3c. Unix**

1. The Role of a Server Operating System

All modern OSs include features that enable a PC to participate in a workgroup (that is, a peer-to-peer network). This includes a protocol stack that supports the activities that happen at various levels of the OSI model, as well as drivers for communicating with network interface cards (NICs). All versions and editions of Windows include this support, for example, as do all versions of Linux, Unix, and macOS. So in that basic sense, every OS is a **network operating system (NOS)**.

However, when most people refer to an NOS, they mean a **server OS**. A server OS is designed to enable multiple admins to manage a network server, whereas a client OS is designed to enable an individual user to run applications and manage files.



TERMS TO KNOW

Network Operating System (NOS)

An OS designed to be used for networking.

Server OS

An OS designed to run a network server.

1a. Client Versus Server Operating Systems

Client OSs are designed for the convenience and ease of client users—in other words, people who are using the PC as a tool to do their work (or play). In a client OS such as Microsoft Windows, each PC has its own keyboard, mouse, and monitor, used by one person at a time. Typically, only one person is signed in at a time.



HINT

Windows does enable multiple users to be signed in, but you have to switch back and forth between them; simultaneous usage is not possible.



In contrast, most server OSs don't require a GUI—or even their own keyboard and monitor. Many servers run "headless," meaning it doesn't have its own input (keyboard, mouse) and output (monitor) devices. Instead, admins connect to a server via a terminal session and type commands to it from another PC. Most server OSs have GUI available as an option (and beginning-level network admins with small networks may find that helpful),

but it isn't required; the OS will enable an admin to perform all network administration duties from a command line.



TERM TO KNOW

Client OS

An OS designed to function on an individual user's personal computer.

1b. Server Applications

One common misconception that beginners have about server OSs is that they include all the software tools you will need to run any kind of network server. In most cases, that is not true. Just as a client OS doesn't contain all the apps you need to do your work, neither does a server OS.

However, depending on the server OS you acquire, it may come with a basic suite of server applications. (They typically won't all be installed by default; there will be a procedure you follow to select and install the optional components.) On some networks, those included apps may be sufficient.

1c. Server Roles

Another common misconception that beginners have is that a server OS is a multipurpose environment designed to run lots of different apps at once. That's a natural misconception to have if you think about a server as just a powerful version of a client, but it's not so. Traditionally, each physical server has one server OS installed, and it fulfills a single role in a network. For example, a server might be a print server or a file server or a web server, but it would not be all three at once. While servers do multitask (very well, in most cases), they do so to deliver a specific set of services to multiple connected clients at once—not to deliver many different types of services. Some common server roles include the following:

Server	Server Role
Web Server	Connects to the internet and responds to client requests for web pages and web-based application access
Mail Server	Stores and forwards incoming and outgoing email messages for a certain domain, such as the domain that the company owns
File Server	Stores files and responds to requests to access and manage those files
Database Server	Responds to queries and other requests from users to access stored information sets
Application Server	Makes applications remotely available to network users; application servers often also integrate with databases connected to the applications
Print Server	Enables multiple clients to access the services of multiple printers



TERMS TO KNOW

Web Server

A server that connects to the internet and responds to client requests for web pages and web-based application access.

Mail Server

A server that stores and forwards incoming and outgoing email messages for a certain domain, such as the domain that the company owns.

File Server

A server that stores files and responds to requests to access and manage those files.

Database Server

A server that responds to queries and other requests from users to access stored information sets.

Application Server

A server that makes applications remotely available to network users; application servers often also integrate with databases connected to the applications.

Print Server

A server that enables multiple clients to access the services of multiple printers.

2. Server Virtualization

In recent years, a new trend in server management called virtualization has become popular. **Virtualization** enables a single physical computer to have multiple OS instances installed, all running simultaneously. A **virtual machine** is an instance of an OS that runs independently of other OS instances running on the same hardware. You can even have a different server OS in each virtual machine. Then within each OS instance, you can set up a different kind of server.

The following are some of the benefits of server virtualization.

- Low licensing expense for the server software (if not using free software)
- Low power usage because you are using less hardware
- Ease of administration because you don't have to sign in to many different physical servers to manage them
- Less space required for servers and their racks and cooling equipment
- Low hardware maintenance and replacement expense



TERMS TO KNOW

Virtualization

A technology that enables a single physical computer to have multiple OS instances installed, all running simultaneously.

Virtual Machine

An instance of an OS that runs independently of other OS instances running on the same hardware.

2a. Hypervisors

A **hypervisor**, also called a virtual machine manager (VMM), is software that manages virtual machines. There are two types, and they are described in the table below.

Hypervisor	Description
Type 1 Hypervisor	This is also called a bare-metal hypervisor. You can install it as the OS on the server hardware. Then, you can create multiple virtual machines and install a server OS on each of them. (Each one can have a different OS.) Most businesses running multiple virtual machines for servers use this type because it has less overhead (since it doesn't have to run a full-fledged copy of a server OS as a platform), so more processing resources are left for the virtual machines.
Type 2 Hypervisor	This is an app that runs within the server's OS. In this scenario, the server's OS is the host. That app is then used to create and manage multiple virtual machines, each of which is referred to as a guest. This type is often used on client PCs that want to run additional OSs.



TERMS TO KNOW

Hypervisor

Software that manages virtual machines.

Type 1 Hypervisor

A hypervisor that interacts directly with the hardware, without relying on a host OS. Also called a bare-metal hypervisor.

Type 2 Hypervisor

A hypervisor that runs as an app in a host OS.

2b. Types of Server Virtualization

Server virtualization can be implemented in the ways described below.

Full Virtualization: This method uses a hypervisor to manage multiple virtual machines. The virtual machines do not need to be aware of each other because the hypervisor is aware of all of them. The hypervisor can manage resources among the virtual machines.

- Benefits: It supports all guest OSs without any modifications. Each virtual machine is very portable and compatible and can be moved to a different server easily.
- Drawbacks: The hypervisor requires a certain amount of resources to operate. This method is slower and less secure than paravirtualization.

Paravirtualization: This method is similar to full virtualization, except each virtual machine is aware of the presence of other virtual machines.

- Benefits: The servers in each of the virtual machines can work together to manage resources. This method is faster and more secure than full virtualization.
- Drawbacks: The virtual machines are not easily portable because the guest OSs are configured for the specific hardware of the host machine.

OS-Level Virtualization: This method, also known as containerization, can be used when the server OS includes virtualization capabilities. In other words, the host OS supplies multiple, independent instances of itself in containers to each virtual machine. It doesn't require a hypervisor per se because the OS takes on that role.

- Benefits: Less overhead, since you don't have to run multiple copies of server OSs at once.
- Drawbacks: Each virtual machine has the same OS (the host OS). So, for example, you can't have some Linux and some Windows Server virtual machines.



TERMS TO KNOW

Full Virtualization

Virtualization in which each virtual machine is unaware of the others and functions independently.

Paravirtualization

Type 1 virtualization in which each virtual machine is aware of the other virtual machines so they can cooperate.

OS-Level Virtualization

Virtualization in which the host OS supplies multiple, independent instances of itself in containers to each virtual machine.

3. Popular Server Operating Systems

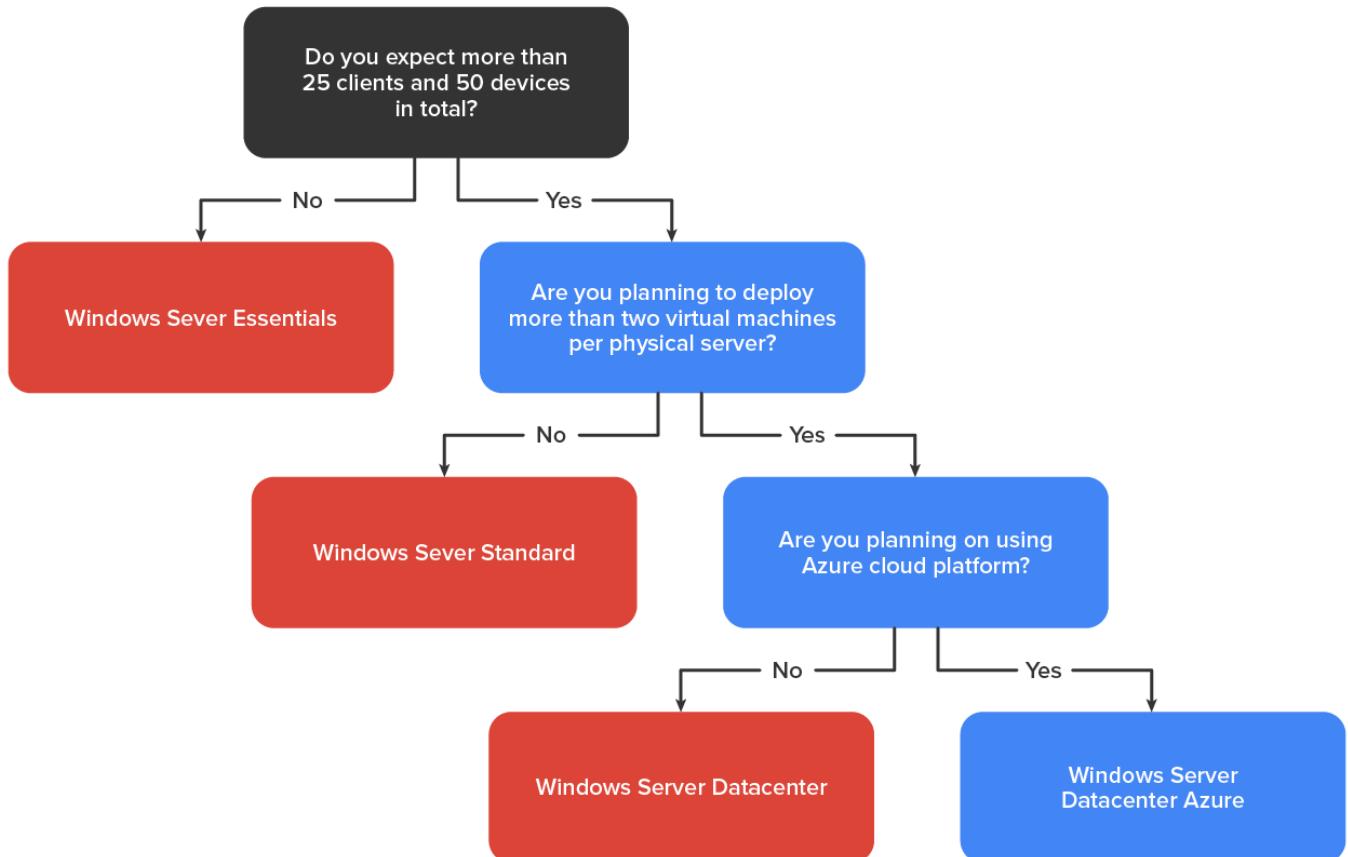
Several different server OSs are available. If you are tasked with choosing an OS for one or more servers in an organization, you must weigh each one's pros and cons in the light of the use case.

3a. Windows Server

Windows Server is Microsoft's server product. It has less of a learning curve than some other server OSs for an admin who is relatively new to network management because it has a GUI that's similar to the client version of Windows, with many of the same features and management tools. The main drawbacks are the requirement of user-based licensing and the fact that Windows-based products are frequently the targets of malware. The higher end versions can be expensive, too. It will cost thousands of dollars per copy, and each copy you deploy on a physical server must be individually licensed.

Windows Server comes in the versions described in the table below.

Essentials	For networks with no more than 25 clients and 50 devices in total; Not available for Windows Server 2022
Standard	For all sizes of networks but without some advanced features, such as software-defined networking; Supports up to two virtualization guests per license
Datacenter	For large networks that need a full feature set of tools, including an unlimited number of virtual machine guests per license and the ability to designate a Network Controller role; Supports software-defined networking and the ability to encrypt Hyper-V virtual machines (Hyper-V is the hypervisor that comes with Windows.)
Datacenter Azure Edition	Same as Datacenter except with extended Azure support; Azure is a cloud platform that, among other things, enables a server to offer virtual desktops , where clients sign in to the server to access their Windows desktop





TERMS TO KNOW

Windows Server

A version of Microsoft Windows designed to run a network server.

Hyper-V

The hypervisor that comes with Windows.

Azure

A Microsoft cloud-based platform for deploying network services including virtual desktops.

Virtual Desktop

A system that enables users to sign into a network account to access a GUI desktop remotely.

3b. Linux Server Distros

Linux is an open-source OS at its basic level. Anyone can create a customized version of it, called a **distro**, and either sell it or give it away for free, and there are hundreds of distros available. Each distro is optimized for a certain kind of usage; some distros are optimized for use as servers.



KEY CONCEPT

This isn't to say you can't use other distros for servers—you can. A distro is designed for server use mostly because it comes with a suite of network management tools—many of which you can also acquire separately.

Some server distros are free; others you must pay for. Because there are so many free Linux server distros available, Linux is an attractive choice for a medium-sized business that needs to keep costs down.

The paid distros generally come with perks such as professional technical support and updates, and many companies find those benefits worth paying for. Red Hat is one of the most successful commercial Linux server distros.

Distros vary widely in how intimidating they are for beginner network admins and how much of a learning curve new admins are subject to. Some include GUI and GUI-based versions of many network management apps. Others are entirely (or almost entirely) command-line based, so admins must memorize and get comfortable with hundreds of command-line commands and their syntax right out of the gate.

The following table lists the pros and cons of some of the most popular server distros.

Red Hat	Pros: Professionally maintained; enterprise support and many paid tools available Cons: Not free; basic subscription can only be deployed on physical systems
Fedora Server	Pros: Similar to Red Hat but free; Modular packages, good credential management, frequent updates Cons: Community-supported; setup takes some time

Fedora CoreOS	Pros: Secure; great for running containerized workloads, automatic updates Cons: No package manager
Ubuntu Server	Pros: Long-term support; free, paid enterprise support available Cons: No GUI
Debian	Pros: Stable, well established, secure, free, easy installation, many online resources available Cons: No official support, no GUI
OpenSUSE	Pros: Well documented, stable, free; web portal with one-click software installation, user control center Cons: Not widely known



TERMS TO KNOW

Linux

An open-source OS with many distros available, some of which are optimized for use as server OSs.

Distro

Short for distribution; a version of Linux that is customized for specific uses.

3c. Unix

Linux is based on an older OS called **Unix** that was originally designed for servers. Unlike Linux, Unix is not free or open source. It is generally only available via one of three commercial system providers: IBM AIX, HP-UX, and Oracle Solaris, but there is a free version of Solaris Unix for development use only.



DID YOU KNOW

Unix was originally a command-line OS, but today's releases include a GUI called Gnome that some Linux distros also use. Unix is a complete OS package for servers, not just a kernel (like Linux). That means there aren't a lot of optional add-ons for it. Over 400 standard utilities come with Unix.

Unix's key benefit is that it is tried and true; it's been around for longer than Windows has (and that's a long time). It does memory management and multitasking quite efficiently. It's also tightly controlled by the few vendors that use it on their systems, so there aren't a lot of bugs left to be found in it and neither are there new bugs being introduced by a flurry of updates (like with Linux).

Unix has most of the same drawbacks as Linux, plus one more: Unix is not usually the most cost-effective option, since Linux can do most of the same things but is free.



TERM TO KNOW

Unix

A multiuser, multitasking OS on which Linux is based; it is still in use today on select systems by IBM, Oracle, and HP.



SUMMARY

In this lesson, you learned about the **role of a server operating system**. You learned about **client and server operating systems**, **server applications**, and **server roles**. You also learned about **server virtualization** including **hypervisors** and **types of server virtualization**. Finally, you learned about **popular server operating systems** including **Windows Servers**, **Linux Server Distros**, and **Unix**.

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TERMS TO KNOW

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Azure

A Microsoft cloud-based platform for deploying network services including virtual desktops.

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